

**ETHNOBOTANICAL STUDIES FROM THE SURINSAR-
MANSAR WILDLIFE SANCTUARY, JAMMU AND
KASHMIR (UT), INDIA.**

Thesis submitted for the Award of the Degree of

DOCTOR OF PHILOSOPHY

in

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By

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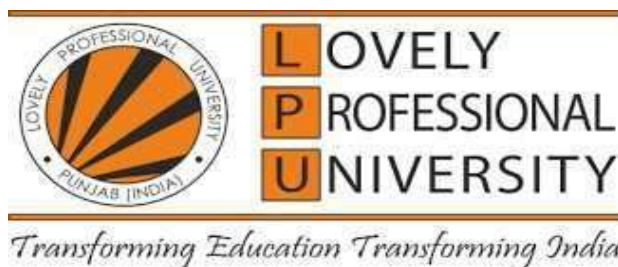
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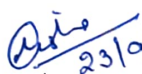


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2026

DECLARATION

I, hereby declared that the presented work in the thesis entitled "**Ethnobotanical Studies from the Surinsar-Mansar Wildlife Sanctuary, Jammu and Kashmir (UT), India.**" in fulfilment of degree of **Doctor of Philosophy (Ph. D.)** is outcome of research work carried out by me under the supervision of **Dr. Hina Upadhyay** working as Professor, in the **Department of Agriculture, School of Agriculture, of Lovely Professional University, Punjab, India.** In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.


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CERTIFICATE

This is to certify that the work reported in the Ph. D. thesis entitled “**Ethnobotanical Studies from the Surinsar-Mansar Wildlife Sanctuary, Jammu and Kashmir (UT), India.**” submitted in fulfillment of the requirement for the award of degree of **Doctor of Philosophy (Ph.D.)** in the **Department of Botany, School of Bioengineering and Biosciences** is a research work carried out by **Nisha Bhagat**, Registration No. **42000445** is Bonafide record of her original work carried out under my supervision and that no part of thesis has been submitted for any other degree, diploma or equivalent course.

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ABSTRACT

The current ethnobotanical study was carried out in the Surinsar–Mansar Wildlife Sanctuary in Jammu and Kashmir in order to record traditional knowledge related to the local communities' utilization of plant resources. Many plant species have medicinal, culinary, and cultural benefits that have been uncovered through extensive field studies and conversations with local residents and traditional healers. Numerous plants have been discovered to be effective in treating common illnesses like fever, wounds, cough, and gastrointestinal issues. The study stresses the need of preserving the region's rich ethnobotanical legacy as well as the variety of plants and the traditional knowledge that goes along with them.

Since ancient times, plants have remained indispensable to human existence, providing food, shelter, medicine, fuel, and other essentials for survival. Over generations, people have developed extensive knowledge about the healing properties of plants through direct experience and experimentation. This traditional wisdom laid the foundation for diverse medical systems such as Ayurveda, Unani, and Siddha, which continue to play a vital role in primary healthcare across many developing regions. Medicinal plants are valued not only for their therapeutic efficacy and cultural relevance but also for their affordability and accessibility compared to modern pharmaceuticals. However, the increasing pressure of population growth, habitat destruction, and urbanization has placed this invaluable ethnobotanical knowledge and biodiversity at serious risk.

Ethnobotany, the scientific study of the relationships between people and plants, serves as a bridge between indigenous wisdom and modern science. It documents how communities identify, utilize, and conserve plant resources for medicinal, nutritional, and cultural purposes. By recognizing the contributions of traditional healers and local practitioners, ethnobotanical studies help preserve both biological and cultural diversity. The field has evolved as a multidisciplinary science contributing significantly to biocultural conservation, sustainable development, and the integration of traditional medicine into contemporary

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healthcare systems. In this context, ethnobotanical research not only enhances our understanding of human–plant interactions but also ensures that traditional knowledge, which holds immense ecological and medicinal value, is protected and transmitted to future generations.

The present research work documented 236 ethnobotanical taxa belonging to 206 genera and 77 families which are used to treat various ailments by the locals as well as tribal population dwelling in the Surinsar Mansar wildlife Sanctuary. Out of 236 taxa, 231 species were angiosperms, 3 pteridophytes, 1 gymnosperm, and 1 fungal genus. Out of 231 angiosperms, 212 species were dicots and 19 species were monocots. Herbs were the most dominant lifeforms represented by 51.7% species followed by trees (25.4%), shrubs (11.9%) and climbers (10.6%). The number of plants used for ethnomedicinal practices, ethnoveterinary practices, as wild edibles and for making traditional plant derived products were 210, 27, 74 and 18 respectively. The dominant family was Fabaceae (28 genera) followed by Lamiaceae (16), Asteraceae (12), Malvaceae (9), Cucurbitaceae (8) Amaranthaceae, Apocyanaceae (7 each), Poaceae (6), Acanthaceae, Apiaceae (5 each), Euphorbiaceae, Moraceae, Solanaceae and Rosaceae (4 each). The remaining families were having 1 to 3 representative members.

Different plant parts were utilized by the locals like roots, leaves, flowers, seeds, tubers, bark, latex, gum etc in treating various ailments. Among these, leaves (39.3%) were the most commonly utilized part by the tribals and locals followed by roots (10.4%), fruits (10.0%), seeds (9.3%), and whole plant (8.6%). 15 types of crude drug preparations were used in the herbal treatments by the locals and tribals viz. infusion, powder, decoction, poultice, raw form, bathing, burning, licking, paste, cooking, oil, latex, rubbing, juice and extract/gum. Of these, the most common method of herbal preparation was decoction (46.4%).

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The present study recorded *Tinospora cordifolia* (Willd.) Hook.f. & Thomson, (UR = 291; UV = 0.95), *Justicia adhatoda* L. (UR = 280; UV = 0.92), *Azadirachta indica* L. (UR = 226; UV = 0.74), *Phyllanthus emblica* L. (UR = 226; UV = 0.74), *Terminalia bellirica* (Gaertn.) Roxb. (UR = 203; UV = 0.66), having the maximum use value (UV). A significant number of plant species (74 species) in the current study showed 100% fidelity for one or more illness categories, indicating that informants were in complete agreement about their use for a given ailment.

The group living in the research region used 210 plant species for medicinal purposes, 27 for ethnoveterinary purposes, 74 for wild edibles, 18 for building agricultural implements, 30 for fuelwood and fodder, 18 for religious purposes, and 44 for other purposes. Among the 74 WEPs the largest genera belonging to wild edibles were *Dioscorea* and *Ficus* (3 sp. each), *Cucumis* (2 sp.) while rest of the genera were having only single species. These plant species were further categorized into four edible usage categories viz, vegetable (39 sp.), raw (32 sp.), preserved food (11 sps.) and chutney (5 sp.).

Among plant species used to make traditional plant-based products, four species were used to make agricultural tools, such as hand-held choppers, axes, and sickles. Four species make brooms for household cleaning, four species make ropes for fastening objects, two species make mats, hats, baskets, and other goods, two species make furniture, two make traditional beds (*Khaats/manji*), and two make traditional bowls (*Dunas*) and plates (*Pattals*). One species was used to make the roofs of Kutcha homes, while another is used to fence agricultural areas. *Dodonaea viscosa* Jacq. (CI = 0.16), *Phoenix dactylifera* L. (CI = 0.14), *Grewia optiva* J.R.Drumm. ex Burret, and *Leucaena leucocephala* (Lam.) de Wit. (CI = 0.08) were the key plant species used in the production of plant-based traditional items.

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The locals and tribals of the sanctuary area uses number of plant species for various purposes that can be categorized under miscellaneous category that includes 44 sp. like *Phoenix dactylifera*, *Butea monosperma* (Lam.) Kuntze, *Mangifera indica* L., *Phanera vahlii* L. etc. Locals used the leaves of *Butea monosperma* to make eco-friendly disposable traditional bowls called "*Dunas*" and traditional plates called "*Pattals*," which were used in ceremonies and communal feasts. Additionally, this may open doors for the establishment of small businesses that will enable residents to make their living.

The antimicrobial activity was performed in five selected plant species based on their high Use value viz. *Acorus calamus* L., *Vitex negundo* L., *Dodonaea viscosa*, *Litsea glutinosa* (Lour.) C.B. Rob. and *Adiantum caudatum* L. against different microorganisms viz. *Enterococcus coli*, *Staphylococcus aureus* and *Enterococcus faecalis*. All the microorganisms were tested for Methanol, Chloroform and n-hexane extract. Amongst these, *Acorus calamus* and *Dodonaea viscosa* were recorded to contain more potent antimicrobial compounds particularly in methanol and n-hexane extracts, with activity dependent on both solvent polarity and concentration and are promising candidates for further phytochemical characterization and potential development of antimicrobial agents. Additionally, the n-hexane and Chloroform extract of *Dodonaea viscosa* showed significant inhibitory effects when tested against *Proteus mirabilis* and *Serratia marcescens*.

The nutritional analysis of five selected plant species viz. *Woodfordia fruticosa* (L.) Kurz, *Phlomis superba* (Royle ex Benth.) Kamelin & Makhm., *Bauhinia variegata* L., *Citrus medica* L. and *Malva pusilla* Sm. was conducted. Among these, *Malva pusilla*, Sm. showed higher energy content (298.52 kcal/100gm) which is a green leafy vegetable and is underutilized now a days.

Since the study area is a protected area there is limited or either no overexploitation of the plant resources. Even though, while documenting the medicinal plant species, some of the species were found in segregated or having scarce distribution. Some of the medicinally important, threatened and rarely distributed plant species like *Phlomis superba*, *Ajuga integrifolia* Buch. -Ham.

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ex D.Don, *Apteranthes tuberculata* (N.E.Br.) Meve & Liede, *Litsea glutinosa*, *Zingiber roseum* (Roxb.) Roscoe, *Hellinia speciosa* (J.Koenig) S.R.Dutta, and *Saraca asoca* (Roxb.) W.J.de Wilde were distributed and planted in various college campuses, home garden and Lovely Professional University for their propagation and conservation.

As a novelty of the present study, some of the plant species were recorded as new reports from UT of Jammu & Kashmir in different categories mentioned. There is scope for future ethnopharmacological study and prospective drug leads for the discovery of new medications attributed to new records and reports of ethnomedicinal plants' innovative uses.

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Nisha Bhagat

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1. Introduction

Plants have remained vital to humans to cater their diverse needs like food, fodder, shelter, fuel, medicine etc. since the prehistoric times (Towns *et al.*, 2016; Faruque *et al.*, 2018; Pei *et al.*, 2020; Zemedede *et al.*, 2024). It is widely acknowledged that plants have impacted human culture over the ages and evolved throughout civilisation. Humans have been searching for medications from the beginning of time, and their knowledge of the use of medicinal plants comes from years of battling illnesses and discovering how to obtain drugs from various plant portions (Zemedede *et al.*, 2024). With their ability to treat a wide range of human illnesses, medicinal plants have played a crucial role in traditional healthcare systems due to their significant affordability (Alarcon, 2015; Lu *et al.*, 2022). Herbal medications are seen as cheap, pure, easily accessible, and safer than conventional or allopathic medicines, thus are gaining popularity in the underdeveloped nations (Rather and Baba, 2015; Yuan *et al.*, 2017; Amjad *et al.*, 2020; Sulaiman *et al.*, 2022). Herbal medicine has been used for more than 5000 years in China, India, Egypt, and Syria, according to historical data (Prasathkumar *et al.*, 2021) and has grown over generations of experiences and practices (Hassan *et al.*, 2013). Studies of ethnobotany have a solid foundation in several medicinal systems, such as Ayurveda, Unani, Sidha, and other regional medical customs. Herbal and traditional medicines have long been important components of majority of the countries healthcare systems that provides important and novel pharmaceutical drugs (Bhatia *et al.*, 2013; Hani *et al.*, 2022). Approximately 70,000 plant species, ranging from smaller lichens to larger trees, have been shown to have the ability to treat a variety of illnesses (Prasathkumar *et al.*, 2021). India's healthcare system has relied heavily on traditional medicine from ancient times. According to Ralte *et al.* (2024), over 88% of people use traditional medicine for their medical requirements.

The first healthcare professionals in the community were traditional healers as they are crucial to the preservation of biodiversity, traditional knowledge, the health of the populace as well as the production and application of medications (Pei, 2001; Zhang

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and Xue, 2011; Peironi, 2000; Teka *et al.*, 2020). According to Dar *et al.* (2018), the tribal people have a vast knowledge of indigenous traditional medicine and phyto-curative techniques, because they lack access to contemporary healthcare facilities (Arya *et al.*, 2014). Indigenous communities are the keepers of traditional knowledge and possess valuable knowledge about the various uses of plants. Mostly herders, forest residents, and cattle grazers are well-versed with the names, morphologies, and characteristics of the therapeutic plants found in the forest (Saklani and Sikarwar, 2021). Forest fringe populations depend heavily on forests to survive, and they pass down traditional knowledge about the different uses of plant species from one generation to the next (Muhakr *et al.*, 2024).

In industrialised nations, the interaction between human populations and the utilisation of plant resources is regarded as an iconic element of ecosystems and an ecological balance system (Koellner *et al.*, 2019; Rehman *et al.*, 2023b). According to Süntar (2020), the majority of plants that contain active chemicals are known to have traditional medicinal benefits. As human populations increase, plant supplies are depleting. This traditional knowledge, which has been handed down through the centuries, is intimately related to their everyday activities and the natural resources in their immediate environment (Sharma, 1998; Hani *et al.*, 2022) with some variations in every generation (Laldingliani *et al.*, 2022; Bekele *et al.*, 2022). The WHO Traditional Medicine Strategy 2014–2023 seeks to enhance the role of traditional medicine and highlights that for millions of people, traditional practitioners, herbal remedies, and therapies are their main, if not their only, source of healthcare (Hani *et al.*, 2022). This close association between humans and plants has resulted in the collection of a wealth of traditional knowledge that is now acknowledged as important for protecting plant biodiversity and comprehending the intricate connections between social, cultural, and wild plant systems (CBD, 1993). Folk medicine and home care traditional medicine have become more popular among those with poor and moderate incomes due to their reduced access to mainstream treatments (Hani *et al.*, 2022). In local communities with little documentation of traditional knowledge, ethnobotanical

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research is primarily carried out with indigenous people. Research of this kind can support biodiversity preservation and the sustainable use of medicinal plants to boost the local population's economy (Janic *et al.*, 2024).

Indigenous knowledge was first documented millennia ago and is still being documented in fragmented form today (Agize *et al.*, 2022). Many Aboriginal communities have great knowledge about the usage of plants in varied way like tools, medicines, food, dyes, artifacts, etc. and are utilizing them effectively. Likewise, particularly in rural areas, wild edible plants contribute significantly to the global food basket. For many indigenous and rural groups worldwide, the usage of wild plant resources has been an essential component of their culture, religion, and health (Doni & Gajurel, 2020). Formal research on these plants has shown to be an effective means of comprehending the relationships that various indigenous groups have with natural resources, particularly in relation to pharmacological and medicinal uses (de Albuquerque and Hanazaki, 2009). Therefore, locally available flora is crucial to the viability and subsistence of rural and indigenous civilizations (Kumar *et al.*, 2015a).

The demand for traditional, complementary and alternative medicine has increased significantly in recent decades. In addition to being utilized as local and customary remedies, traditional medicinal herbs were also approved by the pharmacies and registered as formal medications (Li *et al.*, 2024). Unfortunately, this treasure of information about medicinal plants is seriously threatened by population growth, environmental degradation, and forest loss, as a result indigenous knowledge is declining at a greater pace (Ralte *et al.*, 2024). Additionally, other developmental activities are resulting in the migration of the tribal communities from their own homeland due to which the knowledge is depleting gradually (Asif *et al.*, 2021). Natural resources are in danger since the fast increase in the human population has boosted demand, which has fuelled a greater search for new plant resources (Laldingliani *et al.*, 2022).

Ethnobotany facilitates communication and cooperation between scientists and indigenous groups by acting as a link between scientific understanding and customs.

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Working closely with the local population, ethnobotanists record their customs and knowledge about plants and environments. This collaboration not only increases scientific knowledge but also empowers indigenous people by recognizing and validating their knowledge systems. Ethnobotany supports community-driven conservation initiatives and helps preserve cultural heritage by recognizing the importance of traditional knowledge (Wahab *et al.*, 1996; Eduard, 2023). According to Gaoue *et al.* (2017), ethnobotanical research has the capacity to unite and combine scientific and local knowledge in order to achieve the goal of biocultural conservation. Further, this kind of study acknowledges the importance of traditional knowledge, indigenous people, and ethnobotanists in accomplishing sustainable development goals (Pei *et al.*, 2020). Studies in ethnobotany are crucial for the advancement of conservation and medical procedures, as the traditional knowledge must be conserved before it gets entirely lost (Kumar *et al.*, 2021).

Hence, Ethnobotany emerged as a separate academic field of natural science as a result of this global perspective. It is now evident that data from ethnobotanical research has uncovered an indigenous concept and knowledge system that can be securely included into development planning and environmental management.

1.1 Ethnobotany: Definition

The term ethnobotany was used for the first time by John W. Harshberger way back in 1895 to describe studies of plants used by primitive and aboriginal people and in 1896 his publication, “The Purpose of Ethnobotany” (Harshberger, 1896) marked the beginning of this field of science as academic discipline (Balick and Cox, 1996).

Balick & Cox (1996) defined "Ethnobotany is the study of how people of a particular culture and region make use of indigenous plants for various purposes, including medicinal, religious, and economic applications. According to Arshad *et al.* (2014) and Silva *et al.* (2011), ethnobotanical studies is the intricate relationship between local residents and plants, including customs and cultural beliefs related to various uses. As per Cunningham (2001), The science of recording, characterizing, and elucidating

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the intricate connections between cultures and plant use is known as ethnobotany while Dr. S.K. Jain, a pioneer of ethnobotany in India, defined ethnobotany as: "Ethnobotany is the total relationship between plants and the tribal people, including how they use plants for food, medicine, rituals, and other aspects of life." As per Thomas *et al.* (2019) "Ethnobotany studies the dynamic relationships between plant diversity and human communities, emphasizing the cultural relevance of plants and traditional knowledge systems. Ethnobotany is the interdisciplinary study that explores the complex relationships between plants and people, particularly how various cultures utilize and conceptualize plant resources" (Kumar *et al.*, 2020).

Thus, Ethnobotany, which centers on "the direct relationship between plants and man," has been described differently by many researchers, but its meaning and interpretation have been the same for all of them (Dr. S.K Jain, 1986). Dr. S.K. Jain is referred to as the "Father of Indian Ethnobotany," whereas Richard Evan Schultes is regarded as the Father of Ethnobotany.

1.2 Ethnobotany: Evolution

Indigenous peoples have been using ethnobotany since prehistoric times. But only in the 19th century did ethnobotany become a recognized scientific discipline (Schultes, 1991). Over the past seven decades, it has garnered international interest and developed strong ties with numerous scientific and artistic fields. In India, organized ethnobotanical research began in the second half of the 20th century and was pioneered by Dr. E.K. Janaki Ammal and S.K. Jain of the Botanical Survey of India (BSI) (Sreedevi *et al.*, 2013). In the 1980s, the Government of India initiated the "All India Coordinated Research Project on Ethnobiology (AICRPE)" to conduct extensive surveys for recording the traditional knowledge of tribal peoples related to the use of local flora and fauna. This initiative gave ethnobotanical investigation in India an extra push (Pushpangadan *et al.*, 2018).

Dr. S.K. Jain was instrumental in the development of ethnobotany as a field of study in India, stressing the value of recording traditional knowledge for preservation and

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sustenance. Dr. S.K. Jain was the founding president of the Society of Ethnobotanists (SEB), which was established in India in 1980 with the goal of promoting traditional knowledge based on plants (Padhy *et al.*, 2015). A local chapter of the "Society of Ethnobotanists" was established in 2021 with Dr. H.C. Dutt serving as its regional coordinator in an effort to foster collaboration among ethnobotanists in the Union Territory of Jammu and Kashmir, JKUT, (Daily Excelsior newspaper, October 25, 2021).

India reached a significant milestone in 2022 and became a global leader in the field of traditional medicines when the WHO and the Indian government's Ministry of AYUSH signed an agreement to establish the first-ever WHO Global Centre for Traditional Medicine (GCTM) in Jamnagar, Gujarat. Prime Minister Narendra Modi laid the foundation stone for it in April 2022, with WHO Director-General Dr. Tedros Ghebreyesus presence. The WHO-GCTM was established with the goal of using science, technology, research, and innovations to maximize the advantages of traditional medicines on a worldwide scale (WHO, 2022).

1.3 Ethnobotany: Importance

A great deal of traditional knowledge about medicinal plants has been accumulated as a result of the intimate relationship between man and nature (Pie *et al.*, 2020; Tadesse *et al.*, 2024). The indigenous mountain community has long benefited from the biodiversity of the Indian Himalayan Region, which has shaped their traditional cuisine and medical practices. It is the knowledge that the local population possesses, derived from their experiences and gradual adaptation to the local environment, culture, and way of life. In order to generate money and improve livelihoods, these traditional resources can be creatively employed, traded, or licensed as an economic asset. (Chandra and Uniyal, 2020). These primitive and indigenous healthcare practices were invented in the historical past but could not be proven scientifically, though the results were amazing and satisfying to the people (Adachukwu and Yusuf, 2014). Later, due to the dedication and efficiency of the ethnobotanists the whole world gets

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to know about the importance of the medicinal plants in the traditional health care practices that provide new prospective/areas of research and in the conservation of biodiversity.

It is emphasized by Ghorbani *et al.* (2006), that ethnobotany is an interdisciplinary science which includes botany, phytochemistry, ecology, anthropology, pharmacology, taxonomy, geography, agroforestry, agriculture, archaeology, linguistics, medicines etc.

1.3.1 Nutritional Security

Malnutrition and hunger are two of the biggest worldwide issues of the twenty-first century. Additionally, India has not been immune to the plague of hunger. By recording and promoting the use of traditional food plants, many of which are extremely nutrient-dense and suited to local conditions, ethnobotany serves a critical role in assuring nutritional security. Indigenous knowledge of edible plants improves diet quality, increases food diversity, and fights malnutrition (Singh *et al.*, 2020). A broad variety of wild and cultivated plants can be consumed, increasing nutritional diversity and lowering micronutrient deficits, according to ethnobotanical knowledge. Numerous underappreciated plant species are abundant in vital vitamins and minerals, which support general nutrition and health (Bharucha & Pretty, 2010). Also, native crops and edible wild plants frequently adapt well to the local environment and need little inputs like pesticides and fertilizers. In spite of climatic fluctuations, this resilience guarantees food security (Padulosi *et al.*, 2013). Humans have underutilized the majority of wild food plants because only 20 plant species account for 90% of human food, with rice, maize, and wheat serving as the main sources of staple foods (Singh *et al.*, 2020). Some wild edibles are referred to as nutraceuticals because they have both medicinal and nutritional qualities (Singh *et al.*, 2016).

1.3.2 Socio-economic upliftment of tribals

Ethnobotanical studies help in generating the livelihood through medicinal and aromatic plants. Like numerous rural and tribal population are in practice of collecting and selling essential oils, herbal items, and therapeutic plants which are used in various food industries, basketry etc (Sharma *et al.*, 2019). Natural remedies are in high demand both domestically and internationally, which has led to new revenue streams. Tribal communities provide a substantial economic contribution by harvesting NTFPs (Non-Timber Forest Products) such as bamboo, honey, gum, resins, and wild fruits. Long-term financial gains are guaranteed by sustainable harvesting methods. Economic returns are increased when raw resources are processed into value-added products (such as herbal teas, cosmetics, and biopesticides). Tribal women and young people can be empowered via training in handicrafts, herbal formulation, and food preservation. For instance, Sal (*Shorea robusta*) seeds are processed into edible oil by tribal cooperatives in Jharkhand, India, boosting its market value (Deb *et al.*, 2015).

1.3.3 Development of improved crop varieties

Ethnobotany significantly contributes to the development of new crop varieties by integrating traditional plant knowledge with contemporary agricultural practices. Certain traditional crops have a lot of nutrients. These crops, which can be crossed with staple crops to increase their nutritional value which can be highlighted by ethnobotanical research. In an effort to recover "forgotten crops"- traditional plants that were once mainstays of local diets but have since become obsolete due to the dominance of commercial agriculture, ethnobotany has seen a revival in attention in recent years. Crops like millet, quinoa, and amaranth have become popular again because of their high nutritional content and resilience to adversity (Monika and Dhivya, 2024).

1.3.4 Rural Health Development

Many rural people, especially those in developing nations, rely on medicinal plants because they have little access to contemporary medical services. Addressing healthcare issues, enhancing basic healthcare, and incorporating traditional medicines into contemporary medical systems all depend on ethnobotanical expertise. Medicinal plants are the main source of healthcare in many rural communities that lack proper healthcare facilities. Local cultures use ethnobotanical knowledge to cure common illnesses such as gastrointestinal disorders, respiratory infections, joint problems etc (Mukerjee *et al.*, 2012). Numerous traditional plant-based medications have shown promise in the treatment of infectious diseases like malaria and chronic illnesses like diabetes and high blood pressure. For instance, artemisinin, the active ingredient in *Artemisia annua*, is widely utilized in modern medicine and has been used to treat malaria (Tu, 2011).

1.3.5 Biodiversity Preservation

Ethnobotany plays a crucial role in the preservation of flora by documenting the indigenous knowledge, encouraging sustainable resource use and incorporating cultural practices into contemporary conservation methods. This documentation protects important information that could otherwise be lost as a result of environmental changes and cultural deterioration. Ethnobotany offers insights into sustainable harvesting and production methods by comprehending how indigenous societies use plant species for food, medicine, and other uses. By encouraging the cultivation of desirable species and finding practices that do not deplete resources, this knowledge can help conservation efforts by lessening the strain on wild populations. Ethnobotany provides important insights and strategies for conserving plant species and the cultural legacy connected to them, bridging the gap between biodiversity protection and cultural activities (Pei *et al.*, 2020).

1.3.6 Preservation of Cultural heritage

The sacred cave known as Kamukuwaká, which is home to engravings that are essential to the Wauja people's cultural legacy, was destroyed in the Brazilian Amazon. A life-size model of the cave was made utilizing cutting-edge 3D imaging technology in order to conserve its legacy. The Wauja people are able to preserve their traditional customs and instruct future generations because of this, which is currently housed in the first Indigenous Museum in the Xingu region (theguardian.com). The livelihoods of impoverished populations worldwide depend heavily on medicinal plants (Khan *et al.*, 2015; Shabir *et al.*, 2017). The purpose of ethnobotanical evaluation of medicinal plants is to investigate and record a society's knowledge relevant to the customary use of medicinal plants in their cultural contexts (Aththorick and Berutu, 2018). Community practices around the use of traditional medicine might differ significantly depending on the social and cultural legacies of the various countries (Bekele *et al.*, 2022).

India, which ranks eighth among the world's twelve most biodiverse nations, is known for its abundance of plant resources, rich ethical and cultural diversity with about 17,000 flowering plants, of which 7,000 species are medicinal plants (Manju & Ahad, 2021) majority of which are confined to majestic Himalayas utilized to treat various illnesses (Adhikari *et al.*, 2010; Wani *et al.*, 2015; Akash & Navneet, 2018; Akash *et al.*, 2018 a,b,c; Akash *et al.*, 2019). Almost 7,500 medicinal herbs are used by 4,635 ethnic groups in India for both human and animal purposes (Baba *et al.*, 2012). This is a significant number that are utilized in pharmaceutical preparations, various indigenous medical systems, or as folk treatments (Wani *et al.*, 2016). Because of this biodiversity, the country's traditional plant-based medical systems, including Siddha, Ayurveda, Unani, and homoeopathy are able to meet the health care needs of rural areas (Pandey *et al.*, 2013). In India, wildlife has an important place in its rich heritage and culture where many plants and animals are worshipped and are considered sacred. In spite of the fact, wildlife today is diminishing day by day due to habitat destruction, increased pressure on forests, poaching, illegal trade etc., which needs to be checked

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at an earliest. Hence, protected areas like wild life sanctuaries and national parks play an important role to ensure the biodiversity conservation that allows limited human interference. The traditional use of plants in curing different ailments is well known among the tribal and the natives of the sanctuary. There are 553 wildlife sanctuaries in India that covers an area of 119776.00 Km², which is 3.64% of the geographical area of the country (National Wildlife Database, Dec 2019).

The Himalayan Mountain region is recognized as a significant center of biocultural diversity and is home to a wide variety of edible and medicinal plants (Bisht and Adhikari, 2018; Stryamets *et al.*, 2021). Specifically, the native populations within the area rely more on non-timber forest goods since they make their living from plant-derived materials that are crucial to the operation of conventional healthcare systems (Rahman *et al.*, 2018; Haq *et al.*, 2021). The initial step in any study of traditional plant applications in a given area or among a selected ethnic group is typically ethnobotanical inventories. For over 50 years, such investigations have been conducted in India (Jain, 2003). Since people have traditionally used plants to cure ailments, knowledge of plant diversity has greatly improved human health both domestically and internationally. (Haq *et al.*, 2023).

It is crucial that this information be obtained from traditional healers and recorded for future use because herbal remedies are becoming more and more popular than allopathic medications due to their ability to effectively treat particular illnesses. However, the well-equipped hospitals are still far from many hilly and tribal communities. Additionally, it is practically impossible for these individuals to visit doctors for periodic checks because of the great distances and affordability. As a result, they have created and are still practicing their own medical system utilizing herbal remedies and plants that are readily available in their area (Dugesh, 2020). Also, many rural communities use Wild Edible Plants (uncultivated plants that grows in natural habitats) which (Mallick *et al.*, 2020) are an essential component of their traditional culinary customs (Abdullah and Andrabi, 2021; Kidane and Kejela, 2021; Rehman *et al.*, 2024). Moreover, wild edible plants are offering an excellent source of food to the

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rural communities (Rehman *et al.*, 2022b), addressing the issues of malnutrition (Thakur *et al.*, 2017) and are generating income sources for the local communities (Golait *et al.*, 2021; Rehman *et al.*, 2023c). It can be rightly said that traditional healthcare has a strong cultural foundation but lacks documentation and a working model (Agize *et al.*, 2022).

JKUT is home to a wealth of natural resources including native herbal remedies. In J&K, 4777.282 Km² area has been notified as the protected area network that comprises 3 National Parks, 13 Wildlife Sanctuaries and 29 Conservation/Wetland Reserves (www.jkwildlife.com) that plays an important role towards the conservation of biodiversity. They are the home to many species of flora and fauna, rare and endangered species. Surinsar Mansar wildlife sanctuary is one among them located in Samba district of Jammu province. It covers an area of about 98 km². The sanctuary is named after the twin lakes (Surinsar and Mansar) present at the extreme corners of the Sanctuary.

Jammu province of JKUT forms a prominent part that exhibits wide climatic, altitudinal and ecological variations, which has contributed to the rich biodiversity (Bhagat and Sharma, 2018). The wildlife of J&K is famous for its marked natural and scenic beauty and wild forests that are home to a variety of flora and fauna and some rare species that are native to Himalayan region. UT of J&K has a rich repository of plant species that is used by the local community particularly the tribal community. People of UT (J&K) have diverse ethnic knowledge about the use of the flora so they are using the plants more efficiently to cure various ailments at their respective places. These plant species are well known for traditional uses by the ethnic and tribal groups and the local inhabitants. The tribal community uses the plant resources in extraordinary/reasonable ways for various purposes frequently for curing different ailments (Kumar *et al.*, 2015). Earlier this knowledge was confined only to the traditional herbal healers like *vaid*s and *hakims* of the rural communities, but at the present time locals and tribals use this knowledge as weapons against various diseases. However, due to the availability of modern health care facilities to the doorstep, modernization and diversion of young

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generations towards the allopathic medicines this knowledge is now at the verge of extinction. Still there are some remote areas where due to lack of modern health care facilities most of the people rely only on the plants and their products for meeting their daily needs like food, shelter, and medicines. It is well evident from the historical facts and geographical observation that, Jammu and Kashmir is populated with several ethnic groups (Pie and Manandhar, 1987), and have distinct cultural and social identity that practice their own knowledge of traditional herbal medicine from ages together (Utkarsh, 2001). Hence tribal communities are considered the ecosystem communities who live in harmony with nature and foster a link between man and environment (Das *et al.*, 2009). Folk medication is used for thousands of years with major offerings made by herbal practitioners to human wellness and strength (Jain, 1967).

Documentation pertaining to ethnobotany delves into the ways in which communities engage with their environment, encompassing customs and cultural values surrounding the use of specific plants (Venpoorte *et al.*, 2005; Silva *et al.*, 2011; Arshad *et al.*, 2014). Traditional knowledge must be preserved in order to support and facilitate future studies on the efficacy and safety of medicinal herbs, which can substantiate how they are traditionally utilised (Bunalena *et al.*, 2014). A sizable portion of the populace in poor nations receives their fundamental medical needs from traditional medicines (Pandey, 2021; Rehman *et al.*, 2023a). Many rural groups use wild plants as an essential part of their cultural legacy (Abdullah and Andrabi, 2021).

Researchers have gained a better grasp of how indigenous flora is viewed and utilized in daily life by documenting traditional knowledge on plant use among ethnic groups.

A number of ethnobotanical studies (Bhellum and Singh, 2012; Kumar and Bhagat, 2012; Sharma *et al.*, 2012; Pandita, 2013; Rashid, 2013; Bhatia *et al.*, 2014,15a; Dutt *et al.*, 2015; Manhas *et al.*, 2015; Rao *et al.*, 2015; Shah *et al.*, 2015; Sharma and Manhas, 2015; Ahmed and Ajaz, 2017; Sarad and Kumar, 2017; Fayaz *et al.*, 2019; Kumar *et al.*, 2020; Singh *et al.*, 2020; Kour and Singh, 2021; Singh *et al.*, 2021; Parasher *et al.*, 2024) have been conducted in Jammu province of JKUT. However, the ethnobotanical studies from the Surinsar-Mansar Wildlife Sanctuary are lacking.

1.4 Ethnographic Profile of tribes of JKUT

JKUT is home to a range of ethnic groups viz. *Gaddis*, *Sippis*, *Gujjars* and *Bakarwals*, and religions that have shaped the locals' way of life and cultural values. The *Gaddis* and *Sippis* are two lesser-known transhumant and semi-nomadic Himalayan tribes. Their community is situated on isolated, high-altitude highland areas of the Himalayas. Their primary job is shepherding, and they graze their flocks in the North-West Himalayas' alpine, temperate, and extremely difficult-to-reach areas.

The Kandi areas of JKUT are home to *Gujjars* and *Bakarwals*- the third largest ethnic group who live there and move around. The *Gujjar* and *Bakarwal* communities comprise around 20% of the state's total population who live as nomads. An ethnic group in Afghanistan, Pakistan, and India is called the *Gujjar* (Bhat, 2017).

The *Gujjar* community is a well-known semi-pastoral group who have moved to JKUT from Gujarat, from where they got their name. According to Rajasthani history, JKUT was inhabited by *Gujjars* during the third and fifth centuries CE. Muslim *Gujjars* and their Hindu cousins still live in Rajasthan and Gujarat, especially in Kathiawad. They speak the same language, Rajasthani, and have the same appearance. This implies that the Himalayan *Gujjars* might have migrated from these parts of Western India to the Himalayas, possibly in the sixth and seventh century. However, according to other scholars, the *Gujjars* came to Jammu and Kashmir for the first time in the tenth or eleventh centuries. According to Kennedy, an English researcher, *Gujjars* used to worship the sun and migrated to India from Iran. Mr. V.A. Smith is one of the academics who believes that *Gujjars* are indigenous. Renowned anthropologist Dr. Cornik claims that research has shown that *Gujjar* looks and those of ancient Indian tribes are essentially the same.

There is broad agreement among scholars that the *Gujjars* actually came from Georgia, a Russian realm occasionally known as Gurjistan. According to certain legends, the *Gujjars* are descended from Dravidians. However, there is disagreement among social scientists over how they came to be in India. While one school of thought holds that they were originally from Central Asia and belonged to the Scythian (uchi)

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tribes, other historians believe they were the first people to settle in India (Bhat, 2017). They are distributed in the districts of Anantnag, Pulwama, Kishtwar, Poonch, Doda and Jammu in JKUT. They live in a frigid climate with low humidity, limited precipitation, sparse forests, and moderate to heavy winter snowfall. *Gujjars* speak Gujri language. They converse with others in Hindi, Punjabi, and Kashmiri. They used to wear salwar kameez, long turbans, beards, and a particular kind of cap on their heads. The majority of the adult members uses henna or mehndi to tint their beards. The *Gujjars* take fish, poultry, goat, and sheep meat in their meals along with rice, wheat, and maize as staple foods. They enjoy sipping a particular kind of salty tea with bread. There is social separation based on occupation and religion. There are two sections of *Gujjar* in Kashmir- *Dodhi* and *Zamindar*. *Dodhi Gujjars* are connected to the selling of milk and milk products, whereas *Zamindar Gujjars* are mostly connected to farming. There are several exogamous groups or gotras among the Muslim *Gujjars*, including the *Kasanas*, *Chechi*, *Padhana*, *Lodha*, *Katana*, *Paswar*, and *Banggri* which manage their marriage alliance. They consider themselves as occupying the intermediate position in the local social structure, and others share this perception. Endogamy is always upheld and regarded as the standard for marriage at both the religious and social levels. It is common to have both parallel and cross-cousin weddings, with cousins being given precedence when choosing a bride. The accepted practice is monogamy; however, Sharia (Islamic law) allows for polygamy as well. Women in the *Gujjar* community enjoy equal status and hold significant roles in the social, religious, and economic aspects of life. In addition to helping men with agricultural tasks, their responsibilities also include milking cows, providing portable water, gathering fuel and fodder. They go between hills of varying elevations, from low to high, to find fodder for their buffaloes, which are the foundation of their income. They use agriculture as a supplemental source of income during the winter months when they remain in their natural environment. They allow sharecroppers to use their land in other seasons. More land is owned by the *zamindar Gujjars* than by the *dhodhi Gujjars*. Although there is no system of bonded labour among them, family members

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occasionally work in the paddy and corn fields. They have a structure in place called the baradari panchayat to settle issues within the community. Although the *Gujjars* lack an art and craft system, some family members are skilled in crafting woollen items from sheep wool. Women use to sing folk songs in different social occasions. *Gujjars* have very cordial relations with all Muslims and non-Muslim people of the area they camp. Due to their nomadic lifestyle, *Gujjars* have a negative attitude towards education, especially when it comes to girls. However, boys only complete basic school, with very few going on to higher education. Although the government of Jammu and Kashmir established a few mobile primary schools to help parents educate their children, the initiative was unsuccessful since the students frequently moved to locations with harsh weather and challenging access.

Muslim *Gujjars* in Jammu and Kashmir are in common with *Gujjars* in other parts of the nation, both mutually and bilaterally. Along with the *Gujjars*, who are Hindu, Sikh, and Muslim people living in the Indian plains, they share a history, culture, ethnic ties, beliefs, and languages. According to their occupation and places of settlement, the *Gujjars* in the state of Jammu and Kashmir were classified as: *Muqami*, or cultivators, who had built up villages in valleys or slopes. The *Gujjars* of transhumance were further separated into two groups: the *Bakarwal Gujjars*, who raise sheep and goats, and the Banihara or *Dodhi Gujjars*, who are milkmen. *Gujjars* have made their home in areas of Jammu such as the valleys and slopes of Poonch, Mendhar, Surankot, Darhal, Rajouri, Nowshera, Sunderbani, Udhampur, Jammu, and Kathua, which are suitable for their livestock. These people, called *Dhoks*, lived in the higher alpine meadows of the Pir Panjal and Greater Himalayas during the summer. Their settlements consist of Kothas, or mud homes, which have a different architectural style than structures seen in Kashmir. These Kothas were scattered across the hills, with an animal enclosure and maize fields on one side. Because of the influence of Urdu, the Gojri language of Jammu and Kashmir is written in perso-arabic script. Because of its uniqueness, the *Gujjar Bakarwal* community has a distinct identity (Lone *et al.*, 2023). They continue to use the old-fashioned healthcare system and pay little heed to

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contemporary medical practices.

While, Sheep and goat herders are known as the *Bakarwals*, one of the pastoral communities in JKUT. The name originates from the term Bakariwale, which means sheep or goat rearers. It is said that *Bakarwals* originally came to Kashmir's SWAT region in pursuit of verdant pastures. During the nineteenth century the group relocated to Kashmir Valley. They are mostly found in the districts of Jammu and Doda, Poonch, Rajouri, Udampur and Kathua. The *Bakarwals* were renowned for their hospitality, bravery, and tenacity. Chauhan, Khatama, Hakla, Paswal, Bagadi, Jagel, Kalies, Sood, Kohli, Dhakkar, Thikria, Gegi, Mesi, Bajran, Kandal, Keela, Gors, Khari, Chenija, Chechi, Bajar, and Kataria are among the Gotras (subcastes) that *Bakarwals* share with *Gujjars*. The *Bakarwal* people were mostly nomads. They were a pastoral people who lived in meadows and travelled from place to place with their families, heads of cattle, and herds of sheep and goats. Because they live far away from civilization on the tops of hills, these people are falling far behind due to illiteracy and backwardness during this period of science and technology, when communities are actively participating in improvements (Lone *et al.*, 2023).

The way of life of the *Bakarwal* tribes provides insight into their culture and social structure. They have a very solitary and isolated existence. They migrate from one meadow to another with ease in the summer, when nature is at its most beautiful. These *Bakarwal* tribes typically travel in pairs. However, depending on how many sheep or goats they take for grazing, they occasionally go either alone or in bigger groups. The men of *Bakarwal* tribe are distinguished for their lengthy beards. The community is not divided along socioeconomic lines, however there is a discernible variation in educational attainment, economic standing, and sheep flock size. Although they believe they are in the middle of the regional social structure, others think otherwise. Women assist with housework, livestock milking, gathering firewood and feed, carrying portable water, and shopping for home goods. *Bakarwals'* cattle are essential to their economy. Even if they own land and work in related fields, these are regarded as secondary employment. They used to be able to make money by taking care of visitors'

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bags as they arrived at Sonamarg, Gulmarg, Pathang, and Bhaderwah. The *Bakarwals* have a *biradari* Panchayat of their own to resolve conflicts in the neighbourhood. The *Namberdar*, or head of the panchayat, is chosen by voice vote. They celebrate many Muslim festivals in various months. Women in the village sing folk tunes at social gatherings. Since the Medicare amenities are not available in some of the regions where they camp, they continue to favour their own Medicare system.

These tribes undergo seasonal migration along with their flock of goat and sheep from hills to plains and vice-versa in search of pastures for their livestock (Sharma and Singh, 1989). During their migration they move across different mountainous passes and are thus familiar with high altitudinal medicinal plants which are hardly known to modern society. Many studies have found that herders are the chief collectors of medicinal plants growing on high altitude snow-capped alpine pastures (Kumar and Hamal, 2009). Thus, this forest dwelling agro-pastoral tribes are closely related to the forests and forest produce by virtue of their occupation and lifestyle. Since they have relatively isolated from the mainstream society, they have maintained their ethnic and cultural distinctness. Hence, these communities are still carrying forward the legacy of their rich cultural heritage and are thus expected to be highly knowledgeable about traditional use of plants for varied purposes.

Although, several ethnobotanical studies have been previously conducted on *Gujjar* and *Bakarwal* tribes of some districts of JKUT, the review of published literature has shown that the ethnobotanical studies of said tribes have not been focused by ethnobotanists from the selected area of study. Hence there is significant research gap in current knowledge. Though ethnobotanical studies have gained pace during 1980s all over the country but started late in Jammu and Kashmir and still today not all the parts have been worked out in this context. Therefore, there is great need to document, and explore the plants and their utilities in day-to-day activities, before they are completely diminished because of gradual loss of forests due to excessive felling of trees, forest fires and other natural calamities.

Hence, the present study was proposed to explore and document the indigenous

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knowledge on the ethnobotany of plants used for various purposes by the locals and the tribal inhabiting in the study site. The study was attempted to find a way to preserve the indigenous knowledge of the elderly knowledgeable and herbal practitioners and to test them against contemporary diseases. There is an urgent need to document this knowledge since there is growing worry in the modern era about the indigenous knowledge of herbal medicine being rapidly lost. This documentation will also help to provide the necessary clues regarding the identification of novel drug discovery as well as in sustainable resource management and conservation.

1.5 Research objectives

The present research work was conducted with the following objectives:

1. To collect information about the plants used as plant based traditional products, wild edible plants, ethnomedicinal, and ethnoveterinary plants by the local population as well as nomads like *Gujjars* and *Bakarwals* dwelling in the wildlife Sanctuary.
2. To collect the plants of the study area for proper identification and future references (Herbarium preparation).
3. To analyse the data using various quantitative indices to find the most important plant based traditional products, wild edible plants, ethnomedicinal, and ethnoveterinary plants.
4. To study the antimicrobial activity and nutritional value of some of the important plants used by the inhabitants of the study area.
5. To enlist the traditional methods for the conservation of ethnobotanical plants, and find methods for conservation of important plants.

1.6 Scope

1. **To enrich the discipline:** The traditional knowledge of the dwellers of the Sanctuary shall be documented for the first time as research papers and thesis.
2. **Knowledge preservation and transmission:** Today's young generation rely more on the new technologies and allopathic medicines than that of the traditional one. The efforts of the ethnobotanists can ignite these juvenile minds and can make them realize that the traditional wealth of knowledge can efficiently help them to get out from the related diseases. This indigenous knowledge related to the plant use is restricted more specifically to the old aged knowledgeable and the traditional herbal healers like *Vaid*s and *Hakim*s. So ethnobotanical studies assist in preserving this knowledge from one generation to next, which is the best way to preserve the same for future use.
3. **Improvement in tribal/rural healthcare:** The tribal people and the ethnic groups are in a way lag behind in financial and economic prospects. They cannot afford the expensive imported medicines and other floristic products for their daily use therefore; they mostly depend on the plant-derived prescriptions. Indigenous people use a wide range of plants therapeutically to maintain their health. Hence the acquisition of traditional knowledge regarding the plant use from the forefathers finds a great scope in improvement of the tribal/rural healthcare practices as this is a cheap and easy to use formula for the treatment of various diseases at their places.
4. **Baseline information for development of modern drugs:** Medicinal plants play a vital role in the indigenous medical systems as the ethnobotanical studies helps/aids to identify the most frequently used important species, which should further be studied for phytochemical analysis for identifying the bioactive compounds. The traditional indigenous knowledge regarding the plant use by the ethnic communities open new doors for the development of modern drugs as the raw herbal products and the medicinal folklore provide the baseline information in formulating new/modern/synthetic drugs. This will also help in providing employment to a number of unemployed young generations.

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5. **Conservation of traditional medicinal plants:** The floristic wealth today is declining at an alarming rate either due to natural or anthropological activities. Promoting ethnobotanical studies can retrieve the vanishing traditional indigenous knowledge from remote village communities especially the traditional healers that further will encourage the sustainable conservation strategies for medicinal plants.
6. **Livelihood promotion/Socio economic upliftment of tribal:** The floristic wealth and the tribal are culturally and traditionally associated with each other. A vast majority of the tribal and ethnic groups live in close proximity to forests for their livelihood. The lifestyle of tribal and other nomadic people is completely contrasting from the rest of the World, as they do not indulge in the hustle-bustle of the cities, and restrict themselves to the raw, natural and safe plant products of the forests. The ethnobotanical studies pave a way for the socio-economic upliftment of the local/tribal as their economy and livelihood depend largely on the forest resources.
7. **Preservation of culture of tribes:** Different tribal and rural communities use a variety of plants and plant-based products as offering to God on different religious/cultural occasions. Therefore, with the help of ethnobotanical studies we can locate and conserve the useful varieties of plants that will otherwise be lost from society. The ethnobotanical explorations largely assist to preserve the social, local/tribal customs, beliefs and other rituals of nomadic, tribal and rural people living in a particular region. It is because of their socio-religious and cultural ceremonies that help in preserving the plant resources of the region.

2. Review of literature

The relation between plants and humans is indispensable as many products that man utilizes came from plants. Plants play a vital role in the sustenance of human life especially the tribal community because these groups of populations are utilizing the plants against various diseases as primary health care practices. Many tribal populations depend wholly on the use of medicinal plant species that caters to their day-to-day needs like food, shelter, medicines, wood etc. Many wild edible plants serve as the main source of food for the tribal forest dwellers (Kumar and Hamal 2009). Moreover, a number of plants finds a role in various religious ceremonies, social customs, celebrations and festivals hence there is a prime need to record the indigenous knowledge that is lying with the older generation/herbal healers and to do scientific validation of the same (MG and MG 2019). This indigenous system of traditional knowledge is a way to preserve our cultural and ecological diversity apart from community healthcare and drug development programs (Gupta *et al.*, 2013). Plants contain large number of pharmaceutically active ingredients that have their own unique combinations and properties, and can be used as healing agents and for development of potential drugs or in the pharmaceutical industry (Malla *et al.*, 2015). According to an estimate of (WHO, 2005) about 25% of all modern medicines and drugs are obtained either directly or indirectly from the plants (Heineidy *et al.*, 2018). The treasure of traditional knowledge regarding plants used for curing different ailments lies with the herbal healers or the tribal communities. They play an important role in imparting the health coverage to 75% of population inhabiting in the rural areas (Mahmood, 2020). First among the community's healthcare practitioners were traditional healers. Through the modernisation of the collection, preparation, storage, use, application, and delivery of the service, the majority of contemporary healthcare systems was originated from the traditional system. Indigenous knowledge has been documented for generations and continues in a fragmented fashion today.

Ancient literature records how people used plants for a variety of purposes through ethnobotanical practices. In India, the field of Indian ethnobotany was pioneered by

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Dr. S.K. Jain (1986), also recognized as the Father of Indian ethnobotany, from NBRI, Lucknow. He has made significant contributions to ethnobotanical research and revealed new perspectives on traditional medicine.

In the current period, due to modernization the traditional knowledge regarding the plant use in folk medicines and primary health care practices is decreasing gradually in the young generation. Hence studies on ethnobotany finds a major role in preservation and documentation of the traditional wealth of knowledge, conservation of biodiversity and sustainable management of natural resources (Heineidy *et al.*, 2018).

2.1 Ethnobotany: World Scenario

Around 2500 years ago, people in Central Asia and Greece began using medicinal plants (Jamshidi-Kia *et al.*, 2017; Giannenas *et al.*, 2020). According to the ancient written record of medicinal plants, the Chinese, Indians, and Egyptians were among the first human societies to use medicinal herbs some 5000 years ago. While the renowned Chinese Materia Medica (1100 BC), which means pharmacognosy, and "Pen T' Sao" (2700 BC) both mentions more than 300 and 365 medicinal plant species, respectively, the earliest known written record of Chinese medicines dates back to the reign of Emperor Shen Nong Ben Jing (2700 BC) (Giannenas *et al.*, 2020).

Greek medicine was pioneered by Hippocrates (460–377 BC). Theophrastus (370–287 BC), a Greek scientist and the founder of the School of Medicinal Plants, is regarded as the father of botany. He later contributed to Greek remedies (Jamshidi-Kia *et al.*, 2017).

The Unani medical system dates back to 400 BC in ancient Greece, and Arab physicians who travelled with Mughal invaders brought it to India in the 13th century. India, Pakistan, Bangladesh, Britain, the United States, Canada, and Germany are among the nations that currently use the Unani medical system (Giannenas *et al.*, 2020). In his work *De Historia Stirpium* (1542), German physicist Leonard Fuchs

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(1501–1566) listed around 500 plant species (Giannenas *et al.*, 2020). Swedish botanist Carolus Linneaus wrote numerous publications on medicinal plants in the 18th century, such as *Medicamnta graveolentia* (medicines with strong smells) and *Materia Medica* (pharmacognosy) (Alamgir, 2017).

The renowned ethnobotanist I.A. Abbot (1919–2010) contributed to ethnobotanical research in Hawaii, USA (Abbott, 1982; Abbott, 1991; Abbot, 1992a; Abbott, 1996).

As to the 2005, Constitution of the International Society of Ethnopharmacology, ethnopharmacology is defined as the "interdisciplinary study of the physiological actions of plant, animal, and other substances used in indigenous medicines of past and present cultures." Global botanical exploration reached its zenith during the 19th century. Many pure bioactive compounds have been extracted from medicinal plants during the 19th century, such as morphine from opium poppies in 1803, strychnine from *Strychnos nux-vomica* in 1817, caffeine from green coffee beans in 1820, quinone from cinchona in 1820, nicotine from tobacco plants in 1828, atropine from *Atropa belladonna* and *Hyoscyamus niger* in 1833, and cocaine from coca plants in 1855 (Alamgir, 2017; Giannennas *et al.*, 2020).

The American ethnobiologist Richard Evan Schultes (1915–2001), regarded as the father of modern ethnobotany, focused mostly on the ethnobotany of hallucinogenic plants in Mexico and the Amazon (Schultes, 1960; 1991; 1994; Schultes and Ploughman, 1979; Schultes and Hofmann, 1992). Numerous works on ethnobotany have been authored by American ethnobotanist J.A. Duke (1929–2017) (Duke, 1981, 1992, 1999, 2002, 2008). He referred to plant-based meals and herbal remedies with therapeutic properties as "green pharmacies."

Etkin has written numerous works on ethnobotany (Etkin, 1986; 2000; 2008), and she discusses the significance of food for overall health in her book "Edible medicines: An Ethnopharmacology of Food" (Etkin, 2008). Her research covered the use of traditional remedies to treat illnesses in Nigeria, Indonesia, and Hawaii. The primary focus of Wayne Arthur Whistler's (1944–2020) ethnobotanical research at the

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University of Hawaii (USA) was the flora of the Pacific islands of Tonga, Cook, and Samoa (Whistler, 1988, 1990, 1991a, 2000). According to Whistler (1990), the indigenous residents of the Cook Islands utilize over 600 plant species of ethnobotanical significance for a variety of purposes. Whistler (1991a) mentioned 105 plant species in his second study on the herbal remedies utilized by the Tonga islanders.

A notable American ethnobotanist Paul Alan Cox has won numerous honors for his work in ethnobotany, including the E.K. Janaki Ammal Medal (India).

A number of ethnobotanical studies have been carried out by various workers from different parts of the world viz. (Kadir *et al.*., 2012, 2015; Rehman *et al.*., 2013; Kabir *et al.*., 2014) from Bangladesh, (Yaseen *et al.*., 2015) from Pakistan, (Malla *et al.*., 2015) from Western Nepal, (Skalli *et al.*., 2019) from Morocco, (Wubetu *et al.*., 2017; Estrada *et al.*., 2014; Kefifa *et al.*., 2018) from North western Ethiopia, Mexico and Semi-arid region of Algeria, respectively. Kefifa *et al.*, (2018) like others have also quantitatively analyzed the ethnobotanical field data by means of various indices viz. use value, frequency of citation, relative frequency of citation, fidelity level, relative importance index, and informant consensus factor.

A review of published literature by Rokaya *et al.*, (2014) revealed the folk use of 947 medicinal plants for treatment of gastrointestinal disorders in Nepal. A total of 66 medicinal plant species from 37 families and 60 genera were identified from Terai Forest of western Nepal by Singh *et al.*, (2021). These plants were used to treat a variety of diseases and ailments categorized into 11 disease categories, with gastrointestinal disorders receiving the most species (41) and dermatological disorders receiving the least (34). The informants' consensus on medicinal plant uses in the study region ranges from 0.93 to 0.97, with an average value of 0.94. Herbs were the most common source of medicine (53%), followed by trees (23%). The most often and widely utilized medicinal plant species in the research area were *Curcuma longa* (84%) and *Azadirachta indica* (76%). Threatened species include *Senegalia catechu*, *Bacopa monnieri*, *Bombax ceiba*, *Drymaria diandra*, *Rauvolfia serpentina*, and

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Tribulus terrestris. They observed gastrointestinal disorders to be more prevalent in developing countries.

A total of 131 medicinal plants from 67 families and 119 genera were found to heal 156 illnesses from district Kaski, Nepal. The plant groups Poaceae and Asteraceae have the most members. Among the various plant habits, herbs were the most commonly utilized (N=67). Paste (N=56), juice (N=54), raw (N=47), powder (N=34), decoction (N=19), and cooked (N=10) were the most popular forms of treatment. A considerable number of disorders (N=112) were healed by leaf Gautam and Timilsina (2022).

Bunalema *et al.*, (2014) reported plants, which are traditionally used in the treatment of Tuberculosis in Uganda. A review of published literature by Tariq *et al.*, (2015) enumerated 64 anticancer plant species used in traditional medicinal practices in Himalayan region out of which 42 and 17 species were reported from India and Pakistan respectively.

Pavel Partha (2014), performed study on Laleng community of Bangladesh where they were observed to utilize 112 plant species for curing their common ailments. Faruque *et al.*, (2018) presents information on important ethnomedicinal plants that was acquired for the first time from the study area from traditional healers in three Bangladeshi indigenous tribes. The Jaccard Index evaluated the degree of homogeneity between the current and previous research, as well as among indigenous populations (JI). There were 159 ethnomedicinal plant species in all, distributed in 132 genera. 174 sources interviewed about 62 families. There were 128 native plants and 31 alien plants among them. Mahadkar and Patil (2023) performed recommendable work on wild edible plants also having the medicinal values to treat different diseases from Thane district. Jigme and Yangchen, (2022) worked out on the plants used for socio-religious purposes from Bhutan. Out of a total of 24 plants species documented, maximum plants utilized were of family Poaceae followed by Ericaceae and Cupressaceae.

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Berihun and Molla (2017) documented the use and conservation of 77 wild edible plants from Ethiopia. Usman *et al.*, (2022) performed studies on Oromo people of Ethiopia to document the important medicinal plants used to treat various ailments. In their study they noticed that age, gender, and educational attainment all significantly ($P < 0.05$) impacted conventional medical knowledge. Multiple linear regression analysis revealed that conventional medical knowledge was predicted by age and educational attainment. Another study from Ethiopia by Bekele *et al.*, (2022) recorded 145 medicinal plant species being used by Hamar community of Southwestern Ethiopia. Agize *et al.*, (2022) extracted knowledge from 384 traditional healers regarding the traditional usage of plants for treating various human as well as livestock diseases from Dawuro Zone of Ethiopia. Mersha, (2023) from the said country conducted studies on the native uses and management of edible wild plants by the semi-pastoralist community in Ethiopia's west Guji Zone (Suro-Barguda District). Similarly, study was conducted by Zemedu *et al.*, (2024) from Gamo people of Ethiopia for collecting information of medicinal plant species in which 188 plants were reported to be used against various illnesses. Agize *et al.*, (2024) documented 274 plant species that were utilized by locals of Dawuro Zone of Ethiopia to treat various human and livestock ailments. Agricultural practices, urbanization, low or no charge for healing services, oral transmission and the need for multipurpose and medicinal species were some of the factors observed by the workers that were endangering the resource and related knowledge in the study area. The authors suggested that in order to provide primary healthcare systems to rural populations, it is necessary to integrate with the current system and formalize, legalize, and train practitioners of traditional medicine. Tamene *et al.*, (2023; 2024) also reported plants used to treat different ailments from South-Central Ethiopia. Misganaw and Yiblet, (2024) also contributed in conducting studies pertaining to ethnobotany from Northwest Ethiopia. 64 medicinal plants were reported most of which belonged to family Lamiaceae. Among these, 12 plant species were used for ethnoveterinary purposes. As per this study, *Laggera tomentosa* and *Urtica simensis* conservation

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must be given top priority in order to protect biodiversity and the customs connected to these threatened species.

Plants that are not domesticated and have at least one edible part, like a leaf, root, or fruit, are known as wild edible plants (WEPs). These plants that do not require human assistance to develop in controlled or unmanaged conditions. WEPs are widely used as a primary source of nutrition in many parts of the world, especially during times of hunger and periodic food shortages Asfaw *et al.*, (2023). Asfaw *et al.*, (2023) dealt with finding the variety of wild edible plants, plant part used, the preparation techniques, and the harvest and consumption of WEPs from Ethiopia.

Phumthum *et al.*, (2020) worked out on the thorough summary of the knowledge on Karen ethnomedicinal plants collated from all reputable and published sources. Prasetyo *et al.*, (2024) collected data of ethnomedicinal and traditional practices used by Lio's traditional healers of Indonesia.

Jaric *et al* (2024) documented 136 vascular medicinal plants from south-eastern Serbia, Western Balkans and analyzed the data by means of use reports, citation frequency, use values (UV), and the informant consensus factor (ICF). A large number of medicinal plants are used during the outbreak of COVID-19 which led to a large number of populations depending on them for illness management and prevention. Mogha, (2024) documented 21 medicinal plants exclusively used to combat with this pandemic situation from Tanzania. To ascertain their efficacy in COVID-19 prevention, the study recommends further toxicological research and clinical assessment. Apart from treating human ailments, plants also are utilized to treat certain animal diseases. One such study was carried out recently by Gobvu *et al.* (2024) from Zimbabwe wherein 32 plants were recorded which are utilized in managing poultry diseases. Tiwari *et al.*, (2024), concluded and emphasizes on “think locally and act globally scenario of Indian medicinal plants knowledge its worldwide implementation as lifesaving novel herbal formulations”.

Numerous ethnobotanical studies have been performed from Pakistan viz, Arshad *et*

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al., (2014) did ethnobotanical survey of 91 plants and 65 animal species from Kala Chitta hills of Pothwar region, Pakistan, these show that compared to aerial and annual plant groups, the medicinal and food consumption of subterranean and perennial plants was higher. Abbassi *et al.* (2013) gathered information of cultural values of wild edible vegetables from Pakistan. They emphasized that a key component of the future of wild edibles is the development of farming skills and the application of biotechnological technology to increase productivity. Another remarkable ethnobotanical study was done by (Ahmad, 2014; Irfan *et al.*, 2023) from Pakistan in which they have gathered information of 91 and 147 plants respectively, utilized to treat different ailments prioritizing for conservation of plant resources from Pakistan. Rashid *et al.*, (2018) reported 73 medicinal plants from 40 families and 66 species used in herbal formulations, by indigenous communities in Azad Jammu and Kashmir, Pakistan, Asteraceae being the most abundant. Leaves (20%, roots (17.25%), and fruits were the most commonly used plant elements (16.47%). *Valeriana jatamansi*, *Isodon rugosus*, *Onopordum acanthium*, *Acacia nilotica*, and *Viola canescens* were the top five most used species based on UV. Decoctions, infusions, and tea were the most popular herbal preparations. Amjad *et al.*, (2015) documented 104 plants from Azad Jammu and Kashmir (AJK) and in (2020), collected information of ethnomedicinal plants from Harighal, (AJK) and documented 150 plants distributed in 60 families. Khanum *et al.*, (2022) explored and documented the ethnobotanical knowledge of indigenous rural communities of District Bhimber of Azad Jammu and Kashmir, Pakistan. Various quantitative ethnobotanical indices such as informant consensus factor, use-value, fidelity level, the relative frequency of citation, the relative importance of plants, rank order of priority, Jaccard index, and priority ranking were utilized to validate and investigate innovation of research study. Jaundice had the highest ICF of 0.91, followed by wounds, skin illnesses, and stomach aches with ICFs of 0.89, 0.86, and 0.85, respectively. 153 ethnomedicinal plants have been reported from Sakhra valley, Swat, Pakistan by Shah *et al.*, (2024) that adds feather to the ethnobotanical studies. Majority of the plants used in treating illnesses

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were aromatic belonging to Lamiaceae and were effective in curing gastrointestinal problems. 130 wild plants have been documented from Azad Jammu and Kashmir, Pakistan by Ishtiaq *et al.* (2024) that were utilized by people to maintain their well-being. It also aimed to ascertain the conservation status of these communities and provide recommendations and ideas for the preservation and propagation of the region's rare and endangered wild flora for sustainable use. According to the Fidelity level study, these plants were widely employed in a variety of traditional ethnomedicinal plants, with *Artemisia maritima* and *Berberis lycium* being the most prevalent. *Indigofera linifolia* was having the highest use value index. To assess the significance of plants in traditional ethnomedicine, the relative frequency of citations was computed, by the author identifying *Rosa indica*, *Pinus wallichiana*, and *Morus nigra* as noteworthy species. The research has a high degree of innovation, as per the Jaccard index, which can be used to develop new drugs and discover new ones.

Similar investigations by Ishtiaq *et al.*, (2024) recorded traditional ethnobotanical knowledge (TEMs) of therapeutic plants from the Sudhnoti district's rural people from Pakistan with a view to assess the area's unique and threatened wild plants' conservation status and offer suggestions and proposals for their sustainable use. 150 locally significant plants from 69 families were identified in the present study, with Rosaceae family being the most common and prominent. The results show that many locally important plants serve a range of functions, such as fuel, food, medicine, fodder, shelter, and ornament. TEMs made from these plants have been used to treat a wide range of ailments, including the flu, kidney issues, fever, malaria, cough, migraine, influenza, skin problems, allergies, digestive issues, diabetes, muscular issues etc. The ICF research found that the most prevalent diseases in the mountainous area were rheumatoid arthritis, fever, whooping cough, renal calculus, malaria, and arthritis. The findings of this study contribute to the documentation and preservation of cultural heritage and set the stage for future studies in ethnobotany, ethnopharmacology, and biodiversity conservation efforts to provide wild plants to indigenous communities in a sustainable manner, thereby mitigating the effects of

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severe climate change.

Recently, Shah *et al.*, (2025), conducted studies pertaining to ethnobotany of wild edible plants from Pakistan through interviews from 222 locals and documented 60 plants that serves as a possible resource for ensuring the food security.

Another such investigation was conducted by Xiong and Long (2020) from China in which they documented 122 plant species exclusively utilized to treat livestock ailments by Buyi people. The majority of the ethnoveterinary plants belonged to family Asteraceae followed by Zingiberaceae and Rosaceae. The ethnobotanical research of Liu *et al.*, (2020) in Qingtian, Zhejiang Province, China, is motivated by a desire to preserve the wealth of traditional knowledge related to therapeutic plants that produce foods and beverages. They include 129 plant species from 113 genera and 75 families that are used to make herbal teas to treat at least 31 different types of illnesses. They have observed a slow decline in the usage of herbal teas and the associated knowledge that goes along with it. They anticipate that their study will pique locals' interest in preserving their herbal tea plants.

Li *et al.*, (2023) also gathered traditional information of therapeutic plants from Yi people of China wherein 267 plants were reported to be used in the treatment of health-related issues. The most often utilised were herbs and decoctions were most frequently used method of herbal preparation. Exploration of ethnomedicinal plants by Bi *et al.*, (2024) from Duar people China, is not reported earlier and as per reports 52 plant species were utilized by Duar people to cure various health disorders. Out of which *Betula pendula subsp. mandshurica*, *Artemisia integrifolia*, *Crataegus pinnatifida*, *Saposhnikovia divaricata*, *Artemisia argyi*, and *Jacobaea cannabifolia* were the commonly utilizing species.

Ghazouani *et al.*, (2024), documented 101 plant species and gathered information from 150 informants regarding the socio-economic usage of medicinal plants from Western High Atlas region of Morocco which was reported to have rich biodiversity. Another worker Benamar *et al.*, (2025) worked out on the ethnomedicinal plants from

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Kaddour Morocco and reported 52 medicinal plants. The study found that the use of therapeutic plants was comparatively low among younger, highly educated people which may result in the alteration of cultural practices or a decrease in exchange of information across generations.

Muhakr and Ahmed (2024), gathered information of 59 ethnomedicinal plants from Melit area (North Darfur) of Sudan from 135 locals through semi structured questionnaires. This was the first research from this region to document traditional information pertaining to plants to treat various ailments.

Contribution of Acosta *et al.*, (2025) resulted in the documentation of 124 plant species used to cure variety of illnesses from Argentina. The study's findings are meant to promote sustainable resource management, improve biocultural conservation of forests, and provide local residents with economic options.

Plants exclusively used in treating livestock ailments are reported by Zerbo *et al.*, (2025) from Burkina Faso. 88 plants used by the livestock farmers were documented utilized in curing various ailments pertaining to livestock.

The availability of plant resources and people's level of knowledge determines their utilization. An ethnobotanical investigation conducted in Tharaka-Nithi County, Kenya, Kathambi *et al.*, (2020) were able to record 214 plants known to the locals, which are spread throughout 169 genera and 73 families. Their study helps in increasing the local population's knowledge regarding the significance of their plant resources. The authors stress significance of protecting and making sustainable use of these resources.

Marques *et al.*, (2025) give due emphases on the conservation priorities of ethnomedicinal wealth from Brazil after conducting review of the literature and mentioned uses of 343 medicinal plants, *Socratea exorrhiza* and *Carapa guianensis* with having maximum anthropogenic collection, pressure and great versatility in its uses respectively. Khojimatov *et al.*, (2025) reported 182 ethnomedicinal plants from Fergana region and 125 from Andijan area of Uzbekistan utilized by the community

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in curing various diseases and are of the view that the common species which are utilized at the maximum due to their wide availability and affordability need to be conserved for near future.

Some workers are interested in the documentation of the plants that belongs to same family and get to know about the variation in their usages. One such study was conducted by Nadaf *et al.*, (2025) from Iran where they have taken into consideration the family Asteraceae only and gathered ethnobotanical information, chemistry and pharmacology of plants under this family. They analyzed the medicinal properties of 137 Asteraceae family members and reported polyacetylenes, sesquiterpene lactones and other terpenoids, flavonoids, and phenolic acid derivatives as the most frequently present chemicals in plants of Asteraceae family that determine the biological activity of plant material.

A review study was framed by Frimpong *et al.*, (2024) from Africa, regarding the plants utilized to treat the most prevailing illness like Diabetes. *Allium sativum* L. (n = 6), *Olea europaea* L. (n = 6), *Azadirachta indica* A. Juss (n = 5), *Allium cepa* L. (n = 5), and *Moringa oleifera* Lam. (n = 5) were oftenly utilised native medicinal plants on the African continent. The leaves (45.55%), bark (14.44%), and bulbs (12.22%) were the most frequently mentioned components utilised in managing diabetes in their study. Fisher *et al.*, (2025) reviewed 222 plants exclusively used to cure wounds by the people of South Africa. This study emphasizes the need for more ethnobotanical research to treat wounds in South Africa and offers a useful resource for upcoming phytochemical and pharmacological investigations.

2.2 Ethnobotany: Indian Scenario

Various ethnobotanical studies in India were conducted where different workers analyzed and investigated therapeutic plants utilized by different tribal communities inhabiting in various locations of the country. Numerous scientific studies on various tribal people and their ethnomedicinal knowledge have been conducted in the Indian peninsula (Swain *et al.*, 2022; Marak and Mathew 2022). Some of the important

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studies were done by (Jain *et al.*, 2010) from Maharashtra, (Sharma and Khandelwal, 2010), from Rajasthan and (Ajaib *et al.*, 2014) from Gujrat. Similar surveys were conducted by (Samar *et al.*, 2015) and Sandya and Sandya, 2015) from Guna and Mandla districts of Madhya Pradesh inhabited by the tribal communities.

Data *et al.*, (2014) surveyed 46 plants used by the tribal to cure different health problems from West Bengal. A number of other workers (Manjula and Mamidala, 2013; Mishra *et al.*, 2014; Gurrapu and Mamidala, 2016; Bhattacharya *et al.*, 2020) enlisted the ethnomedicinal plants and gathered information regarding the usage of plants by different tribal populations from Andhra Pradesh, Rajasthan, Telangana, and Assam, respectively. Jain and Namsa *et al.*, (2011) enlisted 50 plant species from 29 families that were utilised by the Monpa ethnic people of Arunachal Pradesh, India, to treat 22 human and four veterinary illnesses. Herbs (40 percent) the most prevalent growth form among the therapeutic plants were reported, followed by shrubs, trees, and climbers. The most used plant pieces were leaves. As per the consensus research, dermatological problems have the greatest FIC (0.56), while gastro-intestinal diseases have the lowest (0.43). The FIC results showed that the users agreed on the utility of plants in the dermatological and gastro-intestinal illnesses categories. *Gymnocladus assamicus* is a critically scarce and endangered species that finds its use to sterilize wounds and livestock pests such as leeches and lice.

Tiwari (2012) did remarkable work on finding the edible plants utilized by tribal population in case of emergency situations from Central India. Deb *et al.*, (2013) studied the status of wild edibles and their customary use as dietary recipes by various ethnic tribes in Tripura. There have been reports of sixty ethnoveterinary plants by Saha *et al.*, (2014) from West Bengal, India. Ahirvar *et al.*, (2017) performed significant work on the potentials and prospects of wild edible fruits in central India wherein they have recorded 46 wild edible plants (WEPs) which have been used as pickle, oil, chutney, in medicine as for commercial purposes thereby suggesting their importance.

Kandari *et al.*, (2012), enlisted 50 plants from 31 families and 44 genera from Dhauili

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Ganga in Nanda Devi Biosphere Reserve (NDBR), in the central Himalaya. 70% were harvested in the wild, 22% were cultivated, and 8% were both cultivated and wild harvested. 8 percent of the cultivated species were discovered in kitchen gardens, and 14 percent in agricultural fields. Roots and rhizomes were employed by 42 percent plants, followed by leaves (26 percent), seeds (10 %), seed and leaf (8 %), bark and whole plant (6 %), and flower (6 %). Singh *et al.*, (2019) conducted a preliminary study on three lesser-known sacred Grooves - Nagdev, Chanderbadni, and Surkanda from Western Himalaya and investigated 78 ethnomedicinal plant species used to cure different health related problems like asthma, cholera, constipation, cuts/wounds, digestive disorders, fever, eye/ear diseases, rheumatism and toothache. They also encountered some rare and threatened animal species like *Naemorhedus gora* (Near Threatened), *Panthera pardus* (Critically endangered), *Ursus thibetanus* (Vulnerable) during their study. Their study focused on the conservation of biodiversity as it is threatened nowadays due to many natural or anthropogenic interferences.

Patel *et al.*, (2020) listed 66 important plants from the sacred natural sites from Panchkoshi Pilgrimage, Varanasi, Uttar Pradesh. This study aids in setting priorities for educating the community about the desire need of plant conservation and the associated indigenous knowledge. Additionally, it would increase the amount of green space in Varanasi's growing urbanized district while Masoodi and Sundriyal, (2020) prepared an inventory of 811 plant utilized as non-timber forest products by collecting information from already published literature and enumerated imported plants. A list of 39 plant species was prepared by Bhattacharyya *et al.*, (2020) being utilized by tea tribes of Assam for treating Jaundice. Bhattacharjya *et al.*, (2023), did ethnobotanical investigation of phytomedicines in the Barpeta district of Assam, India, based on customary knowledge. Later in, 2024, Kalita *et al.*, (2024) documented 80 plant species used in traditional healthcare system by Assamis and the study emphasized on the preservation of taxa.

55 species were identified by Chandra and Uniyal (2021), along with their traditional usage for healing ailments. Relative Frequency Citation (RFC), Relative Importance

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Index (RI), Cultural Importance Index (CI), Cultural Value Index (CV), and Fidelity Level was analyzed to assess the community's reliance on medicinal herbs (FL) villages around Govind Wildlife Sanctuary and National Park in the Western Himalayas.

Agarwal and Rijhwani (2021) suggested that there is an urgent need of ethnobotanical studies due to deforestation, colonization, and industrialization in order to prevent tribal life from going extinct and to ensure the sustainable use of plants growing in wild habitats in Jaipur. Acharya *et al.*, (2023) investigated 214 plant species used by Gowda community of Karnataka in different use categories while Singh and Saxena (2023) did extensive review of plants and practices being used in treating animal bites utilized by different tribal populations of India.

The plants used in treating livestock ailments are considered as ethnoveterinary plants. Compared to artificial drugs and chemicals, the usage of indigenous ethnoveterinary therapies is more affordable, simpler, and durable McCorkle *et al.*, (1998). Rajkumari *et al.*, (2014) conducted studies pertaining to ethnoveterinary plants from Manipur and 36 plants were documented utilized to treat domestic animals. The most widely used and successful ethnoveterinary plants include *Saccharum officinarum* and *Bambusa tulda* for treating placental retention, *Areca catechu* for treating endoparasites, and *Cannabis sativa* in treating diarrhoea and dysentery. *Trigonella foenum graceum* helped in managing haemorrhage, *Mellitia pachycarpa* in removing insects, and *Achyranthes aspera* to treat galactagogue.

Bhagat *et al.*, (2016) gathered 108 potential WEPs from north western ghats and Mulshi region of India. They suggested that these fruits have great nutritional value, remarkable therapeutic qualities which should be investigated further for pharmaceutical business or as an extra fruit crop supply in agriculture. Dorjey *et al.*, (2022) recommended the preservation of *Dactylorhiza hatagirea*, an important Himalayan medicinal plant which finds its use in different medicinal systems like Ayurveda, Unani, Siddha and Sowa-rigpa for treatment of different diseases and which has become threatened due to its overexploitation.

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Uttarakhand- a north Indian region that is well-known for its rich and varied biodiversity due to its varied altitude, climate, and geography. The state is home to a remarkable variety of plants and animals, spanning from the Terai plains to the Himalayan highlands. Uttarakhand is an important part of India's conservation efforts due to its biodiversity, which supports ecological balance and many local residents' livelihoods. As such, its preservation is important for socioeconomic and environmental reasons. Various workers have done remarkable ethnobotanical studies to identify the most important therapeutic plants utilized by the locals and the tribal populace. Bhat *et al.*, (2013) conducted study from Kedarnath Wildlife Sanctuary, Garhwal Himalaya wherein they reported 152 ethnomedicinal plants, of which 18 were detected in rare, endangered, critically endangered and vulnerable categories. Nandini and Shiddamallayya (2014) inventoried 105 WEPs from Mysore utilized by tribal and local populace. Manikandan and Srivastava (2015) dealt with the floristic composition of the Govind Pashu Vihar Wildlife Sanctuary from Uttarkashi district of Uttarakhand, wherein they efficiently investigated 821 species, 8 subspecies, 11 varieties, some cultivated Angiospermic species which are distributed over 479 genera belonging to 125 families. Their study also noted 9 critically endangered species, 14 endangered species, 9 vulnerable species and 7 Least Concern of the total studied plant species. Another study conducted by Bhatt *et al.*, (2017) documented 256 plants from Kumaun Himalaya finding their role in treating ailments. Similar study was conducted by Pandey *et al.* (2016) and reported 186 plant species.

Bohra *et al.*, (2017) listed 59 wild edible plants (WEPs) that the locals and tribal people utilize in the rural Ramnagar region of the district Nainital, Uttarakhand. Studies performed by Sharma *et al.*, (2022) from tribal communities of Uttarakhand documented 34 plant species. According to their cultural index values, species including *Datura stramonium*, *Ocimum tenuiflorum*, *Ficus benghalensis*, *Cynodon dactylon*, *Achyranthes aspera*, and *Calotropis procera* were considered to be the most important as socio religious plants. The authors concluded that the plant species are essential to their customs and traditions. As a result, it is recommended that the sub-

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Himalayan indigenous groups be routinely checked about their beliefs and monitored. The need of plant diversity and the significant loss that would arise from its eradication must be taken into consideration. Bargali *et al.*, (2022), played significant role in documenting more than 5000 species of vascular plants from Uttarakhand state in NW Himalayas of which about 33% species have medicinal values and hence Uttarakhand is recognized as ‘herbal state of India’.

Kanika and Panda (2024) from Uttarakhand gathered information of 64 medicinal plants consumed by the locals for their illnesses. The study's noteworthy conclusions indicate that people in remote hamlet are more knowledgeable about the plant utilization than those in more accessible communities. Sharma *et al.*, (2025) analysed the quantitative perspective of ethnomedicinal plants from Rishikesh, India. 89 ethnomedicinal plants were documented from the study site emphasizing their future studies and their preservation practices.

236 plant species in all were found grouped into 184 genera and 80 families by (Singh *et al.*, 2025) from Lois people of Manipur’s Kakching district, India, as they are having immense knowledge about the therapeutic plants. Some plants were encountered having low fidelity level (40%) that needs proper care and attention. Deforestation was identified as major threats to the region’s flora. The primary emphasis of the study was the community's distinctive ethnobotanical characteristics and the documentation of their traditional knowledge for the efficient and sustainable use of natural resources.

Invasive plants are non-native species that spread rapidly and aggressively, often outcompeting native plants and disrupting ecosystems. They can take over habitats, reduce biodiversity, alter soil composition, and impact wildlife by changing food sources and nesting areas. But invasive plants can be utilized sustainably in treating variety of ailments. Wagh and Jain (2018) conducted detailed ethnobotanical study on the invasive plants of Western Madhya Pradesh wherein it was realized that 102 plants which are invasive but still have the pharmaceutical potential to solve issues pertaining to various illnesses. It was observed that utilizing invasive alien plant species can remove strain on native plant species, which promotes the conservation of native plant

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variety. The results of this investigation can serve as an ethnopharmacological foundation for choosing plants for subsequent phytochemical pharmacological research.

Singh *et al.*, (2022) performed ethnobotanical studies from tribal populations of Dindhori district of Madhya Pradesh used to treat respiratory, digestive and skin ailments. Another such study from the same state was contributed by Gwalwanshi and Bishwas (2023) wherein 51 ethnomedicinal plants were recognized for their therapeutic potential. The results also showed that a number of manmade factors are increasing the burden on many wild species. Therefore, in order to conserve biodiversity and ethnomedical knowledge of *Balaghat* people, it is necessary to promote public awareness and public-based management at all levels. Yet in another extensive study from Madhya Pradesh, Sharma *et al.*, (2024), documented 201 ethnomedicinal plants highlighting the importance of contemporary knowledge regarding plant use that could lead to the formulation of new drugs. The study conducted by Sharma and Wagh (2025) lists the wild edible plants that the *Bhil* and *Bhilala* tribes in Western Madhya Pradesh, India, frequently use. The knowledge of these tribes about wild food plants was evaluated by ethnobotanical field study employing a participatory rural appraisal approach and semi-structured questionnaires. In order to preserve wild edible plants and ensure their future contribution to local diets and revenue, the study emphasizes the necessity of collecting them sustainably.

Anadka and Gulimane (2024) reported 210 plant species from Dakshina Kanada district, Karnataka, India to treat musculoskeletal disorders, among them, *Syzygium travancoricum*- critically endangered whereas *Borassus flabellifer*, *Syzygium caryophyllatum* and *Tectona grandis* are in endangered category as per IUCN red list.

77 plant species exhibiting the ethnomedicinal properties were documented by Sharma *et al.*, (2024) from Haryana which were utilized by the locals to combat various ailments.

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Jennipher and Ayyanar (2024) reported 70 plants of medicinal importance from Tamil nadu, India while a case study of Peliyar tribe of Kadamalaikundu, Theni District of Tamil nadu was conducted by Divya *et al.*, (2024) wherein it was reported that the tribe were utilizing 93 plants for treating their ailments. With seven distinct plants utilized as herbal medicines the Solanaceae family was found to be the most prevalent plant family followed by Acanthaceae with six species. *Withania somnifera* (UV=2) and *Coccinia grandis* (UV=2.5) got the highest usage values. This investigation showed that the Paliyar tribe relied heavily on plants for their primary healthcare and veterinary care. These plants require immediate conservation due to population fragmentation and the unwillingness of the young generation to pursue ethnomedicinal activities as a job, which may also lead to the erosion of this precious knowledge. Additionally, the study highlighted a number of noteworthy uses for medicinal plants that could result in new pharmacological opportunities for modern wellness efforts. In the current year, Muthukrishnan and Ramachandran (2025) made efforts in documenting 199 plant used by locals to cure various ailments and emphasized the role of plants in the life of rural people from region of Alagar hills, Eastern Ghats, Tamil Nadu.

Kakurde and Reshi (2025), also noted the need for the documentation of the ethnomedicinal data and its further validation. They documented 82 plants used against various ailments from Taloda forest of the Nandurbar district in Maharashtra, India.

Sahoo *et al.*, (2022) documented 143 plants from Ranapur Reserve Forest, Odisha.

Gmelina arborea, *Rauwolfia serpentina*, and *Crataeva nurvala* (Varuna) were revolutionary against various diseases and belong to the RET taxonomy (Rare, Endangered, and Threatened). Among the wild plants that dominated the research area were *Shorea robusta*, *Dalbergia sissoo*, *Pterocarpus marsupium*, *Murraya koenigii*, and *Schleichera oleosa*. The present study includes a comprehensive database of the variety of flowers and their potential medical applications. Likewise, Sahu *et al.*,

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(2022) also contributed in documenting 18 ethnomedicinal plants from Nuapada district, Odisha used to treat different human illnesses. Ethnobotanical studies on *Madhuca longifolia* which is well known for its medicinal and economic importance was performed by Sen and Behera (2024) from Western Odisha, India

Cancer is a disease in which some of the body's cells grow uncontrollably and spread to various parts of body. Normally, cells grow and divide in a controlled way, but in cancer, this process goes wrong. The abnormal cells can form tumours (lumps of tissue) or spread through the bloodstream or lymphatic system to other body parts. Treatment options vary but may include surgery, chemotherapy, radiation therapy, immunotherapy, and targeted drug therapy. Early detection can improve the chances of successful treatment. Now a days, more research is being conducted to treat cancer to some level with the help of plant extracts. One such study is conducted by Chouhan *et al.*, (2024) from Kutch district of Gujrat. 147 informants were interviewed among them, 72 were well versed with the traditional information about cancer treating plants. Details of used plant part, method of preparation and administration method were all painstakingly recorded. The herbal compositions were divided into the following categories: Hima, Phant, Kwath, Kalka, Swarasa, and the recommended dosages. Based on the research, Kutch uses plants medicinally to treat malignancies such as lung (UV 11%, FL 15%), hepatocellular (UV 14%, FL 16%), colon (UV 12%, FL 9%), and breast (UV 20%, FIC 21%, FL 22%).

Cervical, oral, leukaemia, colorectal, pancreatic, skin, prostate, osteosarcoma, and ovarian cancers are among the other malignancies that have been treated. Of the plant parts used, leaves account for 40%, followed by roots (25%), seeds (12%), and bark (10%).

Agarwal and Rijhwani (2021) documented 40 medicinal plants from Jaipur, *Anogeissus latifolia*, *Anogeissus pendula* and *Boswellia serrata* being the dominant plants and stressed upon the documentation of ethnobotanical information of medicinal plants from the tribals before their extinction from wild.

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The most challenging experience for a woman's body is giving birth. Tribal societies use nutrient-dense meals and ethnomedicinal plants as natural medicines to increase lactation after giving birth, promote healing, and increase vitality. In the tribal communities of southern Rajasthan, Agarwal and Deora (2025) carried out an ethnobotanical investigation of medicinal plants for mammary stimulation and postpartum recovery from Rajasthan. It might be further incorporated into the contemporary healthcare system to enhance the health of nursing mothers everywhere. The study identified 11 plant species from 9 families that indigenous women have historically utilised to promote lactation and aid in postpartum recuperation. The need of conserving indigenous knowledge and incorporating it into contemporary healthcare procedures is highlighted by these findings.

Babar *et al.*, (2024) gathered information of more than 100 plant species utilized by the tribal people to combat with various ailments in different tribal locations from India. The authors emphasized on the conservational aspects of these medicinal plants which is being declining because of diminishing interest about traditional knowledge among the young generations, urbanization, habitat loss etc.

The western Himalayan state- Himachal Pradesh is home to a variety of tribal groups that have long coexisted with the environment and is a hotspot for biodiversity. The tribal population of Himachal Pradesh forms a vibrant part of state's cultural and ecological heritage, inhabiting some of the most remote and ecologically sensitive regions of the Himalayas.

Numerous workers have contributed in the domain of ethnobotany from Himachal Pradesh *viz.* Sharma and Sood (2013), Rani and Rana (2014), Kumari *et al.*, (2015) and Rana *et al.*, (2019). The study on the migratory shepherds of Sirmaur, Shimla, and Kinnaur districts of Himachal Pradesh (HP) by Radha *et al.*, (2019) reported 78 plant species utilized by shepherds during their route to handle a range of ailments whereas Kumar *et al.*, (2020) enlisted and described the important wild medicinal flora of Lahaul Valley of Himachal Pradesh. Thakur *et al.*, (2020) inventoried 49 wild edible plants consumed in different forms (fruits, vegetables, pickles, chutney, spices etc) by

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the pastoral Gaddi tribe of Chamba and Kangra districts of Himachal Pradesh. They observed that this invaluable knowledge is vanishing among the Gaddi tribe as a result of invasion of modern culture over their culture.

Medicinal plants also proved to be crucial during the COVID-19 pandemic because they strengthened our immune systems and shielded bodies from a range of illnesses. In order to gather information regarding plants used against the harmful effects of corona virus, a study was conducted by Sen (2021) investigated the value of wild edible plants from Himachal Pradesh, NW Himalayas. Considering the results of his research, he recommended the use of ninety-five wild edible plants rich in antioxidants, vitamin C, A and Zinc for boosting immunity. Likewise, Thangjam *et al.*, (2024) reported 40 plants species exclusively used to combat COVID from Manipur. Zingiberaceae and Lamiaceae was the dominant family containing maximum number of plants utilised for therapeutic purposes during pandemic. The study suggested to further work out on the phytochemical and pharmacological activities of the concerned plants and their conservation practices.

One more ethnomedicinal study was conducted from Senapati district of Manipur, India by Biona *et al.*, (2025) wherein 82 plants were identified used against various illnesses. *Rhus chinensis* was having highest relative frequency of citation and 11 species with 100% fidelity level thus making appeal for the preservation of vegetation.

Singh and Mathew (2021) have thrown light on traditional usage of 43 species of wild fruit plants utilized by Garo tribe of Meghalaya for their nutraceutical properties. Ralte and Singh (2024) conducted ethnobotanical studies from the ethnic tribes of Mizoram, India. In total, 102 plants distributed in 58 families playing essential role in solving medicinal issues among the communities as they have their own system of medicine to cure certain ailments. The main emphasis was given on studying the pharmacological applications and its validation in addition to plant species conservation. Another study by Ralte *et al.*, (2024) from Western region of Mizoram inventoried 124 therapeutic plants used to cure a range of illnesses *Oroxylum indicum*

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being widely utilized plant which can be important contributor of novel drug formulations.

Bhardwaj *et al.*, (2025) concentrated on the plants which were employed by the native communities of Arunachal Pradesh used to treat gastrointestinal problems and published a review wherein there have been reports of 256 plants to be shown effective against the said disorder. Research conducted from the Central part of India by Rajpoot and Kareti (2025) reported 24 ethnomedicinal plants utilized by tribals against malaria which may help in the discovery of novel drugs.

Singh *et al.*, (2024) documented 53 plants used to cure different ailments from Andhra Pradesh showing their dependence on traditional medicines. *Amorphophallus paeoniifolius*, *Alpinia galanga*, *Azanza lampas*, *Borassus flabellifer*, *Calotropis procera*, *Ponamia pinnata*, *Pterocarpus marsupium*, *Pterocarpus santalinus*, *Solanum lasiocarpum*, *Tectona grandis*, and *Tinospora cordifolia* are among the plant species for which the study documented new medicinal applications not reported previously. Janardhana and Nekrakalaya (2025) reviewed the status of 1628 ethnomedicinal plants used by the people to cure various ailments from Western Ghats- among hotspots of World that comprises of diversity of medicinal flora. Plant families viz. Fabaceae, Asteraceae, and Acanthaceae were the dominant families. However, only 115 plants have had their pharmacological characteristics confirmed by clinical trials and in vivo tests. As per the available literature the Western Ghats' medicinal plants could be a possible source of the more recent medication. More thorough research on the process of screening medicinal plants to identify and describe the pharmacologically significant active ingredients is necessary in order to support the healthcare industry.

2.3 Ethnobotanical studies from Union Territory of Ladakh

Ladakh's varied environments support a wide variety of flourishing flora. Its floral diversity has been the subject of extensive research efforts. But Ladakh's daunting mix of high elevations, harsh climate, and rugged landscape makes it difficult to study

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the medicinal flora. There are many different ethnic groups in this region, and each has its own traditional knowledge about medicinal flora and their utility. Stewart's 1916 compilation of Ladakh's flora was a major advance in the region. Beyond exploration, further scholars explored the distribution patterns of plants, their traditional significance, their phytochemical characteristics, and their ethnomedicinal uses. Notably, research has primarily focused on ethnobotanical and medicinal elements, overshadowing other parts of study (Hussain *et al.*, 2023).

Dorjey *et al.*, (2012) provided the detailed study of customary knowledge and use patterns of 40 high-altitude plant species found in Ladakh region that are utilised by the community as food, medicine, fuel, fodder and decorative and sacred objects. Given the risks posed by overexploitation and urbanization, the study emphasizes the critical need for conservation. Another study conducted by Hadil and Singh (2012) from Kargil revealed 22 endangered plants to verify information about traditional uses and the local population's perspective of the species' population loss. Likewise, Angmo *et al.*, (2012) conducted ethnobotanical study from Nubra valley, Ladakh. Angmo *et al.*, (2012b), Stobdan *et al.*, (2019), Srivastava *et al.*, (2020), Namgail *et al.*, (2021), Kunzes Dolma *et al.*, (2021), and Namgyal *et al.*, (2023) are among the others who extensively worked on the therapeutic plants of Ladakh region.

Angmo *et al.*, (2022) documented 40 wild edible plants species from Leh among these, *Cotoneaster integerrimus*, *Dracocephalum heterophyllum*, *Astragalus frigidus*, and *Turritis glabra* are the new reports. While an ethnopharmacological review of three plant species viz. *Mentha longifolia*, *Peganum harmala*, and *Podophyllum hexandrum*. was conducted by Shabir *et al.*, (2023) from Ladakh due to their immense medicinal values used by locals to treat diverse ailments. Phytochemical makeup of a few endangered medicinal plants employed in the western Himalayan Ladakh region's traditional Amchi medical system was conducted by Raza *et al.*, (2024). Parveen and Farooq (2025) documented 149 plant species used against diarrhoea, dyspepsia, jaundice, dysentery, lung infections and stomach-ache from district Kargil, Ladakh (UT) having alpine, subalpine and high alpine zones. The authors were of the view

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that insufficient documentation regarding the usage of therapeutic plants and conservation threats will lead to the extinction of these species. There should be the scientific validation of plants having high FIC and UV which helps in the formation of novel drugs.

2.4 Ethnobotanical studies and status in JKUT

Himalayas are extremely rich in biodiversity and also provides shelter to many aboriginal communities (Samant and Dhar, 1997). A number of ethnobotanists prepared inventories of ethnomedicinal flora from the JKUT from their study areas. JKUT harbors varied habitats that support rich floristic diversity, which is employed by the locals and the tribal communities. Several workers have contributed in providing the list of ethnomedicinally significant plant species from both Jammu and Kashmir divisions. Some of the workers that conducted ethnobotanical studies from various locations of Kashmir division are Lone *et al.*, (2013, 2014) (Bandipora), Wani *et al.*, (2016), Mala and Sofi (2014), Yousaf *et al.*, (2012) (Baramulla), Kanta *et al.*, (2018), Fayaz *et al.*, (2019), Khan *et al.*, (2018, 2019) (Anantnag), Shaheen *et al.*, (2017) (Poonch), Dar *et al.*, (2018, 2020) and Zahoor and John (2020) (Pulwama), Wani *et al.* (2020) from Gulmarg, and Asif *et al.* . (2021) from Kupwara.

Kumar *et al.*, (2015) has done remarkable work on the ethnomedicinal plants of Shankaracharya Hills of Srinagar. Similarly, Malik *et al.*, (2020) worked on the ethnobotanical and ethnoveterinary plants of Dachigam National Park, J&K. Khan *et al.*, (2022) conducted ethnomedicinal studies from Sindh Forest division, Kashmir and enumerated 82 Medicinal herbs to treat a variety of conditions.

Malik and Singh (2019) investigated 59 plants belonging to 33 families used for ethnobotanical purposes and 10 species used for ethnoveterinary purposes from Dachigam National Park. Mir *et al.*, (2021) published his work conducted on the ethnomedicinal plants utilized to treat different ailments from Bandipora district of Kashmir Himalayas. In total 71 plants were reported that helps in treating constipation, digestive disorders, fever, diarrhoea, joint pain and as tonic. Asif *et al.*, (2021)

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documented ethnomedicinal plant species from District Kupwara of Kashmir Himalayas and emphasized the worth of their usage in addition to their preservation. Asteraceae was the dominant family and leaves were the most often utilised portion of plants in their study area. Similarly, Mir *et al.*, (2021) reported 81 medicinal flora from Doodhganga region of Budgam, Jammu and Kashmir with *Notholirion thomsonianum* having highest UV and FL of 0.40 and 100%, resp. Of the 32 species of ethnomedicinal plants known to exist in the Indian Himalayan region of Kashmir, some, such as *Aconitum heterophyllum*, *Arnebia benthami*, *Trillium govanianum*, *Bergenia ciliata*, and *Rheum webbianum*, have been identified as endangered because of excessive commercial exploitation (Mir *et al.*, 2021).

Lone and Jain (2022) conducted studies from Baramulla district of JKUT regarding ethnobotanical plants utilized by the locals of the region to cure various ailments. Arfa *et al.*, (2023) conducted ethnomedicinal studies from rural populations of Gulmarg, JKUT wherein they gathered information of 60 medicinal plant species used in treating various ailments majority of which showed their action against gastrointestinal disorders. The study again emphasized on the protection of plant taxa due to their excessive exploitation for their potential usage. Manzoor *et al.*, (2023) contributed in documenting 110 ethnomedicinal plants from Kashmir valley.

Ahad *et al.*, (2023) documented 87 medicinal plants employed by the Dard ethnic tribe of Gurez valley, Kashmir, majority of which are helpful in curing menstrual problems. The Asteraceae and Lamiaceae families had the most plants. Furthermore, 17 plants were discovered to have culinary uses, with *Juglans regia* having the maximum use value (0.73). As per the IUCN categorization, seven plants were critically endangered, ten were endangered, as per the assessment of their conservation status. Apart from having important ramifications for policymaking, cultural preservation, the sustainable use of endemic species, and possible uses in pharmaceutical research for therapeutic compounds, this study offers information about the Dard people's close ties to their natural environment. The Kashmir Himalayas are a important source of therapeutic plants due to their amazingly diverse

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flora.

Khoja *et al.*, (2024), conducted a case study on the Plants' role in conventional medicine and current therapy from Northern region of Kashmir Himalayas and documented 72 ethnobiological plants having various medicinal values. 8 plants were reported to be exotic and 14 were in IUCN red list.

Apart from human medicines, ethnoveterinary medicine has been the subject of numerous research publications from throughout the globe. The development of human civilization depends heavily on domestic animals. In addition to people, a range of domestic animals are treated using plants. Ethnoveterinary research has long been a source of worry for researchers. Earlier, ethnoveterinary research has been used by numerous professionals worldwide. Researchers' interest in ethnoveterinary medicine is expanding, as evidenced by a significant number of research articles on the subject published worldwide (Chakale *et al.*, 2021; Mandal & Rahaman, 2022).

Mushtaq *et al.*, (2024) worked on the ethnobotanical research from Daksum forest range in Anantnag, Kashmir Himalayas wherein 42 plants were documented having the medicinal potential. The study emphasized that to save these valuable plant resources from going extinct, a unique and passionate fight is required, as the vast majority of plants are already listed as endangered. Academic institutions must do more research in this domain at the local levels. Information programs at all levels in the community should be organized to emphasize the importance of medicinal plant's conservation, economic use, current state, and applications.

Gillani *et al.*, (2024a) reported 56 ethnomedicinal plants used against different ailments by the people of Kashmir Himalayas thereby validating the use of customary knowledge held by the locals for healing purposes. The authors are of the view that although younger people in Muzaffarabad are losing knowledge about native flora due to socioeconomic changes, locals still possess important knowledge about it and it is necessary to educate the local populace on the preservation and sustainable utilization of medicinal plants. A much-detailed study was done by Gillani *et al.*, (2024b) from

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Kashmir Himalayas regarding the ethnobotanical usages of plants by rural populations where 72 plants were documented majority of which belonged to family Lamiaceae followed by Rosaceae. The authors were of the view that more field visits are required to extract and document the ethnobotanical information from the people of Kashmir Himalayas in future.

Wild edible plants (WEPs) are an important source of food, medicines and material subsistence and have a complex link with human livelihood in many emerging nations, like India. In the Himalayan region, the Gujjar and Bakarwal tribes employ a wide variety of WEPs. Singh and Bedi (2022) documented 42 wild edible plants utilized by Sheena tribe of Kashmir. Locals sell this raw edible food to augment their income as they are thought to be high in vitamins and minerals. In spite of their food value, over half of the plants under investigation have several uses as medications, medicines, or non-timber forest products. Four species- *Oxalis acetosella*, *Crataegus rhipidophylla*, *Rubus ceasius*, and *Rubus saxatilis*, have their ethnobotanical data documented for the first time in India. Khan *et al.*, (2024) reported 55 wild edible plants from Kashmir Himalayas belonging to 45 genera and 31 families. In their study, *Malva neglecta* showed the greatest RFC value (0.87) of all species, while *Taxus contorta* had the lowest (0.03). Another study pertaining to wild edible plants was conducted by Hassan *et al.*, (2024) from Kashmir region along the Line of control where in 108 plants were recorded and suggested the conservation need of endangered plants of the region like *Trillium govanianum*, *Taxus wallichiana*, *Saussurea costus*, and *Podophyllum hexandrum*.

As far as Jammu Province is concerned extensive research has been carried out from time to time to record the medicinal plants and knowledge pertaining to them. Bhellum and Singh (2012) enlisted 35 therapeutic plants that the locals use to cure different health related issues from district Samba of Jammu division. Another important study on the documentation of herbaceous, medicinal and therapeutic plants of Samba district was planned by Pandita (2013) while Kumar and Hamal, (2011), Gupta *et al.*, (2013), Thakur *et al.*, (2020) have conducted studies in Kishtwar. Kumar and Bhagat

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(2012), Sharma *et al.*, (2012), Sharma and Manhas (2015), Rao *et al.*, (2015), Manhas *et al.*, (2015), Bhushan and Khajuria (2018), Kour and Singh (2021) and Singh *et al.*, (2021) performed extensive work in the field of ethnobotany from district Kathua. Other workers (Shah *et al.*, 2015; Rashid, 2013; Ahmed and Ajaz, 2017; Sarad and Kumar, 2017) investigated and documented the ethnomedicinal plants from district Rajouri.

Dangwal *et al.*, (2014) explored 58 WEPs utilized by the Gujjar and Bakerwal tribes of district Rajouri wherein Rosaceae was dominant family. These tribal people lack contemporary amenities and are economically disadvantaged as a result of their remote location. Apart from providing these communities with a significant source of income, the utilisation of wild edible plants can support the amounts of vitamins, proteins, and fats in human diets. Another remarkable study in ethnobotany was conducted by Dutt *et al.*, (2015) wherein they gathered the knowledge among *Gaddi* tribes on herbal plants in threat from North-Western Himalaya of J&K. The authors collected the information of 190 plants distributed in 70 families that Gaddi tribe utilizes to cure health problems along their migratory route. Bhatia *et al.*, (2015b) documented 50 traditional phyto-remedies used for treatment of menstrual disorders from district Udhampur. Menstrual disorders are one amongst the common problem prevailing in female population. Bhatia *et al.*, (2018) investigated 90 wild edible plants from Udhampur district of JKUT suggesting indigenous culture's legacy needs to be preserved.

Thakur *et al.*, (2019) studied the plant and fungal diversity from Devi Pindiyan Valley in Trikuta Hills of northwestern Himalaya J&K. Singh *et al.*, (2020) worked enthusiastically on the ethnomedicinal plants from Jammu province and gathered information of 226 species used in treating both human and animal diseases which will help in the preparation of novel drugs.

Singh *et al.*, (2021) explored the unexplored Bani valley of JKUT and inventoried 196 ethnomedicinal plant species, among them 6 were in IUCN Red list suggesting the preserving of available plant resources. Dutta *et al.*, (2021) explored 31

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ethnoveterinary flora utilized by Gujjars and Bakarwals in Poonch, JKUT. Among these, *Aconitum violaceum*, *Arisaema jacquemontii*, *Bistorta amplexicaulis*, *Clematis grata*, *Ranunculus bulbosus*, *Ulmus villosa*, and *Viburnum grandiflorum* are having the novel use reports for ethnoveterinary from the study site. The information provided can be utilised to standardize active ingredients, which could result in the production of veterinary medications that are even more effective. Mir *et al.*, (2022) worked on the cross-cultural analysis on the usage of important plants from four communities of Northern region of JKUT to document and assess the mechanisms underlying this system of knowledge evolution within a specific group to sustainably maintain and apply traditional ethnomedicinal knowledge in the future.

Hussain *et al.*, (2023) documented 80 plants used against 17 disease categories from Bhalessa region of district Doda, Jammu and Kashmir. In another remarkable study conducted by Mir *et al.*, (2023) traditional information of 80 therapeutic plants utilized by Gujjars, Bakerwals and Kashmiris from three districts of JKUT was gathered.

The ethnobotanical significance of 58 WEP species consumed by the local populace in block Purmandal of district Samba, UT of Jammu and Kashmir due to their nutritional and organoleptic qualities was evaluated by Bhagat *et al.*, (2022). Sharma *et al.*, (2022) recorded 14 edible fungi, 11 of which were new records from district Jammu. A few of the fungus that were reported also have therapeutic uses and were employed as nutraceuticals. The study found that the two primary causes of the lower quantity of wild edible mushrooms in the study area were an increase in agricultural fields and a decrease in woodland area.

In the 21st century, diabetes mellitus has become biggest global health issues. It is a long-term metabolic disease marked by elevated blood glucose (sugar) levels due to either insufficient insulin production or inefficient insulin use. Because of this, diabetes impacts several bodily systems and, if left untreated, can result in serious problems. Keeping this ailment in mind, Parasher *et al.*, (2023) documented the plant species utilized by the populace of Kathua district, JKUT to treat diabetes, a commendable work in the field of ethnobotany.

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Sarver *et al.*, (2022) reported 210 medicinal plants being employed by local population of district Udhampur. In their study Lamiaceae was the dominant family followed by Fabaceae, Asteraceae, Rosaceae and Moraceae. The most often used plant species was *Berberis lyceum*. Plants like *Senegalia catechu*, *Aegle marmelos*, *Butea monosperma*, *Quercus leucotrichophora*, *Cynodon dactylon*, *Phyllanthus emblica*, *Pistacia integerrima*, *Olea ferruginea*, and *Juglans regia* were used for more than three purposes, 48 species were used for multiple purposes, and the remaining 150 species were utilised in for just one purpose.

Singh *et al.*, (2023) contributed in documenting 77 wild edible plant species consumed by Gaddi and Sippi tribes from district Doda. Among them, *Anethum sowa*, *Arisaema propinquum*, *Diplazium frondosum*, *Dipsacus inermis*, *Elaeagnus umbellate*, *Elwendia persica*, *Geopora sumneriana*, *Impatiens glandulifera*, *Morchella crassipes*, *Morchella conica*, *Prinsepia utilis*, *Sageretia thea*, *Solanum villosum*, *Thymus mongolicus*, and *Ziziphus oxyphylla* can be made popular among the common masses due to their nutraceutical properties that will help in generating revenue and to eradicate poverty. Hence, this study again emphasizes on the documentation of the traditional knowledge which will vanish sooner or later.

The genus of plants known as orchids are well-known for their stunning and eye-catching blooms. Apart from their aesthetic appeal, these have long been utilised for their ethnomedicinal qualities. 21 orchid species have been identified utilized in curing gastro-intestinal, skeleton-muscular and neurological disorders by Thakur *et al.*, (2024) from Jammu and Kashmir. Among these 21 orchids, 10 are common, 3 are sparingly present, 2 are sporadic and extremely rare, and the occurrence status of the remaining 4 is unknown in the Western Himalayas. These plant species are in danger of going extinct soon due to the extreme strain that exploitation is placing on medicinal orchids and hence need conservation practice.

More and more ethnobotanical research has been conducted in recent years keeping in view the preservation of traditional knowledge possessed by the tribals as well as the knowledgeable persons like, Vaid's, Hakims and local healers. This knowledge is at

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the verge of extinction with the death of older people that possesses it. So, there is a dire need to transfer this valuable resource among the young generations and to prepare the documentary for future reference.

The present study aims to address the deficiency in traditional knowledge documentation regarding plant usage by the tribals and locals of the study site as it has not been explored for its ethnomedicinal wealth earlier. In order to preserve traditional indigenous knowledge, the current study may serve as a foundation for reworking in other parts of India and for widespread dissemination through nutrigenomics and pharmaceutical investigations.

3. MATERIALS AND METHODS

3.1 Study Site: Surinsar Mansar Wildlife Sanctuary

3.1.1 Location

The Surinsar–Mansar Wildlife Sanctuary was officially notified by the Government of Jammu and Kashmir through SRO 138 dated 10 April 1990, under Section 17 of the Jammu and Kashmir Wildlife (Protection) Act, 1978. The Sanctuary derives its name from the twin lakes-Surinsar and Mansar, situated at opposite ends of the landscape, separated by approximately 16 km. These lakes were recognized in 2005 for their outstanding biodiversity, ecological value, and cultural significance, and were designated as important wetland ecosystems. Their inclusion under the National Wetland Conservation Programme further underscores their conservation importance at the national level and reflects the Government of India's sustained commitment towards safeguarding ecologically sensitive habitats. This dual recognition highlights the urgency and relevance of conserving these unique wetlands for both present and future generations.

The Sanctuary encompasses an area of 97.82 km² and spans three districts-Jammu, Udhampur, and Samba. The terrain is roughly rectangular in shape and geographically positioned between 32° 41' 29" to 32° 49' 28" N latitude and 74° 59' 05" to 75° 09' 12" E longitude. Altitudinal variation ranges from 547 to 834 m above mean sea level, contributing to habitat heterogeneity and supporting diverse floral and faunal communities. The region experiences a sub-tropical climate, characterized by hot summers and cool winters, which further influences species composition and ecological processes.

Located within the Jammu Province, the Sanctuary is accessible through multiple routes: 42 km from Jammu via Surinsar, 60 km from Jammu via National Highway 44, and 44 km from Samba along the Udhampur–Mansar connecting road. Samba serves as the nearest district headquarters. The Sanctuary includes 19 villages comprising

1,302 households and a population of 7,763 (Census 2011), exerting considerable biotic pressure on the landscape through grazing, fuelwood extraction, and other livelihood-related activities. This interface between human settlements and wildlife habitat necessitates a balanced conservation approach that integrates ecological preservation with community needs (Fig. 4.1).

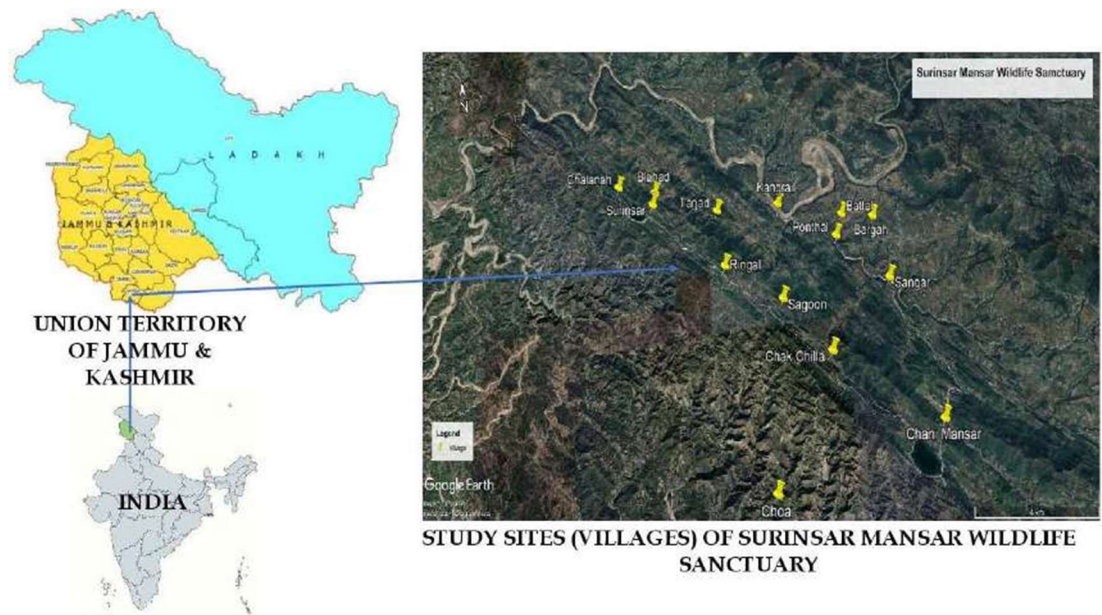


Figure 3.1: Location Map of the study area

3.1.2 Physiography

The major area of the sanctuary falls in the Jammu District. The area has a distinct geographical character because of the twin lakes, which are positioned strategically in opposite corners of the sanctuary and are roughly 16 kilometres apart and are important natural and cultural landmarks in the area. The sanctuary is inhabited by a wide variety of animal species, including birds, reptiles, and mammals, migratory bird species, wild boars, barking deer, leopards, and Indian peafowls. A popular destination for tourists and pilgrims alike, the lakes of Surinsar and Mansar are important religious and cultural landmarks. The local people revere these lakes, which they think are connected to Hindu mythology.

This area encompasses the vicinity of the linked Surinsar and Mansar lakes, together with the adjacent landscapes that sustain a wide variety of flora and fauna. The terrain of the region is hilly, with minor drainage nallas strewn over moderate to severe slopes. Its elevation above mean sea level (MSL) varies from 547 metres to 834 metres. The Tawi River is the northern boundary of the Surinsar-Mansar Wildlife Sanctuary. This connection with the Tawi River benefits the ecosystem of the sanctuary and offers a valuable natural feature for the animals and habitat found there. The lakes are essential to the scenery, wildlife, and cultural significance of the sanctuary. Mansar Lake is semi-oval in shape and measuring an average width of 680 metres with a depth of 37.8 metres, is situated 65 km from Jammu. The study site has a rich legacy of traditional medicinal plants and besides the local *Dogras*, is the home to ethnic groups like *Gujjars* and *Bakerwals*.

3.1.3 Climate

The terrain of the area is hilly, encircled by the steep mountains of Lower Shiwalik Himalayan hills. The maximum temperature ranges between 40-43°C in summers and is cool with average temperature between 16-19°C in winters. The humidity level is 85-90% in the month of July- August. The rainy season exists from last week of June to middle of September. The months of December and January also experience winter precipitation, whereas the remaining months are generally dry.

3.1.4 Socio-Religious Significance

The Sanctuary is very important from a cultural and theological standpoint. There is a shrine to the snake deity *Sheshnag*, who has six heads, on the lake's eastern side and is close to the ancient temples of Durga, Narsimha, and Umapati Mahadev.

The lakes at Mansar and Surinsar are very significant from a religious perspective. Numerous threatened and endangered species of fish and birds use the lakes as their perfect home and breeding grounds. In Hindu mythology, the lake's genesis is strongly linked to Arjun, the mythical hero from Mahabharata. The legend states that the

Pandavas carried out the Ashwamedh Yagna to demonstrate their dominance after the Kurukshetra War. The former king of the region, Babru Vahan, caught the horse, which represented the strength of the Yagna. He killed Arjun in addition to capturing the horse, and he gave his mother the head of Arjuna as a token of his victory. Babar Vahan was informed by her that he had accidentally slain his father. Knowing that, he was determined to earn Arjuna's return, even if it meant obtaining *Mani* from *Sheshnag*. At that moment, Babar Vahan created the "Surangsar," which is today known as Surinsar, by tunnelling with his arrow. He emerged at what is now known as Mansar, the opposite end of the tunnel, having vanquished *Sheshnag* and taken the *Mani* prisoner. The lakes are later formed by a water spring.

3.1.5 Biological Significance

The Surinsar–Mansar Wildlife Sanctuary is well-known for housing a wide variety of herbivores and for having a remarkable biodiversity of both plants and animals. The primary species comprise *Pinus roxburghii*, *Ficus benghalensis*, *Ficus religiosa*, *Bauhinia variegata*, *Cassia fistula*, *Lannea grandis*, *Mallotus philippensis*, *Justicia adhatoda*, *Dodonaea viscosa*, *Carissa opaca* and *Zizyphus jujuba*. etc. The predominant species in the Mansar-Surinsar lakes is the common carp. Among the frequent ichthyofauna of lakes are *Puntius chonchonius*, *Channa gachua*, *Rasbora rasbora*, *Labeo rohita*, and *Trichogaster fasciatus*. *Ophiocephalus punctatus*, *Mastacembelus armatus*, and *Danio rerio* are a few other notable species. Human habitation is dispersed across the sanctuary. The two holy lakes, Mansar Lake and Surinsar Lake, draw a sizable population of waterfowl in winters.

Since the Surinsar–Mansar Wildlife Sanctuary covers large area (97.82 km²), it is exceedingly difficult to define and there is a considerable risk of encroachment. The locals continue to graze cattle on the available areas of grasslands within the Sanctuary. Locals used to collect firewood from nearby forest. Because of its abundant wildlife, the Surinsar-Mansar Wildlife Sanctuary and the surrounding forest region are prioritized for protection. The area is inhabited by populations of endangered animals,

including the Indian Monitor Lizard (VU), Common Leopard (VU), and Indian White rumped Vulture (CR). The region serves as a "gene pool" for the spread, preservation, and continuation of these wild plant and animal species. The sanctuary is not explored yet for the threatened flora if any, present in the area this study is also an attempt to study the same.

3.1.6 Vegetation

The sanctuary is home to the following main forest types: Type 9/C1 Himalayan subtropical pine forest, Subtype 9/C1a Lower Shiwalik Chir Pine Forest, *Dodoniaea* scrub woods, and Forest type 5B/C2—Northern dry mixed deciduous forests. According to the updated Champion and Seth (1968) classification, the Sanctuary contains the following forest types:

Northern Dry Mixed Deciduous Forests (5B/C2): These forests are sparsely distributed and in generally good condition. The flora include: *Butea monosperma*, *Lannea coromandelica*, *Albizia lebbek*, *Mallotous philippensis*, *Dodoniaea viscosa*, *Justicia adhatoda*, *Carissa spinarum*, *Colebrookea oppositifolia*, *Nerium indicum*, *Senegalia catechu*, *Acacia nilotica*, *Senegalia modesta*, *Ficus racemosa*, *Ficus benghalensis*, and *Ficus religiosa*.

Himalayan Sub-tropical Scrub Forests 9/C1/DS1

The Siwalik Chir pine zone is home to this subtropical shrub having open shaped structure. This region is primarily composed of sparse to dense scrubs with sporadic broadleaved plants. This subtype is found in low-lying areas beneath the Chir zone. *Senegalia catechu*, *Butea monosperma*, *Ficus species*, *Vachellia nilotica*, *Dodoniaea viscosa*, *Justicia adhatoda*, *Carissa spinarum*, *Punica granatum*, *Nerium indicum*, *Murraya koenigii*, *Lantana camara*, and *Ipomoea fistula*, *Cymbopogon species*, *Saccharum spontaneum* are among the general floristics., etc.

Lower Siwalik Chir Pine Forest, Subtype 9/C1a.

These forests are primarily found in the lower Siwalik ranges; among their peculiarities is the difficulty of achieving natural regeneration in this area. This might be explained by the rough terrain, where the water table is quite low and the soil is dry for a significant portion of the year with little summer rainfall. At lower elevations, the predominant species is chir, mingled with shrubs and broadleaved species. The common plant species found in this forest type are- *Pinus roxburghii*, *Senegalia catechu*, *Dalbergia sissoo*, *Butea monosperma*, *Mallotus philippensis*, *Zizyphus jujuba*, *Syzygium cumini*, *Emblica officinalis*, *Colebrookea oppositifolia*, *Justicia adhatoda*, *Woodfordia fruticosa*, *Dodonaea viscosa*, *Cymbopogon species*, *Rumex hastatus*, *Nerium indicum* and *Punica granatum*.

10/C1/c Dodonea Scrub Forests

Dodonaea viscosa is the dominant species of *Dodonaea* Scrub Forests, which are found beside roads. Due to excessive grazing, *Dodonaea viscosa* actually covers a large area. It is a sign of degraded and overgrazed forests. It has a propensity to establish a unique habitat in particular places.

3.1.7 Agricultural Pastoralism in Sanctuary

There are several communities all around the Sanctuary area, majority of the people living there are farmers, and their fields reach all the way to the Sanctuary's limits. Field employees keep a close eye out for any intrusion, but if there is no sturdy fencing and insufficient personnel, there is a serious risk of encroachment. The nomadic *Gujjars'* domestic cattle and sheep put a great deal of grazing pressure on the region in winter season. There is tremendous grazing pressure on the sanctuary as a result of the constantly growing number of animals. The amount of grazing is significantly more than the pasture area can support, and it is having a negative impact on the woods' ability to naturally regenerate. Overgrazing damages the ecosystem and prevents grasses, bushes, and trees from sprouting.

There is a lot of strain on water bodies due to human habitation in the lakes' catchment area and surrounding area. The Mansar watershed is home to roughly 200 residents and has a number of stores next to the lake. A significant quantity of waste material finds its way into the lakes as detergents, kitchen trash, animal faeces, and agricultural runoff. Since the rights are still unresolved, it is impossible to tell who is encroaching on someone's property and who is actually the rightful owner. The actions of those who live there and those who use the sanctuary for a means of subsistence fall within the sanctuary's zone of influence. Villages can be found throughout the sanctuary's perimeter. The inhabitants depend on farming, animal husbandry, chicken farming, and dairy farming for their living. People relied on the local resources for activities like firewood gathering and cattle grazing before the sanctuary was declared. The villages close to the sanctuary experience financial losses as a result of livestock losses from straying wild animals and crop raiding. The fringe dwellers have historically been conservationists, so the degree of alienation has not been very great. However, these days, attitudes are shifting as a result of an increase in crop damage caused by wild boar, nilgai, sambar deer, porcupines, and leopards preying on cattle. The study area has a 2 km radius around the established limits. The main occupation of locals is agriculture and rearing of sheep and buffaloes for the tribals. The language used to interact with the locals is Dogri. For extracting information from the tribals, the person knowing the *Gojri* and *Bakerwali* language was hired for accompanying for the survey.

3.1.8 Administrative Structure

The Surinsar-Mansar Wildlife Sanctuary is currently a part of the Warden Kathua Wildlife Division Kathua's administrative unit. With headquarters located at Mansar and support from two foresters stationed in Surinsar-Mansar, the Sanctuary is overseen by Range Officer, Mansar. The Sanctuary's daily operations and security are managed by Wildlife Guards, Helpers, and Need-Based Labourers. In accordance with Government directive No. 215 of FST of 2019, dated July 15, 2019, three trekking routes have been announced in the Surinsar-Mansar Wildlife Sanctuary. Within the Sanctuary, there are two main routes: Mansar to Battal and Surinsar to Mansar.

Additionally, the Sanctuary has a few fair-weather roadways.

3.2 Methodology

3.2.1 Ethnobotanical field survey and collection of data

Regular field trips (twice a month) are conducted for ethnobotanical exploration and collection of plant specimens from 14 randomly selected villages of the Sanctuary area viz. Surinsar, Tarjad, Chak Chilla, Bargah, Chillana, Blahad, Sagoon, Choa, Sangar, Ringal, Kangrail, Pounthal, Chani Mansar and Battal. Data is collected from the tribals (Gujjars and Bakerwals) and local '*Dogra*' population from the study area. The informants were elderly, knowledgeable persons, local traditional healers, of both sexes, who were well equipped with the traditional usage about the plants. Information is gathered by conducting interviews and focused discussion as per a semi-structured questionnaires that include the name of the plant species, local name, and ailment treated using these species, method of preparation of the crude drug, and mode of administration.

3.2.2 Collection of Plant Specimens

The plants utilized for treating various ailments were collected during different seasons. During the visits some locals and knowledgeable persons were taken for plant identification based on their local and tribal names. Photographs of plants were taken. Field data was recorded in notebook regarding important aspects of plants like, flower colour, life form, date and place of collection, altitude of the place during forest visit. Small herbs were collected as intact with roots while twigs bearing flowers were collected from the woody plants.

3.2.3 Identification of plants

Identification of the plant species was done by using the local and relevant floras i.e., Flora of Jammu (Sharma and Kachroo, 1983), Flora of Udhampur (Swami and Gupta, 1998), and comparing the collected plant specimens with the established preserved

specimens in the Herbaria of Department of Botany, University of Jammu, Jammu, and online version of Janaki Ammal Herbarium of IIIM, Jammu <https://iiim.res.in/herbarium/herbarium.htm>. The help of taxonomists from Jammu University and retired Principal Chief Conservator of Forests, Dr. Om Prakash Vidhyarthi (*known by the names “man of woods”, “Dogra Green Man”, “Walking encyclopaedia of forest” in UT of Jammu and Kashmir*) was also taken to identify some plant specimens. The botanical names of the plants were confirmed from the online database viz. plants of world online (POWO) (<https://powo.science.kew.org/>) and World Flora Online (<https://www.worldfloraonline.org/>).

3.2.4 Herbarium preparation

The collected plant specimens were placed in between the folds of old newspapers by arranging their parts in right position and then dried and pressed. The newspaper sheets were replaced every 24 hours until the plant specimens were totally dry to prevent fungal harm and plant deterioration. To keep the specimen safe from bug attacks, insect repellents such as naphthalene balls were used. They were then mounted on a herbarium sheet (42 x 28 cm²) by following standard herbarium technique (Jain and Rao, 1977) with suitable label and are submitted to the Herbarium, University of Jammu, Jammu.

3.2.5 Quantitative ethnobotanical data Analysis

Data analysis is done for Wild Edible Plants (WEP); Plant-based Traditional Products (PTPs), and Ethnomedicinal and Ethnoveterinary Plants. Information regarding plants that are used by the inhabitants of the Sanctuary in their day-to-day life as food, fodder, fuelwood, beverage, and fiber is collected. These uses are grouped into various categories viz. vegetable processed, vegetable raw, fruit, religious, fiber, medicine, fuelwood, fodder, and other uses. The ethnobotanical information is then assessed quantitatively using Relative frequency of citation (RFC) and cultural importance index (CI) to find traditionally important plants for the inhabitants of the Sanctuary. In

addition to this, information on Plant- based Traditional Products (PTPs) is also collected and assessed using the above RFC and cultural importance index (CI) to find in use and vanishing/vanished traditional products.

The sampling size was determined using the formula given by Cochran (1977), which is:

$$n_{\alpha} = Z_{\alpha}^2 \times [P \times (1-P)]/d^2$$

where n = minimum sample size; confidence level (95%), $Z_{\alpha} = 1.96$; P is the prevalence rate or estimated proportion of MPs used by the local population (0.5); and d = 0.05 is the precision level or margin of error. The calculated n_{α} is 384. The total households, distributed sparsely, in the Surinsar Mansar wildlife sanctuary is 1302 as per 2011 census, therefore finite correction factor (FPC) was applied to adjust the sample size, which states:

$$n = n_{\alpha}/1 + (n_{\alpha}-1)/N$$

where n_{α} is the initial sampling size, and N is the population size. The adjusted sample size n is 306 households. This is the sample size used in the present study.

The ethnomedicinal and ethnoveterinary plant data collected from the informants, local *vaidyas*, or any other medicine man was analyzed by using different quantitative indices viz. Use value (UV), factor informant consensus (Fic), and fidelity level (FL%).

Use value (UV)

The relative importance was calculated by employing the use-value as suggested by (Phillips *et al.*, 1994).

$$UV = \sum U/n$$

Where, U is the number of use reports cited by each informant for a given species and n refers to the total number of informants.

Factor Informant Consensus (Fic)

Factor informant Consensus (Trotter and Logan, 1986) was used to test the homogeneity of knowledge about medicinal plants (Heinrich *et al.*, 1998). It is calculated as:

$$Fic = \frac{nur - nt}{nur - 1}$$

Where Fic is the Factor informant Consensus, nur is the number of use reports, and nt is the number of taxa used.

If Fic value comes out to be low (near 0), it indicates that plants are chosen randomly or there is no exchange of information about their use among informants. If the value approaches (1) it means there is a defined selection criterion or information is exchanged between informants (Gazzaneo *et al.*, 2005; Bhatia *et al.*, 2014).

Fidelity Level (FL)

Fidelity Level (FL %) was calculated to determine the ideal species used for the treatment of an ailment (Friedman *et al.*, 1986).

$$FL (\%) = (Np/N) \times 100$$

where Np is the number of use-report cited for a given species for a particular ailment and N is the total number of use-reports cited for any given species.

Relative Frequency of Citation (RFC)

RFC is obtained by dividing the number of citations (FC) by the total number of informants (N):

$$RFC = FC/N$$

Cultural Importance (CI)

CI is calculated by using the following formula:

$$CI_s = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} UR_{ui}/N$$

Where UR is use-reports and N is the number of informants.

Jaccard Similarity Index (JSI)

Jaccard Similarity Index (JSI) (Jaccard 1901) was used to evaluate the species composition of medicinal plants among the ethnic *Dogras* and the tribal populations of *Gujjars* and *Bakarwals*. The species reported in the sixteen published research papers and the present study was tabulated in Microsoft Excel and JSI was calculated on the basis of presence and absence of a species. The following formula was used to calculate JSI:

$$JSI = c / (a + b - c)$$

JSI quantifies the degree of similarity between two distinct study areas: study area a (the current study area) and study area b (other study area). Each area's species is represented by the variables; "a" stands for the number of species in research area a, "b" for study area b, and "c" for the number of species that are shared by both areas. JSI values range from 0 to 1, where a value of 1 indicates complete similarity and a value of 0 signifies no similarity. To express JSI as a percentage, it can be multiplied by 100, resulting in a percentage JSI (Awoke *et al.*, 2024).

Further, the cluster analysis was employed to analyze the data on the basis of ethnicity using neighbouring cluster method, JSI, and with present study as root conducted through the software Past 5.0.2 (<https://www.nhm.uio.no/english>)

/research/resources/past).

3.2.6 Statistical analysis

The Pearson correlation test was also employed to evaluate whether there was a significant ($p < 0.05$) correlation between the number of ethnobotanical uses of plants and (i) age of informants; and (ii) educational status of informants. Other statistical analyses like arithmetic mean, standard deviation, student's t-test, Analysis of Variance (ANOVA), and multiple range tests shall also be applied as per requirement.

3.2.7 Analysis of antimicrobial activity

Plants provide a wide range of structurally diverse compounds, which can further be used for formulating new drugs (Balouiri *et al.*, 2016). For evaluating antimicrobial activity of selected plants, Agar well diffusion method is followed.

Selection of plant species

In the present study, five plants were selected for performing antimicrobial study and nutritional status based on the following criteria;

- i. Ethnobotanical importance of plants based on their antimicrobial effect.
- ii. Selection of plants (five) amongst top ten ethnomedicinal plants possessing high Use value.
- iii. Plants with inadequate published literature.
- iv. Availability of enough population for sample collection.

Agar Well Diffusion Method: In this method, the surface of the agar plate is inoculated by 0.1ml culture spread of microbial inoculums. Then, a well (6-8mm in diameter) is formed by inserting a sterile cork-borer in the inoculums plate. After that about 20-100 μ L of the extract solution or antimicrobial agent is poured into the well aseptically. Depending upon the microorganism to be tested the agar plates are then incubated under desired conditions. The extract solution/antimicrobial agent was

diffused into the agar medium and inhibits the growth of the microbial strain (Balouiri *et al.*, 2016). The antimicrobial activity is assessed by the diameter of the inhibition zone.

Preparation of Plant extract

Fresh plant material (Leaves/bark) were collected, washed and dried for few days in shady area. The dried plant material was cut into small pieces and then grounded to fine powder under sterilized conditions. About 60 gms of this dried powder was taken and defatted with methanol for about 6 hours at 75 °C. It is then weighed and stored for further use under sterilized conditions.

Microbial cultures

The antimicrobial susceptibility test of selected plant samples viz. *Acorus calamus*, *Dodonaea viscosa*, *Adiantum caudatum*, *Vitex negundo* and *Litsea glutinosa* were tested against *Micrococcus luteus*, *Proteus mirabilis*, *Serratia marcescens*, *Staphylococcus aureus* and *Escherichia coli* and *Enterococcus faecalis*, in three extracts i.e. methanol, n-hexane and chloroform. All the tested microbes were (Microbial Type Culture Collection) MTCC.

Antimicrobial Susceptibility Test

A 24-hour culture of *Escherichia coli*, *E. faecalis*, *Staphylococcus aureus*, was prepared in Luria Bertini (LB) broth and Brain Heart Infusion (BHI) broth respectively. LB agar and BHI agar plates were subsequently prepared, and four wells were aseptically punched into the solidified medium. The plates were then subjected to UV sterilization for 5 to 10 minutes. Following sterilization, 100 µL of the respective bacterial culture was uniformly spread over the surface of respective agar plate using a sterile spreader. Subsequently, defined volumes of the test samples were introduced into the wells. The inoculated plates were incubated at 37°C for 24 hours. Post-incubation, the plates were examined for the presence and measurement of zones of inhibition around the wells,

indicating antibacterial activity.

Minimum Inhibitory Concentration Test (MIC)

E. coli, *E. faecalis* and *S. aureus* cultures were cultured in LB broth and BHI broth media, respectively for 24 hours. Four test tubes of LB broth and 8 test tubes of BHI broth media were prepared and autoclaved. To this LB broth *E. coli* and to BHI broth *E. faecalis* and

S. aureus were inoculated 100 μ L, while the respective sample of different volumes (50, 100, 150, 200 μ L) was added to the media, and incubated for 24 hours at 37° C. After incubation, absorbance was noted at 600 nm using UV spectrophotometer.

3.2.8 Analysis of Nutritional Status of Wild edible plants

The nutritional status of some of the most important wild edible plants was analyzed by using the standard methods of food analysis.

Estimation of Proteins

It was done by using Bradford method.

Bradford Method: The capacity of a protein to bind (quantitatively) with a dye is used to assess protein content in each sample in this approach. A dye [(Coomassie brilliant blue (CBB)] that changes its spectral characteristics when bound to proteins is used to estimate total proteins. CBB has absorption maxima of 465 and 650 nm in its free (unbound) form at low pH, but it has the greatest absorbance of 595 nm when it binds to proteins.

For estimating the protein content present in the sample, 0.2, 0.4, 0.6, 0.8, and 1.0 ml of standard BSA solution from the stock solution was taken into a series of test tubes, and filled to 1.0 ml with distilled water to make several solutions of known protein concentration. To conduct the experiment in triplicate, placed 0.2 ml of the protein sample extract in two other tubes and filled to 1.0 ml with distilled water. As a blank, filled a tube with 1.0 mL of water. To each tube, added 5.0 mL of Coomassie brilliant

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blue and vortex to combine. Waited 30 minutes before taking a reading at 595 nm on the standards and samples. Then the standards' absorbance (OD) against their protein concentrations was plotted and the protein content in the unknown sample using the standard curve was determined (Kumar, 2019).

Estimation of Oil

The oil content from the food sample was quantified by using the Soxhlet method (Kumar, 2019).

Soxhlet Method: The principle is based on extracting oil with non-polar solvents such as ether, hexane, petroleum ether (40-60 degrees Celsius), and chloroform: methanol (2:1), which involve repeated oil extraction. After that, all the solvents have to be distilled away. The oil was dried, weighed, and its percentage is determined. For the extraction of oil, a sheet of filter paper was folded to form a sample pouch to hold the sample powder (2-5g), depending on the oil content. After adding some cotton at the bottom, placed the sample packet in the extractor of the Soxhlet apparatus. When the solvent drips on the sample during extraction, a piece of cotton is placed on top to equally distribute it. Added two and a half times the capacity of the extractor with organic solvent and extracted oil for six hours or until the solvent in the extractor turns colorless. Turn the heaters off and let it cool. Using a flash evaporator or a water bath, evaporated the solvent until there is no more ether odor. Put it in the oven for 10 minutes at 70 degrees. Bring it to room temperature. After draining moisture, weighed the flask. Repeated the heating process until a constant weight is recorded.

Calculations

% Oil in the sample = $\text{Weight of oil (g)} \times 100 / \text{Weight of sample (g)}$.

Estimation of Carbohydrates

Carbohydrates are essential components of plant storage and structural materials. They

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are polysaccharides and free sugars. The carbohydrate content can be determined by acid hydrolysis of polysaccharides into simple sugars and calculating the monosaccharide produced. The carbohydrate content in the plant samples was done by using Phenol-Sulphuric acid method. A standard stock solution of glucose (1 mg/mL) was prepared. From this stock, a series of standard glucose solutions with concentrations of 0.2, 0.4, 0.6, 0.8, and 1.0 mg/mL were prepared by diluting appropriate volumes of the stock solution with distilled water to a final volume of 1 mL. For the sample analysis, 0.5 mL of the test sample was used. To each standard and sample solution, 1 mL of 5% phenol was added, followed by the addition of 5 mL of 96% sulfuric acid (H_2SO_4). The reaction mixtures were initially incubated in the dark at room temperature for 10–15 minutes, followed by a second incubation in a boiling water bath (100 °C) for another 10–15 minutes. The absorbance of the resulting-coloured complexes was measured at 490 nm using a UV-Visible spectrophotometer. 0.5 g of the respective samples was dissolved in 1 mL of distilled water and 1 mL of 5% phenol, subsequently 96% H_2SO_4 was added to the sample, and the sample was incubated in dark at room temperature for 10 to 15 minutes, then in water bath at 100° C, for another 10 to 15 minutes. At last Absorbance of the sample was noted at 490 nm, using UV Spectrophotometer.

Calculations

Amount of carbohydrate in 100 mg of the sample = $\text{mg of glucose} \times 100/\text{volume of sample}$

Fiber Ash Content Analysis:

$$\text{Total Fiber Ash \%} = \frac{\text{M2} - \text{M}}{\text{M1} - \text{M}} \times 100$$

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where,

M1 = Weight in gm of the dish with the material before ashing
M2 = Weight in gm of the dish with the material after ashing
M = Weight in gm of the empty crucible

Determination of moisture content

The moisture content of the samples was evaluated by drying them at 105 °C for about 12 to 16 hours, cooled, and then weighed. By removing the % moisture content from 100, the dry matter content was calculated. The weight changes then be used to measure moisture loss and reported as a percentage of oven-dry weight (AOAC, 2000).

Calculation:

$$\text{Moisture Content (\% age)} = \frac{\text{Fresh Weight} - \text{Dry Weight} \times 100}{\text{Fresh weight}}$$

Where:

Fresh Weight (FW) = Weight of the plant sample before drying.
Dry Weight (DW) = Weight of the sample after drying

Determination of nutritive value- The total energy value in kcal/100g is calculated using the following method given by FAO in 2003.

Calculation-

Nutritive value = 4 x protein percentage + 9 x fat percentage + 4 x carbohydrate percentage.

4. Results and Discussion

4.1 Demographic Characteristics and Ethnobotanical Wisdom of Informants

A total of 306 informants belonging to three ethnic groups viz. Bakarwal (men, 19; women, 9), Gujjar (26; 23), and Dogra (196; 33) were interviewed (Table 4.1). Analysis of variance (ANOVA) shows that age of men and women informants in both the tribal population didn't varied significantly. However, the age of the men was significantly (ANOVA: $F = 11.08$; $P = 0.001$) higher than the women informants among Dogras. The other two attributes, education and knowledge of ethnobotanical plants didn't vary between the men and women informants for all the three ethnic groups. The finding that there is no significant difference in ethnobotanical knowledge between male and female informants is consistent with previous studies conducted in India (Chekole *et al.*, 2017; Parasher *et al.*, 2024; Ralte *et al.*, 2024) and other parts of the world (Karakose, 2022; Febriyanti *et al.*, 2024). In contrast, some other studies have reported either the men (Tadesse *et al.*, 2024; Zemede *et al.*, 2024) or women (Lim *et al.*, 2017; Shai *et al.*, 2024) having more knowledge of ethnobotanical plants than their counterparts.

A total of 236 ethnobotanical taxa belonging to 77 families and 208 genera were recorded in the study site (Table 4.1). The elder informants, with the age more than 50 yrs, were having significantly (ANOVA: $F = 9.68$, $P = 0.002$) higher knowledge of ethnobotanical plants (19.9 ± 5.89) than the younger informants (17.5 ± 7.07). The statement is also supported by the Pearson correlation analysis ($r_{304,2} = 0.29$; $P < 0.001$), which shows that as people get older, their understanding of ethnobotanical plants increases (Fig. 4.1).

Table 4.1: Characteristics of informants of Surinsar and Mansar wildlife Sanctuary

Attributes	Ethnic group	Men	Women	F	<i>P-value</i>
Age	ANOVA between all the ethnic groups			3.84	0.002
	Bakarwal (n = 28)	44.2	36.3	1.46	0.238
	Gujjar (n = 49)	49.3	40.6	3.50	0.068
	Dogra (n = 229)	47.2	39.2	11.08	0.001
Educations	ANOVA between all the ethnic groups			6.38	<0.001
	Bakarwal (n = 28)	4.0	2.8	0.44	0.510
	Gujjar (n = 49)	4.8	3.5	1.08	0.304
	Dogra (n = 229)	7.3	7.5	0.06	0.812
Ethnobotanical plants known	ANOVA between all the ethnic groups			6.98	<0.001
	Bakarwal (n = 28)	12.9	13.7	0.46	0.502
	Gujjar (n = 49)	17.3	15.0	0.25	0.140
	Dogra (n = 229)	19.8	18.3	1.26	0.262
Pearson's Correlation analysis (n = 306)				R	<i>P-value</i>
Age x No. of ethnobotanical plants known				0.29	< 0.001
Education x No. of ethnobotanical plants known				0.45	< 0.001

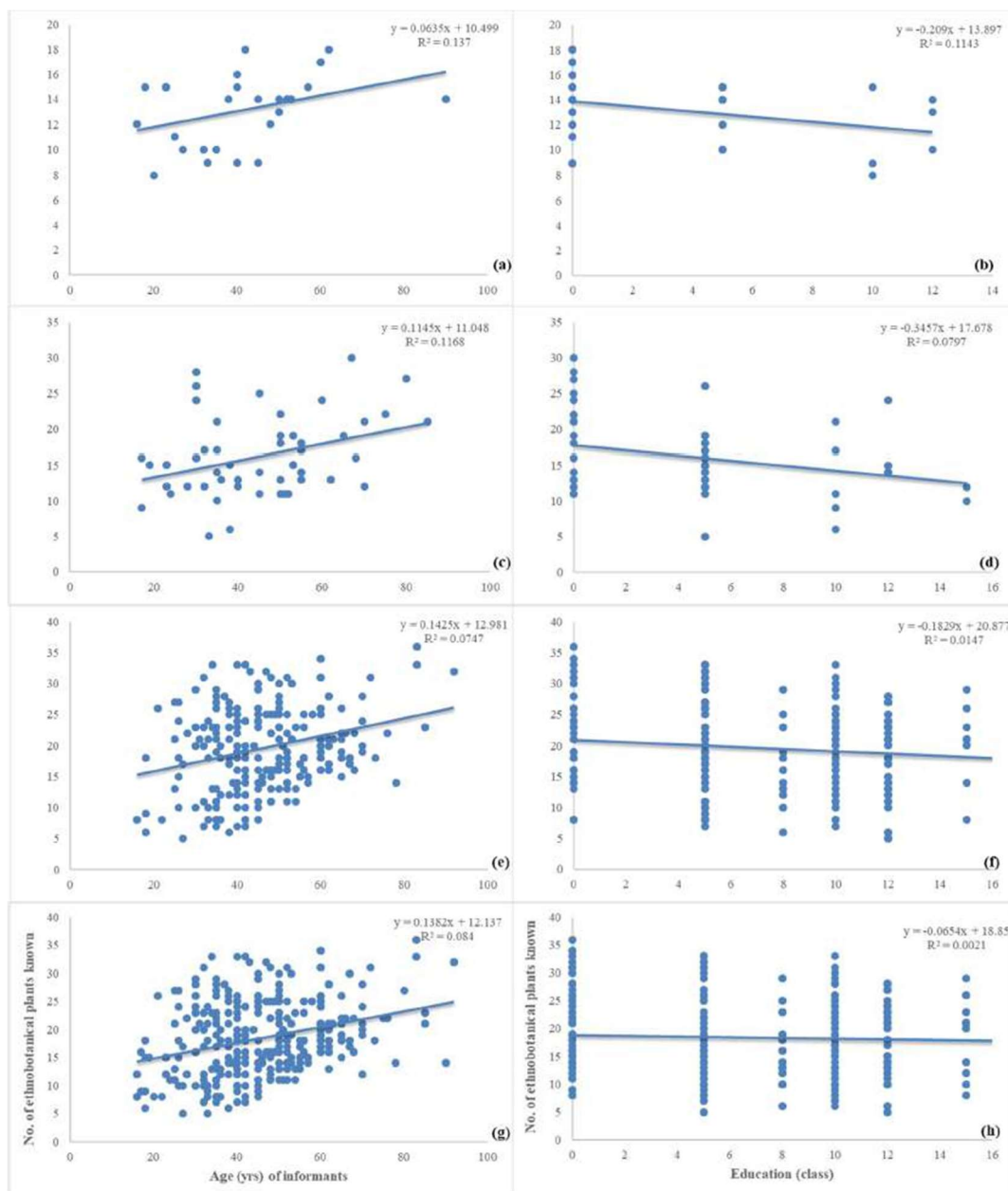


Figure 4.1. Pearson correlation analysis between age and education of Bakarwals (a and b), Gujjars (c and d), Dogras (e and f), and all the informants (g and h). All the correlation values, except that of b and h, were statistically significant at $P < 0.05$).

Phillips and Gentry (1993) suggested that this could be because gaining knowledge about ethnobotanical plants is a lifelong process, which is more challenging to learn compared to other ethnobotanical uses. Yineger *et al.* (2008) found that in communities where there was a significant loss of knowledge about ethnobotanical plants, the understanding and use of these plants tended to increase with age.

Informants with no formal education reported a higher mean number of ethnobotanical plants (19.3 ± 6.97) compared to those with formal schooling (18.1 ± 6.59); however, this difference was not statistically significant (ANOVA: $F = 1.83$, $P = 0.177$). The reasons for higher knowledge possessed by the elderly people may be that people from rural areas move away from their residence to acquire higher education and after getting education they move to cities for employment, and after being educated, they are exposed to modernization. According to Bhatia *et al.* (2014), the decreasing knowledge of using indigenous ethnobotanical plants among younger generations can be linked to the community's improving education standards. Additionally, the lack of interest among the younger generation in inheriting and utilizing ethnomedicinal knowledge plays a role in this decline. Whereas, Emmanuel and Didier (2011) also attributed the decline in knowledge about ethnobotanical plants to modernization factors such as education, occupation, and consumerism.

4.2 Diversity of Plants for Ethnobotanical Usage

The present study revealed that the tribal population (Gujjar and Bakarwal) as well as the local populace of the study area are utilizing the plant resources very efficiently for their sustenance. The present study recorded 236 taxa belonging to 206 genera and 77 families being utilized by the local and tribal populations for treating various human and animal ailments. Out of 236 species, 231 species (212 dicots and 19 monocots) were angiosperms, 3 species pteridophytes, 1 species gymnosperm, and 1 species fungus (Table 4.2).

Table 4.2: Ethnobotanical plants of Surinsar and Mansar wildlife Sanctuary

Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Abelmoschus moschatus</i> Medik.	Malvaceae	<i>Muskdana</i>	HBJU17835	Herb
<i>Abrus precatorius</i> L.	Fabaceae	<i>Ratti</i>	HBJU17828	Climber
<i>Achyranthes aspera</i> L.	Amaranthaceae	<i>Purkanda</i>	HBJU16907	Herb

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Acorus calamus</i> L.	Acoraceae	<i>Barian</i>	HBJU18329	Herb
<i>Adiantum capillus-veneris</i> L.	Pteridaceae	<i>Khoo Jari</i>	HBJU16921	Herb
<i>Adiantum caudatum</i> L.	Pteridaceae	<i>Khoo Jari</i>	HBJU17712	Herb
<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	<i>Bael</i>	HBJU18352	Tree
<i>Ajuga integrifolia</i> Buch.-Ham. ex D.Don	Lamiaceae	<i>Neelkanthi</i>	HBJU17675	Herb
<i>Ajuga macrosperma</i> Wall. ex Benth.	Lamiaceae		HBJU18360	Herb
<i>Albizia lebbeck</i> (L.) Benth.	Fabaceae	<i>Sareen</i>	HBJU17690	Tree
<i>Alysicarpus monilifer</i> (L.) DC.	Fabaceae		HBJU18347	Herb
<i>Amaranthus blitum</i> L.	Amaranthaceae	<i>Chaleri</i>	HBJU17633	Herb
<i>Angelica glauca</i> Edgew.	Apiaceae		-	Herb
<i>Anisomeles indica</i> (L.) Kuntze	Lamiaceae	<i>Kala bhangra</i>	HBJU16917	Herb
<i>Apteranthes tuberculata</i> (N.E.Br.) Meve & Liede	Apocynaceae	<i>Karongaliyan</i>	HBJU18341	Herb
<i>Argemone mexicana</i> L.	Papaveraceae		HBJU17702	Herb
<i>Argyrobium roseum</i> (Camb.) Jaub. & Spach	Fabaceae	<i>Hari Jri</i>	HBJU16931	Herb
<i>Artocarpus lacucha</i> Buch.-Ham	Moraceae	<i>Teau</i>	HBJU18332	Tree
<i>Arundo donax</i> L.	Poaceae		HBJU18323	Shrub
<i>Asparagus racemosus</i> Willd.	Asparagaceae	<i>Sanspaurd</i>	HBJU16935	Climber
<i>Avena sativa</i> L.	Poaceae	<i>Oats</i>	HBJU18358	Herb
<i>Azadirachta indica</i> A. Juss.	Meliaceae	<i>Neem</i>	HBJU17687	Tree
<i>Barleria cristata</i> L.	Acanthaceae	<i>Vajr Danti</i>	HBJU17629	Herb
<i>Barleria prionitis</i> L.	Acanthaceae	<i>Kali Braenkar</i>	HBJU16485	Shrub
<i>Bauhinia variegata</i> L.	Fabaceae	<i>Kartaer</i>	HBJU17657	Tree
<i>Bergenia ciliata</i> (Haw.) Sternb.	Saxifragaceae	<i>Zakhme hayat</i>	-	Herb
<i>Bidens bipinnata</i> L.	Asteraceae		HBJU18351	Herb
<i>Bidens pilosa</i> L.	Asteraceae		HBJU18362	Herb
<i>Boehmeria virgata</i> (G. Forst.) Guill.	Urticaceae		HBJU18335	Shrub
<i>Boerhavia diffusa</i> L.	Nyctaginaceae	<i>Itt-sitt</i>	HBJU17698	Herb
<i>Bombax ceiba</i> L.	Malvaceae	<i>Simbal</i>	HBJU17848	Tree
<i>Brassica campestris</i> L.	Brassicaceae	<i>Sarson</i>	HBJU17645	Herb
<i>Broussonetia papyrifera</i> (L.) L'Hér. ex Vent.	Moraceae	<i>Jangli toot</i>	HBJU17691	Tree
<i>Buddleja asiatica</i> Lour.	Scrophulariaceae	<i>Dhoora</i>	HBJU17723	Tree

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Butea monosperma</i> (Lam.) Kuntze	Fabaceae	<i>Palah</i>	HBJU17656	Tree
<i>Cajanus scarabaeoides</i> (L.) Thou.	Fabaceae	<i>Pigeon pea</i>	HBJU17664	Herb
<i>Callicarpa macrophylla</i> Vahl	Lamiaceae		HBJU18333	Shrub
<i>Calotropis procera</i> (Aiton) W.T. Aiton	Apocynaceae	<i>Desi Akk</i>	HBJU17637	Shrub
<i>Cannabis sativa</i> L.	Cannabaceae	<i>Bhaang</i>	HBJU17647	Herb
<i>Cardiospermum helicacabum</i> L.	Sapindaceae		HBJU17842	Climber
<i>Carissa spinarum</i> L.	Apocynaceae	<i>Garna</i>	HBJU17636	Shrub
<i>Casearia tomentosa</i> Roxb.	Salicaceae	<i>Chilla</i>	HBJU17721	Tree
<i>Cassia fistula</i> L.	Fabaceae	<i>Karangal</i>	HBJU17658	Tree
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	Rubiaceae	<i>Raada</i>	HBJU17719	Tree
<i>Celosia argentea</i> L.	Amaranthaceae		HBJU17800	Herb
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	<i>Brahm Bhooti</i>	HBJU17803	Herb
<i>Chenopodium album</i> L.	Amaranthaceae	<i>Bathu</i>	HBJU17632	Herb
<i>Cissampelos pareira</i> L.	Menispermaceae	<i>Battal Bael</i>	HBJU17688	Climber
<i>Citrus × limon</i> (L.) Osbeck	Rutaceae	<i>Nimbu</i>	HBJU17838	Shrub
<i>Citrus medica</i> L.	Rutaceae	<i>Kimb</i>	HBJU17840	Tree
<i>Citrus pseudolimon</i> Tanaka	Rutaceae	<i>Gargal</i>	HBJU17839	Tree
<i>Clematis barbellata</i> Edgew.	Ranunculaceae	<i>Dadri Bael</i>	HBJU17713	Climber
<i>Clematis gouriana</i> Roxb. ex DC.	Ranunculaceae		HBJU17836	Climber
<i>Cleome viscosa</i> L.	Cleomaceae		HBJU17813	Herb
<i>Clinopodium nepeta</i> (L.) Kuntze	Lamiaceae		HBJU17679	Herb
<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	<i>Kandoori</i>	HBJU17652	Climber
<i>Colebrookea oppositifolia</i> Sm.	Lamiaceae	<i>Soali</i>	HBJU16918	Shrub
<i>Commelina benghalensis</i> L.	Commelinaceae		HBJU17815	Herb
<i>Corchorus aestuans</i> L.	Malvaceae	<i>Jute</i>	HBJU17833	Herb
<i>Cordia dichotoma</i> G. Forst.	Boraginaceae	<i>Lasooda</i>	HBJU17643	Tree
<i>Coriandrum sativum</i> L.	Apiaceae	<i>Dhaniya</i>	HBJU17635	Herb
<i>Crotalaria medicaginea</i> Lam.	Fabaceae		HBJU16933	Herb
<i>Cryptolepis buchananii</i> R.Br. ex Roem. & Schult.	Asclepiadaceae	<i>Shyamlati</i>	HBJU17799	Tree
<i>Cucumis maderaspatanus</i> L.	Cucurbitaceae		HBJU17819	Climber
<i>Cucumis sativus</i> L.	Cucurbitaceae	<i>Kheera</i>	HBJU18504	Climber
<i>Cucurbita pepo</i> L.	Cucurbitaceae	<i>Kaddu</i>	HBJU17818	Climber

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Cuscuta cassytoides</i> Nees ex Engelm.	Convolvulaceae	<i>Aandal-kandal</i>	HBJU17649	Tree
<i>Cynoglossum zeylanicum</i> (Sw. ex Lehm.) Thunb. ex Brand	Boraginaceae	<i>Shudri</i>	HBJU17810	Herb
<i>Dalbergia sissoo</i> Roxb. ex DC.	Fabaceae	<i>Taali</i>	HBJU17827	Tree
<i>Datura stramonium</i> L.	Solanaceae	<i>Akk datura</i>	HBJU17724	Shrub
<i>Digera muricata</i> (L.) Mart.	Amaranthaceae		HBJU17631	Herb
<i>Dioscorea belophylla</i> (Prain) Voigt ex Haines	Dioscoreaceae	<i>Tarad</i>	HBJU18509	Climber
<i>Dioscorea bulbifera</i> L.	Dioscoreaceae	<i>Kathhi</i>	HBJU17819	Climber
<i>Dioscorea pentaphylla</i> L.	Dioscoreaceae	<i>Saadu</i>	HBJU18350	Climber
<i>Diospyros diversilimba</i> Merr. & Chun	Ebenaceae	<i>Riyaan</i>	HBJU17654	Tree
<i>Diplocyclos palmatus</i> (L.) C. Jeffrey	Cucurbitaceae	<i>Kaneri</i>	HBJU16934	Herb
<i>Dodonaea viscosa</i> Jacq.	Sapindaceae	<i>Santha</i>	HBJU16926	Shrub
<i>Dolomiaea costus</i> (Falc.) Kasana & A.K. Pandey	Asteraceae	<i>Haldu/Kuth</i>	-	Herb
<i>Duranta erecta</i> L.	Verbenaceae	<i>Hedge plant</i>	HBJU17728	Herb
<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amaranthaceae		HBJU17801	Herb
<i>Eclipta prostrata</i> (L.) L.	Asteraceae	<i>Bhringraj</i>	HBJU18336	Herb
<i>Erioscirpus comosus</i> (Wall.) Palla	Cyperaceae	<i>Ghaa</i>	HBJU18339	Herb
<i>Eucalyptus globulus</i> Labill.	Myrtaceae	<i>Safeda</i>	HBJU17696	Tree
<i>Eulaliopsis binata</i> (Retz.) C.E. Hubb.	Poaceae	<i>Babeyan</i>	HBJU18511	Herb
<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	<i>Dudhal Pattal</i>	HBJU17824	Herb
<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	<i>Dudhi</i>	HBJU17823	Herb
<i>Euphorbia hirta</i> L.	Euphorbiaceae		HBJU17655	Herb
<i>Euphorbia hypericifolia</i> L.	Euphorbiaceae		HBJU17822	Herb
<i>Euphorbia royleana</i> Boiss.	Euphorbiaceae	<i>Thor</i>	HBJU17821	Shrub
<i>Ficus auriculata</i> Lour.	Moraceae	<i>Trimbal</i>	HBJU17692	Tree
<i>Ficus benghalensis</i> L.	Moraceae	<i>Borh</i>	HBJU17693	Tree
<i>Ficus palmata</i> Forssk.	Moraceae	<i>Fakwara</i>	HBJU16920	Shrub
<i>Ficus populifolia</i> Vahl	Moraceae	<i>Barh/peepal</i>	HBJU16499	Tree
<i>Ficus racemosa</i> L.	Moraceae	<i>Rumbal</i>	HBJU17694	Tree
<i>Flacourtia indica</i> (Burm.f.) Merr.	Salicaceae	<i>Kakoa</i>	HBJU17841	Tree
<i>Foeniculum vulgare</i> Mill.	Apiaceae	<i>Saunf</i>	HBJU17802	Herb
<i>Fumaria indica</i> (Hausskn.) Pugsley	Fumariaceae	<i>Pit-Paapra</i>	HBJU16491	Herb

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Gentiana decemfida</i> Buch.-Ham. ex D.Don	Gentianaceae		HBJU17674	Herb
<i>Gloriosa superba</i> L.	Colchicaceae		HBJU18328	Climber
<i>Grewia optiva</i> J.R.Drumm. ex Burret	Malvaceae	Dhamman	HBJU18510	Tree
<i>Grona heterophylla</i> (Willd.) H.Ohashi & K.Ohashi	Fabaceae		HBJU17659	Herb
<i>Hellenia speciosa</i> (J.Koenig) S.R.Dutta	Costaceae	Jangli adrak	HBJU17816	Herb
<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton	Apocynaceae	Oan Bael	HBJU18337	Climber
<i>Impatiens balsamina</i> L.	Balsaminaceae	Tira	HBJU17808	Herb
<i>Indigofera cassioides</i> Rottler ex DC.	Fabaceae		HBJU17661	Shrub
<i>Indigofera linifolia</i> (L.f.) Retz.	Fabaceae		HBJU17662	Herb
<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae		HBJU17814	Climber
<i>Jacobaea nudicaulis</i> (Buch.-Ham. ex D.Don) B.Nord.	Asteraceae		HBJU17640	Herb
<i>Janochloa antidotalis</i> (Retz.) Zuloaga & Delfini	Poaceae	Girm ghaa	HBJU17708	Herb
<i>Jasminum multiflorum</i> (Burm.f.) Andrews	Oleaceae		HBJU18354	Climber
<i>Jurinea heteromalla</i> (D.Don) N.Garcia, Herrando & Susanna	Asteraceae	Kaliziri	HBJU16493	Herb
<i>Justicia adhatoda</i> L.	Acanthaceae	Brankad	HBJU16912	Shrub
<i>Kydia calycina</i> Roxb.	Malvaceae	Pula	HBJU17834	Tree
<i>Lamium amplexicaule</i> L.	Lamiaceae		HBJU17676	Herb
<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	Kembel	HBJU16927	Tree
<i>Lathyrus aphaca</i> L.	Fabaceae	Mithusaag	HBJU17671	Herb
<i>asiatica</i> (L.) Ridsdale	Vitaceae		HBJU17846	Shrub
<i>Lepidagathis cuspidata</i> Nees	Acanthaceae		HBJU17797	Herb
<i>Lepidium didymum</i> L.	Brassicaceae	Jangli halain	HBJU17811	Herb
<i>Leptodermis lanceolata</i> Wall.	Acanthaceae		HBJU18508	Shrub
<i>Lespedeza juncea</i> (L.f.) Pers.	Fabaceae		HBJU17829	Herb
<i>Leucaena leucocephala</i> (Lam.) de Wit	Fabaceae	Lasini	HBJU17672	Tree
<i>Leucas aspera</i> (Willd.) Link	Lamiaceae	Dronpushpi	HBJU16915	Herb
<i>Litsea glutinosa</i> (Lour.) C.B.Rob.	Lauraceae	Maidasikd	HBJU17680	Tree
<i>Luffa aegyptiaca</i> Mill.	Cucurbitaceae	kandoli	HBJU17651	Climber
<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Euphorbiaceae	Kaamla	HBJU16940	Tree
<i>Malva pusilla</i> Sm.	Malvaceae	Sounchal	HBJU17684	Herb

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Mangifera indica</i> L.	Anacardiaceae	<i>Aam</i>	HBJU17634	Tree
<i>Martynia annua</i> L.	Martyniaceae		HBJU17685	Herb
<i>Mazus pumilus</i> (Burm.f.) Steenis	Mazaceae		HBJU18353	Herb
<i>Medicago sativa</i> L.	Fabaceae	<i>Maina</i>	HBJU17663	Herb
<i>Melia azedarach</i> L.	Meliaceae	<i>Dharank</i>	HBJU17686	Tree
<i>Melilotus indicus</i> (L.) All.	Fabaceae		HBJU17660	Herb
<i>Mentha spicata</i> L.	Lamiaceae	<i>Pudina</i>	HBJU17830	Herb
<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don)	Lamiaceae		HBJU16919	Herb
<i>Mirabilis jalapa</i> L.	Nyctaginaceae		HBJU17699	Herb
<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae	<i>Kaim</i>	HBJU18327	Tree
<i>Momordica charantia</i> L.	Cucurbitaceae	<i>Jangli karela</i>	HBJU17653	Climber
<i>Morchella esculenta</i> Fr.	Morchellaceae	<i>Gucchi</i>	HBJU/M/19 2	Mycelium
<i>Moringa oliefera</i> Lam.	Moringaceae	<i>Sohanjana</i>	HBJU17695	Tree
<i>Morus alba</i> L.	Moraceae	<i>Toot</i>	HBJU17849	Tree
<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae	<i>Kadi Patta</i>	HBJU16911	Shrub
<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	<i>Kamal doda</i>	HBJU18507	Shrub
<i>Nepeta hindostana</i> (B.Heyne ex Roth) Haines	Lamiaceae		HBJU18342	Herb
<i>Nerium indicum</i> L.	Apocynaceae		HBJU17638	Shrub
<i>Nicotiana tabacum</i> L.	Solanaceae	<i>Desi tambaku</i>	HBJU17844	Herb
<i>Nyctanthes arbor-tristis</i> L.	Oleaceae	<i>Parijaat</i>	HBJU17830	Shrub
<i>Ocimum americanum</i> L.	Lamiaceae	<i>Ghareeda</i>	HBJU17677	Herb
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	<i>Tulsi</i>	HBJU17831	Herb
<i>Oenothera rosea</i> L'Hér. ex Aiton	Onagraceae		HBJU17700	Herb
<i>Oplismenus burmanni</i> (Retz.) P.Beauv.	Poaceae	<i>Ghaa</i>	HBJU17709	Herb
<i>Oplismenus compositus</i> (L.) P.Beauv.	Poaceae	<i>Ghaa</i>	HBJU18338	Herb
<i>Opuntia tuna</i> (L.) Mill.	Cactaceae	<i>thor</i>	HBJU18345	Shrub
<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae		HBJU17809	Tree
<i>Ougeinia oojeinensis</i> (Roxb.) Hochr.	Fabaceae	<i>Sannan</i>	HBJU17723	Tree
<i>Oxalis corniculata</i> L.	Oxalidaceae	<i>Khatti ammi</i>	HBJU17701	Herb
<i>Packeria aurea</i> (L.) Á.Löve & D.Löve	Asteraceae		HBJU16942	Herb
<i>Paeonia emodi</i> Royle	Paeniaceae	-		Herb
<i>Pergularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae		HBJU17798	Climber

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Phanera vahlii</i> (Wight & Arn.) Benth.	Fabaceae	<i>Balungar</i>	HBJU17668	Climber
<i>Phlomoides superba</i> (Royle ex Benth.) Kamelin & Makhm.	Lamiaceae	<i>Gajarmoola</i>	HBJU17678	Herb
<i>Phoenix dactylifera</i> L.	Arecaceae	<i>Khajoor</i>	HBJU17639	Tree
<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae		HBJU18334	Herb
<i>Phyllanthus emblica</i> L.	Phyllanthaceae	<i>Amla</i>	HBJU17703	Tree
<i>Phyllanthus urinaria</i> L.	Phyllanthaceae	<i>Bhoomiamla</i>	HBJU18340	Herb
<i>Phyllanthus velutinus</i> (Wight) Müll.Arg.	Euphorbiaceae	<i>Garsamma</i>	HBJU17825	Tree
<i>Physalis angulata</i> L.	Solanaceae		HBJU17726	Herb
<i>Pinus roxburghii</i> Sarg.	Pinaceae	<i>Chilgoza pine</i>	HBJU17704	Tree
<i>Pityrogramma calomelanos</i> (L.) Link	Pteridaceae		HBJU18326	Herb
<i>Pleurolobus gangeticus</i> (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi	Fabaceae	Surkanni	HBJU18349	Herb
<i>Plumbago zeylanica</i> L.	Plumbaginaceae		HBJU17706	Herb
<i>Pogostemon benghalensis</i> (Burm.f.) Kuntze	Lamiaceae		HBJU17805	Shrub
<i>Polygala abyssinica</i> R.Br. ex Fresen.	Polygalaceae		HBJU16944	Herb
<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	<i>Sukh chain</i>	HBJU17673	Tree
<i>Poranopsis paniculata</i> (Roxb.) Roberty	Convolvulaceae	<i>Safed Bel</i>	HBJU17650	Climber
<i>Portulaca oleracea</i> L.	Portulacaceae	<i>Kulfa saag</i>	HBJU17711	Herb
<i>Potentilla indica</i> (Andrews) Th.Wolf	Rosaceae	<i>Jangli strawberry</i>	HBJU17716	Herb
<i>Psidium guajava</i> L.	Myrtaceae	<i>Amrood</i>	HBJU16910	Tree
<i>Pueraria tuberosa</i> (Roxb. ex Wild.) DC.	Fabaceae	<i>Siyaali</i>	HBJU17666	Herb
<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae		HBJU17630	Herb
<i>Pyrus pashia</i> Buch.-Ham. ex D.Don	Rosaceae	<i>Kainth</i>	HBJU18361	Tree
<i>Ranunculus sceleratus</i> L.	Ranunculaceae	<i>Kaudtan</i>	HBJU17714	Herb
<i>Reinwardtia indica</i> Dumort.	Linaceae	<i>Basant Phool</i>	HBJU17832	Shrub
<i>Rhamnus triquetra</i> (Wall.) Brandis	Rhamnaceae		HBJU17707	Tree
<i>Ricinus communis</i> L.	Euphorbiaceae	<i>Im</i>	HBJU17826	Shrub
<i>Rosa macrophylla</i> Lindl.	Rosaceae	<i>Gulab</i>	HBJU16936	Herb
<i>Rostellularia procumbens</i> (L.) Nees	Acanthaceae		HBJU17796	Herb
<i>Rubus ellipticus</i> Sm.	Rosaceae	<i>Aakhrey</i>	HBJU17837	Herb
<i>Rumex dentatus</i> L.	Polygonaceae	<i>Jangli palak</i>	HBJU18359	Herb
<i>Salvia plebeia</i> R.Br.	Lamiaceae	<i>Sol samunder</i>	HBJU16916	Herb

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Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Sapindus mukorossi</i> Gaertn.	Sapindaceae	Reetha	HBJU18331	Tree
<i>Saraca asoca</i> (Roxb.) W.J.de Wilde	Caesalpinaceae	<i>Sita ashok</i>	HBJU17646	Tree
<i>Scandix pecten-veneris</i> L.	Apiaceae	<i>Indu saag</i>	HBJU16483	Herb
<i>Senegalia catechu</i> (L.f.) P.J.H.Hurter & Mabb.	Fabaceae	<i>Khair</i>	HBJU17667	Tree
<i>Senegalia modesta</i> (Wall.) P.J.H.Hurter	Fabaceae	<i>Farlai</i>	HBJU18324	Tree
<i>Senna tora</i> (L.) Roxb.	Fabaceae	<i>Hedema</i>	HBJU17665	Herb
<i>Sesamum indicum</i> L.	Pedaliaceae	<i>Til</i>	HBJU18330	Herb
<i>Sida cordata</i> (Burm.f.) Borss.Waalk.	Malvaceae		HBJU18343	Herb
<i>Silybum marianum</i> (L.) Gaertn.	Asteraceae		HBJU16943	Herb
<i>Solanum erianthum</i> D.Don	Solanaceae		HBJU17725	Tree
<i>Solanum nigrum</i> L.	Solanaceae	<i>Kaya kothi</i>	HBJU16939	Herb
<i>Solanum viarum</i> Dunal	Solanaceae		HBJU17843	Herb
<i>Solanum virginianum</i> L.	Solanaceae	<i>Kandyari</i>	HBJU16938	Herb
<i>Sonchus asper</i> (L.) Hill	Asteraceae	<i>Duddal Pattal</i>	HBJU18357	Herb
<i>Spermacoce articularis</i> L.f.	Rubiaceae		HBJU17718	Herb
<i>Spermadictyon suaveolens</i> Roxb.	Rubiaceae		HBJU17717	Herb
<i>Sterculia villosa</i> Roxb. ex Sm.	Malvaceae		HBJU17727	Tree
<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae		HBJU17804	Herb
<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	<i>Dhallan</i>	HBJU17697	Tree
<i>Taraxacum officinale</i> F.H.Wigg.	Asteraceae	<i>Handar</i>	HBJU18355	Herb
<i>Tectona grandis</i> L.f.	Lamiaceae		HBJU17845	Tree
<i>Telosma pallida</i> (Roxb.) Craib	Apocynaceae	<i>Gual Mande</i>	HBJU18505	Climber
<i>Tephrosia purpurea</i> (L.) Pers.	Fabaceae	<i>Sarpunkha</i>	HBJU18325	Herb
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	<i>Beheda</i>	HBJU17817	Tree
<i>Terminalia chebula</i> Retz.	Combretaceae	<i>Rheed</i>	HBJU18344	Tree
<i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thomson	Menispermaceae	<i>Gloe</i>	HBJU18346	Climber
<i>Toona ciliata</i> M.Roem.	Meliaceae	<i>Tunu</i>	HBJU16923	Tree
<i>Trema politoria</i> (Planch.) Blume	Cannabaceae		HBJU17812	Tree
<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae	<i>Pandole</i>	HBJU17811	Climber
<i>Tridax procumbens</i> L.	Asteraceae		HBJU17641	Herb
<i>Trifolium repens</i> L.	Fabaceae		HBJU17670	Herb
<i>Trigonella foenum-graecum</i> L.	Fabaceae	<i>Methre</i>	HBJU17669	Herb

Botanical Name	Family	Vernacular Name	Accession No.	Habit
<i>Tripidium bengalense</i> (Retz.) H.Scholz	Poaceae	<i>Khad</i>	HBJU17723	Shrub
<i>Tulipa clusiana</i> Redouté	Liliaceae	<i>Beshankha</i>	HBJU17681	Herb
<i>Urena lobata</i> L.	Malvaceae		HBJU17683	Herb
<i>Vachellia nilotica</i> (L.) P.J.H.Hurter & Mabb.	Fabaceae	<i>Babool</i>	HBJU18506	Tree
<i>Vallisneria spiralis</i> (L.) Kuntze	Apocynaceae	<i>Kanak bel</i>	HBJU16924	Climber
<i>Verbascum thapsus</i> L.	Scrophulariaceae	<i>Jangli tambaku</i>	HBJU17722	Herb
<i>Veronica persica</i> Poir.	Plantaginaceae		HBJU17705	Herb
<i>Viola canescens</i> Wall.	Violaceae	<i>Banafsha</i>	HBJU17729	Herb
<i>Vitex negundo</i> L.	Lamiaceae	<i>Banah</i>	HBJU16914	Shrub
<i>Woodfordia fruticosa</i> (L.) Kurz	Lythraceae	<i>Taiin</i>	HBJU17682	Shrub
<i>Xanthium strumarium</i> L.	Asteraceae	<i>Joojre</i>	HBJU17806	Herb
<i>Xylosma longifolia</i> Clos	Salicaceae		HBJU17720	Tree
<i>Zingiber roseum</i> (Roxb.) Roscoe	Zingiberaceae		HBJU18356	Herb
<i>Ziziphus jujuba</i> (L.) Gaertn.	Rhamnaceae	<i>Ber</i>	HBJU17715	Shrub

The most dominant family was Fabaceae (28 genera and 30 species), followed by Lamiaceae (16 and 18), Asteraceae (12 and 13), Malvaceae (9 and 9), and Cucurbitaceae (7 and 8) (Fig 4.2). As many as forty species were represented by only one species.

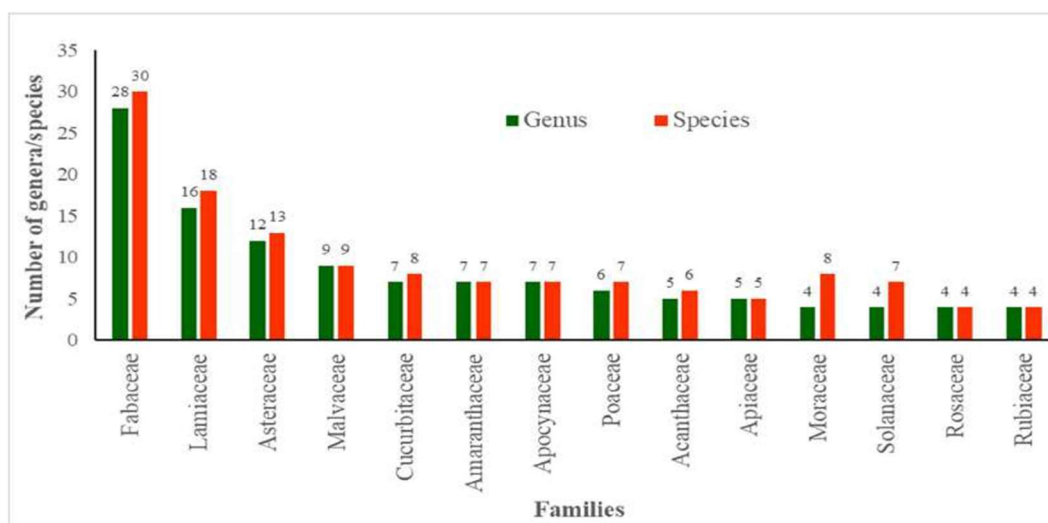


Figure 4.2: The most represented plant families of ethnobotanical species

Herbs were the most dominant lifeforms represented by 51.3% species (Fig. 4.3), followed by trees (25.4%), shrubs (11.9%) and climbers (10.6%). One fungal genus was also reported accounting only 0.4% of the total reported species.

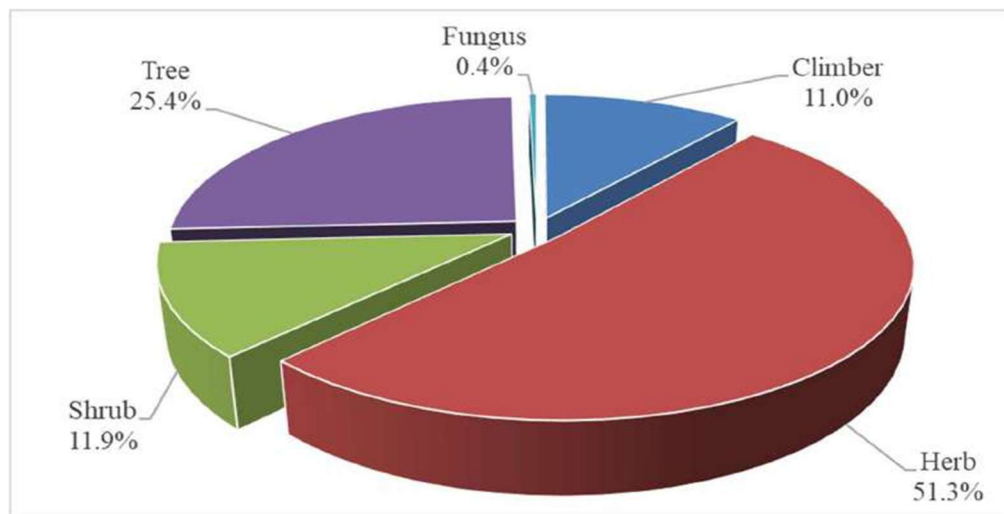


Figure 4.3: Percentage contribution of various life-forms of ethnobotanical species

For the convenience, the conducted study was categorized into five different major use groups viz. ethnomedicinal, ethnoveterinary, wild edible, plant based traditional products, and miscellaneous uses.

4.2.1 Ethnomedicinal Plants

The present study recorded 210 plant species which are used to treat various ailments belonging to 187 genera and 75 families (Table 4.3). Among 210 plants, 206 species were angiosperms whereas gymnosperms and pteridophytes were represented by 1 and 3 species, respectively. The largest genera in the study area were *Euphorbia* and *Ficus* (5 species each) and *Solanum* (4 species).

Table 4.3: Plant part used, traditional medicinal uses, use-reports and use-value of ethnomedicinal plants of the Surinsar and Mansar wildlife Sanctuary

Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Abelmoschus moschatus</i>	Se	Seeds are used against snake bite (4).	4	0.01
<i>Abrus precatorius</i>	Se, R	Seed oil is effective in relieving joint pains (3). Seeds are given with chapati to dogs in case they have any body swellings (3). Powdered roots mixed with ghee used to treat acne, boils and pimples (3).	9	0.03

RESULTS AND DISCUSSION

Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Achyranthes aspera</i>	L, R, Se	Leaves are effective against pain and fever due to scorpion sting (4). Root juice is used to cure toothache (6). The root extract is applied externally to remove the pus out from the boils (10). Root powder is also effective in treating cancer (9). Roots effective against fever (4). Seeds are burned and mixed with honey effective against cough (12). Roots boiled in water are effective in relieving earaches (8). Tea prepared from boiled roots mixed with <i>Elachi</i> and <i>loun</i> helps to treat pneumonia (1). Inflorescence is used to treat snakebites (4).	58	0.19
<i>Acorus calamus</i>	L, Rh	Used against cold and cough (11). Leaf juice mixed with 'Bala' applied to head to children in case he cries too much (2). Rhizome is eaten to remove intestinal worms (30) and pinworms in children (2). Rhizome is rubbed and applied to gums and teeth to relieve toothache (3).	48	0.16
<i>Adiantum capillus-veneris</i>	L	Leaves are crushed and rubbed in ghee / curd to treat Kalvatra (9).	9	0.03
<i>Adiantum caudatum</i>	L	Leaves are crushed and rubbed in ghee / curd to treat Kalvatra (29).	29	0.09
<i>Aegle marmelos</i>	L, Fr, S	Fruit juice is effective against diarrhea (12), anaemia (2), jaundice (36), and pneumonia (13). Fruit pulp is dried and taken with milk to cure cough (4). Leaves warmed with oil tied to relieve headache (23), diabetes (12), jaundice (7). Leaves mixed with guava and jamun leaves taken to cure diabetes (23). Stem is used to make mortar; the water is poured into it for some time and taken for curing stomach problems (27).	159	0.52
<i>Ajuga integrifolia</i>	WP, L	Sliced plant soaked overnight in water is effective in treating gout (3), paste and extract of leaves are used in pimples (2), skin inflammations (2), swellings (9), wounds and boils (1). Leaves are eaten to cure diabetes (31). Leaf juice is poured directly in the anus to get rid of pinworms in children (9).	57	0.19
<i>Ajuga macrosperma</i>	R	Root juice is effective in curing pimples (7) and other skin problems like boils (7).	14	0.05
<i>Albizia lebbek</i>	L	Leaves used for bathing by ladies after 21 days of delivery in order to keep body warm (13).	13	0.04
<i>Alysicarpus monilifer</i>	L	Cough (1)	1	0.00
<i>Amaranthus blitum</i>	L	Effective in treating diabetes (23) and dysentery (5).	28	0.09
<i>Anisomeles indica</i>	WP	The herb is used against dysentery (8), snake bite (3), and stomachache (3).	14	0.05
<i>Argemone mexicana</i>	L	Leaves are used as an antidote for scorpion (2), and snake bite (7).	9	0.03

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Argyrolobium roseum</i>	WP	Used as sex-tonic by females (2). Powdered form mixed with butter taken with milk or water is effective in the treatment of leucorrhea (4). Leaves crushed with black pepper mixed with sugar syrup to form paste eaten for snake bite (10).	16	0.05
<i>Arundo donax</i>	R	Treats pneumonia (3).	3	0.01
<i>Asparagus racemosus</i>	L, Tu	Dry powder of leaf used to cure diarrhea (3) and skin diseases (3). While tuber is used in anemia (4), fever (4), jaundice (4), and female problems (5).	23	0.08
<i>Avena sativa</i>	Se	Eaten as cereal grain (4), nutritious (9), controls diabetes (9), and rich in fibre (9).	31	0.10
<i>Azadirachta indica</i>	L, Tw, R	Leaves are used in treating acne (45), pimples (54) boost immunity (7), reduces dandruff (22), purifies blood (49), twigs are used as toothbrush (24). Leaves are burnt to prevent mosquitoes (7). Leaf juice taken to expel out the worms from body (11). Roots boiled in water is taken to treat jaundice (7).	226	0.74
<i>Barleria cristata</i>	L, Se	Leaves are used as tonic (3), and against diabetes (5), and toothache (7). Seeds helps against snake bites (3).	18	0.06
<i>Barleria prionitis</i>	Tw, L	Dried and Powdered twigs are burnt into ash mixed with banana leaf, burnt <i>Luffa acutangula</i> fruit and honey is effective against acute cough (<i>Kali Khansi</i>) (42). Leaves are used to relieve toothache (7) and bleeding gums (7).	56	0.18
<i>Bauhinia variegata</i>	Fl	Flowers are used to treat thyroid (4).	4	0.01
<i>Bergenia ciliata</i>	L	Leaves are made into powder and applied to treat wounds (10).	10	0.03
<i>Bidens bipinnata</i>	L	Leaves are used to make tea effective against cold (2).	2	0.01
<i>Bidens pilosa</i>	L	Leaves are used to treat toothache (3). Tea prepared from leaves helps in relieving cold (3).	6	0.02
<i>Boerhavia diffusa</i>	WP	Powdered herb is used as an antidote for snake-bite (11). Extract of plant given in renal problems (4). Leaf paste is applied to treat body swellings (1). Roots are tied in white fabric and kept near person having fever (5).	21	0.07
<i>Bombax ceiba</i>	Fr, Fl	Gum obtained from stem is used to cure dysentery (19).	19	0.06
<i>Brassica campestris</i>	Se	Seed oil is effective in treating skin related issues (8). Head massage is done from oil for healthy hairs (11).	19	0.06
<i>Broussonetia papyrifera</i>	L, Se	Leaf juice is effective in treating dysentery (3). Seed oil is effective in treating body pains in humans (1).	4	0.01
<i>Buddleja asiatica</i>	L	Leaves are effective in treating dysentery (2) and fever (4).	6	0.02

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Butea monosperma</i>	R, B, Fl	Root paste is applied as an antidote for snake-bite (21). Bark of the stem is applied to relieve body swellings (3), diarrhoea (21), snake bite (21), and toothache (8) due to gum pains. Bark is powdered and applied to treat mouth ulcers (10). Flowers are grinded with maize hairs and rat excreta applied to stomach in case one is having problem in passing urine (3). Flowers used to treat skin problems (15).	102	0.33
<i>Cajanus scarabaeoides</i>	L	Used in the treatment of gonorrhea (4) and dysentery (6).	10	0.03
<i>Callicarpa macrophylla</i>	L	Leaves are used to cure diarrhoea (2).	2	0.01
<i>Calotropis procera</i>	R, La	The powdered root is applied to take pus out from the gums (3). Latex helps in relieving toothache (54), and cure scorpion sting (8).	65	0.21
<i>Cannabis sativa</i>	L	Leaf paste is applied on skin ulcers (11) and to relieve toothache (28). Leaves are rubbed to remove wasp sting from skin (57).	96	0.31
<i>Cardiospermum helicacabum</i>	S	Plant is used to cure stomachache (3).	3	0.01
<i>Carissa spinarum</i>	L, Fr, R, La	Mixture of powdered dry fruit and leaves are used to cure jaundice (36) and roots used in asthma (8). Latex is used to eject out the prickles from the skin (18).	62	0.20
<i>Casearia tomentosa</i>	L	Leaves effective in curing stomach problems in children (65), and wounds (36).	101	0.33
<i>Cassia fistula</i>	L, Fr, Fl	Boiled Pods are effective against snake bite (5). Raw pod paste is used in treating <i>Dadri</i> (5). Boiled pods are given to treat bone pains along with sesame oil, <i>Syzygium</i> fruits, <i>Jaiphal</i> (4). Flower <i>murabba</i> is prepared used to cure cough (2). Tender leaves are cooked as vegetable for curing constipation (21). Leaves paste mixed with curd applied to treat Shingles 'Kalvatra' (19).	56	0.18
<i>Catunaregam spinosa</i>	Fr	Treats gastrointestinal problems (3).	3	0.01
<i>Celosia argentea</i>	Se	Seeds help in curing diabetes (4), wounds (3), and diarrhoea (1).	8	0.03
<i>Centella asiatica</i>	L	Leaves taken with water is effective coolant (18), and treats swollen gums (1). Leaves also helps as memory enhancer (13).	32	0.10
<i>Chenopodium album</i>	L	Leaves are consumed as vegetable to purify blood (2), and as antidiabetic (6). Helpful in treating cancer (9), constipation (19), and piles (15). Effective vegetable as supplement of iron (8).	59	0.19
<i>Cissampelos pareira</i>	L	Leaves effective in curing loose motions (67).	67	0.22
<i>Citrus × limon</i>	Fr	Tea prepared from fruit is helpful in treating indigestion (6).	6	0.02

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Citrus pseudolimon</i>	L, Fr	Leaves are tied to head to relieve headache (30) and throat ulcers (45). Fruit juice is taken for at least one week to remove kidney stones (5). Leaves tied to have cooling effect and to cure tonsils (<i>pabbu</i>) (5).	85	0.28
<i>Clematis barbellata</i>	L	Leaf paste helps in curing ringworm (9).	9	0.03
<i>Clematis gouriana</i>	S	Paste of stem is used to treat wounds (6) and fever (1).	7	0.02
<i>Cleome viscosa</i>	L	Helps in wound healing (4). Treats gastrointestinal troubles (2), and joint pains (5).	11	0.04
<i>Clinopodium nepeta</i>	L	Leaf paste helps in poultices for bruises (2), effective against gastric problems (5).	7	0.02
<i>Coccinia grandis</i>	L	Leaf juice is used to cure diabetes (28).	28	0.09
<i>Colebrookea oppositifolia</i>	L	Leaves are tied to relieve bone-fracture pains (63). Leaf paste is applied to heal wounds (22).	85	0.28
<i>Commelina benghalensis</i>	L	Treats inflammation (4).	4	0.01
<i>Corchorus aestuans</i>	WP	Cures fever (1), and stomach disorders (1).	2	0.01
<i>Cordia dichotoma</i>	Fr, B, L	Bark powder with oil is used treatment of skin diseases (20). Dried fruit is given in fever (3), cough (18), asthma (11), diarrhea (10), and intestinal worms (7). Leaves are tied to stomach of babies to prevent constipation (19). Leaves used as toothbrush to remove <i>garmi</i> from body (14).	102	0.33
<i>Coriandrum sativum</i>	L	Leaf decoction is helpful in treating mouth ulcers (8), and treats indigestion (8).	16	0.05
<i>Crotalaria medicaginea</i>	L	Leaf paste when taken with milk used to treat white discharge i.e. leucorrhea (8).	8	0.03
<i>Cryptolepis buchananii</i>	R	Root is effective in treating fever (3) and skin diseases (2).	5	0.02
<i>Cucumis maderaspatanus</i>	Se	Seeds are used as tonic (1).	1	0.00
<i>Cucumis sativus</i>	Fr	Cucumber fruit is consumed to relieve burning micturition (2), heavy bleeding during periods (4), nasal bleeding (6), and jaundice (2).	14	0.05
<i>Cucurbita pepo</i>	Se, Fr	Fruit is good for heart (3), and helps in boosting immunity (3).	6	0.02
<i>Cuscuta cassyoides</i>	WP	Plant is boiled in water and this water is used to bath which is effective in curing skin problems like itching (10) and swellings (10). The decoction is applied on hair to prevent dandruff (6).	26	0.08
<i>Cynoglossum zeylanicum</i>	L	Leaf paste is applied to cure ringworm (19).	19	0.06
<i>Dalbergia sissoo</i>	B, L	Bark is used in treating skin problems (9). Leaves are used to treat nasal bleeding (6).	15	0.05

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Datura stramonium</i>	L, Se	Used to cure asthma (5). Leaf juice is applied on scalp to treat hair fall (3) and dandruff (6). Seeds are used to relieve toothache (3).	17	0.06
<i>Digera muricata</i>	L	Leaves are used to cure diabetes (2). Helps to cure kidney stones (2).	4	0.01
<i>Dioscorea bulbifera</i>	Tu	Tubers are boiled in water, mashed with ghee and taken to treat backpain (17) and joint pains (13).	30	0.10
<i>Diospyros diversilimba</i>	L, B	Paste of leaves and bark applied on boils (16). Powdered form of Stem bark is effective in curing bone fracture pains (37).	53	0.17
<i>Diplocyclos palmatus</i>	Fr, R, L	Root powder is used in treating fever (33). The powdered form of fruit is put into the nose to get rid of cold (19). The leaves and fruits are used to cure stomachache (6). Roots boiled in water to make tea effective in relieving pains (9) and cough (22).	89	0.29
<i>Dodonaea viscosa</i>	L, S	Leaves juice used to cure toothache (16). Powdered leaves are applied to cure burns (22), and wounds (27). Leaves are tied to treat joint pains (35).	100	0.33
<i>Dolomiaea costus</i>	R	Powdered roots warmed with ghee and applied to joint pains (22).	22	0.07
<i>Duranta erecta</i>	Se	Seeds are used in the treatment of piles (2).	2	0.01
<i>Dysphania ambrosioides</i>	WP	Leaf paste is applied to treat roundworms (3). Plant is useful in curing indigestion (1), diabetes (16), and piles (7)	27	0.09
<i>Eclipta prostrata</i>	WP	Used in promoting hair growth (1), makes healthy hairs (1) and dandruff free hairs (1).	3	0.01
<i>Eucalyptus globulus</i>	L	Tea prepared from leaves is helpful in relieving sore throat (2), cold (19), cough (7). The paste of leaves is used in joint pains (15).	43	0.14
<i>Euphorbia helioscopia</i>	La	Latex is applied to treat ringworm (6), fungal infections (4).	10	0.03
<i>Euphorbia heterophylla</i>	L	Helps to treat snake and scorpion sting (1), wounds (1) and dysentery (2).	4	0.01
<i>Euphorbia hirta</i>	L	Used to promote lactation in females (5), cough (1) and digestive problems (1). Leaves are effective in treating piles (7).	14	0.05
<i>Euphorbia hypericifolia</i>	L	Leaves helps in treating gastrointestinal problems (2). Leaf latex is applied to cuts and wounds (4).	6	0.02
<i>Ficus auriculata</i>	B, L	Bark juice is taken to cure dysentery (1), and diarrhoea (10). Leaves warmed with Ghee tied to head to relieve headache (4).	15	0.05
<i>Ficus benghalensis</i>	L	Cures internal body pains (4) and knee pains (1).	5	0.02
<i>Ficus palmata</i>	La, L	Latex mixed with sugar is used to treat leukoderma (29). Paste of leaves is used in eruption of skin (11).	62	0.20

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
		Latex is applied to eject out the prickle from the skin (22).		
<i>Ficus populifolia</i>	B, L, La	Bark and leave are used to treat skin diseases like acne (8) and itching (8). Latex is used to cure toothache (5). Bark is burned and taken with water to treat indigestion (2). Leaves mixed with black pepper and water effective in piles (6).	29	0.09
<i>Ficus racemosa</i>	L, Fr, La	Leaves are used to treat fungal infections (2) and wounds (2). Fruits are eaten raw which is a blood purifier (13). Milky latex is applied to cure acne (14).	31	0.10
<i>Flacourtia indica</i>	B	Antidote for snake bite (7). Bark is boiled in water to make tea which is effective in curing fever (8), diarrhoea (7) and anemia (5).	27	0.09
<i>Foeniculum vulgare</i>	Se	Seeds increases milk production in females (3). Used to treat digestive disorders (3).	6	0.02
<i>Fumaria indica</i>	WP	The dried plant mixed with black pepper is given in jaundice (13). Plant boiled in water helps in curing diabetes (13).	26	0.08
<i>Gentiana decemfida</i>	R	Helps to recover from loss of appetite (8).	8	0.03
<i>Gloriosa superba</i>	Tu	Tubers are used to treat wounds (2) and intestinal worms (2).	4	0.01
<i>Grewia optiva</i>	L, R	Twigs are used as toothbrush to clean teeth (18).	18	0.06
<i>Grona heterophylla</i>	L	Herb is used to treat dysentery (2)	2	0.01
<i>Hellenia speciosa</i>	Rh	Rhizome helps in relieving fever (4) and intestinal worm (1).	5	0.02
<i>Ichnocarpus frutescens</i>	La	Helps in treating dysentery (8). Wood latex put in eyes as eye drop to relieve eye infection in humans (16).	24	0.08
<i>Impatiens balsamina</i>	Fl, L	Flowers are helpful in curing burns (7). Leaf juice effective in treating snake bite (7).	14	0.05
<i>Indigofera cassioides</i>	R	Roots are helpful in curing coughs (4).	4	0.01
<i>Indigofera linifolia</i>	L	Plant is used to treat wounds (4).	4	0.01
<i>Ipomoea pes-tigridis</i>	L	Treats ulcers (1), treats wounds (1) and skin problems (1).	3	0.01
<i>Jacobaea nudicaulis</i>	WP	Plant is used to repel insects (1). Cure stomachache (3) and cough (2).	6	0.02
<i>Janochloa antidotalis</i>	L, R	Leaves used to treat mouth ulcers (1). Roots grinded along with “Bala” and applied to child’s hand, feet in case he is crying too much (locally knows as <i>Shiram</i>) (3). Roots are boiled to make tea to cure cough (3) and chest infection (3).	10	0.03
<i>Jasminum multiflorum</i>	Fl	Treats wounds (3).	3	0.01
<i>Jurinea heteromalla</i>	L	Leaf paste is applied on wounds (1).	1	0.00

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Justicia adhatoda</i>	Se, R, Fl, L	Roots and seeds boiled in water mixed with neem oil is used to relieve fever (85). Flower is used to improve vigor (4), while leaves are used in cough (35). Yellow leaves are tied to head and stomach to relieve headache (43) and stomachache (5). Leaves are warmed with oil and tied to relieve pains and tied to belly for treating constipation (45). Leaves tied to stomach in case of flatulence (1). Leaf juice along with honey taken to cure vomiting (18). Leaves burnt to ashes with cow dung mixed with 'Godantiya bhasam' to made tablet used to treat fever (8). Leaves are eaten in case of having gastric troubles (12). Twigs are used as toothbrush to clean teeth (24).	280	0.92
<i>Kydia calycina</i>	L	Leaf paste is applied to treat body pains (4) and wound healing (5).	9	0.03
<i>Lamium amplexicaule</i>	L	Used to treat fever (7).	7	0.02
<i>Lannea coromandelica</i>	B, S	Bark is used to treat toothache (3).	3	0.01
<i>Lathyrus aphaca</i>	L	Leaves are purgative (18).	18	0.06
<i>Leea asiatica</i>	R	Root bark is helpful in treating snakebite (7).	7	0.02
<i>Lepidagathis cuspidata</i>	L	Leaf paste is applied to treat wounds (2).	2	0.01
<i>Lepidium didymum</i>	L	Helps in removing inflammation (4).	4	0.01
<i>Leptodermis lanceolata</i>	L	Fever (3), headache (3)	6	0.02
<i>Lespedeza juncea</i>	WP	Root juice is effective against diarrhoea (1).	1	0.00
<i>Leucas aspera</i>	WP	Insect repellent properties (4). Treats skin eruptions (2).	6	0.02
<i>Litsea glutinosa</i>	L, B	Powdered leaves and bark are tied to treat bone fracture pains (25). Powder is also taken with milk to treat internal body pains (4). Leaves are mashed and applied on wounds (24).	53	0.17
<i>Luffa aegyptiaca</i>	Fr	The fruit is helpful in treating diabetes (3).	3	0.01
<i>Mallotus philippensis</i>	L, Se	Red powder obtained from the fruit is mixed with curd is effective against loose motions (43). Seeds washed in water given to sheep for killing worms (16). Fruit powder is eaten to cure piles (15).	74	0.24
<i>Malva pusilla</i>	L	Used to treat inflammation (4).	4	0.01
<i>Mangifera indica</i>	Fr	Fruit is digestive provides bone strength (15).	15	0.05
<i>Mazus pumilus</i>	L	Leaves juice is used against fever (3).	3	0.01
<i>Melia azedarach</i>	L	The leaves are applied externally to prevent itching (23). Crushed leaves applied to cure toothache (7).	30	0.10
<i>Melilotus indicus</i>	L	Leaves are used to treat swellings (6).	6	0.02
<i>Mentha spicata</i>	L	Chutney prepared from the leaves help in treating indigestion (33).	33	0.11

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Micromeria biflora</i>	WP	Leaves are used as herbal tea to cure stomach disorders (10).	10	0.03
<i>Mirabilis jalapa</i>	L	Leaves are helpful in removing inflammation (3). Used in treating snake (3) and scorpion stings (19). Leaf paste is applied to treat swellings (7).	32	0.10
<i>Mitragyna parvifolia</i>	WP	Leaves are used to treat wounds (12).	12	0.04
<i>Momordica charantia</i>	Fr	The fruit is anti-diabetic (32). Leaf juice is taken in fever (20) and cough (12).	64	0.21
<i>Moringa oliefera</i>	L, B, R	Powdered leaves and bark are applied to cure pimples (3). Roots are used in digestive troubles (14). Helps in boosting immunity (31). Effective against diabetes (11). Leaves are made into paste and applied to body swellings (17). Roots boiled in water is used to gargle which is effective against toothache (6).	82	0.27
<i>Morus alba</i>	Fr	Fruits are eaten to cure diabetes (13), and treats cough (3), and nose bleeding (4).	20	0.07
<i>Murraya koenigii</i>	L	Leaves are effective in treating digestive disorders (28). Leaves are tied to treat joint pains (18).	46	0.15
<i>Nelumbo nucifera</i>	Se	Powdered and dried seeds taken with water helps in treating vomiting (13) and diarrhoea (12).	25	0.08
<i>Nepeta hindostana</i>	L	Leaf juice is helpful in treating heart related problems (1). Leaf boiled in water used to gargle that is effective in treating mouth ulcers (1).	2	0.01
<i>Nerium indicum</i>	Fl	Dye of flower is used to treat skin problems (19).	19	0.06
<i>Nicotiana tabacum</i>	L	Leaves are powdered helps in relieving toothache (6).	6	0.02
<i>Nyctanthes arbor-tristis</i>	Fr, L, Fl	Dried fruits are taken to cure cough (16). Leaf paste is applied to treat ringworm infection (3). Leaves and flowers are taken to expel the intestinal worms (3). Leaves used to cure dengue (18)	40	0.13
<i>Ocimum americanum</i>	L, Se	Leaves are used in the treatment of skin diseases (2) and applied to burns (3) and wounds (4). Seeds when soaked in water gets swell and is used as a drink for relieving backache (12). Seeds boiled with milk taken for treating dysentery (11).	32	0.10
<i>Ocimum tenuiflorum</i>	L	Leaves are made into tea which is effective in treating cold (45), cough (45) and fever (25). Leaves are effective mosquito repellent (12). Leaves helps in treating indigestion (14). Leaves cures mouth ulcers (7). Leaves are boiled in water and the water is used in gargles as mouth freshener (2). Improves immunity (12).	162	0.53
<i>Oenothera rosea</i>	L	Leaves have antibacterial properties (3) and applied on wounds (4).	7	0.02
<i>Opuntia tuna</i>	Fr	Latex is used against cancer (3).	3	0.01

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Oroxylum indicum</i>	R	Root bark helps in treating dysentery (6) and jaundice (4). Stem is useful in treating rheumatoid arthritis (1). One of the ingredients of 'Dashamoolarishta' (1).	12	0.04
<i>Ougeinia oojeinensis</i>	L	Leaf and bark paste is effective in treating wounds (3) and dysentery (1).	4	0.01
<i>Oxalis corniculata</i>	L	Leaf drops put in eyes to treat eye infections (6). Sap is used to treat ear pain (17).	23	0.08
<i>Packera aurea</i>	WP	Used in treating female disorders (4).	4	0.01
<i>Paeonia emodi</i> Royle	Fl	Flowers in powdered form are eaten to treat backache (13).	13	0.04
<i>Pergularia daemia</i>	R	Root powder is effective in treating wounds (5).	5	0.02
<i>Phanera vahlii</i>	L	Paste of leaves mixed with oil is tied on head to take pus out from boils (21). Leaves are tied on head to get relief from extreme cold (15) and headache (29).	65	0.21
<i>Phoenix dactylifera</i>	Fr	Fruit helps to get relief from constipation (28) and body pains (34).	62	0.20
<i>Phyla nodiflora</i>	WP	Used in treating stomachache (3).	3	0.01
<i>Phyllanthus emblica</i>	Fr	Fruit is effective in treating dandruff (43) and grey hair (39), jaundice, anemia (38), and diabetes (39). It also improves immunity (16). Dried fruit is powdered and applied to head to prevent hair fall (18). One of the ingredients of <i>triphala</i> used for treating constipation (33).	226	0.74
<i>Phyllanthus urinaria</i>	WP	Treats jaundice (4) and diabetes (4).	8	0.03
<i>Phyllanthus velutinus</i>	R, L	Roots helps in treating cough (4), dysentery (3). Leaf juice helps in treating snake bite (9).	16	0.05
<i>Pinus roxburghii</i>	Se, B	Powdered bark is used in treatment of dysentery (2).	2	0.01
<i>Pityrogramma calomelanos</i>	L	Leaves paste helpful in treating wounds (3).	3	0.01
<i>Pleurolobus gangeticus</i>	R	Roots are used as an ingredient of <i>Dashmoolarishta</i> churn (7). Effective in treating fever (11), cough (12), pneumonia (8), and diarrhoea (10).	48	0.16
<i>Plumbago zeylanica</i>	R, L	Used in treating digestion (3) and pains (2).	5	0.02
<i>Pogostemon benghalensis</i>	L	Leaves are used to cure cough (4) and cold (6).	10	0.03
<i>Polygala abyssinica</i>	WP	Helpful in inflammation (4).	4	0.01
<i>Pongamia pinnata</i>	Tw	Twigs are used in cleaning teeth (15) and gums (15).	30	0.10
<i>Poranopsis paniculata</i>	S	Stem paste helps in curing pains (3).	3	0.01
<i>Portulaca oleracea</i>	L, S	Used to treat burns (2).	2	0.01

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Psidium guajava</i>	Se, Tw	Dried seeds along with honey are used against diarrhea (35). Twigs used as brush in bleeding gums (18). Seeds are roasted in traditional gas “Chulli” and taken for flatulence (6). Young leaves are dried and powdered taken with water to stop bloody loose motions (10). Leaves and fruits consumed to cure diabetes (28).	97	0.32
<i>Pueraria tuberosa</i>	Tu	The tubers are eaten to treat jaundice (13).	13	0.04
<i>Pupalia lappacea</i>	L	Leaf paste is used to treat bone fracture (1). Leaf paste used in treating wounds (5).	6	0.02
<i>Ranunculus sceleratus</i>	L, Gum	Leaves used to treat wounds (1). White gum from stem is used to cure itching (2) and fungal infection (2).	5	0.02
<i>Reinwardtia indica</i>	L	Leaf paste is applied to treat wounds (3).	3	0.01
<i>Rhamnus triquetra</i>	B	Bark juice is given to treat dysentery (3).	3	0.01
<i>Ricinus communis</i>	Fr	Seed oil is effective against joint pains (39). Leaves are tied to head for relieving headache (10).	49	0.16
<i>Rosa macrophylla</i>	Fl	Flowers are given to children to treat constipation (23).	23	0.08
<i>Rostellularia procumbens</i>	L	Used to treat fever (3), cough (4) and snakebite (5).	12	0.04
<i>Rubus ellipticus</i>	Fr	Fruit helps to relieve constipation (3).	3	0.01
<i>Salvia plebian</i>	L, Se	The seeds boiled in milk are used against dysentery (26). Paste of leaves used in wounds (10).	36	0.12
<i>Sapindus mukorossi</i>	Fr	Fruits are effective in treating dandruff (10), hair loss (10), and promoting hair growth (10).	30	0.10
<i>Saraca asoca</i>	Fl	Flowers used to treat inflammation (2).	2	0.01
<i>Scandix pecten-veneris</i>	WP	Used to cure toothache (3).	3	0.01
<i>Senegalia catechu</i>	B, R	Root paste helpful in treating toothache (1), mouth ulcers (14). Bark in curing cold (12) and cough (19). Stem bark boiled in water is given for 21 days to lactating mothers for good health (8). Bark powder is effective in treating mouth ulcers (32).	86	0.28
<i>Senegalia modesta</i>	Gum, Tw	Twig is used as toothbrush for removing mouth odor (27). Gum obtained from stem mixed with dry fruits taken for bone strength (24).	51	0.17
<i>Senna tora</i>	L, Se	Leaves are used to cure fever (23), joint pains (23), cough (22), stomachache (9) and backache (13). Seeds boiled in water effective in curing backache (10).	100	0.33
<i>Sesamum indicum</i>	Se	Seed oil is used in treating wounds (11) and inflammation (4), and good hair growth (4). Seed oil is used in body massage for treating joint pains (26). Good against constipation (1).	46	0.15

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Sida cordata</i>	L	Juice obtained from leaves is helpful in treating diarrhoea (4).	4	0.01
<i>Silybum marianum</i>	S, L	Used in treating snake (11) and scorpion sting (15).	26	0.08
<i>Solanum erianthum</i>	R	Treats digestive disorders (1) and skin infections (1). Leaves are tied to forehead to relieve headache (2).	4	0.01
<i>Solanum nigrum</i>	WP	The herb is consumed as vegetable by the people suffering from paralysis due to stroke (2). Leaves made to paste applied to treat swellings (2). Leaf juice is applied to cure acne (2).	6	0.02
<i>Solanum viarum</i>	Se	Seeds helps in relieving toothache (5) and diabetes (4).	9	0.03
<i>Solanum virginianum</i>	Fr	Fruit used in treating cold (11) and cough (11).	22	0.07
<i>Spermacoce articularis</i>	L	Leaves in treating hemorrhoids (3).	3	0.01
<i>Spermadictyon suaveolens</i>	R	Root oil in treating wounds (4)	4	0.01
<i>Sterculia villosa</i>	R, La	Roots are used to treat kidney stones (2). Latex is used to treat skin eruptions (2).	4	0.01
<i>Synedrella nodiflora</i>	L	Leaf paste helps in clotting of blood (3) and treats inflammation (3).	6	0.02
<i>Syzygium cumini</i>	Fr, Se	Fresh fruit and powdered seeds effective in the treatment of diabetes (63). Bark is chewed to cure mouth ulcers (18).	81	0.26
<i>Taraxacum officinale</i>	WP	Herb is used in treating diabetes (13).	13	0.04
<i>Telosma pallida</i>	L	Used to treat eye-infections (5).	5	0.02
<i>Tephrosia purpurea</i>	R	Root juice effective in treating wounds (2), boils (2), and pimples (2).	6	0.02
<i>Terminalia bellirica</i>	Fr, L	Fruit is an effective ingredient of <i>trifla churan</i> helps in relieving cold (49) and cough (49), digestive problems (36), anemia (36), and one of the ingredients of <i>triphala</i> used for treating constipation (33)	203	0.66
<i>Terminalia chebula</i>	Fr	Fruit used in treatment of cold (28), cough (33), diarrhoea (5), and one of the ingredients of <i>triphala</i> used for treating constipation (33). Cooked as curry in winters to relieve backache (3). Powdered fruit is used to treat bleeding gums (14), sore throats (13), and mouth ulcers (9).	138	0.45
<i>Tinospora cordifolia</i>	S	Stem juice is effective in treating cold (65), cough (64), fever (31), liver disorders (8). Twig is used as toothbrush that helps in purifying blood (12), mouth ulcers (5) and bad mouth odor (33). The stem is anti-diabetic (47), improves immunity (16), increases blood platelets during dengue (10).	291	0.95

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Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Toona ciliata</i>	Gum, L	Gum obtained from the bark is used to treat boils (9). Leaves paste in skin eruptions (2).	11	0.04
<i>Trema politoria</i>	L	Leaf paste is effective in wound healing (4).	4	0.01
<i>Tridax procumbens</i>	L, S	Helps in treating liver problems (12) and dysentery (14). Leaf paste helps in wound healing (1).	27	0.09
<i>Trifolium repens</i>	L	Tea prepared from leaves effective in treating cold (4) and cough (4).	8	0.03
<i>Trigonella foenum-graecum</i>	Se	Seeds are effective in treating digestive disorders (18), helps in increasing milk production in women (15).	33	0.11
<i>Tulipa clusiana</i>	L	Tea prepared from leaves helpful in treating cold (9) and cough (9).	18	0.06
<i>Vachellia nilotica</i>	B	Bark is used in the treatment of dysentery (4) and piles (1).	5	0.02
<i>Vallaris solanacea</i>	La	The milky latex obtained from the stem is effective against ringworms (9) and other fungal disorders (2).	11	0.04
<i>Verbascum thapsus</i>	R, Fl	Roots are boiled with <i>Justicia adhatoda</i> roots taken for fever (10).	10	0.03
<i>Veronica persica</i>	L	Leaves are eaten to treat diabetes (5).	5	0.02
<i>Viola canescens</i>	WP	Used in herbal beverages like <i>Joshanda</i> , <i>roohafza</i> drink, and cough syrups to cure cold (16), cough (23), fever (9), and malaria (1).	49	0.16
<i>Vitex negundo</i>	WP	Leaves are effective in reducing toothache (4), mouth ulcers (7), boils (27) and wounds (34). Powdered leaves mixed with jaggery helps in treating loose motion (1). Leaves are used culturally for doing “ <i>Faanda</i> ” (a traditional practice of being fanned by leaves in case of body swelling “ <i>Zeher</i> ” (27). Roots are given to children for licking for child growth (3). Leaves are boiled in water and the water is used for bathing by the ladies after 21 days of giving child birth along with the leaves of <i>Albizia lebbbeck</i> (L.) Benth., mango, <i>Aegle marmelos</i> (L.) Corrêa (19). Leaves are Vitex are tied to relieve joint pains (8). Leaves are tied hot on the area in case someone has developed pus to remove it out (11). Leaves are chewed to cure cold (2) and cough (5).	148	0.48
<i>Woodfordia fruticosa</i>	Fl	Dried flowers are used to cure dysentery (16), cold (26), cough (26), and wounds (14).	82	0.27
<i>Xanthium strumarium</i>	Se, Fr	Dried seeds in powdered mixed with dry fruits given to mother after delivery to overcome weakness (7).	7	0.02
<i>Xylosma longifolia</i>	B	Bark is used to treat stomach disorders (10).	10	0.03

Botanical Name	Plant Part Used	Traditional Medicinal Uses	UR	UV
<i>Zingiber roseum</i>	WP	Used in treating cold (2), cough (2) and stomach troubles (6).	10	0.03
<i>Zizypus jujube</i>	Gum	The gum obtained is used to treat leucorrhea (11). Leaf powder taken to expel out stomach worms (2).	13	0.04

Abbreviation used in the table: B, bark; La, latex; L, leaves; R, roots; Rh, rhizome; S, stem; Se, seed; Fr, fruit; Fl, flower; WP, whole plant; UR, use-report; and UV, use-value.

In the present study, three ethnic groups viz. *Gujjar*, *Bakarwal*, and *Dogras* were interviewed. The maximum number of plants (207 species) were recorded by the *Dogras* followed by *Gujjars* (111) and *Bakarwals* (73). *Dogras* recorded 97 unique plants, shared 68 species with both the *Gujjars* and *Bakarwals*, 40 species with *Gujjars* only, and 02 species with *Bakarwals* only. Both the *Gujjars* and *Bakarwals* didn't recorded any unique species, and only 03 species were shared between them (Fig. 4.4). These species viz. *Dolomiaea costus* (Falc.) Kasana & A.K. Pandey, *Paeonia emodi* Royle, *Bergenia ciliata* (Haw.) Sternb., are found in higher reaches of the Himalayas and carried by these nomads during their stay in the sanctuary.

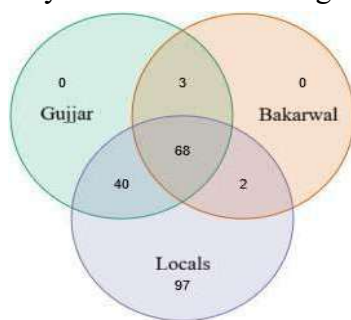


Figure 4.4: Venn diagram showing the distribution of species among the three ethnic groups of the Surinsar and Mansar wildlife Sanctuary

The entire ethnomedicinal flora was classified into five groups (Fig 4.5). The first group had the 97 unique species mentioned only by the *Dogras*, whereas the second group was segregated on the basis of knowledge shared with the *Gujjars*. The third large group, comprised of only two species that were known to both the *Dogras* and *Bakarwals*. Group IV comprised of the 68 species shared by all the three ethnic groups. Group V had only three species shared between *Gujjars* and *Bakarwals*.

RESULTS AND DISCUSSION

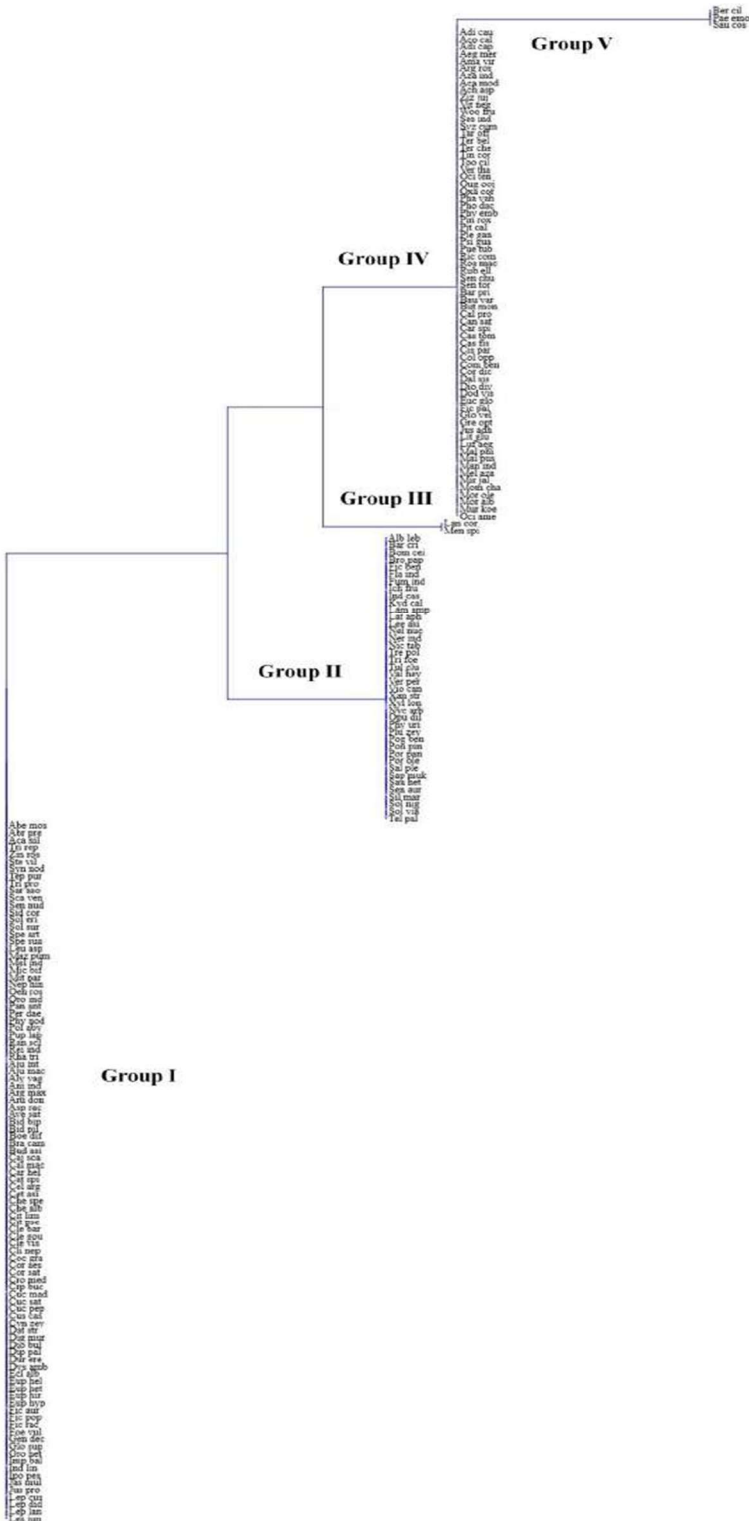


Figure 4.5: Clustering of ethnomedicinal species on the basis of ethnicity

RESULTS AND DISCUSSION

The three ethnic communities were classified into distinct groups based on their ethnomedicinal knowledge (Fig. 4.5). Each group exhibited traditional uniqueness influenced by differences in religion, habitation, livelihood, and even the type of livestock they owned. The *Gujjars* reside along the outskirts, where they rear cattle herds, predominantly buffaloes. They maintain regular interactions with the *Dogras*, primarily through the sale of milk and the procurement of agricultural by-products such as wheat husk and paddy straw, often assisting the *Dogras* in crop harvesting.

This close association fosters a strong cultural and ecological linkage between the two communities, leading to a considerable overlap in the ethnomedicinal plant species they utilize (Fig. 4.6). In contrast, the *Bakarwals* remain a relatively isolated pastoral group, mainly rearing goats, and they seldom come into contact with either the *Dogras* or the *Gujjars*. Haq *et al.* (2023) have also reported the least similarity between the local ethnic Kashmiri population with the *Gujjar* and *Bakarwal* tribes because of their different cultural identities and regions of habitations.

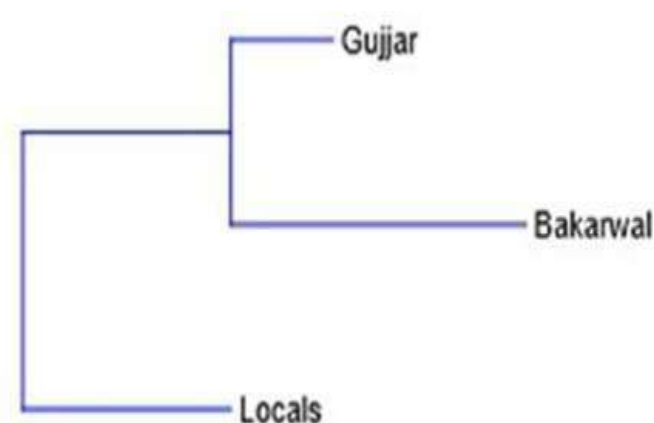


Figure 4.6: Classification of ethnic groups as per the ethnomedicinal plants knowledge

The most represented family for the ethnomedicinal usage was Fabaceae (26 genera and 28 species). The other important families were Lamiaceae (14 and 16), Asteraceae (10 and 13), Amaranthaceae and Malvaceae (7 genera and 7 species, each), and Cucurbitaceae

(6 and 7) (Fig. 4.7). As many as 36 families were represented by only one species.

The dominance of family Fabaceae, Lamiaceae and Asteraceae was also earlier reported by Rao *et al.* (2015) from Kathua, Kumar *et al.* (2023) from Udhampur, and Parasher *et al.* (2024) from Kathua. The work of Patel *et al.* (2020) from Uttar Pradesh, Hani *et al.* (2022) from Lebanon, Zemedet *et al.* (2024) from Southern Ethiopia, Muhakr *et al.* (2024) from Western Sudan, Tadesse *et al.* (2024) Ethiopia, Bi *et al.* (2024) China, Li *et al.* (2024) China validated the present results from their respective study sites.

According to Bhatia *et al.* (2014), the abundance of herbal plant species in these families can be attributed to their widespread distribution, greater availability in the study area, and predominately herbaceous habit. This might be explained by the representative members' high seed production and potential efficient dispersal systems. These families may be more prevalent because of suitable habitat, and favourable environmental conditions that support the growth of the representative members of these families.

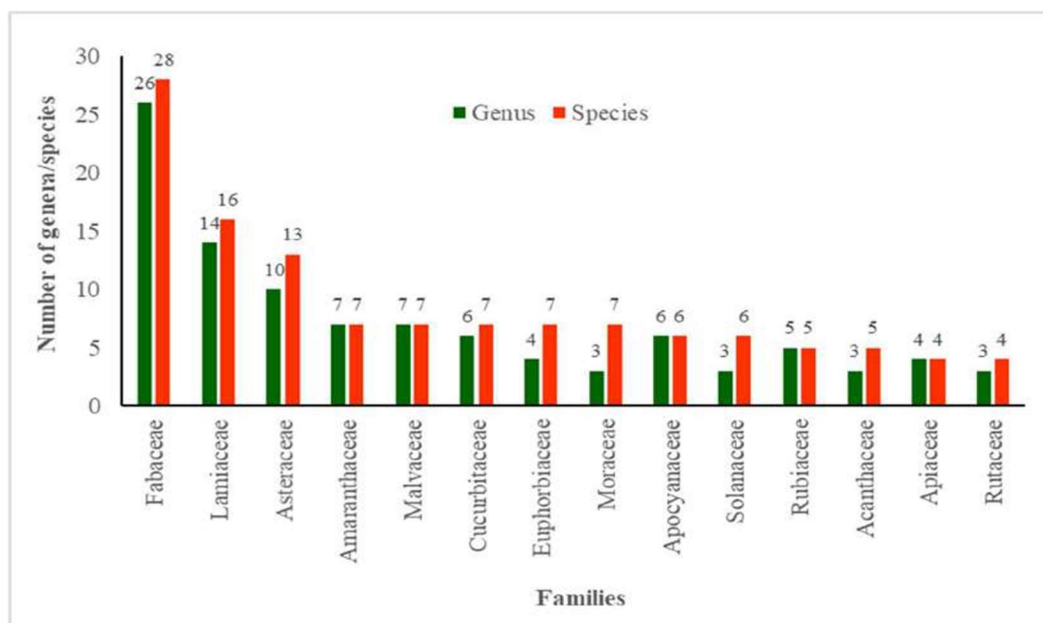


Figure 4.7: The most represented families of ethnomedicinal plants in the study area

The fragrant compounds in the Lamiaceae family may discourage pathogens and

herbivores, thus increasing their chances of surviving in any forest. Many species of plants in the Lamiaceae family are well suited to the dry, partially shaded conditions found in forest understory habitats. This has also been reported by Silva *et al.* (2021), Sun *et al.* (2022), and Joujeh (2024). These studies emphasise the ecological roles and possible uses of aromatic compounds in a variety of industries, underscoring the importance of these compounds in Lamiaceae species.

Herbs (107 sps.) were the most commonly used life forms contributing 51.7% of the total, while trees, shrubs and climbers contributed 25.4%, 11.9% and 10.6%, respectively (Fig. 4.8). In comparison to shrubs and trees, these findings generally align with the distribution of medicinal plants (1020 herbs) in Indian Himalayan regions. A number of other workers (Singh *et al.*, 2012; Getriet Chekole 2017; Ishtiaq *et al.*, 2021; Khan *et al.*, 2022; Singh *et al.*, 2022; Agize *et al.*, 2022; Hussain *et al.*, 2023; Bhattacharya *et al.*, 2020; Manzoor *et al.*, 2023; Mir *et al.*, 2023; Tamene *et al.*, 2023; Muhakr *et al.*, 2024; Li *et al.*, 2024; Bi *et al.*, 2024) have also reported herbs to be the most utilized life forms in treating various ailments in their study sites. This could be due to the ease of access and abundance (Karkose, 2022).

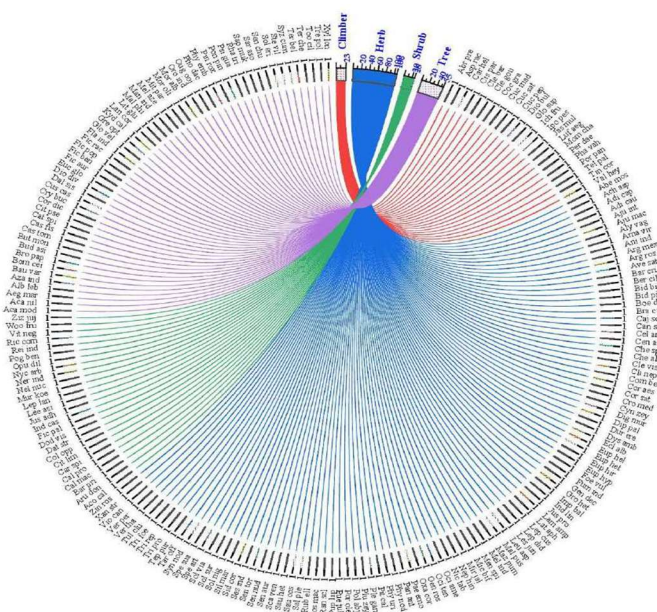


Figure 4.8: Cord diagram showing the distribution of species in various life-forms. The same findings were proposed by Umair *et al.* (2019), Shuaib *et al.* (2021)

and Rehman *et al.* (2022a). The herbaceous plants are utilised for therapeutic purposes either in their entirety or in their portions, particularly the leaves (Shinwari *et al.*, 2011; Abbassi *et al.*, 2013; Meragiaw *et al.*, 2016), which contain bioactive compounds. As per the studies of Singh *et al.* (2022), trees were the second dominant life form in his study area which coincides with our study. This may be due to the reason that the present study site is a protected area where cutting of trees is prohibited and tree population thus shows greater number than that of shrubs. While as per the studies of Patel *et al.* (2020) and Tadese *et al.* (2024), trees were dominant that contributed 46.97% and 25.6% of the total life forms respectively in their study site.

The locals were utilizing different plant parts like Roots, Leaves, flowers, seeds, tubers, bark, latex, gum etc in treating various ailments (Fig. 4.9). Among these, Leaves (39.3%) were the most commonly utilized part by the tribals and locals followed by Roots (10.4%), Fruits (10.0%), Seeds (9.3%), and Whole plant (8.6%).

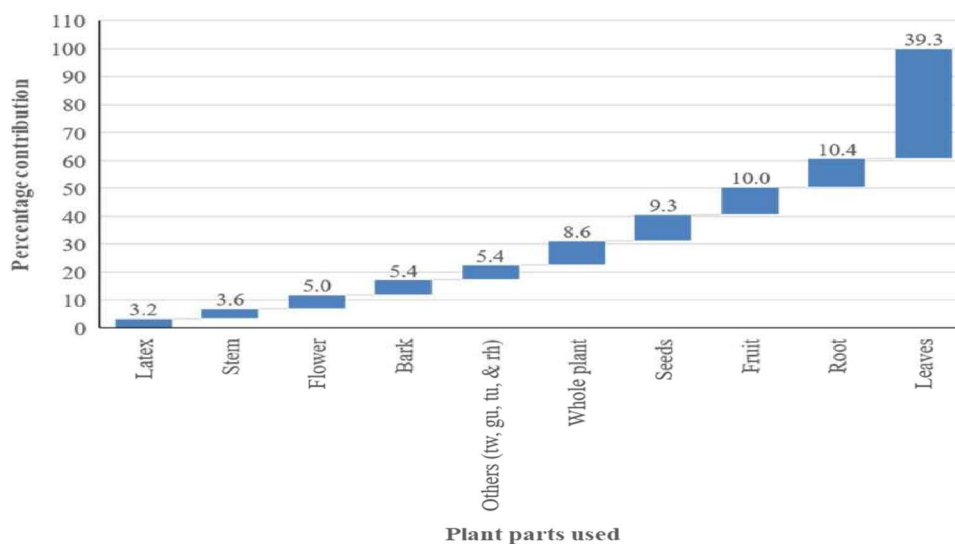


Figure 4.9: Waterfall diagram showing percentage contribution of various plant-parts of ethnomedicinal plants in Surinsar and Mansar wildlife Sanctuary. (abbreviation used: tw, twig; gu, gum; tu, tuber; rh, rhizome)

Leaves being frequently utilized plant part is in accordance with that reported by

other workers from other Himalayan regions (Chandra *et al.*, 2013; Kumar *et al.*, 2015; Rao *et al.*, 2015; Akasha *et al.*, 2021). Some other workers (Khan *et al.*, 2022; Singh *et al.*, 2022; Manzoor *et al.*, 2023; Hussain *et al.*, 2023; Irfan *et al.*, 2023; Parasher *et al.*, 2024; Tamene *et al.*, 2024; Zemedu *et al.*, 2024) also validated the same results from their work area. Compared to other plant parts, leaves are more sustainable part of plant to harvest because of their ease of growth and regeneration. Additionally, leaves may contain significant levels of health-promoting phytochemicals, essential oils, and secondary metabolites that can help treat a variety of conditions as validated by Bekele *et al.* (2022).

Roots were the second most utilized plant part after leaves by the locals. As per the study of Mergerisa *et al.* (2013) from Ethiopia, roots were utilized for the treatment of various animal diseases. The accessibility and availability of roots, along with the possible concentration of bioactive substances in the root tissues, justify their use in the treatment of animal diseases. However, relying too much on roots could cause sustainability issues because collecting roots can be more detrimental to a plant's existence than harvesting leaves or other parts that are above ground (Misganaw and Yiblet, 2024).

Herbal drug preparation and utilization.

The preparation of herbal treatments and the usage of plant parts were grouped into 15 categories (infusion, powder, decoction, poultice, raw form, bathing, burning, licking, paste, cooking, oil, latex, rubbing, juice and extract/gum). Of these, the most popular approach for preparing drugs was decoction (46.4%) followed by paste (30%), powder (20%), juice (10%), raw form (7%), poultice and latex (5.6%) each, cooking (5%), burning and extract/gum (3%) each, infusion and oil (2.3%) each, bathing and rubbing (1.4%) each and licking (0.9%).

The usage of herbal drugs as decoctions, powder, juice and paste concurred with the findings of other studies (Ahmed *et al.*, 2014; Islam *et al.*, 2014; El Amri *et*

al., 2015; Malla *et al.*, 2015; Shaheen *et al.*, 2017). The amount and dose of medications were found to vary depending on the patient's age, health, and the extent of the ailment being treated. Decoctions were defined as the extracted contents made by boiling plant parts in water until the water volume was lowered to half or one-third, depending on the parts used and the application. These were then ingested as a drink to treat internal wounds or illnesses.

Recent research by Dapar *et al.* (2020) validated the usage of decoction as the main preparation method. The Manobo tribe of Agusan del Sur employs the decoction method as the most prevalent way to cure ailments, followed by other methods including powder, poultice, juice extract, paste, or infusion. The people of Jasrota Hill in the Western Himalaya likewise reported using decoctions as their primary method of preparation, according to Singh *et al.* (2020). Other researchers who recorded decoctions as the frequently used method of preparation were Gurdal and Kultur (2013) and Ahmad *et al.* (2014) from their respective study sites.

Another widely used method for treating a variety of illnesses in the study area is the paste mode of administration, which is made by grinding fresh or dried plant components (leaves, stem, bark, roots, flowers, and fruits) with water, honey, or oil. Prior studies on tribal populations in India (Singh and Shanpru, 2010) and other regions of the world (Roosita *et al.*, 2008) also endorsed this study. In ethnobotanical research of the Ivatan community in Luzon, Abe and Ohtani (2013) noted that paste was the most often used external remedy for conditions like skin infections, wounds, poison bites, headaches, joint pains, and more. The dried plant parts which include roots, barks, tubers, leaves, rhizomes, and stems were ground into a fine powder in the research region to create the herbal remedy powder. Additionally, Ayyanar and Ignacimuthu (2011) validated this conclusion. Similarly, decoction and powder were documented as the most commonly used methods for preparing herbal medications in previous literature (Gurdal and Kultur, 2013; Bano *et al.*, 2014).

According to studies by Thakur *et al.* (2020) and Teklehaymanot *et al.* (2007), plant formulations (decoctions, infusions, juice, powder, paste, etc.) that use a single plant or parts of it were prevalent in hilly and mountainous areas. As per Ayyanar and Ignacimuthu (2011) and Singh *et al.* (2014) preparations that include a variety of plants and their components have a higher capacity for healing since they contain a range of active substances that serve biological purposes. The majority of herbal remedies were administered orally to treat human health issues, with the exception of skin-related illnesses. Similar findings have been documented in many ethnic populations in Nepal, the neighbouring nations, and globally (Upreti *et al.*, 2010; Singh *et al.*, 2012; Kunwar *et al.*, 2013; Lelekal *et al.*, 2013; Luitel *et al.*, 2014).

Further, other herbal formulations and usages viz, juice, extract/gum, bathing, burning, cooking, latex etc were in accordance with the study performed by Singh *et al.* (2020) from Jasrota Hills. The rhizomes of *Acorus calamus* L. and roots of *Vitex negundo* L. were given to children for licking for expulsion of intestinal worms and child growth respectively is new record of the present study.

The substantial age-group difference, which was consistent with other research, showed that younger individuals knew less about traditional medicinal herbs than older people did (Tahir *et al.*, 2021). Oral transmission and contemporary schooling are two factors that could account for this decreased level of knowledge (Tahir *et al.*, 2023). Conversely, young people typically don't care much about traditional knowledge. The findings, however, indicated that respondents with lower levels of education knew more than those with higher levels. According to Tahir *et al.* (2021), this might have something to do with the negative impact of modern education on knowledge of traditional medicine.

Use value

In the present study the maximum use value (UV) for the ethnomedicinal plants was recorded for *Tinospora cordifolia* (Willd.) Hook.f. & Thomson, (UR = 291;

UV = 0.95), *Justicia adhatoda* L. (UR = 280; UV = 0.92). Other significant species having higher use values were *Azadirachta indica* A. Juss. (UR = 226; UV = 0.74), *Phyllanthus emblica* L. (UR = 226; UV = 0.74), *Terminalia bellirica* (Gaertn.) Roxb. (UR = 203; UV = 0.66), *Ocimum tenuiflorum* L. (UR = 162; UV = 0.53) and *Aegle marmelos* (L.) Corrêa (UR = 141; UV = 0.52) (Fig. 4.10). A plant species with a high use value is well-known and valued for its practical uses, including medicine, nutrition, and culture (Silva *et al.*, 2019).

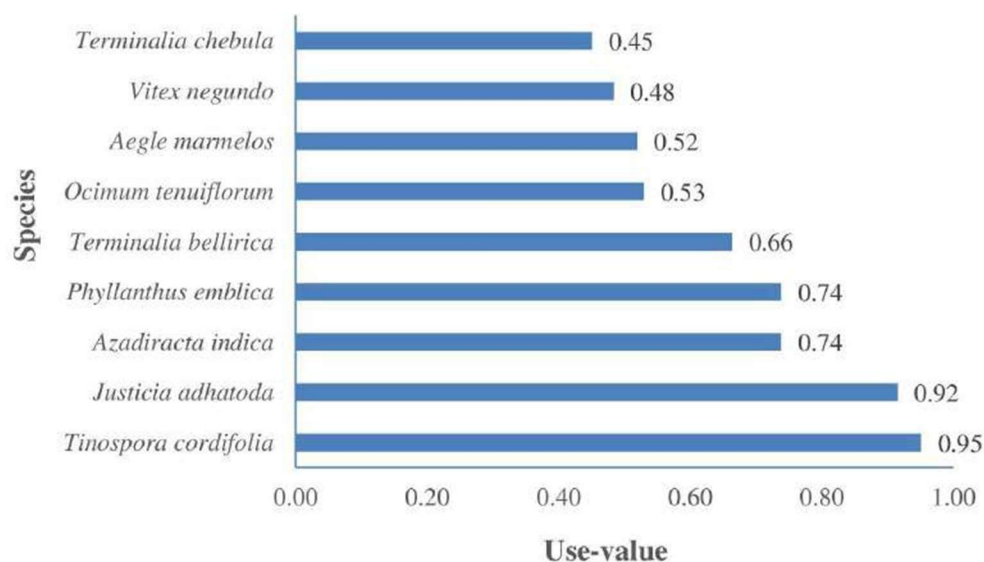


Figure 4.10: Plants with the maximum use-value (UV)

Factor Informant Consensus (Fic)

The Factor Informant Consensus (Fic) is the quantitative tool to gauge the degree of agreement among informants regarding the therapeutic usage of plants for particular disease categories. In the present study, the Fic value varied between 0.96 (ear, and respiratory disease categories) and 0.60 (cardiovascular diseases). A high Fic suggests that a large number of respondents use a specific plant species and that knowledge is shared uniformly across the participants, creating opportunities for further ethnopharmacological research that could result in the development of new medications (Bhatia *et al.*, 2014; Rao *et al.*, 2015). The

highest citations/use reports (UR = 2004) and plant species (118) was recorded for the digestive disorder category while skin ailments with (UR = 1257) and plant species (94), respiratory disease with (UR = 919) and plant species (40), other ailments (UR = 654) and plant species (49) and musculoskeletal (UR= 582) plant species (35). Few species were consistently used for treating particular ailment, thus showing strong agreement and reliability but conversely many species utilized to treat particular disease showing variable and lesser consensus among informants (Table 4.4).

Table 4.4: Informant consensus factor (F_{ic}) of the various disease categories

Disease category (ICPC-3)	N_u	N_{tax}	F_{ic}
Blood, Blood Forming Organs and Immune Mechanism	275	16	0.95
Cardiovascular	6	3	0.60
Digestive	2004	118	0.94
Ear	25	2	0.96
Endocrine/Metabolic and Nutritional	434	23	0.95
Eye	27	3	0.92
Female genital	69	8	0.90
Musculoskeletal	582	35	0.94
Other	654	49	0.93
Respiratory	919	40	0.96
Skin	1257	94	0.93
Urological	14	5	0.69

The highest F_{ic} (0.96) was recorded for ear disorders having 25 URs treated by 2 plant species (*Oxalis corniculata* L. and *Achyranthes aspera* L.). The study conducted by Ahirvar *et al.* (2025) observed high F_{ic} for curing bloody coagulants and ear pains. The second highest F_{ic} (0.95) was recorded for eye and Endocrine/Metabolic and Nutritional categories. Plant species like *Ichnocarpus frutescens* (L.) W.T.Aiton and *Oxalis corniculata* were widely used by the locals and tribals to treat eye infections in both human and livestock

while *Amaranthus blitum* L., *Syzygium cumini* (L.) Skeels, *Dysphania ambrosoides* (L.) Mosyakin & Clemants, *Morus alba* L., *Momordica charantia* L., *Coccinia grandis* (L.) Voight, and *Avena sativa* L. were extensively used in treating the endocrine/ Metabolic and Nutritional issues. For instance, Bitter melon (*Momordica charantia*) is widely available and is included in the diet of many communities as it is easily accessible and can be eaten on regular basis. It is frequently mentioned and recommended for metabolic health disorders because of its easy accessibility, presence of active compounds, high nutritional content and experimental evidences that validates the higher Fic of the said plant species (Gayathry and John, 2022).

Moreover, there were the reports of some plant species used in treating the most serious illness “Cancer”. The present study recorded three plant species from the study area viz. *Ficus palmata* Forssk., *Chenopodium album* L. and *Achyranthes aspera* being utilized to help in combating the said disease. In the study conducted by Subbarayan *et al.* (2010), Zhao *et al.* (2016) and Khajuria *et al.* (2017), on *Ficus palmata*, *Chenopodium album* and *Achyranthes aspera* respectively indicated the validation of the present results. However, *Achyranthes aspera*, *Chenopodium album*, *Ficus palmata* are new records from JKUT that are helpful in combating Cancer. In a review work conducted by Imtiaz *et al.* (2024) other plants that may help in combating Cancer were *Allium sativum* L., *Nigella sativa* L., *Curcuma longa* L., *Taxus brevifolia* Nutt., *Catharanthus roseus* (L.) G.Don, *Withania somnifera* (L.) Dunal, *Centella asiatica* (L.) Urb., *Cannabis sativa* L., and *Calendula officinalis* L.

The third highest Fic (0.94) was recorded for Blood, Blood forming Organs and Immune Mechanism, digestive and Musculoskeletal diseases. Symptoms like weakness, non-healing and recurrent wound, recurring infections and skin eruptions are common with disorders involving blood or immunological function. Plants such as *Chenopodium album*, *Azadirachta indica*, *Tinospora cordifolia* (Willd.) Hook.f. & Thomson were used as blood purifier. While *Moringa oliefera* L., *Ocimum tenuiflorum* L., *Cucurbita pepo* L., and *Phyllanthus emblica* L. were used as immunity booster by the respondents in the study area. The study conducted by Wali *et al.* (2019) and Amin *et al.* (2024) from

Northern Pakistan is in accordance with our findings that citations for digestive disorders like stomach ache, constipation, diarrhoea, indigestion etc are common health issues in rural tribal and indigenous communities were high. This may be attributed to the fact that the rural communities lack access to clean water, proper hygiene and have open defecation. Traditional water sources including Bowlis (stepwells) and Naaru pani (natural water springs) are no longer safe to drink because of seepage, trash, and other contaminants that people are utilizing so are more prone to digestive infections. Lack of balanced and nutritious diet, open food, increases the chances of infections that may lead to gastric troubles.

The maximum Fic (0.88) was calculated for digestive and liver disorders in the study conducted by Farooq *et al.* (2019) while the present study recorded Fic (0.94) for digestive disorder that validates our result. The plant species like *Cissampelos pareira* L., *Mentha spicata* L., *Pueraria tuberosa* (Roxb ex Wild) DC., *Xylosma longifolia* Clos., *Mallotus philippensis* (Lam.) Müll.Arg., *Verbascum thapsus* L., *Casearia tomentosa* Roxb., *Terminalia chebula* Retz., and *Carrissa spinarum* L. were the most frequently utilizing plants to treat digestive disorders in the study area. Comparative analysis with previous reports showed that earlier workers also recorded high fic for digestive disorders (Adnan *et al.*, 2014; Bhatia *et al.*, 2014; Bibi *et al.*, 2014; Sher *et al.*, 2016; Aziz *et al.*, 2017; Shaheen *et al.*, 2017; Hussain *et al.*, 2018). The study aligns with the research conducted by Weckerle *et al.* (2018), who examined the valley of Juruena and indicated that gastro-intestinal diseases, skin infections, and respiratory issues can be effectively treated using locally available plant resources. Rao *et al.* (2015) also found that the greater number of gastrointestinal issues in hilly and mountainous areas is caused by inadequate sanitary facilities.

Musculoskeletal diseases having Fic (0.94) were also found common in the study area as the people have to carry on heavy loads, faced injuries while collecting fodder for their animals, poor eating habit, unbalanced diet etc. Plants like *Dioscorea bulbifera* L., *Ricinus communis* L., *Colebrookea oppositifolia* Sm., *Dodonaea viscosa* Jacq., *Diospyros diversilimba* Merr. & Chun., and *Litsea glutinosa* (Lour.) C.B. Rob. were used to treat

muscle and joint related issues. Chakraborty *et al.* (2021) conducted an interesting study to assess the frequency and distribution of musculoskeletal disorders among workers in tea gardens of Darjeeling, West Bengal wherein various factors like age, altitude, and nutrition were significant indicators of musculoskeletal problems. According to their findings, the respondents were working with bad posture, which increased their risk of injury and degraded the health of their muscles and bones. Shukla *et al.* (2021) also mentioned the reason of joint and muscular problems as common injuries and stress. As per the study of Singh *et al.* (2020), Musculoskeletal system disorders had an ICF of 0.958 that ranked fourth in the number of use reports (482) and number of species (21) that is close to our findings (0.94) with use reports (470) and number of species (30). Anadka and Gulimane, (2024) documented 210 plants exclusively utilized for treating musculoskeletal disorders by the people of Dakshina Kannada of Tamil Nadu and recorded highest ICF for vertigo (ICF = 0.67), followed by spasm (ICF = 0.56), bone fracture (ICF = 0.51), muscle pain (ICF = 0.27), backache (ICF = 0.18), joint pain (ICF = 0.12) and the least ICF value for arthritis (ICF = 0.03) in musculoskeletal disorders category. Likewise, ICF values for musculoskeletal conditions were high (ICF = 0.547), according to previous research conducted in Tamilnadu's Siddha practitioners' ethnomedicine (Esakkimuthu *et al.*, 2021) whereas, according to Kantasrila *et al.* (2020), Karen in Thailand reported extremely low ICF values for a number of different types of musculoskeletal conditions.

The value of F_{ic} (0.93) was recorded for respiratory, skin and other disorders. This may be due to the fact that tribals as well as locals has to deal with their livestock that increases the chances for germs and different kind of spore inhalations in respiratory tract. Improper sanitation may also be the reason for respiratory infections among individuals. Moreover, the middle-aged persons were observed smoking cigarettes, *bidis* etc that might impose detrimental effects on their lungs. Further, livestock grazing may lead to excessive exposure to sunlight that may cause skin related issues like rashes, acnes, pimples, itching etc. The locals as well as tribals who rely on collecting firewood has to travel to long distances through the forests, woody areas and collect the fallen logs of woods. While

cutting, gathering, bundling and carrying these logs on their head or back may sometimes lead to cuts and wounds, rashes, infections and other skin related issues. Furthermore, the culture of cooking in traditional *Chullas* may sometimes lead them to burning injuries. Hence, they are more knowledgeable regarding the plants utilized to treat skin related problems. The present study recorded plants like *Dalbergia sissoo* Roxb. ex DC., *Nerium indicum* L., *Ajuga macrosperma* Wall. ex Benth., *Ajuga integrifolia* Buch.-Ham. ex D.Don, *Clematis gouriana* Roxb. ex DC., *Melia azadirachta* L., *Argyrolobium roseum* (Camb.) Jaub. & Spach., *Cannabis sativa* L., which were commonly utilizing in treating skin disorders.

The present study also reported female genital and urinary tract related issues in the study area. The Fic recorded was (0.88) and (0.73) respectively. Khadim *et al.* (2023) documented 59 plants predominantly used to treat gynaecological problems that include delivery issues, abortion, sexual problems etc from district Gujrat, Pakistan. The gynaecological issues may be attributed to the ignorance of females towards themselves, lack of personal hygiene, menstrual related problems, postpartum issues etc. Due to prevalence of such issues, effective plant-based medicines are developed and shared that increases informant consensus. Plants like *Crotolaria medicaginea* Lam., *Ziziphus jujuba* Mill., *Albizia lebbeck* (L.) Benth., *Argyrolobium roseum* (Camb.) Jaub. & Spach. were effectively utilized for treating female genital problems. Apart from these plant species, *Foeniculum vulgare* Mill. is also effective in treating gynaecological problems. Studies conducted by Bhatia *et al.* (2015), Aziz *et al.* (2018) too noticed the plant utilizing for the same cause. *Trigonella-foenum -graceum* L. was having highest FL% for amenorrhea in the study of Bhatia *et al.* (2015) while the current study recorded the usage of the said plant species in increasing lactation in females.

The lowest Fic value was calculated for cardiovascular disorder (0.50) and only 3 species were reported by 5 informants in treating the said disorder in contrast to that observed by Bhatt *et al.* (2021) high Fic (0.75) for cardiovascular problems from their study area. However, in the study conducted by Ralte *et al.* (2024) the category of cardiovascular disorders, which includes heart disease and hypertension, earned the highest ICF score

(0.94) which might be due to high occurrence, high-use report and the highest informants' agreement with this disease. Low Fic may be because cardiovascular disorders are difficult to diagnose with conventional techniques and are less visible unlike other common problems like gastrointestinal and skin issues. Traditional medicines may not have a long-lasting effect on heart related issues. Some traditional healers may attribute the heart related symptoms like palpitations to spiritual issues; hence only fewer plants were reported by informants for treating cardiovascular problems. Therefore, a lower Fic value for heart issues indicated that the informant's information was less consistent. The results are in accordance with (Lin and Mvelare, 2002).

The high degree of agreement regarding the use of medicinal plants for treatment that is common in the study area indicates that traditional knowledge and ethnomedicinal uses of plant species are still in use today, and various researchers support this.

Fidelity Level (FL%)

FL% is a quantitative tool for evaluating the specificity and dependability of medicinal plant use in a community. Species with a high FL% are frequently used to cure a certain prevalent disease in the region, indicating their medicinal preference and cultural significance. In the present study, a very high number of plant species (74 species) exhibited 100% fidelity level for one or the other disease category that indicates the unanimous agreement among informants regarding their use for particular disease (Table 4.5).

Table 4.5: Fidelity level (FL) of ethnomedicinal species for various ailment categories.

Botanical name	UR	FL	Ailment category
<i>Cucurbita pepo</i>	3	50.0	Blood, Blood Forming
<i>Synedrella nodiflora</i>	3	50.0	Organs and Immune Mechanism
<i>Cucumis sativus</i>	6	42.9	
<i>Ficus racemosa</i>	13	41.9	
<i>Dalbergia sissoo</i>	6	40.0	

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Botanical name	UR	FL	Ailment category
<i>Moringa oliefera</i>	31	37.8	
<i>Opuntia tuna</i>	3	100	Cancer
<i>Achyranthes aspera</i>	9	15.5	
<i>Chenopodium album</i>	9	15.3	
<i>Cucurbita pepo</i>	3	50.0	Cardiovascular
<i>Nepeta hindostana</i>	1	50.0	
<i>Solanum nigrum</i>	2	33.3	
<i>Bauhinia variegata</i>	4	100	Digestive
<i>Bombax ceiba</i>	19	100	
<i>Callicarpa macrophylla</i>	2	100	
<i>Cardiospermum helicacabum</i>	3	100	
<i>Catunaregam spinosa</i>	3	100	
<i>Cissampelos pareira</i>	67	100	
<i>Citrus × limon</i>	6	100	Digestive
<i>Duranta erecta</i>	2	100	
<i>Gentiana decemfida</i>	8	100	
<i>Grewia optiva</i>	18	100	
<i>Grona heterophylla</i>	2	100	
<i>Lannea coromandelica</i>	3	100	
<i>Lathyrus aphaca</i>	18	100	
<i>Lepidium didymum</i>	4	100	
<i>Lespedeza juncea</i>	1	100	
<i>Malva pusilla</i>	4	100	
<i>Mentha spicata</i>	33	100	
<i>Micromeria biflora</i>	10	100	
<i>Nicotiana tabacum</i>	6	100	
<i>Phyla nodiflora</i>	3	100	
<i>Pinus roxburghii</i>	2	100	
<i>Polygala abyssinica</i>	4	100	
<i>Pueraria tuberosa</i>	13	100	
<i>Rhamnus triquetra</i>	3	100	

RESULTS AND DISCUSSION

Botanical name	UR	FL	Ailment category
<i>Rosa macrophylla</i>	23	100	
<i>Rubus ellipticus</i>	3	100	
<i>Saraca asoca</i>	2	100	
<i>Scandix pecten-veneris</i>	3	100	
<i>Sida cordata</i>	4	100	
<i>Xylosma longifolia</i>	10	100	
<i>Calotropis procera</i>	54	83.1	
<i>Vachellia nilotica</i>	4	80.0	
<i>Broussonetia papyrifera</i>	3	75.0	
<i>Oxalis corniculata</i>	17	73.9	Ear
<i>Achyranthes aspera</i>	8	13.8	
<i>Coccinia grandis</i>	28	100	Endocrine/Metabolic and Nutritional
<i>Luffa aegyptiaca</i>	3	100	
<i>Taraxacum officinale</i>	13	100	Endocrine/Metabolic and Nutritional
<i>Veronica persica</i>	5	100	
<i>Amaranthus blitum</i>	23	82.1	
<i>Syzygium cumini</i>	63	77.8	
<i>Morus alba</i>	13	65.0	
<i>Dysphania ambrosioides</i>	16	59.3	
<i>Ajuga integrifolia</i>	31	54.4	
<i>Celosia argentea</i>	4	50.0	
<i>Digera muricata</i>	2	50.0	
<i>Fumaria indica</i>	13	50.0	
<i>Momordica charantia</i>	32	50.0	
<i>Phyllanthus urinaria</i>	4	50.0	
<i>Telosma pallida</i>	5	100	Eye
<i>Ichnocarpus frutescens</i>	16	66.7	
<i>Crotalaria medicaginea</i>	8	100	Female genital
<i>Packera aurea</i>	4	100	
<i>Zizypus jujuba</i>	11	84.6	
<i>Ficus palmata</i>	29	46.8	

RESULTS AND DISCUSSION

Botanical name	UR	FL	Ailment category
<i>Cajanus scarabaeoides</i>	4	40.0	Musculoskeletal
<i>Mangifera indica</i>	15	100	
<i>Melilotus indicus</i>	6	100	
<i>Paeonia emodi</i>	13	100	
<i>Poranopsis paniculata</i>	3	100	
<i>Dolomiaea costus</i>	22	100	
<i>Ficus benghalensis</i>	4	80.0	
<i>Ricinus communis</i>	39	79.6	
<i>Colebrookea oppositifolia</i>	63	74.1	
<i>Diospyros diversilimba</i>	37	69.8	
<i>Dioscorea bulbifera</i>	17	56.7	
<i>Sesamum indicum</i>	26	56.5	Other
<i>Phoenix dactylifera</i>	34	54.8	
<i>Albizia lebbeck</i>	13	100	
<i>Cucumis maderaspatanus</i>	1	100	
<i>Lamium amplexicaule</i>	7	100	
<i>Mazus pumilus</i>	3	100	
<i>Verbascum thapsus</i>	10	100	
<i>Xanthium strumarium</i>	7	100	
<i>Hellenia speciosa</i>	4	80.0	
<i>Buddleja asiatica</i>	4	66.7	
<i>Leucas aspera</i>	4	66.7	Respiratory
<i>Cryptolepis buchananii</i>	3	60.0	
<i>Corchorus aestuans</i>	1	50.0	
<i>Foeniculum vulgare</i>	3	50.0	
<i>Leptodermis lanceolata</i>	3	50.0	
<i>Leptodermis lanceolata</i>	3	50.0	
<i>Solanum erianthum</i>	2	50.0	
<i>Alysicarpus monilifer</i>	1	100	
<i>Arundo donax</i>	3	100	
<i>Bidens bipinnata</i>	2	100	

RESULTS AND DISCUSSION

Botanical name	UR	FL	Ailment category
<i>Indigofera cassioides</i>	4	100	
<i>Barleria prionitis</i>	42	75.0	
<i>Pogostemon benghalensis</i>	6	60.0	
<i>Bidens pilosa</i>	3	50.0	
<i>Solanum virginianum</i>	11	50.0	
<i>Solanum virginianum</i>	11	50.0	
<i>Trifolium repens</i>	4	50.0	
<i>Trifolium repens</i>	4	50.0	
<i>Tulipa clusiana</i>	9	50.0	
<i>Abelmoschus moschatus</i>	4	100	Skin
<i>Adiantum capillus-veneris</i>	9	100	
<i>Adiantum caudatum</i>	29	100	
<i>Bergenia ciliata</i>	10	100	
<i>Clematis barbellata</i>	9	100	Skin
<i>Commelina benghalensis</i>	4	100	
<i>Cynoglossum zeylanicum</i>	19	100	
<i>Indigofera linifolia</i>	4	100	
<i>Jasminum multiflorum</i>	3	100	
<i>Leea asiatica</i>	7	100	
<i>Lepidagathis cuspidata</i>	2	100	
<i>Mitragyna parvifolia</i>	12	100	
<i>Nerium indicum</i>	19	100	
<i>Pergularia daemia</i>	5	100	
<i>Pityrogramma calomelanos</i>	3	100	
<i>Portulaca oleracea</i>	2	100	
<i>Reinwardtia indica</i>	3	100	
<i>Jurinea heteromalla</i>	1	100	
<i>Spermacoce articularis</i>	3	100	
<i>Spermadictyon suaveolens</i>	4	100	

Botanical name	UR	FL	Ailment category
<i>Trema politoria</i>	4	100	
<i>Clematis gouriana</i>	6	85.7	
<i>Pupalia lappacea</i>	5	83.3	
<i>Toona ciliata</i>	9	81.8	
<i>Vallaris solanacea</i>	9	81.8	
<i>Argemone mexicana</i>	7	77.8	
<i>Melia azedarach</i>	23	76.7	
<i>Ougeinia oojeinensis</i>	3	75.0	
<i>Digera muricata</i>	2	50.0	Urological
<i>Sterculia villosa</i>	2	50.0	
<i>Cucumis sativus</i>	2	14.3	

Plants species like *Bombax ceiba* L., *Cissampelos pareira*, *Grewia optiva* J.R. Drumm. ex Burret, *Lathyrus aphaca*, *Mentha spicata* L., *Micromeria biflora*, *Pueraria tuberosa*, *Rosa macrophylla* Lindl., and *Xylosma longifolia* Clos. reported 100% FL for digestive ailments like stomach ache, dysentery and indigestion.

Coccinia grandis, *Luffa aegyptica*, *Taraxacum officinale* F.H. Wigg., and *Veronica persica* Poir. recorded 100% FL for endocrine/metabolic and nutritional ailments. *Alysicarpus monilifer* (L.) DC., *Bidens bipinnata* L., *Arundo donax* L., and *Indigofera cassioides* Rottler ex DC. showed 100% FL in respiratory issues. *Abelmoschus moschatus* Medik., *Adiantum capillus-veneris* L., *Adiantum caudatum* L., *Bergenia ciliata* (Haw.) Sternb., *Clematis barbellate* Edgew., *Commelina benghalensis* L., *Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex Brand., *Indigofera linifolia* (L.f.) Retz., *Jasminum multiflorum* (Burm.f.) Andrews, *Leea asiatica* (L.) Ridsdale, *Lepidagathis cuspidata* Nees, *Mitragyna parvifolia* (Roxb.) Korth., *Nerium indicum* L., *Pergularia daemia* (Forssk.) Chiov., *Pityrogramma calomelanos* (L.) Link, *Portulaca oleracea* L., *Reinwardtia indica* Dumort., *Jurinea heteromalla* (D.Don) N. Garcia, Herrando & Susanna, *Spermacoce articularis* L.f., *Spermadictyon suaveolens* Roxb., and *Trema politoria* (Planch.) Blume reported 100% FL in skin disorders and 100% FL in musculoskeletal disease category was recorded for plants like *Mangifera indica* L.,

Melilotus indicus (L.) All., *Paeonia emodi* Royle, *Poranopsis paniculata* (Roxb.) Roberty, and *Dolomiaea costus* thus can further be used in ethnopharmacological research.

In the previous study performed by Mandal *et al.* (2024) *Pueraria tuberosa* was used by the ethnic communities to rejuvenate livestock health and to treat helminthiasis and exhibited (68.42% FL). As per Gindi *et al.* (2010), *Pueraria tuberosa* exhibited antiulcerogenic properties. The research published by Ran *et al.* (2016) from Central Nepal, mentioned that the mixture of *Bombax ceiba* bark juice with *Mangifera indica* and *Psidium guajava* was used to treat dysentery and remove intestinal spasms that validates the present study as FL of *Bombax ceiba* come out as 100% in digestive ailment category. As far as *Xylosma longifolia* is concerned the fidelity level was recorded as 100% in digestive diseases category from the study area which is the first and new record from JKUT. There is no report of having 100% FL for this plant to our knowledge. Though there is a report of its antidiarrheic and anti-ulcer effects as suggested by Bhattacharya *et al.* (2020).

Cross-cultural comparison

A comprehensive review of published ethnomedicinal literature (Kaul 1997; Kirn *et al.* 1999; Khan *et al.* 2009; Tantray *et al.* 2009; Singh and Bhellum 2011; Bhellum and Singh 2012; Kumar and Bhagat 2012; Dangwal and Singh 2013; Kumari *et al.* 2013; Lone *et al.* 2013; Bhatia *et al.* 2014; Dutt *et al.* 2015; Rao *et al.* 2015; Shah *et al.* 2015a; Shah *et al.* 2015b; Pandita *et al.* 2018; Rana *et al.* 2019; Tali *et al.* 2019; Singh *et al.* 2020; Kumar *et al.* 2021; Kumar *et al.* 2023a; Parasher *et al.* 2024; Thakur *et al.* 2025) revealed that, of the 210 medicinal species and 282 uses documented in the present investigation, 99 species (47.1%) and 152 (53.2%) uses have been reported in the earlier studies as well. This finding indicates a considerable degree of knowledge sharing among local communities (Tadesse *et al.*, 2024), particularly among the Dogra populations, which frequently visits Purmandal and nearby villages due to the region's religious importance. Such frequent interactions have likely facilitated the exchange and preservation of valuable traditional medicinal knowledge (KMP).

Among the remaining 99 species, 48 (22.9%) were recorded as new ethnomedicinal reports for the Jammu and Kashmir Union Territory (JKUT). The most noteworthy

among these were *Pleurolobus gangeticus* (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi (UV= 0.16), *Adiantum caudatum* L. (UV = 0.09), *Dysphania ambrosioides* (L.) Mosyakin & Clemants (UV = 0.09), and *Cuscuta cassytoides* Nees ex Engelm. (UV = 0.08). This underscores a critical research gap and highlights the need for systematic investigations to scientifically validate its traditional uses and explore its potential for novel drug development.

In addition to these newly reported species, the present study recorded 51 species with 79 novel ethnomedicinal applications, despite their prior mention in literature. For example, the roots and seeds of *Justicia adhatoda* L. were boiled in water along with neem oil and administered to reduce fever. In contrast, earlier studies have reported its use as a root and leaves decoction for cough, chronic bronchitis (Khan *et al.*, 2009; Rao *et al.*, 2015), whooping cough and asthma (Kumar *et al.*, 2021), and antispasmodic (Gupta, 2016); leaves are tied around the joints to get rid of inflammation (Ali *et al.*, 2015), boiled leaves are used to relieve rheumatic pain (Gupta, 2016); flowers, leaves, and roots are antiseptic (Khan *et al.*, 2009); boiled leaves are used to relieve pain of urinary tract infection, powder of the shrub boiled with sesame oil is used to heal ear infections and arrest bleeding (Gupta, 2016), and leaf juice is given on diarrhoea and dysentery (Kumar and Bhagat, 2012). Similarly, the leaves of *Azadirachta indica* L. were burnt as mosquito repellant in this study, whereas previous reports mention their use as a leaf extract for stomach ailments (Rao *et al.*, 2015), expel worms and diuretic (Gupta, 2016); bark against leprosy, syphitis (Singh and Bhellum, 2011).

Jaccard Similarity Index (JSI) was also employed to assess cultural similarities among different ethnic communities based on shared plant species and their medicinal uses. This comparative analysis highlights both the similarities and differences between the current findings and previous studies conducted in the various parts of the JKUT and neighbouring state of Himachal Pradesh (Fig. 4.11).

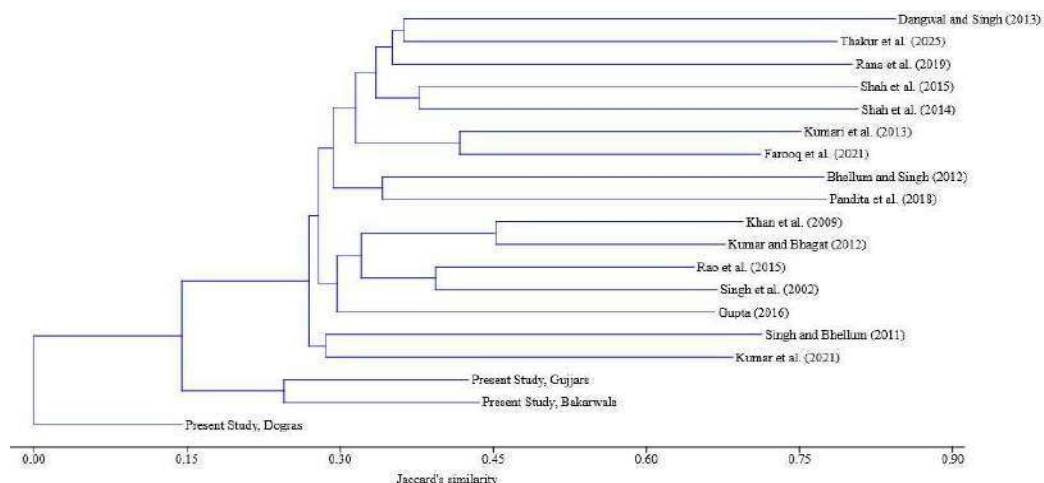


Figure 4.11: Cluster diagram showing the cross-cultural comparison

The present study was having ethnic *Dogra*, *Gujjar*, and *Bakarwal* populations. The medicinal plants of the present study were compared with a total of sixteen studies conducted on Dogras, and tribal populations of *Gujjar*, *Bakarwal*, and *Gaddi* (Table 4.6). The values of JSI ranged from 0.01 (Rajouri district of JKUT, *Gujjar* tribe) to 0.23 (Samba district of JKUT, *Dogra* ethnic population).

Table 4.6: Jaccard's similarity index of the ethnomedicinal plants between the various ethnic groups of the present study and other published literature.

District (State)	Ethnnicity	Present study ethnicity	b	c	j	%age	Reference
Samba (JKUT)	Dogra	Bakarwal	50	9	0.08	7.89	Bhellum and Singh (2012)
Samba (JKUT)	Dogra	Dogra	50	21	0.09	8.90	Bhellum and Singh (2012)
Samba (JKUT)	Dogra	Gujjar	50	11	0.07	7.33	Bhellum and Singh (2012)
Rajouri (JKUT)	Gujjar	Bakarwal	29	2	0.02	2.00	Dangwal and Singh (2013)
Rajouri (JKUT)	Gujjar	Dogra	29	3	0.01	1.29	Dangwal and Singh (2013)
Rajouri (JKUT)	Gujjar	Gujjar	29	2	0.01	1.45	Dangwal and Singh (2013)
Poonch (JKUT)	Gujjar and Bakarwal	Dogra	144	41	0.13	13.23	Farooq <i>et al.</i> (2021)
Poonch (JKUT)	Gujjar and Bakarwal	Gujjar and Bakarwal	144	29	0.13	12.72	Farooq <i>et al.</i> (2021)
Kathua (JKUT)	Dogra	Bakarwal	108	29	0.19	19.08	Gupta (2016)

District (State)	Ethnnicity	Present study ethnicity	b	c	j	%age	Reference
Kathua (JKUT)	Dogra	Dogra	108	48	0.18	17.98	Gupta (2016)
Kathua (JKUT)	Dogra	Gujjar	108	34	0.18	18.38	Gupta (2016)
Kathua (JKUT)	Dogra	Bakarwal	185	30	0.13	13.16	Khan <i>et al.</i> (2009)
Kathua (JKUT)	Dogra	Dogra	185	56	0.17	16.67	Khan <i>et al.</i> (2009)
Kathua (JKUT)	Dogra	Gujjar	185	42	0.17	16.54	Khan <i>et al.</i> (2009)
Kathua (JKUT)	Dogra	Bakarwal	134	32	0.18	18.29	Kumar and Bhagat (2012)
Kathua (JKUT)	Dogra	Dogra	134	60	0.21	21.35	Kumar and Bhagat (2012)
Kathua (JKUT)	Dogra	Gujjar	134	44	0.22	21.89	Kumar and Bhagat (2012)
Billawar (JKUT)	Dogra	Bakarwal	62	22	0.19	19.47	Kumar <i>et al.</i> (2021)
Billawar (JKUT)	Dogra	Dogra	62	30	0.13	12.55	Kumar <i>et al.</i> (2021)
Billawar (JKUT)	Dogra	Gujjar	62	24	0.16	16.11	Kumar <i>et al.</i> (2021)
Jammu (JKUT)	Gujjar	Bakarwal	70	12	0.09	9.16	Kumari <i>et al.</i> (2013)
Jammu (JKUT)	Gujjar	Dogra	70	22	0.09	8.63	Kumari <i>et al.</i> (2013)
Jammu (JKUT)	Gujjar	Gujjar	70	16	0.10	9.70	Kumari <i>et al.</i> (2013)
Samba (JKUT)	Dogra	Bakarwal	103	12	0.07	7.32	Pandita <i>et al.</i> (2018)
Samba (JKUT)	Dogra	Dogra	103	32	0.12	11.51	Pandita <i>et al.</i> (2018)
Samba (JKUT)	Dogra	Gujjar	103	16	0.08	8.08	Pandita <i>et al.</i> (2018)
Chamba (HP)	Gujjar	Bakarwal	82	7	0.05	4.73	Rana <i>et al.</i> (2019)
Chamba (HP)	Gujjar	Dogra	82	10	0.04	3.58	Rana <i>et al.</i> (2019)
Chamba (HP)	Gujjar	Gujjar	82	8	0.04	4.32	Rana <i>et al.</i> (2019)
Kathua (JKUT)	Dogra	Bakarwal	195	41	0.18	18.06	Rao <i>et al.</i> (2015)
Kathua (JKUT)	Dogra	Dogra	195	76	0.23	23.31	Rao <i>et al.</i> (2015)
Kathua (JKUT)	Dogra	Gujjar	195	55	0.22	21.91	Rao <i>et al.</i> (2015)
Poonch (JKUT)	Gujjar and Bakarwal	Dogra	42	15	0.06	6.41	Shah <i>et al.</i> (2015a)

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District (State)	Ethnnicity	Present study ethnicity	b	c	j	%age	Reference
Poonch (JKUT)	Gujjar and Bakarwal	Gujjar and Bakarwal	42	10	0.07	6.90	Shah <i>et al.</i> (2015a)
Rajouri (JKUT)	Gujjar and Bakarwal	Dogra	104	15	0.05	5.07	Shah <i>et al.</i> (2015b)
Rajouri (JKUT)	Gujjar and Bakarwal	Gujjar and Bakarwal	104	6	0.03	2.84	Shah <i>et al.</i> (2015b)
Samba (JKUT)	Dogra	Bakarwal	32	20	0.24	23.53	Singh and Bhellum (2011)
Samba (JKUT)	Dogra	Dogra	32	26	0.12	12.21	Singh and Bhellum (2011)
Samba (JKUT)	Dogra	Gujjar	32	22	0.18	18.18	Singh and Bhellum (2011)
Kathua (JKUT)	Dogra	Bakarwal	120	32	0.20	19.88	Singh <i>et al.</i> (2020)
Kathua (JKUT)	Dogra	Dogra	120	52	0.19	18.91	Singh <i>et al.</i> (2020)
Kathua (JKUT)	Dogra	Gujjar	120	39	0.20	20.31	Singh <i>et al.</i> (2020)
Kullu, Mandi, Hamirpur, & Kangra (HP)	Gaddi and Gujjar	Bakarwal	64	9	0.07	7.03	Thakur <i>et al.</i> (2025)
Kullu, Mandi, Hamirpur, & Kangra (HP)	Gaddi and Gujjar	Dogra	64	14	0.05	5.45	Thakur <i>et al.</i> (2025)
Kullu, Mandi, Hamirpur, & Kangra (HP)	Gaddi and Gujjar	Gujjar	64	10	0.06	6.06	Thakur <i>et al.</i> (2025)

4.2.2 Ethnoveterinary plants

A total of 27 ethnoveterinary plants were recorded from the study site belonging to 18 families. All the species belongs to angiosperm group. Among 27 angiosperms 25 were dicots and two were monocots (Table 4.7).

Table 4.7: Ethnoveterinary plants of the Surinsar and Mansar wildlife Sanctuary

Botanical Name	Plant Part Used	Traditional Medicinal Uses	UV
<i>Abrus precatorius</i>	Se	Seeds are given with chapati to dogs in case they have any body swellings (3).	0.010
<i>Achyranthes aspera</i>	L, R, Se	Powdered form of roots is given to animals for easy delivery (4).	0.013
<i>Acorus calamus</i>	R	It is also applied on wounds of animals (31).	0.101
<i>Aegle marmelos</i>	L, Fr	Fruit pulp is given to animals to cure dysentery (6). Fruit along with feed is given to cattle helps in increasing milk yield (12).	0.059
<i>Ajuga integrifolia</i>	WP	Sliced plant soaked overnight in water is effective in treating gout (3)	0.010
<i>Albizia lebbek</i>	L	Leaves increases milk yield in cattle (12).	0.039
<i>Apteranthes tuberculata</i>	L	Seeds given to animal as fodder (2) to provides energy (1).	0.010
<i>Asparagus racemosus</i>	L, Tu	Given to cattles to remove garma from body (3).	0.010
<i>Bergenia ciliata</i>	L	Leaves are made into powder and applied to treat wounds (13).	0.042
<i>Broussonetia papyrifera</i>	L	Seed oil is effective in treating body pains in animals (2). Fruit is eaten by animals (12).	0.046
<i>Cassia fistula</i>	Fr	Boiled Pods are effective against constipation in animals (4). Crushed pods are given to goats and cattle in case it has overeaten the grains (14). Pods are given to animals for treating flatulence (15).	0.108
<i>Dolomiaea costus</i>	L, R	Leaves given to cattle to increase milk yield (13).	0.04
<i>Eucalyptus globulus</i>	L	Leaf paste is applied to nipples of the cows in case of having infection (5).	0.016
<i>Euphorbia royleana</i>	WP	Stem boiled with water mixed with salt and <i>Trigonella</i> seeds given to goats and camel as their feed (7).	0.023
<i>Ichnocarpus frutescens</i>	La	Wood latex put in eyes as eye drop to relieve eye infection in animals (16).	0.052
<i>Leea asiatica</i>	R	Roots effective in treating inflammation of breasts in cattle (4).	0.013
<i>Leucaena leucocephala</i>	L, St	Leaves helps in increasing milk yield in animals (23).	0.075
<i>Mallotus philippensis</i>	L, Se	Seeds washed in water given to sheep for killing worms (16).	0.052
<i>Mangifera indica</i>	L, Fr, Ba, S	Old pickle of mango is given to animals in case of loss of appetite (4), indigestion (4), gastric troubles (4).	0.039
<i>Martynia annua</i>	L	Leaf paste helps in treating wounds in animals (7), and swelling (1).	0.03 0.01
<i>Melia azedarach</i>	WP	Leaves and wood tied to animal mouth in case not eating properly (2).	

Botanical Name	Plant Part Used	Traditional Medicinal Uses	UV
<i>Oplismenus burmanni</i>	WP	Helpful in treating galactagogue in animals (2).	0.01
<i>Ougeinia oojeinensis</i>	L	Leaves increases milk yield in animals (19).	0.06
<i>Phlomodoides superba</i>	Tu	Tubers are used to increase milk yield in animals (39). Tuber are also used to treat wounds (22).	0.20
<i>Sonchus asper</i>	L	Increases milk yield in cattle (3).	0.01
<i>Urena lobata</i>	L, R	Leaf paste helps to treat animal wounds (6).	0.02
<i>Vitex negundo</i>	WP	Leaves are effective against wounds of animals (26). Leaf juice is given to cows in case of having gas problem (17).	0.14

The most represented families were Fabaceae (5 genera, 5 species), Lamiaceae (3, 3), Asteraceae (2, 2), and Euphorbiaceae (2, 2). Remaining fourteen families were represented by only one species (Fig. 4.12). Fabaceae family was the most prevalent among the 72 ethnoveterinary plants identified by Sharma *et al.* (2012) in their thorough assessment of the district Kathua in the Jammu division (J&K). According to Galav *et al.* (2013), ethnoveterinary practices in Rajasthan mostly employed the members of family Euphorbiaceae. In their latest analysis, Sikarwar and Tiwari (2020) listed 270 plant species from 84 families that are used in ethnoveterinary procedures by Central Indians and rural groups.

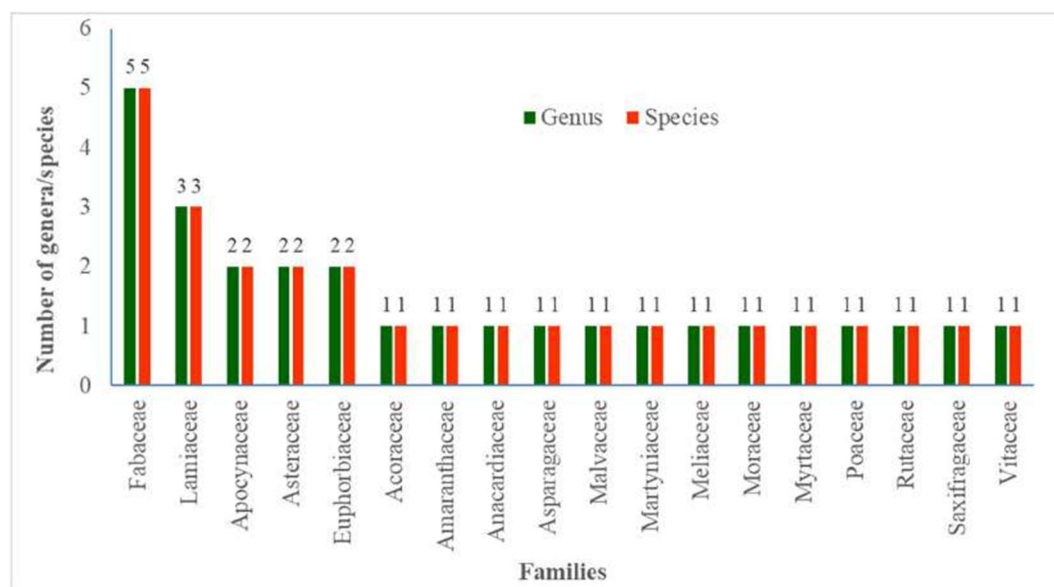


Figure 4.12: The number of genera and species of various ethnoveterinary plants.

Herbs (11 species) contributed 40.7%, and trees (10 species) contributed to 37.03%

of the total life-forms. Other life-forms viz. shrubs and climbers contributed 11.1 %, each.

Leaves (47.8%) were the most utilized plant part followed by Seeds, fruits (13.0% each), Roots (8.7%), and Phylloclade, Rhizome, Tuber, latex (4.3%) each. The preference of traditional healers for using leaves in the preparation of herbal remedies is likely attributed to their year-round availability and the convenience they offer in terms of collection, storage, processing, and handling. Leaves and seeds represent renewable and regenerative plant parts, and their harvesting does not lead to the destruction of the plant. Moreover, leaves are believed to contain a higher concentration of readily extractable phytochemicals, crude drugs, and diverse bioactive compounds that contribute to their effectiveness in traditional formulations (Ahmad *et al.*, 2014; Bano *et al.*, 2014; Chaachouay *et al.*, 2022; Gonçalves *et al.*, 2025). Moreover, the effectiveness of leaves and seeds against a wide range of diseases may be attributed to the abundance of secondary metabolites present in these plant parts (Bhattacharjya *et al.*, 2023; Kalita *et al.*, 2024).

Different type of crude preparations was used in ethnoveterinary purposes, these were raw form (52%), paste (26%), boiled form (8.7%) and powdered form (4.3%), and oil, latex, and decoction (4.3%) each. Aruna and Shrinitha (2023) also reported a high usage (72%) of fresh plant materials in Madurai, Tamil Nadu. This preference for fresh plants may be attributed to their higher metabolite content compared to dried plants, as well as the fact that animals consume fresh materials more readily.

Phlomoides superba (Royle ex Benth.) Kamelin & Makhm., *Vitex negundo*, *Cassia fistula* L., and *Acorus calamus* L., with 0.199, 0.141, 0.108, and 0.101 use-values respectively, were the most frequently used ethnoveterinary species (Table 4.7). These plants mainly cure digestive disorders like flatulence, constipation, and over eating of grains, and wounds of the animals.

The fidelity level (FL%) tells us about the reliability of a plant for the treatment of an ailment category. In the present study, 100% FL was recorded for 23 plants (Table 4.8). For the digest disorders, *Ajuga integrifolia*, *Cassia fistula*, *Euphorbia royleana* Boiss., *Mallotus philippensis*, *Mangifera indica* and *Melia azedarach* recorded 100 % FL. *Ichnocarpus frutescens* (L.) W.T. Aiton recorded 100% FL for eye related problems and *Abrus precatorius* L. for musculoskeletal ailments. *Achyranthes aspera*, *Albizia lebbek* (L.) Benth., *Asparagus racemosus*, *Leucaena leucocephala*, *Oplismenus burmanni* (Retz.) P. Beauv., *Ougeinia oojeinensis*, *Phlomoidea superba*, *Dolomiaea costus*, and *Sonchus asper* (L.) Hill recorded 100% FL for the unclassified ailments. The maximum reliability for the skin ailments was shown by *Acorus calamus*, *Bergenia ciliata*, *Eucalyptus globulus*, *Leea asiatica*, *Phlomoidea superba*, and *Urena lobata* L.

Table 4.8: Fidelity level (FL%) of the most important plants in different ailment categories

Botanical Name	Ailment category	Citations	FL
<i>Ajuga integrifolia</i>	Digestion	3	100
<i>Cassia fistula</i>	Digestion	4	100
<i>Euphorbia royleana</i>	Digestion	7	100
<i>Mallotus philippensis</i>	Digestion	16	100
<i>Mangifera indica</i>	Digestion	4	100
<i>Melia azedarach</i>	Digestion	2	100
<i>Broussonetia papyrifera</i>	Digestion	12	85.7
<i>Apteranthes tuberculata</i>	Digestion	2	66.7
<i>Ichnocarpus frutescens</i>	Eye	16	100
<i>Abrus precatorius</i>	Musculoskeletal	3	100
<i>Broussonetia papyrifera</i>	Musculoskeletal	2	14.3
<i>Achyranthes aspera</i>	Other	4	100
<i>Albizia lebbeck</i>	Other	12	100
<i>Asparagus racemosus</i>	Other	3	100
<i>Leucaena leucocephala</i>	Other	23	100
<i>Oplismenus burmanni</i>	Other	2	100
<i>Ougeinia oojeinensis</i>	Other	19	100
<i>Phlomoides superba</i>	Other	39	100
<i>Dolomiaea costus</i>	Other	13	100
<i>Sonchus asper</i>	Other	3	100
<i>Aegle marmelos</i>	Other	12	66.7
<i>Acorus calamus</i>	Skin	31	100
<i>Bergenia ciliata</i>	Skin	13	100
<i>Eucalyptus globulus</i>	Skin	5	100
<i>Leea asiatica</i>	Skin	4	100
<i>Phlomoides superba</i>	Skin	22	100
<i>Urena lobata</i>	Skin	6	100
<i>Martynia annua</i>	Skin	7	87.5
<i>Vitex negundo</i>	Skin	26	60.5

Informant consensus factor (F_{ic}) was another quantitative index used to find the extent of acceptability of the plant in the treatment of an ailment category. The ailments of animals were classified into five categories. The values of F_{ic} ranged between 1.00 (eye ailments) and 0.60 (musculoskeletal ailments). The maximum number of citations and species were recorded for the unclassified ailments (Table 4.9). These findings indicate that enhancing milk production (listed under the “others” category) was the most frequently mentioned and significant concern among informants, with 131 citations. Skin-related (114 citations) and digestive (110 citations) ailments also emerged as major issues. The prominence of such ailments may reflect the widespread dominance of invasive weeds like *Lantana camara* L. in the region, whose thorny branches frequently cause wounds.

Table 4.9: Informant consensus factor (F_{ic}) of the plants used for ethnoveterinary ailments.

Ailment category	n_u	n_{tax}	F_{ic}
Musculoskeletal	6	3	0.60
Digestion	110	10	0.92
Other	131	11	0.92
Skin	114	8	0.94
Eye	16	1	1.00

Abbreviations used: n_u , number of use-reports; n_{tax} , number of species.

Novelty and future prospects of ethnoveterinary plants

The use of *Achyranthes aspera* roots in powdered form which are given to animals for their easy delivery process is a new record from JKUT, though previously the use of this herbaceous plant was recorded for treating fever and snakebites (Abasi *et al.*, 2021). The use of *Acorus calamus* paste in treating wounds in animals is also a new record from JKUT. Earlier Khateeb *et al.* (2015) mentioned its use in treating diarrhoea in animals. The roots of *Acorus calamus* mixed with salt and Chilli is given to horses to cure stomach pain as per Dutta *et al.* (2021).

Fruit of *Aegle marmelos* (L.) Corrêa when given along with the feed increases milk yield in cattles is new record from study area of JKUT. Sliced plant of *Ajuga integrifolia* is kept overnight in water and given to animals in treating gout. The mentioned use is reported for the first time in JKUT to the best of my knowledge. Previous studies as conducted from

Doda by Khateeb *et al.* (2015), it is used to treat diarrhoea, indigestion and wounds in animals. *Albizia lebbeck* (L.) Benth. leaves are helpful in increasing milk yield in cattle as per the present study which is not on record in the previous studies conducted from JKUT. The seed oil of *Broussonetia papyrifera* (L.) L'Hér. ex Vent. is used to treat body pains in animals which is again a new record from JKUT. The crushed pods of *Cassia fistula* are given to goats and cattle in case it has overeaten the grains was reported by Bakarwal tribe while the pods are used against digestive disorders in other studies. The present study reported the use of leaf paste of *Eucalyptus globulus* which is applied to the nipples of the cows in case of having infection (mastitis) which is reported in a study conducted from Karnataka previously. The phylloclade of *Euphorbia royleana* Boiss. boiled with water and mixed with salt and *Trigonella* seeds (*Methi dana*) given to goats and camel as their feed to increase milk yield is a novel report from JKUT. The latex of *Ichnocarpus frutescens* is forced to poured into eyes as eye drops through the hollow stem to treat eye infection in animals which is not recorded earlier to best of my knowledge. As per some of the tribal people (Bakarwal) the seeds of *Mallotus philippensis* are washed in water first and the water is given to sheeps to expel the worms. The old pickle of *Mangifera indica* is given to animals in case of loss of appetite. While earlier report from Kathua mentioned its use in treating mouth infections in cattle. The monocot plant *Oplismenus burmanni* (Retz.) P. Beauv. is used to treat galactagogue in animals which is firstly reported from JKUT in the present study. The leaves of *Ougeinia oojeinensis* are given to animals to increase their milk production. More scientific research should be done on these plants with fresh ethnoveterinary use records from the UT of J&K, as they could lead to the development of new ethnoveterinary medications.

Current Status of ethnoveterinary knowledge of tribals and locals of study area.

The tribal populations viz Gujjars and Bakarwals main occupation is shepherding. They possess a large flock of sheeps and goats along with some horses and Bakarwali dogs. Usually, they are settled in the higher altitudinal regions of north western Himalayas, in close vicinity of forests, grazing lands in order to facilitate grazing of their cattle. Mostly male members are devoted to the grazing of their livestock while female members and children usually look after their house hold chores. In order to cope with the cold and snowy weather conditions in the higher reaches, shepherds migrate towards the plain areas spending few days in migration process as they move along the roadsides covering long

distances by foot. Horses helps the female and children as they serve their means of transportation during winters and again back to their place during summers to escape from the extreme heat waves of high temperatures. These people lead extremely difficult lives and encounter numerous difficulties when they migrate and graze their animals in the forests. Additionally, there is no medical facility available to them or their animals during their seasonal migration. Hence, they are well acquainted with the plants used in ethnoveterinary practices. They keep some of the plant remedies from higher altitudinal regions to treat their livestock so that it can be given at the time of emergency while on migration route.

It has observed that there is sharp decline in shepherding profession due to the change in lifestyle of younger generations as they don't want to do more laborious work. The females have started their weaving of threads, dying of the wool obtained from their sheep and other handicraft activities and one male member is always there to help them at home. This occupation helps them to serve their livelihood. Modern facilities adopted by them may lead to the loss of traditional knowledge pertaining to ethnoveterinary usage of plants that needs to be documented at the earliest before it gets lost forever.

4.2.3 Relative Frequency of Citation (RFC) and Cultural Importance (CI)

4.2.3.1 Ethnomedicinal and ethnoveterinary plants

Relative Frequency of Citation (RFC) is an ethnobotanical index used to assess the local importance of a plant species based on how many informants mention it. The value ranges from 0 to 1, with higher values indicating greater cultural recognition and use within the study area (Table 4.10). In the present study the maximum RFC was recorded for *Justicia adhatoda* (0.572). The other important species were *Carrisa spinarum* (0.405), *Phyllanthus emblica* (0.382), *Aegle marmelos* (0.363), *Tinospora cordifolia* (0.333), *Terminalia chebula* (0.314), and *Phanera vahlii* (0.301). The importance of these species has been discussed under the cultural importance section.

Cultural Importance (CI) index is used to evaluate the importance of plant species within a particular culture or community that reflects how widely and diversely a plant is used by people in specific group. The greater a plant's CI, the more applications it has and the more often community members mention or use it.

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Table 4.10: Relative Frequency of Citation (RFC) and Cultural importance (CI) values of various ethnobotanical usages of plants.

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Abelmoschus moschatus</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013
<i>Abrus precatorius</i>	0.02	0.01	-	-	-	-	-	-	-	-	-	0.013
<i>Achyranthes aspera</i>	0.19	0.01	-	-	-	-	-	-	-	0.03	-	0.101
<i>Acorus calamus</i>	0.16	0.10	-	-	-	-	-	-	-	0.01	-	0.147
<i>Adiantum capillus-veneris</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.029
<i>Adiantum caudatum</i>	0.09	-	-	-	-	-	-	-	-	-	-	0.095
<i>Aegle marmelos</i>	0.48	0.06	-	0.08	-	-	-	-	-	0.40	-	0.363
<i>Ajuga integrifolia</i>	0.18	0.01	-	-	-	-	-	-	-	-	-	0.111
<i>Ajuga macrosperma</i>	0.05	-	-	-	-	-	-	-	-	-	-	0.023
<i>Albizia lebbeck</i>	0.11	0.04	-	-	-	-	-	-	-	0.04	-	0.042
<i>Alysicarpus monilifer</i>	0.00	-	-	-	-	-	-	0.00	-	-	-	0.003
<i>Amaranthus blitum</i>	0.09	-	0.15	-	-	-	-	0.03	-	-	-	0.150
<i>Angelica glauca</i>	-	-	-	-	-	-	-	-	-	-	0.05	0.046
<i>Anisomeles indica</i>	0.05	-	-	-	-	-	-	-	-	-	-	0.026
<i>Apteranthes tuberculata</i>	-	0.00	0.00	-	-	-	-	0.01	-	-	-	0.007
<i>Argemone mexicana</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.023
<i>Argyrolobium roseum</i>	0.11	-	-	-	-	-	-	-	-	-	-	0.046
<i>Artocarpus lacucha</i>	-	-	-	-	0.05	-	-	-	-	-	-	0.052

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Botanical Name	Cultural importance (CI)										RFC	
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious		Miscellaneous
<i>Arundo donax</i>	0.01	-	-	-	-	-	0.03	-	-	-	-	0.042
<i>Asparagus racemosus</i>	0.08	0.01	-	-	-	-	-	-	-	0.02	-	0.056
<i>Avena sativa</i>	0.09	-	-	-	-	-	-	0.01	-	-	0.01	0.056
<i>Azadiracta indica</i>	0.74	-	-	-	-	-	-	-	-	-	0.02	0.225
<i>Barleria cristata</i>	0.06	-	-	-	-	-	-	-	-	-	-	0.033
<i>Barleria prionitis</i>	0.18	-	-	-	-	-	-	-	-	-	-	0.163
<i>Bauhinia variegata</i>	0.01	-	0.17	-	-	-	-	0.04	-	-	-	0.114
<i>Bergenia ciliata</i>	0.03	0.04	-	-	-	-	-	-	-	-	-	0.075
<i>Bidens bipinnata</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Bidens pilosa</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.020
<i>Boehmeria virgata</i>	-	-	-	-	-	-	0.02	-	-	-	-	0.049
<i>Boerhavia diffusa</i>	0.07	-	-	-	-	-	-	-	-	-	-	0.020
<i>Bombax ceiba</i>	0.06	-	0.08	0.01	0.01	-	-	0.02	-	-	0.12	0.167
<i>Brassica campestris</i>	0.06	-	0.07	-	-	-	-	-	-	-	-	0.052
<i>Broussonetia papyrifera</i>	0.01	0.01	-	0.04	-	-	-	-	-	-	-	0.065
<i>Buddleja asiatica</i>	0.02	-	-	-	-	-	-	-	0.03	-	-	0.029
<i>Butea monosperma</i>	0.34	-	-	0.01	-	-	-	0.06	-	-	0.45	0.212
<i>Cajanus scarabaeoides</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.023
<i>Callicarpa macrophylla</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Calotropis procera</i>	0.21	-	-	-	-	-	-	-	-	-	-	0.186

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Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Cannabis sativa</i>	0.31	-	-	-	-	-	-	-	-	0.39	-	0.190
<i>Cardiospermum helicacabum</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Carissa spinarum</i>	0.20	-	-	0.40	-	-	-	-	-	-	-	0.405
<i>Casearia tomentosa</i>	0.21	-	-	-	-	-	-	-	-	-	0.15	0.212
<i>Cassia fistula</i>	0.18	0.11	-	-	-	-	-	-	-	-	0.04	0.173
<i>Catunaregam spinosa</i>	0.01	-	-	-	-	-	-	-	-	-	0.01	0.010
<i>Celosia argentea</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.020
<i>Centella asiatica</i>	0.10	-	-	-	-	-	-	-	-	-	-	0.046
<i>Chenopodium album</i>	0.18	-	0.16	-	-	-	-	-	-	-	0.03	0.170
<i>Cissampelos pareira</i>	0.22	-	-	-	-	-	-	-	-	-	-	0.219
<i>Citrus × limon</i>	0.02	-	-	-	0.01	-	-	-	-	-	-	0.020
<i>Citrus medica</i>	-	-	-	0.19	-	-	-	-	-	-	-	0.190
<i>Citrus pseudolimon</i>	0.28	-	-	-	0.17	-	-	-	-	-	0.10	0.193
<i>Clematis barbellata</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.029
<i>Clematis gouriana</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.020
<i>Cleome viscosa</i>	0.04	-	-	-	-	-	-	-	-	-	-	0.026
<i>Clinopodium nepeta</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.016
<i>Coccinia grandis</i>	0.09	-	0.14	-	-	-	-	-	-	-	-	0.150
<i>Colebrookea oppositifolia</i>	0.28	-	-	-	-	-	-	-	-	-	0.02	0.049
<i>Commelina benghalensis</i>	0.01	-	0.08	-	-	-	-	-	-	-	-	0.229

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Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Corchorus aestuans</i>	0.01	-	-	-	-	-	0.02	-	-	-	-	0.026
<i>Cordia dichotoma</i>	0.33	-	0.27	-	0.34	-	-	-	-	-	-	0.288
<i>Coriandrum sativum</i>	0.05	-	0.03	-	-	0.05	-	-	-	-	-	0.072
<i>Crotalaria medicaginea</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.026
<i>Cryptolepis buchananii</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.010
<i>Cucumis maderaspatanus</i>	0.00	-	0.01	-	-	-	-	-	-	-	-	0.010
<i>Cucumis sativus</i>	0.05	-	-	0.02	-	-	-	-	-	-	-	0.042
<i>Cucurbita pepo</i>	0.02	-	0.01	0.01	-	-	-	-	-	-	-	0.010
<i>Cuscuta cassytoides</i>	0.08	-	-	-	-	-	-	-	-	-	-	0.039
<i>Cynoglossum zeylanicum</i>	0.06	-	-	-	-	-	-	-	-	-	-	0.062
<i>Dalbergia sissoo</i>	0.05	-	-	-	-	-	0.04	-	0.04	-	-	0.046
<i>Datura stramonium</i>	0.06	-	-	-	-	-	-	-	-	0.04	0.00	0.049
<i>Digera muricata</i>	0.01	-	0.01	-	-	-	-	-	-	-	-	0.010
<i>Dioscorea belophylla</i>	-	-	0.13	-	0.01	-	-	-	-	-	-	0.134
<i>Dioscorea bulbifera</i>	0.10	-	0.07	-	-	-	-	-	-	-	-	0.078
<i>Dioscorea pentaphylla</i>	-	-	0.15	-	-	-	-	-	-	-	-	0.147
<i>Diospyros diversilimba</i>	0.30	-	-	0.03	-	-	-	-	-	-	-	0.144
<i>Diplocyclos palmatus</i>	0.29	-	-	-	-	-	-	-	-	-	-	0.147
<i>Dodonaea viscosa</i>	0.33	-	-	-	-	-	0.16	-	-	-	-	0.268
<i>Dolomiaea costus</i>	0.07	0.04	-	-	-	-	-	-	-	-	-	0.088

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Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Duranta erecta</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Dysphania ambrosioides</i>	0.09	-	-	-	-	-	-	-	-	-	-	0.088
<i>Eclipta prostrata</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.003
<i>Erioscirpus comosus</i>	-	-	-	-	-	-	0.02	-	-	-	-	0.016
<i>Eucalyptus globulus</i>	0.14	0.02	-	-	-	-	0.06	-	0.00	-	-	0.131
<i>Eulaliopsis binata</i>	-	-	-	-	-	-	0.08	-	-	-	-	0.078
<i>Euphorbia helioscopia</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.023
<i>Euphorbia heterophylla</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Euphorbia hirta</i>	0.05	-	-	-	-	-	-	-	-	-	-	0.029
<i>Euphorbia hypericifolia</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.013
<i>Euphorbia royleana</i>	-	0.02	0.02	0.01	-	-	-	-	-	-	-	0.062
<i>Ficus auriculata</i>	0.05	-	-	0.04	-	-	-	0.00	-	-	-	0.049
<i>Ficus benghalensis</i>	0.02	-	-	0.04	-	-	-	-	-	0.04	-	0.062
<i>Ficus palmata</i>	0.20	-	-	0.2	-	-	-	-	-	-	-	0.248
<i>Ficus populifolia</i>	0.09	-	-	-	-	-	-	-	-	0.03	-	0.075
<i>Ficus racemosa</i>	0.10	-	-	-	-	-	-	0.02	-	0.02	-	0.062
<i>Flacourtia indica</i>	0.09	-	-	0.04	-	-	-	-	-	-	0.02	0.046
<i>Foeniculum vulgare</i>	0.02	-	-	-	-	-	-	-	-	-	0.08	0.078
<i>Fumaria indica</i>	0.08	-	0.04	-	-	-	-	0.03	-	-	-	0.085
<i>Gentiana decemfida</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.026

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Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Gloriosa superba</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Grewia optiva</i>	0.06	-	-	0.00	-	-	0.08	0.15	-	-	-	0.219
<i>Grona heterophylla</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Hellenia speciosa</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.013
<i>Ichnocarpus frutescens</i>	0.08	0.05	-	-	-	-	-	-	-	-	-	0.105
<i>Impatiens balsamina</i>	0.05	-	-	-	-	-	-	-	-	-	0.02	0.023
<i>Indigofera cassioides</i>	0.01	-	-	0.01	-	-	-	-	-	-	-	0.026
<i>Indigofera linifolia</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013
<i>Ipomoea pes-tigridis</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Jacobaea nudicaulis</i>	0.02	-	-	-	-	-	-	-	-	-	0.00	0.007
<i>Janochloa antidotalis</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.010
<i>Jasminum multiflorum</i>	0.01	-	-	-	-	-	-	-	-	0.03	0.07	0.046
<i>Jurinea heteromalla</i>	0.00	-	-	-	-	-	-	0.01	-	-	-	0.013
<i>Justicia adhatoda</i>	0.92	-	-	0.27	-	-	-	-	-	-	-	0.572
<i>Kydia calycina</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.016
<i>Lamium amplexicaule</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.023
<i>Lannea coromandelica</i>	0.01	-	-	-	-	-	0.01	-	-	-	-	0.023
<i>Lathyrus aphaca</i>	0.06	-	0.04	-	-	-	-	0.00	-	-	-	0.101
<i>Leea asiatica</i>	0.02	0.01	-	-	-	-	-	-	-	-	-	0.033
<i>Lepidagathis cuspidata</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Lepidium didymum</i>	0.01	-	0.00	-	-	-	-	-	-	-	-	0.013
<i>Leptodermis lanceolata</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.010
<i>Lespedeza juncea</i>	0.00	-	-	-	-	-	0.01	-	-	-	0.01	0.010
<i>Leucaena leucocephala</i>	-	0.08	-	-	-	-	0.06	-	0.06	-	-	0.092
<i>Leucas aspera</i>	0.01	-	-	-	-	-	-	-	-	-	0.01	0.013
<i>Litsea glutinosa</i>	0.09	-	-	-	-	-	-	-	-	-	-	0.088
<i>Luffa aegyptiaca</i>	0.01	-	0.11	-	-	-	-	-	-	-	0.05	0.111
<i>Mallotus philippensis</i>	0.19	0.05	-	-	-	-	-	-	-	-	-	0.163
<i>Malva pusilla</i>	0.01	-	0.18	-	-	-	-	-	-	-	-	0.183
<i>Mangifera indica</i>	0.05	0.04	0.11	0.20	0.09	0.18	0.08	-	-	0.06	0.08	0.203
<i>Martynia annua</i>	-	0.03	-	-	-	-	-	-	-	-	-	0.026
<i>Mazus pumilus</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Medicago sativa</i>	-	-	0.05	-	-	-	-	-	-	-	-	0.052
<i>Melia azedarach</i>	0.10	0.01	-	-	-	-	-	-	-	-	-	0.176
<i>Melilotus indicus</i>	0.02	-	-	-	-	-	-	0.06	-	-	-	0.020
<i>Mentha spicata</i>	0.11	-	-	-	-	0.08	-	-	-	-	-	0.108
<i>Micromeria biflora</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.033
<i>Mirabilis jalapa</i>	0.10	-	-	-	-	-	-	-	-	0.02	-	0.101
<i>Mitragyna parvifolia</i>	0.04	-	-	-	-	-	-	-	-	0.01	-	0.049
<i>Momordica charantia</i>	0.21	-	0.10	-	0.04	-	-	-	-	-	-	0.163

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Morchella esculenta</i>	-	-	0.18	-	-	-	-	-	-	-	-	0.065
<i>Moringa oliefera</i>	0.27	-	0.09	-	0.11	-	-	-	-	-	-	0.203
<i>Morus alba</i>	0.07	-	-	0.13	-	-	-	0.01	-	-	0.01	0.131
<i>Murraya koenigii</i>	0.15	-	0.09	-	-	-	-	-	-	-	-	0.147
<i>Nelumbo nucifera</i>	0.08	-	0.06	-	-	-	-	-	-	-	-	0.049
<i>Nepeta hindostana</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Nerium indicum</i>	0.06	-	-	-	-	-	-	-	-	-	0.02	0.082
<i>Nicotiana tabacum</i>	0.02	-	-	-	-	-	-	-	-	-	0.02	0.036
<i>Nyctanthes arbor-tristis</i>	0.13	-	-	-	-	-	-	-	-	-	-	0.075
<i>Ocimum americanum</i>	0.10	-	-	-	-	-	-	-	-	-	-	0.062
<i>Ocimum tenuiflorum</i>	0.49	-	-	-	-	-	-	-	-	0.06	0.04	0.216
<i>Oenothera rosea</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.023
<i>Oplismenus burmanni</i>	-	0.01	-	-	-	-	-	-	-	-	-	0.007
<i>Oplismenus compositus</i>	-	-	-	-	-	-	-	0.02	-	-	-	0.020
<i>Opuntia tuna</i>	0.01	-	-	0.10	-	-	0.07	-	-	-	-	0.127
<i>Oroxylum indicum</i>	0.04	-	-	-	-	-	-	-	-	-	-	0.023
<i>Ougeinia oojeinensis</i>	0.01	0.06	-	-	-	-	-	-	0.04	-	0.06	0.072
<i>Oxalis corniculata L.</i>	0.08	-	-	-	-	0.04	-	-	-	-	-	0.098
<i>Packera aurea</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013
<i>Paeonia emodi</i>	0.04	-	-	-	-	-	-	-	-	-	-	0.075

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Pergularia daemia</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.016
<i>Phanera vahlii</i>	0.21	-	0.01	-	-	-	-	0.10	0.10	-	0.35	0.301
<i>Phlomoides superba</i>	-	0.13	-	-	-	-	-	-	-	-	-	0.127
<i>Phoenix dactylifera</i>	0.20	-	-	0.04	-	-	0.14	-	-	-	0.27	0.141
<i>Phyla nodiflora</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Phyllanthus emblica</i>	0.74	-	-	0.22	0.47	0.02	-	-	-	0.10	-	0.382
<i>Phyllanthus urinaria</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.013
<i>Phyllanthus velutinus</i>	0.05	-	-	-	-	-	-	-	-	-	-	0.042
<i>Physalis angulata</i>	-	-	-	0.03	-	-	-	-	-	-	-	0.029
<i>Pinus roxburghii</i>	0.01	-	-	0.25	-	-	-	-	0.05	-	0.21	0.219
<i>Pityrogramma calomelanos</i>	0.01	-	-	-	-	-	-	-	-	-	0.05	0.049
<i>Pleurolobus gangeticus</i>	0.16	-	-	-	-	-	-	-	-	-	-	0.059
<i>Plumbago zeylanica</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.007
<i>Pogostemon benghalensis</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.016
<i>Polygala abyssinica</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013
<i>Pongamia pinnata</i>	0.10	-	-	-	-	-	-	-	-	-	-	0.056
<i>Poranopsis paniculata</i>	0.01	-	-	-	-	-	-	-	-	-	0.03	0.023
<i>Portulaca oleracea</i>	0.01	-	0.12	-	-	-	-	-	-	-	-	0.118
<i>Potentilla indica</i>	-	-	-	0.05	-	-	-	-	-	-	-	0.052
<i>Psidium guajava</i>	0.32	-	-	0.14	-	-	-	-	-	-	-	0.219

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Pueraria tuberosa</i>	0.04	-	-	0.04	-	-	-	-	-	-	-	0.065
<i>Pupalia lappacea</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.013
<i>Pyrus pashia</i>	-	-	-	0.06	-	-	-	-	-	-	-	0.059
<i>Ranunculus sceleratus</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.007
<i>Reinwardtia indica</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Rhamnus triquetra</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Ricinus communis</i>	0.16	-	-	-	-	-	-	-	-	-	-	0.124
<i>Rosa macrophylla</i>	0.08	-	-	-	-	-	-	-	-	-	0.05	0.075
<i>Rostellularia procumbens</i>	0.04	-	-	-	-	-	-	-	-	-	-	0.016
<i>Rubus ellipticus</i>	0.01	-	-	0.07	-	-	-	-	-	-	-	0.072
<i>Rumex dentatus</i>	-	-	0.08	-	-	-	-	0.03	-	-	-	0.075
<i>Salvia plebeia</i>	0.12	-	-	-	-	-	-	-	-	-	-	0.085
<i>Sapindus mukorossi</i>	0.10	-	-	-	-	-	-	-	-	-	0.03	0.033
<i>Saraca asoca</i>	0.01	-	-	-	-	-	-	-	-	-	0.01	0.007
<i>Scandix pecten-veneris</i>	0.01	-	-	-	-	-	-	0.01	-	-	-	0.010
<i>Senegalia catechu</i>	0.28	-	-	-	-	-	0.04	0.11	-	-	0.05	0.291
<i>Senegalia modesta</i>	0.17	-	-	-	-	-	-	0.04	-	-	-	0.101
<i>Senna tora</i>	0.33	-	0.01	-	-	-	-	-	-	-	-	0.147
<i>Sesamum indicum</i>	0.15	-	-	0.03	-	-	-	-	-	0.01	0.03	0.157
<i>Sida cordata</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Silybum marianum</i>	0.08	-	-	-	-	-	-	-	-	-	-	0.046
<i>Solanum erianthum</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Solanum nigrum</i>	0.02	-	-	0.03	-	-	-	-	-	-	-	0.036
<i>Solanum viarum</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.016
<i>Solanum virginianum</i>	0.07	-	-	-	-	-	-	-	-	-	-	0.036
<i>Sonchus asper</i>	-	0.01	0.01	-	-	-	-	-	-	-	-	0.020
<i>Spermacoce articularis</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.010
<i>Spermadictyon suaveolens</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013
<i>Sterculia villosa</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.007
<i>Synedrella nodiflora</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.010
<i>Syzygium cumini</i>	0.26	-	-	0.21	-	-	-	-	-	-	-	0.209
<i>Taraxacum officinale</i>	0.04	-	0.08	-	-	-	-	-	-	-	-	0.114
<i>Tectona grandis</i>	-	-	-	-	-	-	-	-	-	-	0.02	0.010
<i>Telosma pallida</i>	0.02	-	0.03	-	-	-	-	0.03	-	-	-	0.036
<i>Tephrosia purpurea.</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.007
<i>Terminalia bellirica</i>	0.66	-	-	-	-	-	-	-	-	-	-	0.258
<i>Terminalia chebula</i>	0.44	-	0.01	-	0.09	-	-	-	-	-	-	0.314
<i>Tinospora cordifolia</i>	0.90	-	-	-	-	-	-	-	-	-	-	0.333
<i>Toona ciliata</i>	0.04	-	-	-	-	-	-	-	0.08	-	0.08	0.092
<i>Trema politoria</i>	0.01	-	-	-	-	-	-	-	-	-	-	0.013

RESULTS AND DISCUSSION

Botanical Name	Cultural importance (CI)											RFC
	Medicinal plants	Ethno-veterinary	Vegetable (cooked)	Fruit (raw)	Preserved Food	Chutney	Agricultural products	Fodder	Fuelwood	Religious	Miscellaneous	
<i>Trichosanthes cucumerina</i>	-	-	0.07	-	-	-	-	-	-	-	-	0.072
<i>Tridax procumbens</i>	0.09	-	-	-	-	-	-	-	-	-	-	0.078
<i>Trifolium repens</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.013
<i>Trigonella foenum-graecum</i>	0.11	-	0.06	-	-	-	-	-	-	-	-	0.059
<i>Tripidium bengalense</i>	-	-	-	-	-	-	0.08	-	-	-	0.02	0.085
<i>Tulipa clusiana</i>	0.06	-	-	-	-	-	-	-	-	-	-	0.029
<i>Urena lobata</i>	-	0.02	-	-	-	-	-	-	-	-	-	0.023
<i>Vachellia nilotica</i>	0.02	-	-	-	-	-	-	0.00	0.01	-	0.00	0.023
<i>Vallis solanacea</i>	0.04	-	-	-	-	-	-	-	-	-	-	0.036
<i>Verbascum thapsus</i>	0.13	-	-	-	-	-	-	-	-	-	0.04	0.101
<i>Veronica persica</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.016
<i>Viola canescens</i>	0.11	-	-	-	-	-	-	-	-	-	0.05	0.075
<i>Vitex negundo</i>	0.40	0.14	-	-	-	-	-	-	-	-	0.24	0.291
<i>Woodfordia fruticosa</i>	0.27	-	-	0.12	-	-	-	-	-	-	-	0.121
<i>Xanthium strumarium</i>	0.02	-	-	-	-	-	-	-	-	-	-	0.023
<i>Xylosma longifolia</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.033
<i>Zingiber roseum</i>	0.03	-	-	-	-	-	-	-	-	-	-	0.020
<i>Ziziphus jujuba</i>	0.04	-	-	0.19	-	-	0.03	-	-	0.03	0.03	0.193

In total, 210 plant species were utilized by the community residing in the study area in medicinal use category, 27 in ethnoveterinary category, 74 as wild edible, 18 in making agricultural tools, 30 for fodder and fuelwood purposes, 18 in religious category, and 44 were having miscellaneous uses (Table 4.10).

Among medicinal plants the highest CI (0.92) was recorded for *Justicia adhatoda* as it was having multiple utilities like in relieving fever, improving vigor, cough, headache, stomach ache, constipation, flatulence, vomiting, as toothbrush and many more depicting its wide and diverse usage. Previously Singh and Huidrom (2013) documented the ethnobotanical uses of *Justicia adhatoda* where it was reported to have multi use species and utilized as medicines and in food by Meitei community of Manipur and underscore high CI. Other workers viz. Gairola *et al.* (2014), Mir *et al.* (2022), Haq *et al.* (2022) also mentioned the high cultural importance of *Justicia adhatoda*. *Tinospora cordifolia* exhibited CI (0.90) in ethnomedicinal category which is validated by Modi *et al.* (2019). In his study the plant was utilized either alone or in combination with other medicinal plants for treating various ailments like fever, diabetes, Urinary tract infections, piles etc. Likewise, studies conducted by Kataria *et al.*, 2021; Choudhary, (2021) highlights the potential of *Tinospora cordifolia* as a therapeutic plant used to combat COVID-19.

Vitex negundo exhibited total CI (0.78), with 0.14 CI for ethnoveterinary category. Its importance in treating livestock ailments was also reported earlier by Kekude and Jayakumar *et al.* (2018) and Mahalakshmi (2020) who reported that the plant species was used by the indigenous community to treat foot and mouth disease, diarrhoea and horn avulsion in cattle. CI of 0.71 was recorded for *Phyllanthus emblica* in wild edible category depicting its significant culture and dietary usage in the study area. The similar findings were reported earlier by Bhatia *et al.* (2018) from Udhampur, Jammu and Kashmir, where CI of *Phyllanthus emblica* was recorded as (0.94) and that of *Cordia dichotoma* was (0.60). The CI and RFC of *Cordia dichotoma* and *Carissa spinarum* recorded in the present study was 0.94 and 0.288 and 0.60 and

0.405, respectively. As per the study of Abbasi et al (2013) from Pakistan *Ficus carica* was the most cited plant species in edible usage followed by *Bauhinia variegata*, *Solanum nigrum*, *Amaranthus blitum*, *Medicago polymorpha*, *Chenopodium album*, *Cichorium intybus*, *Amaranthus hybridus* and *Vicia faba*. The CI values of 1.67 of *Phyllanthus emblica* and 0.29 of *Carrissa spinarum* was earlier reported by Bhagat et al. (2022) from Purmandal block of district samba. The present study exhibited high CI (0.40) for *Carrissa spinarum* as wild edible against (0.29) from Purmandal.

Fruits and leaves were the primary plant parts utilised among wild food plants for purposes other than medicine. These results are consistent with those of Addis et al. (2013), Arya et al. (2018), Kumar (2019), and Ahmad et al. (2022), who all reported using more fruits in their research.

Phyllanthus emblica is one of the important trees for locals and having religious believes associated to it. The tree is revered for good health and prosperity on Amla Navami, which is observed in October or November according to the lunar calendar, according to informants. Additionally, it is thought that eating beneath a tree brings wealth and that Devi Lakshmi, the Goddess of Wealth, bestows her blessings on those who adore it. Utilising plants for religious purposes guarantee their conservation and sustainable use for upcoming generations. In traditional medicine, *Phyllanthus emblica* is used to treat anaemia, asthma, bronchitis, cardiac disorders, cephalalgia, colic, cough, diabetes, diarrhoea, dysentery, dyspepsia, emaciation, erysipelas, flatulence, haematogenesis, haemorrhages, hepatopathy, hyperacidity, inflammations, intermittent fevers, jaundice, leprosy, leucorrhoea, menorrhoea, ophthalmopathy, peptic ulcer, premature greying of hair, skin conditions, and tridosha (Krishnaveni and Mirunalini 2010; Dasaroju and Gottumukkala 2014).

Young *Cordia dichotoma* L. fruits are cooked as vegetables, and their fruits are kept as pickles. In Jaiselmer, Rajasthan, India, *Cordia dichotoma* is consumed raw, as a vegetable, and pickled, according to Singh et al. (1997). In Udhampur, Jammu and Kashmir (UT), India, Bhatia et al. (2018) reported the use of fruits in making pickles

and vegetables. While green fruits are consumed fresh as vegetables or pickled, matured fruits are consumed fresh in tropical regions of Africa. Additionally, sorghum beer and meals are flavoured with the fruits (Elkot *et al.* 2017). *Cordia dichotoma* showed analgesic, anti-inflammatory, antibacterial, antiparasitic, cardiovascular, gastrointestinal, immunomodulatory, insecticidal, and respiratory properties, according to pharmacological investigations (Al-Snafi, 2016).

Out of 210 medicinal plant species, 18 species like *Dodonaea viscosa*, *Morus alba*, *Dalbergia sissoo* Roxb. Ex DC., *Phoenix dactylifera* etc. were used for making agricultural products, hedge and fencing, handicrafts, construction and in making household items. The CI of 0.16 and 0.14 was recorded for *Dodonaea viscosa* and *Phoenix dactylifera*, respectively. The high cultural importance of *Dodonaea viscosa* for making agricultural implements was also mentioned in the study of Arif *et al.* (2021). Similarly, Khan *et al.* (2010) described that *Dodonaea viscosa* was used as wound healing, house thatching, fuel wood, fencing, in making toothbrushes and house cleaning brushes like our findings while as per the studies of Singh *et al.* (2022), *Quercus leucotrichophora*, *Q. semicarpifolia*, *Q. floribunda* were exploited for making plough and its parts, sickle, saw and other agricultural tools.

4.2.3.2 Fodder and Fuelwood plants

Phanera vahlii (Wight & Arn.) Benth. (CI, 0.20), *Grewia optiva* J.R.Drumm. ex Burret (0.15) and *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb. (0.11) were among the 30 plants having high CI in fodder and fuelwood use category and were utilized widely. Since the present study area is having sub-tropical climatic conditions, that supports the growth of plant species like *Amaranthus blitum*, *Avena sativa* L., *Bauhinia variegata*, *Fumaria indica*, *Grewia optiva*, *Senegalia catechu* and *Phanera vahlii*, which were collected by the locals and the indigenous community for feeding their cattle and meeting their daily fuelwood requirements in such low altitudinal region. While results are in contrast in the high altitudinal regions where

locals collect the woods of *Taxus wallichiana*, *Aesculus indica*, *Juglans regia*, *Cedrus deodara*, *Buxus wallichiana* and *Pinus wallichiana* due to their availability and sustainability in this climatic zone for their fuelwood purposes (Singh *et al.*, 2022).

According to Fitzgerald *et al.* (1990) and Bhattacharya (2015), the use of fuel wood is frequent in developing nations, particularly in areas where it is easily accessible. In India, 49% of families use firewood as their main cooking fuel, according to Kumar *et al.* (2020). The dried logs and branches of plant species like *Butea monosperma*, *Vachellia nilotica*, *Buddleja asiatica*, *Dalbergia sissoo*, *Leuceana leucocephala*, *Pinus roxburgii*, *Tonna ciliata* etc were collected from the forest or the open lands particularly by low-income families as fuelwood for cooking their food and as a source of fire in winters.

4.2.3.3 Religious plants

The CI of *Aegle marmelos* (0.40) in religious category from the study area was in accordance with the study conducted by Guneseakaran & Balasubramanyam (2012) where the said plant was dominantly found in the temples of Tamilnadu where the fruits of the plant species is offered to Lord Shiva while other plants like *Cannabis sativa* (CI = 0.39), *Phyllanthus emblica* (CI = 0.10) were equally served and played role for religious purposes. In the present study, *Cannabis sativa*, *Datura stramonium*, *Ficus benghlensis*, *Ficus populifolia*, *Ficus racemosa*, *Jasminium multiflorum*, *Mangifera indica*, *Mirabilis jalapa*, *Mitragyna parvifolia* (Roxb.) Korth., *Ocimum tenuiflorum*, *Phyllanthus emblica*, *Sesamum indicum* L. and *Ziziphus jujuba* are widely used for religious purposes in one way or another. *Cannabis sativa* leaves are offered to lord shiva on the occasion of Shivratri and the drink made from the leaves known as *Bhaang* is consumed on that day as it is considered to be associated with Lord Shiva. The snacks prepared from the leaves of *Cannabis sativa* are also consumed by the locals. *Sesamum indicum* holds

religious and cultural significance in Jammu as the seeds are used in preparing a sweet known as “*Tilcholi*” on the festival of Lohri that is thrown into the fire as an offering to the sun god (*Surya*) and the fire goddess (*Agni*). This custom shows gratitude for the abundant harvest and asks for good fortune for the upcoming year.

While *Zizyphus jujuba* shrubs are unique in the sense that the newly wed couples take circumambulations (*Rakaade*) around the plant as it is considered auspicious and a ritual in *Dogra* culture. In the present study, ladies used to take bath under the tree namely *Mitragyna parvifolia* (commonly known as *Kaim*) in the month of “Saavan” and consider it auspicious. Its religious and cultural connotations are particularly pronounced in southern India and in places like Vrindavan as it is associated with Lord Krishna. The tree is found in the temple premises or associated with the sacred grooves and village deities. As per the study of Meenakshi Bhaghel (2022) from Meena Tribe of Sawai Madhopur, Rajasthan, some plants including *Mitragyna parvifolia* were recorded considered auspicious by the tribal community and it became a sin to cut down particular plants around Meenas, anyone who attempted to do so was either punished or shunned by the community. The twigs of *Mangifera indica* are used in hawans as it is considered auspicious and keep evil and negative energies away.

4.2.3.4 Miscellaneously used plants

A total of 44 plant species have been utilized under miscellaneous category like *Butea monosperma* (0.45), *Phanera vahlii* (0.37), *Phoenix dactylifera* (0.27). The leaves of *Butea monosperma* were widely utilized by locals in making eco-friendly disposable traditional bowls “*Dunnas*” and traditional plates “*Pattals*” and were utilized in traditional ceremonies and community feasts. Similarly, the large and broad leaves of *Phanera vahlii* are also made into *Dunas* and *Pattals* that are biodegradable and can be easy to compost. This can also pave way for small entrepreneurship to be established so that the underprivileged and locals can earn

for their living. The leaves of *Phanera vahlii* also serves as a source of fodder that are largely collected by the locals to feed their cattle. The leaves of *Butea monosperma* are given to cattle as fodder, while flowers are used to obtain an orange-coloured dye which is further used to dye the fabrics and in religious use as coloured water is offered in temples. Sometimes also used as a natural substitute for Holi colours.

The leaves of *Phoenix dactylifera* were utilized in making house cleaning brooms. Some families were observed in the study area who sustains their earnings by making and selling these brooms made from the leaves of *Phoenix dactylifera* and *Triplidium bengalense*, that could also lead to the revival of the old tradition and the craft methods. Leaves are also utilized in making variously styled baskets for keeping the things, traditional chapati box “*Chabri*”, traditional mats “*Binna*” and even woven hats. In the kutcha houses and in the houses where there exists kutcha floor, the people are in practice of levelling and beautify the floors with the cow dung and after that white paint (obtained from the soil) known as “*Parola*” is done with the help of the paint brushes made from the leaves of *Phoenix dactylifera*, *Eulaliopsis binata* (Retz.) C.E.Hubb. *Vitex negundo* leaves along with the leaves of *Aegle marmelos*, *Mangifera indica* and *Albizia lebbeck* are boiled in water and used for bathing after 11 days of child-birth (postpartum bath). This practice is considered for early recovery of mother and to fulfil a myth prevalent in local people that it makes the mother pure and pious after delivery.

The needles of *Pinus roxburghii* were collected and dried by the locals that were then clustered together and made into tiny brooms for cleaning the small areas like kitchen, pooja rooms etc. Likewise, *Lespedeza juncea* twigs are also made into small brooms for cleaning purposes. Twigs of *Dodonaea viscosa* was utilized as brooms locally known as “*Radka*” by the locals as well as tribals to clean the Kutcha floor, cattle sheds etc. The leaves of *Impatiens balsamina* L. are crushed and applied on hands as Mehndi by the females and small girls. Leaves of *Azadirachta indica* is usually kept in the clothes to keep the insects away. A very unique formula to clean

the brass utensils (*Peetal ke Bartan*) was observed in the villages of study site as the fruit juice of *Citrus pseudolimon Tanaka* was used to wash them. Further, the sponge of dried fruits of *Luffa aegyptiaca* were utilized as sponge in washing utensils by the locals and tribals as it is rough in texture and can clean the utensils effectively. It is observed as a common practice in the rural regions.

The branches of *Grewia optiva* are cut and kept in the water bodies for some times so that the bark fibres get soften and can remove easily. This is then washed thoroughly to extract the fibre from the bark which is then dried and woven to make ropes, mats and other household items. Since the branches of *Grewia optiva* are flexible they are also used to tie the bundles of wheat crop after reaping. The branches of *Ziziphus jujuba* are cut and used for fencing the agricultural fields to protect from grazing cattle. The spine of *Ziziphus jujuba* is frequently used as nose-pin and ear pin by many local and tribals females in the initial stages after ear and nose-piercing that should be given credit as creative thinking by traditional communities in using available resources for both practical and decorative reasons. Hence, personal ornamentation that incorporates natural materials shows a wider cultural awareness for the natural world and its resources.

Some other plant species that are widely utilized by the local people to keep the evil powers away from home were *Achyranthes aspera*, *Albizia lebbeck*, *Asparagus racemosus* and *Vitex negundo* as cultural practice. The twigs of the mentioned plants are hanged on the entrance points and on windows as a belief that they keep the evil or negative powers away on the eve of Diwali.

Unique Reports

The report that newlywed couples take circumbations around the plant *Zizyphus jujuba* to seek blessings is not reported in the available literature and is a unique report from JKUT in cultural sense. *Mitragyna parvifolia* that is associated with Lord Krishna, ladies used to take bath under this tree in the month of *Savan* in JKUT that is not reported in the earlier studies. There is no report in which it is

mentioned that *Phanera vahlii* has high cultural importance in context to fodder and fuelwood from JKUT. The spine of *Ziziphus jujuba* utilized as ear and nose pin by the females is also recorded as a unique report as it is not a common practice shown anywhere to the best of the knowledge.

4.2.3.5 Wild Edible plants (WEPs)

4.2.3.5.1 Diversity and Characteristics of wild edible plants

In the present study a total of 74 taxa of WEPs belonging to 38 families have been reported. Angiosperm was the largest group reported to be used as WEPs represented by 72 members while one species each of gymnosperm and fungi was reported to be consumed. Among angiosperms, 70 plant species were dicots and 2 were monocots. The largest genera belonging to wild edibles were *Dioscorea* and *Ficus* (3 sps. each), *Cucumis* (2 sps) while rest of the genera were having only single species.

The dominant life form of WEPs observed in the study area was of herbs (26 sps) followed by trees (23 sps), Shrubs (11 sps) and climbers (10 sps). The study previously carried out by (Rashid *et al.*, 2008), Dangwal *et al.*, 2014) also reported herbs to be the main source of forest foods consumed by Gujjar and Bakarwal tribes of district Rajouri, Garo tribe of Meghalaya (Singh *et al.*, 2012), tribal area of western Himalayas (Thakur *et al.*, 2017), Sheena tribe of Kashmir (Singh and Bedi, 2018), Galo tribe of Arunachal Pradesh (Doni and Gajure, 2020), Paddar valley Jammu division, (Singh *et al.*, 2021). According to Thakur *et al.* (2017), indigenous communities like the Bhangalis and Gaddis have a long history of using wild herbs in areas like the western Himalayas. For instance, the Bhangali group reported consuming 50 plant species, with herbs accounting for 56% of their wild edible plants. These plants are essential to regional cuisines and traditional remedies. This information is transmitted from one generation to the next, guaranteeing the plants' continuous usage and preservation. Wild herbs are frequently free to collect, making them an economically viable food source for marginalized population. This is

especially significant in rural places when economic restrictions prevent access to commercial food markets. Bhatia *et al.*, 2018; Showkat and Akhtar, 2018, Farooq, (2021) have also reported different parts of herbs to be consumed as wild edibles.

Among the wild edible plant species in the study area maximum contribution was observed for the members of family Fabaceae (11 sps) followed by Cucurbitaceae (6sps), Moraceae (5 sps.), Rutaceae (4 sps), Rosaceae, Malvaceae, Dioscoreaceae (3 sps each). Rest all the families were having one-two plant species which were utilized as wild edibles. The subtropical climate of the study area supports the growth of the representative members of the dominant families. This is also validated from the research carried out by Bhatia *et al.* (2018). Their easy availability and nutritional value make them common in wild edible category.

Fruits (57%), Leaves (33.3%) were the commonly consumed plant part either in raw or cooked form. This is also in accordance to Singh *et al.* (2021). While Tubers (5.5%), Flowers and seeds were contributing (4.1%) each.

Role of wild edible plants in local diet: The locals and tribals of the study area use a large number of WEPs for meeting their dietary and nutritional requirements. For the convenience of the study the documented 74 wild edible plants were categorized into four usage categories mentioned below:

A. Vegetable: Thirty-six plant species have been recorded that are being cooked and consumed as vegetables. This category further includes following five subcategories.

Leaves cooked as vegetable: This category includes 23 plant species the leaves of which are cooked and consumed as vegetable. The most commonly used species are *Malva pusilla*, *Chenopodium album*, *Amaranthus blitum*, and *Portulaca oleracea* L., *Lathyrus aphaca*, *Medicago sativa*, *Rumex acetosa* L., and *Senna tora*.

Mushroom cooked as vegetable: In the present study, one species of edible fungus is recorded namely *Morchella esculenta* Fr. commonly known as *Gucchhi* (CI = 0.18), is a local delicacy. The fungus is prominent particularly in Mountainous and

temperate woods, for its distinctive look, culinary worth, and cultural importance. It is cooked as Pulao, soups and as vegetable. The fruiting bodies are utilised in traditional medicine as well as having commercial importance for livelihoods reliant on forests as it is highly costly.

Morchella esculenta is usually found in the higher reaches of Doda, Bhaderwah, Kishtwar, Bani etc from UT of J&K, but it is also found in the low altitudinal region of study area. The locals were observed to trade this mushroom at a high rate of app. Rs. 4000-10000/kg to the vendors and earn their livelihood. So, the locals are dependent on this edible fungus which are hard to collect in the season.

Fruits cooked as vegetable: The present study reported nine species, the fruits of which are cooked and consumed as vegetable viz. *Bombax ceiba*, *Coccinia grandis*, *Cordia dichotoma*, *Euphorbia royleana* Boiss., *Luffa acutangula*, *Momordica charantia*, *Moringa oleifera*, *Terminalia chebula* Retz. and *Trichosanthes cucumerina* L. The highest CI was recorded for *Cordia dichotoma* (CI = 0.27) followed by *Coccinia grandis* (CI = 0.14) and *Momordica charantia* (CI = 0.10).

Flowers cooked as vegetable: Two species namely *Bauhinia variegata* (CI = 0.17) and *Telosma pallida* belongs to this sub-category of vegetables. Kachnar flower raita is prepared in yogurt.

Tubers cooked as vegetable: Three species belonging to genus *Dioscorea* viz. *D. bellophylla*, (CI = 0.13), *D. bulbifera* (CI = 0.07) and *D. pentaphylla* (CI = 0.15) belongs to this sub category. The said genus is a climber bearing edible tubers that are nutritious and are cooked and consumed widely by the locals.

B. Raw: Thirty-two species have been reported having edible parts being eaten as raw form. It is further categorized into different sub-categories.

Raw fruits: The tribal people like Gujjar and Bakarwal spend almost whole day in the forest area for grazing their livestock and collecting fuelwood from the forest area. While navigating in the slopy terrains, steep mountains the body gets exhausted and needs strength. In that situation, wild edible fruits may likely provide that

endurance to the body. They encounter with number of plant species whose fruits can be eaten as raw. Fruits of the plants viz. *Broussonetia papyrifera*, *Carrissa spinarum*, *Citrus medica* L., *Cucumis sativus*, *Euphorbia royleana* Boiss., *Ficus auriculata*, *F. palmata*, *Flacourtia indica* (Burm.f.) Merr., *Morus alba*, *Phoenix dactylifera*, *Phyllanthus emblica* L., *Psidium guajava*, *Zizyphus jujuba* etc are consumed in raw form that have the potential of providing energy.

Seeds consumed Raw: Three species viz. *Pinus roxburgii* (CI = 0.25), *Sesamum indicum*

L. (CI = 0.03) and *Physalis angulata* L. (CI = 0.03) are reported under this sub-category. Mostly seeds are consumed as raw and also in roasted form.

Flowers nectar consumed raw: The flower nectar of three plant species viz. *Butea monosperma* (CI = 0.01), *Justicia adhatoda* (CI = 0.27) and *Woodfordia fruticosa* (L.) Kurz (CI = 0.12) were recorded to be consumed by small children as a source of fun and occasionally by locals also. Plucking the flowers and sucking their nectar not as a source of food but just for fun and joy plays role in making the kids familiar with their local flora.

C. Preserved food: This category includes pickles and murabba. A total of eleven species of plants belongs to this category viz. *Cordia dichotoma* (CI = 0.34), *Citrus pseudolimon* Tanaka (CI = 0.17), *Moringa oleifera* (CI = 0.11) and *Mangifera indica* (CI = 0.09) are being preserved as pickles by the locals as well as tribals. While the fruits of *Phyllanthus emblica* L. (CI = 0.47) and *Terminalia chebula* Retz. (CI = 0.09) are both preserved as pickle and murabba. The fruit pulp of *Mangifera indica* is made into Aam Papad and sold in the market by the locals for earning their livelihood.

D. Chutney: This category includes different parts of plant species like leaves of *Mentha spicata* L. and *Oxalis corniculata*, raw fruits of *Mangifera indica* and *Phyllanthus emblica* L. that are crushed and consumed as delicious chutney.

Certain plants species are consumed because of their medicinal values. Plant species like *Aegle marmelos*, *Amaranthus blitum*, *Apteranthes tuberculata*, *Carrisa spinarum*, *Cocinia grandis*, *Cordia dichotoma*, *Psidium guajava*, *Pueraria tuberosa*, *Sygygium cumini*, *Momordica charantia*, *Morus alba*, *Murraya koengii*, *Terminalia chebula* Retz. etc are having the nutraceutical properties that also helps in preventing certain ailments, due to which they are being consumed as food or as part of food.

4.2.3.5.2 Current status of traditional knowledge of WEPs

The tribal populations are not permanently residing in the study area as they used to migrate from higher reaches of Kishtwar, Bhaderwah, Doda and even from Kashmir valley during winters when there is cold spell in the mountainous slopes. They all gets migrate towards the lower altitudinal belts like the area under study along with their sheep flocks, cattles, horses, and *Bakarwali dogs*. During their migration they have to rely on these WEPs as their dietary requirements for which the ethnobotanical knowledge is significant, but it faces several challenges that threaten its survival. The younger generations don't have enough knowledge pertaining to WEPs due to loss of interest, modernization, easy access to market food etc.

Some of the wild edible plant species like *Malva pusilla*, *Lathyrus aphaca*, *Medicago sativa*, *Oxalis corniculata* L. etc which were once widely cooked and consumed as vegetables due to their abundance are now missing in their diet due to loss of the traditional knowledge. It may also be attributed to the over-exploitation, habitat loss and climatic conditions.

In this modern era, the young individuals prefer modern foods over the traditional wild edibles. Wild edibles are only taken by them as fun activity as forced to taste by their parents. Mostly children are aware of the common wild fruits like *Mangifera indica*, *Morus alba*, *Psidium guajava*, *Syzygium cumini*, *Carrissa spinarum* etc and are unaware of the consumption of the wild fruits like *Aegle marmelos*, *Bombax ceiba*, *Dioscorea belophylla* (Prain) Voigt ex Haines, *Diospyros diversilimba*, *Ficus auriculata*, *Flacourtia indica*, *Physalis angulata* L. etc, which should be given due

importance. This knowledge is getting depleted day by day as the younger generation is becoming more sophisticated due to modern facilities and are losing connection with the traditional practices that their forefathers and parents have gone through. Efforts are required to pass down this traditional knowledge orally and may be taken care of, by this generation.

The traditional knowledge pertaining to WEPs from the study site have not been documented earlier and getting diminished with the deaths of knowledgeable older generations. In light of the obvious threat to traditional knowledge in the future, there was a dire need to document and preserve these WEPs before they get entirely lost. The protection of endangered wild edible plant species should be promoted through local conservation strategies that include growing wild edible plants and using sustainable harvesting techniques.

4.2.3.5.3 Wild Edibles- Future Economic perspective

Aegle marmelos, commonly known as *Bael*, a medicinally, religiously, ethnoveterinary and is important wild edible plant species. Due to its cultural significance and nutritional advantages, *bael* fruit has a lot of potential for market growth in JKUT. So, the locals have been encouraged to sell the fruits for their sustainable living. The fruits of *Artocarpus lacucha* Buch.-Ham is preserved as pickle and has observed to have its own significance to be sold in the local markets of JKUT as it is not popular among communities of the Union Territory. Efforts must be put to cultivate this tree for its sustainable utilization. The cultivation of underutilized plant species, *Carrissa spinarum* also requires due attention as the fruits are sweet, delicious and have nutraceutical properties (Sheeba and Nazareth, (2021) that can have the scope of selling in the local market.

The population of the herbaceous plant species like *Amaranthus blitum*, *Chenopodium album* that are rich in protein, Vitamins, calcium were seen growing in the wild habitats only. There is a strong scope of selling them in the local market for their leafy vegetable. Efforts must be put for the cultivation of these important plant species. Similarly, *Malva pusilla*, can also be included in health food markets

and goods based on traditional medicine because of its dietary content and adaptability though it grows in wild and is being diminishing from the modern dining plates that may otherwise was known to the traditional and indigenous people. *Medicago sativa* known as alfalfa was utilized by the locals as leafy vegetable for its nutritious content. However, the consumption is declined either due to its bitter taste which may not be appealing to the today's generation or due to its outdated socio-economic status. Now a days, it is utilized as fodder crop in India, which may reduce the inclusion of this vegetable in local markets. So, efforts can be made to revive the utilization of this leafy vegetable in the meals. Likewise, *Rumex acetosa* commonly known as *Jagli palak* is also an underutilized leafy vegetable which may find its place in local meals and in markets.

The fruit-bearing tree *Ficus palmata*, often called the Wild Himalayan Fig "*Fagade*" is indigenous to the Himalayas and is often neglected. Its edible fruits need attention due to its therapeutic and nutritional qualities, which offers prospects for market growth and to earn livelihood by the locals. Similarly, the fruits of *Sygygium cumini* holds special place in the local markets of Jammu during Summers that are serving the purpose of helping the local needy people for sustainable living.

4.2.3.5.4 Novelty and future prospects of WEPs

Although majority of the plant species reported finds its edible usage in the previous studies carried out from different regions of UT of J&K particularly from low altitudinal areas. Some species like seeds of *Physalis angulata* L., tubers of *Dioscorea pentaphylla* L., fruits of *Broussonetia papyrifera*, flowers of *Butea monosperma*, fruits of *Cucumis mederaspatanus*, and *Diospyros diversilimba* are new record from UT of J&K. There is need to further validate the pharmacological, toxicological and nutritional studies for these species in future.

4.2.3.6 Plants used as Traditional products (PTPs)

4.2.3.6.1 Diversity and Characteristics of plants used for making plant based

traditional products

A total of 18 plant species were recorded from the study area used by locals and tribals to make various traditional plant products. All the plants were angiosperms belonging to

11 families. Dicots were represented by 14 species and monocots by 5 species. Most of the species belonged to family Fabaceae (4sps.) and Poaceae (3 sps.) while Anacardiaceae and Malvaceae were represented by 2 sps. each and rest of the families were having one sps each.

Trees (9 species) were the most used life form followed by shrubs (6sps), herbs (4sps) and climber (1 sp.). All the PTPs were made by using different plant parts like stem, branches, leaves and culms. Branches (50%) were the most used plant parts followed by stem and leaves (27.7%) each and culms (11.1%).

Out of the total plant species used in making PTPs, 4 were used in making agricultural tools like Sickle, axe, hand held chopper etc. 4 species in making brooms for cleaning the houses, 4 species in making ropes for tying the objects, 2 species in making items like mats, hats, baskets etc, 2 in making furniture items, two in making traditional beds (*Khaats/manji*) and two in making traditional bowls (*Dunas*) and plates (*Pattals*). One species is used for fencing the agricultural fields while one was used in making the roofs of the *Kutchha* houses.

The important plant species utilized in making plant based traditional products was *Dodonaea viscosa* (CI = 0.16), *Phoenix dactylifera* (CI = 0.14), *Grewia optiva*, and *Leucaena leucocephala* (CI = 0.08) each.

Previous studies performed by Arif *et al.* (2021), *Dodonaea viscosa* was mentioned as being used in making walking sticks, thatching, fuelwood, fodder, hedge, fencing, agricultural products and in handicrafts. However, the major role of wood was for fuel purpose. Another study by Ajaib *et al.* (2010) reported the species to play important role for the said purpose. Amjad and Arshad. (2014) also observed the utilization of the plant species mainly as fuelwood. The current study observed the

focus of *Dodonaea viscosa* in making the agricultural implements by the locals like the handles of sickle (*Dharati*), axe (*Koadu*), hoe (*Kei*), soil tiller (*Khurpi*), spade (*Belcha*), cutting tool (*Toka*) etc. Further, the twigs of *Dodonaea viscosa* are utilized by the local populace as fencing around their agricultural fields in order to protect from grazing animals. The twigs are arranged in a flat manner to make doors of cattle sheds and even the door of their boundary walls of their home or land. The roof of cattle sheds and some sheds alongside the roads for rest and waiting purpose were observed to be made from the twigs of *Dodonaea viscosa*. The wood is also used in making the sitting tools.

The wood of a number of other plant species viz. *Leuceanea leucocephala*, *Lannea coromandelica*, *Grewia optiva*, *Senegalia catechu* and *Toona ciliata* are utilized to make the handles of the agricultural products and small tools (*Benti*) for sitting purpose. The frame of traditional beds *Khaats/Manji* is made from the wood of *Leucaena leucocephala* and *Albizia lebbeck* and the fibre obtained from *Opuntia dilenii* is utilized to make ropes (*Sann*) that is further used to weave the sleeping area of the traditional bed *Manji*. The wood of *Senegalia catechu* is reported to be crafted in traditional weaving tool - the *Charkha* by the tribals. The traditional pestle and Mortar (*Chathhu Batta*) that is used to grind the things or made powder are made from the wood of *Senegalia catechu*.

For cleaning the floors in the rural areas, the leaves of *Tripedium benghalense* are collected and bundled together to make brooms. Many rural communities make brooms from this grass in huge quantities and sell them in local marketplaces to make their living, that provides a source of revenue.

Further, the wood of *Dalbergia sissoo* locally known as *Talli* is used to make furniture items like beds, sofa sets, chairs etc. In modern lifestyles as of today, the bride is given farewell to her husband's home in luxury cars after their wedding, but in past times bride used to take departure from her parental home to her in-law's home in a small cabinet type mode of transport known by the name "*Doli*" in Dogra culture. Though it is an outdated practice and is extinct now a days, the author

recorded this mode of transport when discussing about the PTPs with the interviewers. Some of the respondents mention the use of durable wood of *Dalbergia sissoo* in framing and crafting *Doli*. Efforts must be put to revive the utilization of vanished *Doli* culture through the present study.

Mangifera indica, the kings of all fruits, the leaves of this tree are utilized in the traditional way of local Dogra culture as they are considered auspicious for festive decorations. The leaves are arranged in a beautiful hanging manner known as “*Torans*” and tied on the doors and windows on marriage ceremonies, festivals and other occasions. The twigs of mango tree are utilized in *hawans* of various occasions as they are considered auspicious, that wipes out the evil powers and negativities from homes.

The ropes are made by twisting the grass species like *Eulaliopsis binata* (Retz.) C.E.Hubb. and *Erioscirpus comosus* (Wall.) Palla which are used in the fields for tying the bundles of fodder collected or the harvested crops as an alternative to the plastic ropes. Fibre obtained from wild jute plant *Corchorus aestuans* is also made into ropes to tie light weight products as it obtains low strength fibre in comparison to *Boehmeria virgata* (G. Forst.) Guill. the stem of which provides high strength fibre for making ropes and nets. The culms of *Arundo donax L.* are utilized to make storage containers like Baskets to carry things and are sold in the local markets. Mats and hats were also observed to be woven with the culms of *Arundo donax L.* in the study area that makes it an important PTP.

4.2.3.6.2 Current status of traditional knowledge of tribes and locals on PTPs

Tribal communities' traditional expertise on plant-based goods serves as a storehouse of environmentally friendly methods and cultural legacy. Even though there are many obstacles to its preservation, coordinated efforts through documentation, legal safeguards, and community-based programs provide opportunities to preserve and revive this priceless information for coming generations. As the young individuals of locals used to embrace a modern lifestyle,

the knowledge of these PTPs is vanishing as it not passing in their descendants. While the tribal generations have not been engaged in the modern lifestyle yet, the younger individuals were having the knowledge held by their forefathers.

The utilization of the traditional plant-based products by the locals may be considered as vulnerable aspect of oral tradition and sustainable living. Due to modernization and adoption of new lifestyles, the oral traditional knowledge is getting depleted day by day and the younger generation is getting away from the natural systems and disregards this valuable traditional knowledge pertaining to plant-based products. The information and utilization of PTPs like *Darati*, *Koadu*, *Toka*, *Bongdu*, *Khurpa* etc as agricultural tools is hardly known to them as they are busy with the modern lifestyles. *Manjis* are being replaced by foam and sophisticated mattresses, while brooms made from grass species used in earlier times have been replaced by the plastic brooms now-a-days that is hampering the traditional knowledge lineage. *Doli* (palanquin) which was used to transport the bride to her in-law's home after marriage is constructed from the wood of *Dalbergia sissoo Roxb. ex DC.*, decorated with colourful fabrics and beautiful carvings has completely been obsoleted that once represented the traditional culture. The smaller kids of today even don't knew the meaning of *Doli* that is something to worry about the diminishing traditional knowledge among younger generation.

Hence, traditional plant-based approaches could be seen by younger people as outdated or unnecessary in today's world. The perception may deter others from seeking out and sharing this knowledge, which could cause it to gradually fade away.

4.2.3.6.3 Novelty of PTPs

Some of the plant species are the first report from UT of J&K that finds its use in the construction of some unique objects. Like, there is the report of *Charkha* making from the wood of *Leucaena leucocephala* from the study site. The usage of

Senegalia catechu wood in *Charkha* making is also a novel report from Jammu and Kashmir as observed among the tribal community. Due to the durability of wood of *Dalbergia sissoo*, it is used in the construction of *Doli* (palanquin) in UT of J&K and no such report is there to the best of my knowledge. The traditional pestle and mortar used to grind the materials is made by the wood of *Senegalia catechu* (L.f.) P.J.H. Hurter & Mabb. which is a novel report.

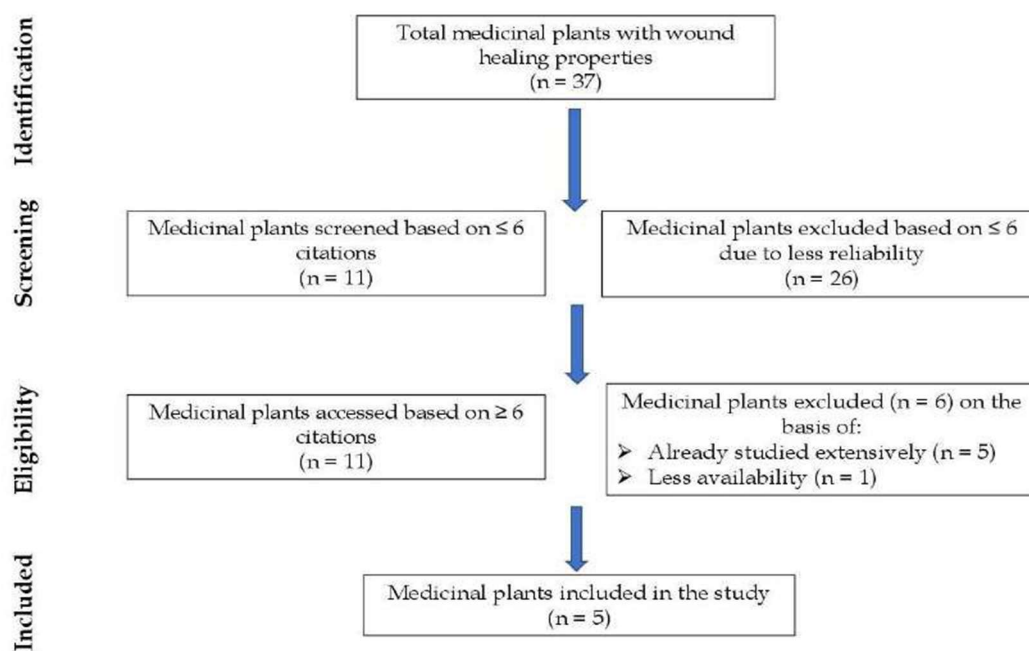
4.3 Antimicrobial activity

Plant-based traditional medicine plays a vital role in healthcare, particularly in developing countries. However, the rising incidence of antibiotic-resistant microbial pathogens has become an alarming problem. Therefore, discovering and developing novel antibacterial compounds with minimal or no side effects is crucial. Due to the side effects of antimicrobial agents, many people are using natural bioactive alternatives for their primary healthcare.

Antimicrobial activity is defined as the ability of any compound which kills the growth of microbes or have inhibitory effects on other microbes, fungi or bacteria. This assay was performed for some selected plants based on their high use value and diverse microbial strains to provide a comprehensive assessment of the antimicrobial potential of the medicinal plants under investigation. The size of the inhibition zone in antimicrobial assays serves as a crucial indicator of a plant sample's antimicrobial potency. Larger inhibition zones signify more effective antimicrobial activity against the test microorganism. The results from these assays not only validate the traditional medicinal applications of various plants but also identify promising candidates for further investigation. The most effective plant extracts can then undergo purification and characterization to isolate the active antimicrobial compounds. Extracts from various plants have demonstrated considerable antibacterial capabilities, validating these plants' traditional medicinal applications.

A total of 37 plants were having the property of healing wounds in the present study.

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) like analysis was performed for the selection of species to be tested for their antimicrobial properties. Screening analysis segregated 11 species on the basis of high number of citations. In total 26 species were excluded on the basis of having less than 6 citations as fewer citations means less reliability. The 11 screened species were subjected to eligibility analysis. The eligibility analysis further suggested the exclusion of 6 species based on already extensively studies ($n = 5$) and insufficient availability ($n = 1$). Finally, 5 species were selected for the antimicrobial studies due to; (i) their popularity amongst the informants as evident from the high citations, (ii) fewer antimicrobial studies, and (iii) sufficient availability in the study site.



Flowchart of PRISMA for the selection of plants for testing antimicrobial properties

The Minimum Inhibitory Concentration (MIC) is a critical parameter in evaluating antimicrobial agents which is defined as the lowest concentration that prevents visible microbial growth, the MIC helps determine the potency of antimicrobial compounds. This information is particularly valuable in the context of rising

antibiotic resistance among microbial pathogens, which has become a significant global health concern. The urgent need for novel antibacterial compounds with minimal side effects has led to increased interest in plant-based traditional medicine, especially in developing countries. The Minimum inhibitory concentration (MIC) was performed only for that plant species that exhibited maximum inhibitory effect against particular microorganism like (Chloroform and n-hexane extract of *Acorus calamus* against *Enterococcus coli*, Chloroform extract of *A. calamus* against *Enterococcus faecalis*, n-hexane extract of *A. calamus* against *Staphylococcus aureus*, methanolic extracts of *Dodonaea viscosa* and *Litsea glutinosa* against *Proteus mirabilis* and *E. faecalis*, respectively (Table 4.11).

Table 4.11. Antimicrobial susceptibility test of *Acorus calamus* L., *Vitex negundo* L., *Adiantum caudatum* L., *Dodonaea viscosa* Jacq. and *Litsea glutinosa* (Lour.) C.B. Rob. against *E. coli*, *E. faecalis*, and *S. aureus*.

sample	<i>E. coli</i>			<i>E. faecalis</i>			<i>S. aureus</i>		
	Chl.	Meth.	n-hex	Chl.	Meth.	n-hex.	Chl.	Meth.	n-hex
<i>Acorus calamus</i>	+ve	-ve	+ve	+ve	-ve	+ve	-ve	+ve	+ve
<i>Vitex negundo</i>	-ve	-ve	-ve	-ve	+ve	-ve	-ve	+ve	-ve
<i>Adiantum caudatum</i>	-ve	-ve	-ve	-ve	+ve	+ve	-ve	+ve	+ve
<i>Dodonaea viscosa</i>	-ve	+ve	-ve	-ve	+ve	-ve	-ve	+ve	-ve
<i>Litsea glutinosa</i>	-ve	+ve	-ve	-ve	+ve	-ve	-ve	+ve	-ve

4.3.1. *Acorus calamus* L.

Acorus calamus rhizome extracts (Chloroform, methanol and n-hexane) exhibited strong antimicrobial activity against *E. coli*, *S. aureus*, and *E. faecalis*, as evidenced by both Zone of inhibition (ZOI) and MIC assays (Fig. 4.13-4.16). Among the three solvent extracts, n-hexane extract of rhizome of *Acorus calamus* was most effective, particularly against *E. coli* and *S. aureus*, showing strong and dose-dependent antimicrobial activity (Table 4.12). Kongkham *et al.*, 2024 validated the present result. Same results were shown by Rahamoz-Haghighi (2014) where hexane extract was effectively inhibiting the growth of *E. coli* and *S. aureus*. Chloroform extract was effective against *E. coli* and *E. faecalis* but ineffective against *S. aureus*. Methanolic extract demonstrated minimal to no antimicrobial activity against all tested strains, indicating that the active antimicrobial constituents of *A. calamus* may be more soluble in non-polar solvents like n-hexane and chloroform.

The MIC results demonstrated that both chloroform and n-hexane extracts *A. calamus* exhibit concentration-dependent antibacterial activity. The n-hexane extract showed strong inhibition against *E. coli*, as evidenced by a consistent and marked decrease in OD values, indicating potent antibacterial efficacy (Table 4.13 & 4.14). The chloroform extract was comparatively more effective against *E. faecalis*, although slight fluctuations at higher concentrations suggest partial inhibition. Moderate activity was observed against *S. aureus* with the n-hexane extract, showing a steady but less pronounced reduction in bacterial growth.



Figure 4.13: Dried, grinded, methanolic, chloroform and n – hexane extract of *A. calamus*

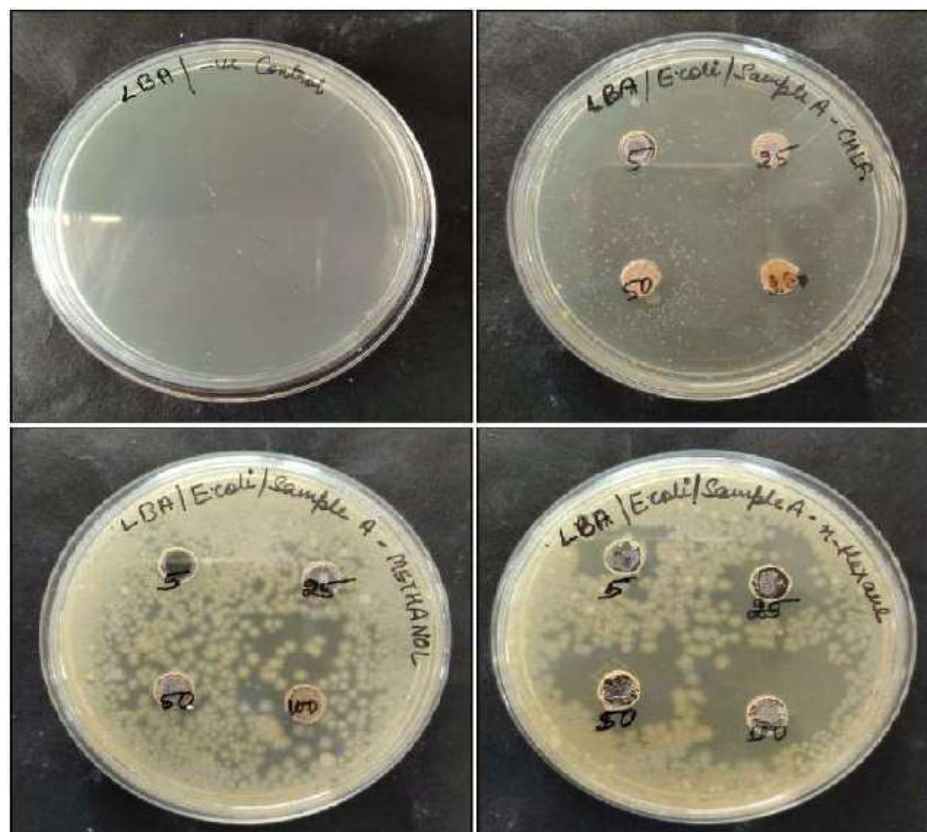


Figure 4.14: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of rhizome of *A. calamus* against *E. coli*.



Figure 4.15: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of rhizome of *A. calamus* against *E. faecalis*.

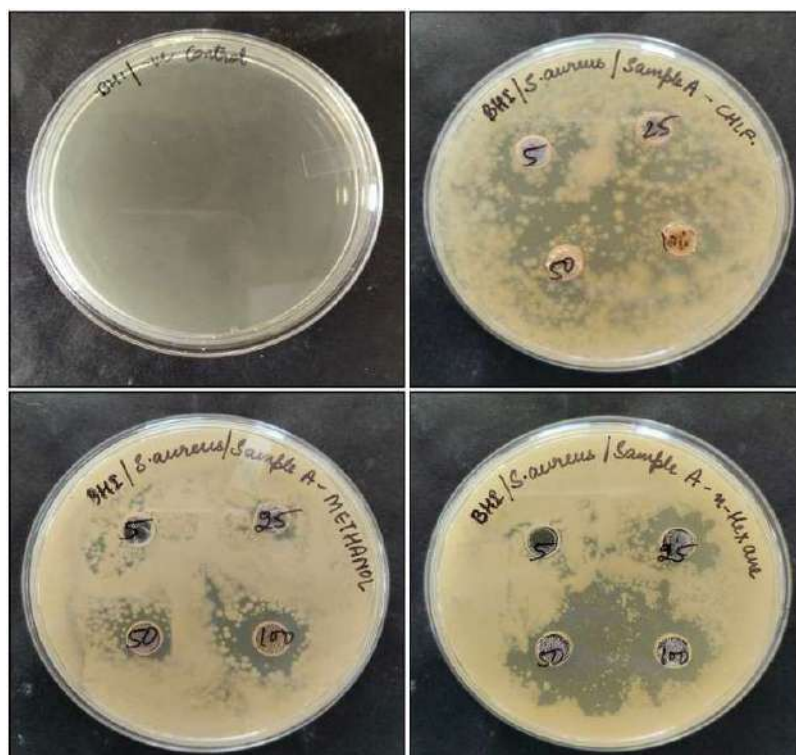


Figure 4.16: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of rhizome of *A. calamus* against *S. aureus*.

Table 4.12: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of rhizome of *A. calamus* against *E. coli*, *S. aureus* and *E. faecalis*.

Microbe	Volume	ZOI (mm)		
		Methanol	Chloroform	n - hexane
<i>E. coli</i>	5	0	0	0
	25	0	12.25 $\pm$ 0.20	15 $\pm$ 1
	50	0	14.50 $\pm$ 0.15	20 $\pm$ 0
	100	0	20 $\pm$ 0	25.33 $\pm$ 1.53
<i>S. aureus</i>	5	0	0	0
	25	0	0	9 $\pm$ 0
	50	11 $\pm$ 0	0	18.67 $\pm$ 0.58
	100	15 $\pm$ 0	0	20 $\pm$ 1
<i>E. faecalis</i>	5	0	10 $\pm$ 0	0
	25	0	15 $\pm$ 1	0
	50	0	17.33 $\pm$ 0.58	10 $\pm$ 0
	100	0	18 $\pm$ 1	19 $\pm$ 1

Minimum Inhibitory Concentration Test (MIC)

E. coli, *E. faecalis* and *S. aureus* cultures were cultured in LB broth and BHI broth media, respectively for 24 hours. Four test tubes of LB broth and eight test tubes of BHI broth media were prepared and autoclaved. To this LB broth *E. coli* and to BHI broth *E. faecalis* and *S. aureus* were inoculated 100 μ L, while the respective sample of different volumes (50, 100, 150, 200 μ L) was added to the media, and incubated for 24 hours at 37° C. After incubation, absorbance was noted at 600 nm using UV spectrophotometer.

Table 4.13: Minimum Inhibitory Concentration Test of chloroform and n-hexane extracts of rhizome of *A. calamus* against *E. coli*

S.No.	Sample	OD @ 600 nm	
		Chloroform	n - hexane
1	50	0.754	0.540
2	80	0.590	0.370
3	100	0.451	0.246
4	110	0.435	0.210
5	130	0.432	0.175
6	150	0.425	0.145
7	170	0.426	0.138
8	180	0.424	0.134
9	190	0.422	0.131
10	200	0.421	0.129

Table 4.14: Minimum Inhibitory Concentration Test of Chloroform and n-hexane extracts of rhizome of *A. calamus* against *E. faecalis* and *S. aureus*, respectively.

S.No.	Sample	OD @ 600 nm	
		<i>E. faecalis</i>	<i>S. aureus</i>
		Chloroform	n - hexane
1	50	0.634	0.654
2	80	0.470	0.525
3	100	0.331	0.427
4	110	0.310	0.390
5	130	0.281	0.355
6	150	0.259	0.329
7	170	0.264	0.320
8	180	0.265	0.316
9	190	0.261	0.313
10	200	0.266	0.311

4.3.2 *Vitex negundo* L. (Fig. 4.17 – 4.20)

The chloroform, methanol and n-hexane leaf extract of *V. negundo* showed no antibacterial activity against *E. coli*. Methanolic extract showed minimum activity against *E. faecalis* and *S. aureus* only at higher concentrations viz 50 and 100 μ L while no activity was observed in Chloroform and n-hexane extract against *E. faecalis* and *S. aureus* (Table 4.15). As per the previous studies conducted by Gautam *et al.*, 2008; Chowhury *et al.*, 2009; Rose *et al.*, 2011; Malathi *et al.*, 2011; Moanraj *et al.*, 2012; Sorifull, 2013; Sunita *et al.*, 2014; methanolic leaf extracts of *Vitex negundo* showed effective antimicrobial activity against *E. coli* and *S. aureus*.



Figure 4.17: Dried, grinded, and ethanol, chloroform and n – hexane extract of *Vitex negundo*



Figure 4.18: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *V. negundo* against *E. coli*.



Figure 4.19: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *V. negundo* against *E. faecalis*

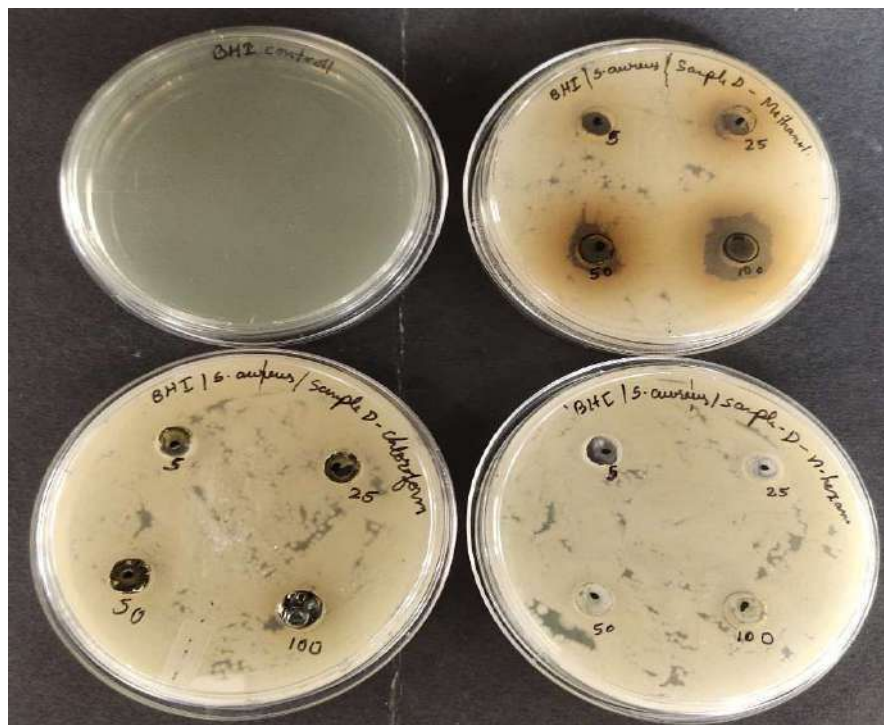


Figure 4.20: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts *V. negundo* against *S. aureus*.

Table 4.15: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of leaves of *Vitex negundo* against *E. coli*, *S. aureus* and *E. faecalis*.

microbe	volume	ZOI (mm)		
		Methanol	Chloroform	n- hexane
<i>E. coli</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	0	0	0
<i>E. faecalis</i>	5	0	0	0
	25	0	0	0
	50	6.0 ± 0	0	0
	100	10.0 ± 0	0	0
<i>S. aureus</i>	5	0	0	0
	25	0	0	0
	50	5.0 ± 0	0	0
	100	10.0 ± 1	0	0

4.3.3 *Adiantum caudatum* L. (Fig. 4.21 – 4.24)

Methanolic and n-hexane leaf extracts of *A. caudatum* showed limited antimicrobial activity against *E. faecalis* and *S. aureus* at high concentration of 100 µL while

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no inhibitory effect was observed against *E. coli* in any of the extracts viz. Chloroform, methanolic and n-hexane (Table 4.16). Mehmood *et al.*, (1989) showed high antimicrobial activity of methanolic extracts against *E. coli* and *S. aureus* in another species of *Adiantum* i.e *A. capillus veneris*. The study by Ahmed *et al.*, (2015) is also in accordance with the present study where Methanolic and n hexane extracts showed limited antimicrobial activity against *E. coli* but higher against *Pseudomonas aeruginosa*.



Figure 4.21: Dried, grinded, and ethanol, chloroform and n – hexane extract of *A. caudatum*



Figure 4.22: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *A. caudatum* against *E. coli*.



Figure 4.23: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *A. caudatum* against *E. faecalis*



Figure 4.24: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *A. caudatum* against *S. aureus*

Table 4.16: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of leaves of *Adiantum caudatum* against *E. coli*, *S. aureus* and *E. faecalis*.

Microbe	Volume	ZOI (mm)		
		Methanol	Chloroform	n – hexane
<i>E. coli</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	0	0	0
<i>E. faecalis</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	12 ± 0.50	0	10 ± 0.25
<i>S. aureus</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	12.33 ± 0.50	0	14.25 ± 0.15

4.3.4 *Dodonaea viscosa* Jacq. (Fig. 4.25 – 4.33)

The methanolic extract of *D. viscosa* exhibited strong and broad-spectrum antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, and *Enterococcus faecalis*, with zones of inhibition increasing proportionally with concentration.



Figure 4.25: Dried, grinded, and ethanol, chloroform and n – hexane extract of *D. viscosa*

D. viscosa extracts were also tested against some other microorganisms. The n-hexane extract of *D. viscosa* showed strong inhibitory effects against *Proteus mirabilis*, and moderate activity against *M. luteus*. While chloroform extract showed strong inhibitory effects against *P.mirabilis*. (Table 4.17 & 4.18). Because of its traditional use, a significant amount of research has been conducted by various

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researchers. They isolated the individual plants and researched on the biological activities of the plant extracts. A few of them separated the physiologically active substances and assessed their bioactivity using different models (AL-Oraimi and Hossain, 2016; Khaloud and Hossain, 2016). All of the components and extracts from the selected plant were shown to have the potential to be pharmacologically active in earlier studies. The potential activity of the plant extracts may be explained by their chemical constituents (Abdel-Mogib *et al.*, 2010; Wabo *et al.*, 2012; Lai-Bin *et al.*, 2012; Akhtar *et al.*, 2012a, 2012b). The results showed that *D. viscosa* contains more potent antimicrobial compounds, particularly in methanol and n-hexane extracts, with activity dependent on both solvent polarity and concentration.



Figure 4.26: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *E. coli*.



Figure 4.27: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *E. faecalis*

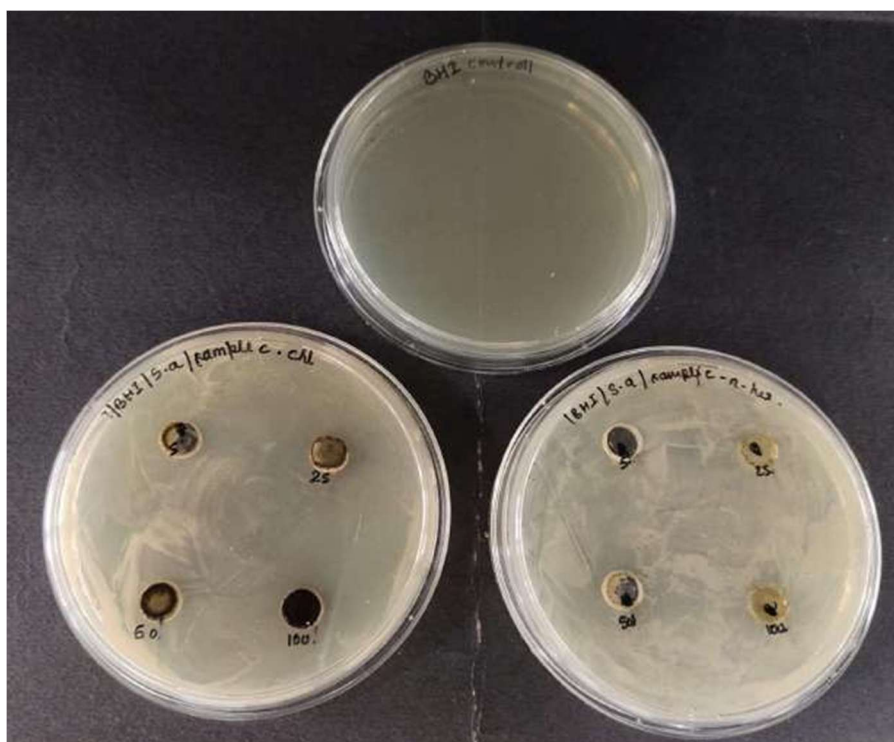


Figure 4.28: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *S. aureus*.



Figure 4.29: Antimicrobial Susceptibility Test of Methanol extract of *D. viscosa* against *E. coli*, *E. faecalis*, *S. aureus*



Figure 4.30: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *M. luteus*



Figure 4.31: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *Proteus mirabilis*



Figure 4.32: Antimicrobial Susceptibility Test of chloroform and n-hexane extracts of *D. viscosa* against *Serratia marcescens*

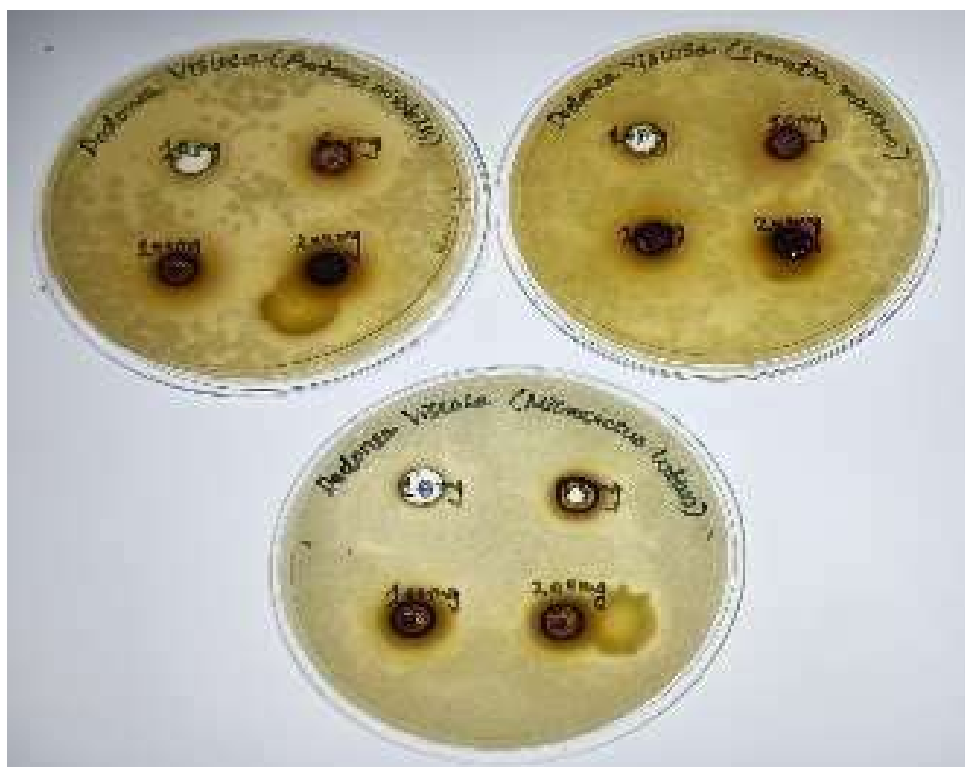


Figure 4.33: Antimicrobial Susceptibility Test of methanolic extracts of *D. viscosa* against *P. mirabilis*, *M. luteus* and *Serratia marcescens*

Table 4.17: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of leaves of *Dodonaea viscosa* against *E. coli*, *S. aureus* and *E. faecalis*.

Microbe	Volume	ZOI (mm)		
		Methanol	Chloroform	n – hexane
<i>E. coli</i>	5	15.33 ± 0.58	0	0
	25	23.67 ± 0.58	0	0
	50	29.27 ± 0.64	0	0
	100	29.33 ± 0.58	0	0
<i>S. aureus</i>	5	18.63 ± 1.10	0	0
	25	21.97 ± 1.05	0	0
	50	23.33 ± 0.58	0	0
	100	24.33 ± 0.58	0	0
<i>E. faecalis</i>	5	0	0	0
	25	13.17 ± 0.76	0	0
	50	14.03 ± 0.95	0	0
	100	17 ± 0.00	0	0
<i>M. luteus</i>	5	0	0	11 ± 0.00
	25	0	0	11.27 ± 0.23
	50	18 ± 1	0	11.67 ± 0.58
	100	20.67 ± 1.15	11.33 ± 0.58	13.33 ± 0.58
	200	22.67 ± 0.58	-	-
<i>P. mirabilis</i>	5	0	19.67 ± 0.58	23.67 ± 1.53
	25	0	21.67 ± 0.58	24.67 ± 0.58
	50	15 ± 0	26.00 ± 1.00	26.67 ± 0.58
	100	21 ± 1	27.33 ± 0.58	27.67 ± 0.58
	200	25.33 ± 1.53	-	-
<i>S. marcescens</i>	5	0	0	0
	25	0	0	0
	50	0	0	11.33 ± 0.58
	100	15.33 ± 0.58	0	15.33 ± 0.58
	200	20 ± 0	-	-

Table 4.18: Minimum inhibitory concentration and Minimum Bactericidal Concentration of *Dodonaea viscosa* (leaves) against *Proteus mirabilis*

S. No.	Concentration	<i>Proteus mirabilis</i>	
		MIC* (O.D. @ 600nm)	MBC**
1	50	0.403	43
2	60	0.368	37
3	70	0.337	34
4	80	0.303	31
5	90	0.272	28
6	100	0.263	0
7	110	0.228	0
8	120	0.205	0
9	130	0.164	0
10	140	0.132	0
11	150	0.112	0

* Minimum inhibitory concentration, and ** Minimum Bactericidal Concentration

4.3.5 *Litsea glutinosa* (Lour.) C.B.Rob. (Fig. 4.34 – 4.39)

The methanolic extract of *L. glutinosa* showed mild to moderate antibacterial activity against *E. coli*, *E. faecalis*, *S. aureus*, at 50 and 100 µg/mL, but was inactive at lower concentrations (Table 4.19 & 4.20). Previous study by Bakth *et al.*, (2019) also depicted the moderate inhibitory effect of methanolic extract against *E. coli*. When tested against *Proteus mirabilis* and *Serratia marcescens*, both chloroform and n-hexane extracts showed no inhibitory effect against *Proteus mirabilis*, while in n-hexane extract only mild activity was observed against *Serratia marcescens* at higher concentrations of 50 and 100 µL. Methanol extract showed maximum inhibitory effect against *M. luteus* and *S. marcescens* while moderate activity was shown against n-hexane extract of *S. marcescens* at higher concentrations 50 and 100 µg/mL. It has been demonstrated that the phytochemical components of *L. glutinosa* bark exhibit potent antibacterial and antifungal properties (Hosamath, 2011). According to Reddy and Reddy (2008), this species is critically endangered. Low seed viability and non-rooting vegetative cuttings hinder conventional propagation (Rabena, 2010).



Figure 4.34: Dried, grinded, and methanol, chloroform and n – hexane extract of *L. glutinosa*



Figure 4.35: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *L. glutinosa* against *E. coli*.



Figure 4.36: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanol extracts of *L. glutinosa* against *E. faecalis*



Figure 4.37: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanolic extract of *L. glutinosa* against *S. aureus*.



Figure 4.38: Antimicrobial Susceptibility Test of chloroform, n-hexane and methanolic extract of *L. glutinosa* against *P. mirabilis*



Figure 4.39: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extract of *L. glutinosa* against *S. marcescens* and methanolic extract of *L. glutinosa* against *Micrococcus luteus*

Table 4.19: Antimicrobial Susceptibility Test of Chloroform, n-hexane and methanolic extracts of bark of *Litsea glutinosa* against *E. coli*, *S. aureus* and *E. faecalis*.

Microbe	Volume	ZOI (mm)		
		Methanol	Chloroform	n - hexane
<i>E. coli</i>	5	0	0	0
	25	11 ± 0.00	0	0
	50	12.10 ± 0.17	0	0
	100	12.57 ± 0.12	0	0
<i>S. aureus</i>	5	0	0	0
	25	0	0	0
	50	11 ± 0.00	0	0
	100	15.93 ± 0.12	0	0
<i>E. faecalis</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	15 ± 0	0	0
	200	20.33 ± 0.58	0	0

<i>P. mirabilis</i>	5	0	0	0
	25	0	0	0
	50	0	0	0
	100	0	0	0
	200	19.67 ± 0.58	-	-
<i>S. marcescens</i>	5	0	0	0
	25	0	0	0
	50	26.97 ± 0.06	0	11.67±0.58
	100	28.97 ± 0.06	0	13.67±0.58
<i>M. luteus</i>	5	-	0	0
	25	-	0	0
	50	20.33 ± 0.58	0	0
	100	23.93 ± 0.12	0	0

*ZOI -Zone of inhibition

Table 4.20: Minimum inhibitory concentration and Minimum Bactericidal Concentration of *Litsea glutinosa* (Bark) against *Enterococcus faecalis*

S. No	Concentration	<i>Enterococcus faecalis</i>	
		MIC (O.D. @ 600nm)	MBC
1	50	0.374	38
2	60	0.362	36
3	70	0.348	35
4	80	0.324	33
5	90	0.301	30
6	100	0.290	0
7	110	0.261	0
8	120	0.228	0
9	130	0.189	0
10	140	0.142	0
11	150	0.126	0

The agar well diffusion assay demonstrated that some of the selected medicinal plant samples viz *Acorus calamus*, *Dodonaea viscosa*, and *Litsea glutinosa*, exhibited significant antimicrobial activity against a range of pathogenic microorganisms. The minimum inhibitory concentration and minimum bactericidal concentration results further confirmed the potent antimicrobial properties of these plant extracts, providing valuable insights into their potential

therapeutic applications. The size of the inhibition zone in antimicrobial assays serves as a crucial indicator of plant sample's antimicrobial potency. Larger inhibition zones signify more effective antimicrobial activity against the test microorganism. This standardized screening method is applied across a wide range of plant samples and diverse microbial strains, providing a comprehensive assessment of the medicinal plants' antimicrobial potential. The results from these assays not only validate the traditional medicinal applications of various plants but also identify promising candidates for further investigation. The most effective plant extracts can then undergo purification and characterization to isolate the active antimicrobial compounds.

These findings highlight the importance of further investigating the chemical composition of these plant extracts to identify the specific bioactive compounds responsible for their antimicrobial effects, which could lead to the development of novel antimicrobial drugs to combat the growing threat of antibiotic-resistant infections.

4.4 Nutritional value of the wild edible species

To fully understand the nutritional value of the plant samples, it is essential to analyze their Moisture Content, ash content, Lipid content, Carbohydrate content, and Protein content. This comprehensive nutritional analysis provides a deeper insight into the plants' composition and potential health benefits.

The Moisture Content is a crucial parameter that determines the shelf life and storage stability of the plant materials. The ash content, which reflects the mineral content, offers information about the plants' potential as sources of essential minerals. The Lipid content analysis reveals the fatty acid profile and energy-providing potential of the plants.

Carbohydrate content analysis is important to understand the plants' ability to provide readily available energy sources. Similarly, the Protein content analysis can highlight the plants' potential as dietary protein sources, which is particularly relevant for populations relying on plant-based diets.

Gathering this detailed nutritional information is essential to fully characterize the medicinal plants and evaluate their suitability for various applications, such as food, nutraceuticals, or pharmaceutical development. The findings from these analyses can

guide the selection and utilization of the most nutritionally-rich plant samples for further research and potential commercialization.

4.4.1 Moisture Content Analysis

The moisture content of *Citrus medica* (85.3 %) and *Malva pusila* (85.2 %) was recorded as highest of all the samples and lowest was recorded for *Woodfordia fruticosa* flowers (32.17%) indicating lowest and highest dry matter content respectively, like carbohydrates, proteins per gram sample in terms of nutritional content. While *Bauhinia variegata* and *Phlomoides superba* exhibited 75.98%, 79.97 % moisture content, respectively (Table 4.21).

Table 4.21: Proximate Nutritional status in various plants used as wild edible species in the study site.

Plant	Moisture content	Ash content	Fat content	Total carbohydrate	Protein content	Energy Kcal/
Sample	(% age)	(% age)	(% age)	rates (% age)	(% age)	100gm
<i>Phlomoides superba</i>	79.97±0.39	7.26± 0.96	5.6 ±0.20	17.77 ± 0.03	1.94 ± 0.039	129.24
<i>Malva pusila</i>	85.2± 0.72	21.11± 1.48	2.20 ± 0.00	54.88 ± 0.03	14.8 ± 0.033	298.52
<i>Woodfordia fruticosa</i>	32.17±2.26	8.02 ± 1.25	7.00 ±0.00	25.83 ± 0.03	0.93± 0.043	170.04
<i>Bauhinia variegata</i>	75.98±1.53	8.21 ± 1.00	13.20±0.00	16.82 ± 0.04	2.93 ± 0.034	197.8
<i>Citrus medica</i>	85.36±1.57	7.47 ± 0.96	5.26±0.14	6.42 ± 0.03	0.47 ± 0.033	74.9

Among all the analyzed samples, *Citrus medica* (85.3%) and *Malva pusilla* (85.2%) exhibited the highest moisture content. Such high moisture levels are characteristic of fresh fruits and leafy vegetables, which typically contain large proportions of water. This elevated moisture content directly correlates with lower dry matter availability, meaning that nutrients such as carbohydrates, proteins, fats, and minerals are present in smaller quantities per gram of fresh sample. As a result, even though both species may possess valuable phytochemicals, their nutritional density on a fresh weight basis is relatively low. A comprehensive nutritional evaluation of *Citrus medica* fruit by Khan *et al.* (2014) reported 82.9% moisture, close to our value (85.3%). A proximate analysis of citrus fruits by Ibrahim *et al.* (2018) also found 80–87% moisture across *Citrus limon*, *C. medica* and related species. A recent review by Joseph & Koshy (2020) on *Citrus medica* documented high water content ranging 78–86% depending on fruit maturity and climate. Specific proximate data for *Malva pusilla* is less, but studies on different *Malva* species show very similar moisture levels like *Malva sylvestris* leaves reported 82.4–84.1% moisture (Bnouham *et al.*, 2016). *Malva parviflora* reported moisture 83.7% (El-Shamy *et al.*, 2013) and Nutritional profiling of wild leafy vegetables in Punjab by Sharma & Kaur (2019) listed *Malva* species with moisture 80–86% which is close to our values.

In contrast, the lowest moisture content was recorded in *Woodfordia fruticosa* flowers (32.17%). The reduced water content indicates a high proportion of dry matter, thereby increasing the concentration of nutrients per gram of sample. Flowers of *W. fruticosa*, therefore, naturally contains higher levels of carbohydrates, proteins, and other constituents when calculated on a fresh weight basis. This explains their comparatively elevated nutritional density relative to the more moisture-rich species. Study by Grover *et al.* (2014) on *W. fruticosa* flowers reported 28.4–35.2% moisture, depending on drying conditions. Chandel *et al.* (2018) also recorded 30.1% moisture in dried floral samples used for pharmacognostic analysis. While study on wild edible flowers by Lal *et al.* (2020) noted that *W. fruticosa* typically shows low moisture due to its leathery floral texture. The present value of (32.17%) is in accordance with the previous literature

values *Bauhinia variegata* flowers and *Phlomis superba* tubers showed intermediate moisture levels of 75.98% and 79.97%, respectively. These values suggest a moderate dry matter content, which aligns with their expected nutritional profiles. *B. variegata* flowers, being fleshy floral tissues, retain substantial moisture, while *P. superba* tubers, though underground storage organs, also exhibit high hydration typical of many edible tubers. Moisture values for *B. variegata* flowers in previous studies by Singh *et al.* (2015) reported 74.6% moisture, Shukla *et al.* (2012) measured 72–76% moisture in fresh *Bauhinia* flowers and Leaves and floral tissues studied by Kumar *et al.* (2018) showed 70–78% moisture. This range is also close to the present moisture value of *Bauhinia variegata*.

Consequently, the nutrient concentration per gram in these samples falls between the highly hydrated species (*C. medica* and *M. pusilla*) and the low-moisture species (*W. fruticosa*).

Overall, the observed moisture variation among the studied plants highlights the inverse relationship between water content and nutritional density, emphasizing that species with lower moisture levels generally provide higher per-gram concentrations of nutritive components.

4.4.2 Ash Content Analysis

Ash content represents the overall mineral composition and micronutrient status, whereas fibre content shows the degree of dietary roughage and digestibility in plants. The high ash content was observed in *Malva pusilla* (21.1%) and lowest in *Phlomis superba* (7.26%) indicating high and low mineral density present in the sample that is essential for the health of individual. While *Bauhinia variegata*, *Woodfordia fruticosa* and *Citrus medica* have 8.21%, 8.02 % and 7.47 % respectively. High ash means a dense mineral profile (micronutrients like Ca, Mg, Fe, etc.), and high fibre suggests it could contribute to digestive health (roughage) when included in diets.

This supports the assumption that a variety of *Malva* species are excellent providers of minerals. For instance, Devrim *et al.* (2023) found that Mg, Zn, K, Ca, and Fe were all present in high concentrations (e.g., Ca ~ 5594 mg/100 g dry matter) in the

leaves of *Malva pusilla*. No previous literature reported the ash content of *Malva pusilla* to the best of my knowledge which further demands need for elemental analysis for this plant species.

According to Khare *et al.* (2017), *B. variegata* leaves had a total ash value of 8.15% which is very close to the present findings (8.21%) that validates our result. According to Chandel *et al.* (2018) the total ash for *W. fruticosa* root was 6.5% w/w that may be plausible as different plant parts have varied ash content. A systematic review of *Citrus medica* by Beneditto *et al.*, (2023), reported that for pulp and peel, the ash content is 0.44–1.23 g/100 g fresh weight (i.e., ~0.44–1.23%) but the present report is higher than this value, as this is on dry basis. There is no pharmacogonostic study for *Phlomoides superba* in the earlier literature so the present value is a novel report.

4.4.3 Determination of lipids content

One important determinant of the nutritional quality of plant samples is their lipid content. It shows the material's energy density and capacity to provide fat-soluble vitamins, critical fatty acids, and bioactive substances that are vital for sustaining health. Higher lipid content indicates higher caloric value and possible usage as a nutrient- and energy-rich food source, while lower lipid levels indicate a low-calorie profile, making these plants excellent for dietary management but contributing less to nutrients obtained from lipids. Lipid assessment thus sheds light on the prospective dietary function and overall nutritional relevance of plant samples.

The lipid content has been determined according to the Soxhlet method extraction using the hexane like solvent (AOCS, 1990). The leafy vegetable *Malva pusilla* (2.18%) exhibited lowest fat percentage while highest was recorded in flowers of *Bauhinia variegata* (13.2%). The *Citrus medica* fruit, tubers of *Phlomoides superba* and flowers of *Woodfordia fruticosa* showed (5.2%), (5.6%) and (6.97%) respectively.

There is relatively scarce data for *Malva pusilla* but from closely related species (*Malva sylvestris*) like in a study on *Malva sylvestris* leaf powder used in broiler chicken feed, the ether-extract content was 4.83% (on dry matter basis) Batiha *et al.*, (2023). A review on *Malva sylvestris* (nutritional compounds) reported lipid content in leaves around

2.76–3.09 g/100 g dry weight, depending on the plant part (Mousavi *et al.*, (2021)). These values suggest that *M. pusilla* is relatively low in lipids, consistent with its characterization as a leafy vegetable.

As per Rajendiran (2023) the fat content of *Citrus medica* was reported as 6gm/100gm which is close to our value while there is no published report of fat content present in *Phlomoides superba*. Limited literature is available for fat content analysis for *Woodfordia fruticosa* flowers to the best of my knowledge.

4.4.4 Carbohydrate estimation

The carbohydrate content is recorded maximum for *Malva pusilla* (54.88 %) followed by *Woodfordia fruticosa* flowers and *Phlomoides superba* (25.83 %) and (17.77%) respectively. *Bauhinia variegata* 16.82 % and *Citrus medica* 6.42 %. Different species of *Malva* possess high total carbohydrate on a dry-weight basis because the remaining dry mass after removing moisture, protein, fat and ash is largely carbohydrate. Several recent analyses of *Malva* species report carbohydrate / total carbohydrate values and show that *Malva* leaves/vegetative parts can have carbohydrate as a large fraction of dry matter Devrim-Lanpir, A. (2023). *Bauhinia variegata* and *Woodfordia fruticosa* flowers contains higher carbohydrate fractions in previous research by ShivPrasad *et al.*, (2016) and Verma *et al.*, (2012) than some leaves or other parts as the percentage of carbohydrates on dry weight is typically high since "flowers" frequently contain more simple sugars. There is no peer reviewed proximate nutritive analysis of threatened *Phlomoides superba* so the present analysis is a novel report having carbohydrate content of 25.83 % in the tubers of *Phlomoides superba*. Chhikara *et al.*, (2018) reported low percentage of carbohydrate of *Citrus medica* on fresh basis as citrus fruits are mostly water while the present analysis was conducted on dry weight basis that recorded total carbohydrate content of 6.42 %.

4.4.5 Protein Estimation by Bradford's Method

The highest protein content recorded was of *Malva pusilla* 14.8 % followed by *Bauhinia variegata* 2.93 %, *Phlomoides superba* 1.94 %, *Woodfordia fruticosa* 0.93 % and *Citrus medica* 0.47 %. The value of protein percentage of *Malva pusilla* (14.8 %) is very close

to the value earlier recorded by Devrim-Lanpir, A. (2023) thus validating our readings. For *Bauhinia variegata*, we recorded 2.93% protein, whereas published data report somewhat higher values: Liaw (2012) reported 3.24% protein in flower buds and analyses of flower petals indicate ~3.70% Verma *et al.*, (2012). For *Woodfordia fruticosa* flowers, we measured only 0.93%, which is substantially lower than the 8.19% dry-weight found in a wild-plant bromatological study (Shivprasad *et al.* 2016). This discrepancy may reflect differences in plant provenance, sample drying, or analytical method. *Citrus medica* showed ~0.47% protein; this is broadly consistent with low-protein values typical for citrus pulp on a fresh-weight basis.

Calculation-

Nutritive value = 4 x protein % + 9 x fat % + 4 x carbohydrate %.

Based on the calculated proximate composition, the highest caloric (energy) value was recorded in *Malva pusilla*, which contained 298.52 kcal/100 g (Table 4.20). This comparatively high energy value can be attributed to its enriched carbohydrate and moderate protein content, which together contribute significantly to caloric yield. Such a composition indicates that *M. pusilla* can serve as an important dietary plant in traditional food systems, offering substantial energy and nutritional support.

The next highest energy value was observed in the flowers of *Bauhinia variegata* (197.8 kcal/100 g). The moderate carbohydrate and protein fractions present in the floral tissue justify this energy level. Owing to this, *B. variegata* flowers are traditionally used as a vegetable, providing not only micronutrients but also appreciable caloric intake.

Woodfordia fruticosa flowers 170.04 kcal/100g and *Phlomis superba* tubers showed 129.24 kcal/100 g, indicating a moderate energy contribution. Although these species contain useful amounts of bioactive compounds, their caloric values are primarily governed by their relatively lower carbohydrate levels compared to *M. pusilla* and *B. variegata*. Nonetheless, their energy values fall within the range typical of edible flowers and tubers used in ethnobotanical food practices.

The lowest energy value among the studied species was recorded for *Citrus medica* (74.9 kcal/100 g). This is expected, as citrus fruits generally contain higher moisture and lower carbohydrate content, reducing their overall caloric density. Despite its lower energy

contribution, *C. medica* is valued for its medicinal properties, vitamin C content, and digestive benefits rather than for its caloric output.

4.5 Strategies implemented for conservation of plants

Anthropogenic stresses like habitat destruction, invasive species, and climate change are putting plant biodiversity at greater risk. Maintaining ecological balance and promoting sustainable ecosystems depend heavily on the conservation of endemic and vulnerable plant species, particularly in biodiversity hotspots like Surinsar Mansar Wildlife Sanctuary. Ethnobotanical knowledge combined with contemporary conservation techniques offers a comprehensive method for managing resources sustainably. The ethnobotanical importance and conservation requirements of some of the culturally, medicinally significant and rarely distributed species from the study area- *Apteranthes tuberculata*, *Barleria prionitis*, *Phlomis superba*, *Gloriosa superba*, *Ougeinia ougeinensis*, *Morchella esculenta*, *Tinospora cordifolia*, *Ajuga integrifolia*, *Hellinia speciosa*, *Saraca asoca*, *Oroxylum indicum*, *Litsea glutinosa* that are threatened by various anthropogenic and ecological factors are highlighted in this study.

According to ethnobotanical studies, *Gloriosa superba*, which is utilised by nearby tribes for its strong therapeutic qualities especially as a source of colchicine may get under a lot of anthropogenic stress because of habitat disturbance and overharvesting. Similar to this, commercial demand is driving the unsustainable collection of *Morchella esculenta*, a highly valued edible mushroom native to the Himalayan region. Important information on ecologically sensitive collecting techniques can be gained from the documentation of indigenous tribes' customary harvesting times and procedures. These results highlight how crucial it is to include traditional knowledge into conservation strategy. To guarantee the survival and propagation of these species, in-situ conservation which involves identifying and safeguarding natural habitats in conjunction with ex-situ techniques like seed banking and tissue culture is advised.

The concept of biodiversity can be viewed in a variety of ways, some of which are a bit confusing to everyone else. In order for biodiversity protection to be widely practiced, practical methods for boosting public support must be found. The quantitative grading system established by Qian *et al.* (2020) to identify worthy candidates for flagship

species is thought to mobilize local support for conservation initiatives. They recommend using six criteria to select the best flagship species: three linked to the functioning of the local ecosystem and socioeconomic and cultural factors; and three based on conservation science, such as the species' endangered, endemic, and rare statuses.

***Ex situ* Conservation**

As part of the *ex-situ* conservation efforts, saplings of selected species were collected from within the sanctuary and transplanted to controlled environments outside their natural habitat. These included both the researcher's home garden and the botanical garden at the workplace, where the plants could be monitored, nurtured, and protected from anthropogenic pressures.

To facilitate successful establishment, small plantlets and viable seeds were carefully gathered from the study area during their appropriate collection seasons. These propagules were then transported to the conservation sites under suitable conditions to avoid desiccation or damage. Upon arrival, they were planted in designated plots with soil and microhabitat conditions adjusted to approximate their natural environment. Regular irrigation, protection from grazing, and monitoring of growth parameters were carried out to ensure healthy establishment.

This *ex-situ* approach not only supported the preservation of ethnomedicinally important species but also served as a living repository for educational, research, and future reintroduction purposes. Moreover, maintaining these species outside the sanctuary provided an opportunity to study their growth behaviour, phenology, and propagation potential under semi-managed conditions.

Distribution of plantlets to various institutes

The collected saplings were further distributed to several educational institutions, including Government Degree College for Women, Kathua; Government College for Women, Gandhi Nagar, Jammu; and Lovely Professional University, Phagwara, Punjab. This collaborative effort aimed to promote the multiplication, preservation, and long-term conservation of ethnomedicinally important species. By involving academic institutions, the initiative also encouraged student engagement, strengthened awareness about plant conservation, and created additional *ex situ* repositories where these species

could be propagated, studied, and safeguarded for future research and restoration programmes.

Awareness programmes

Various awareness programmes focusing on the conservation of important medicinal, wild edible, and threatened plant species were organized, in which students actively participated and gained substantial knowledge. Local communities residing in and around the sanctuary were also sensitized about the importance of protecting and cultivating valuable medicinal plants found in their region. They were encouraged not to disturb or overexploit plant resources and were specifically motivated to support the conservation of threatened species such as *Gloriosa superba* and *Phlomis superba*. As part of the educational outreach, students were taken to the field to observe plant species in their natural habitats. During these visits, the ethnomedicinal value and ecological significance of various taxa were explained to them. This hands-on learning experience helped enhance their understanding of conservation needs and instilled a sense of responsibility towards preserving biodiversity. Students were encouraged to become proactive stewards of nature and to contribute to the protection of local plant diversity.

In addition, a one-day ethnobotanical exhibition was recently organized at Government College for Women, Gandhi Nagar, Jammu, with enthusiastic student participation. The exhibition showcased a wide range of ethnobotanical articles, wild edibles, preserved plant-based products, and ethnomedicinal species. Such initiatives not only foster greater appreciation for traditional knowledge systems but also serve as effective platforms for promoting the conservation and sustainable use of valuable plant resources.

Seed Bank

The author has collected seeds of various plant species for future conservation and research purposes. These seeds will be preserved using cryogenic storage techniques, specifically in liquid nitrogen, to maintain their viability over extended periods. Furthermore, the first author plans to establish a nursery dedicated to ethnobotanically important and rare plant species found within the Sanctuary. This nursery will serve as a vital resource for propagation, conservation, and long-term preservation of these valuable taxa.

Community Based Conservation- Sacred Grooves

Areas of forest or natural vegetation that have historically been preserved by local communities because of their religious, cultural, or spiritual beliefs are known as sacred groves. It is prohibited to damage these groves because they are frequently connected to ancestral worship, spirits, or deities. They can be found in many regions of India, such as the tribal belts of Rajasthan and Odisha, the Western Ghats, Northeast India, and Central India. Sacred forests serve as organic havens where endangered, uncommon, and unique species can flourish in their native environments.

Rare medicinal plants and species that are absent from nearby disturbed regions can be found in many sacred groves. *Gloriosa superba* and *Oroxylum indicum*, for instance, are occasionally better preserved in these woods.

Activities like hunting, grazing, and logging are frequently forbidden due to religious prohibitions and cultural taboos. By doing this, plants are shielded from habitat loss and overharvesting. The soil stability and canopy cover that sacred groves offer preserve a microclimate that promotes biodiversity, particularly for species that like moisture and shade. As genetic reservoirs, they preserve robust and genetically varied populations of plant species that would be in decline elsewhere as a result of human activity.

Through customs, ceremonies, and traditional knowledge, sacred groves encourage a

conservation mentality, particularly in rural and tribal societies. This facilitates the transfer of ecological knowledge from one generation to the next.

Other important strategies adopted or required to be adopted

Some of the plant species are planted by the forest department and soil and water conservation department in the sanctuary area for their propagation and also as an ornamental. Plant species like *Nerium oleander* has been planted along the roadside to beautify the area which also aids in their conservation. Likewise, *Yucca* sp. has been seen grown along the slopes of the region in order to prevent soil erosion and also with the conservation point of view.

Through ethnobotanical documentation, *Ougeinia oogeinensis* was identified as a culturally significant species used in multiple traditional practices, yet found to be facing pressure due to overharvesting. Such insights guide conservation prioritization. The plant is having low regeneration potential. The population of the said genus was not up to the mark in the study area thus require conservation practices.

Phlomidoides superba in UT of J&K is under vulnerable category of their IUCN conservation status. In the present study area, the said genus was reported from village Choa in the forested area where the individuals were growing in a scattered manner in their natural habitat. The total number of individuals were approximately 80-100. The local respondent leads the author towards this area after discussion about the plant. *P. superba* is mainly exploited for its tubers which are given to cattle for increasing the milk production. The practice of extracting the tubers was recorded as destructive harvest. So, the plant needs conservation efforts for the survival of its individuals in the study area.

As far as India is concerned, the genus has been classified as a critically endangered plant species (Khan *et al.*, 2022). It is a critically endangered taxon found in India's Uttarakhand, Himachal Pradesh, and Jammu & Kashmir regions of the Northern Himalaya (Knorring *et al.* 1954; De Filippis *et al.* 1972; Azizian *et al.* 1982; Rechinger *et al.* 1982; Chowdhary *et al.* 1984; Jain *et al.* 1984; Radcliffe-Smith *et al.*

1986 ; Hedge *et al.* 1990; Li *et al.* 1994; Rao *et al.* 1994; Kalvandi *et al.* 2007; Hariri *et al.* 2021; Khan *et al.*, 2022). According to Srivastava *et al.* (2017), the previous reports included data from 10 localities: 7 from J&K (Domel, Tara, Bal Shama, Suketor, Panj Grain, and Jallow), 2 from Himachal Pradesh (Gujreda, Kundian), and 1 from Uttarakhand (Mohand). In the previous research, this plant species have been categorized in different threat status as 'Vulnerable' (Jain & Sastry 1980; Ved *et al.* 2003; Samant *et al.* 2007; Pant & Pant 2011), 'Endangered' (Jain & Sastry 1984; Garg & Rao 1997; Verma *et al.* 2007; Panwar & Srivastava 2015; Panwar *et al.* 2015; Pundir 2015), 'Critically Endangered' (Verma *et al.* 2007; Panwar 2014; Panwar *et al.* 2014) and 'Near to Extinction' (Som 1968; Rao & Garg 1994). However, according to CAMP exercise (Conservation Assessment and Management Prioritization), 2020 this taxon has been classified as Vulnerable in the UT of Jammu and Kashmir.

The distribution of *P. superba* in the study area is the first report from Jammu and Kashmir. Due to its poor regeneration potential the plant does not show its abundant distribution. Other associated species with the genus are plants like *Ageratum conyzoides*, *Lamium amplexicaul*, *Ajuga integrifolia*, *Vicia sativa*, *Justicia adhatoda* and *Carissa ophaca*. The plants were in full bloom with beautiful yellow flowers in verticillaster arrangement on the long spike. The plants were seen in the seedling stage when observed from the village. Two seedlings were collected from the region and planted in the author's place that survived well but got dried after flourishing well in pot.

The photographs were clicked before and after flowering of the seedlings from the spot. They were undisturbed in the forest area and only some plants attained maturity up to flowering stage.

The locals are trying their best to conserve this plant by growing their seedlings and seeds in their fields but they are not getting the results satisfactorily as there is very low seed set and the plant grows hardly (rarely) from the seeds. Regarding this, the locals were motivated to conserve this endangered and declining plant species in wild. The cultivation approach was found successful when some of the seedlings and tubers

attained maturity and flower planted in home garden as well as in the botanical garden of the institution.

Hellinia speciosus is a medicinally important plant that is used to cure fever and diabetes. It is also a threatened plant species that is included under Least concerned (IUCN), Tiwari *et al.* (2009), Endangered (Rani *et al.*, 2012), Near threatened (Maji *et al.*, 2020, Sohrab *et al.*, 2021). The plant is beautiful can be cultivated for ornamental purposes. Very scarce distribution was observed in the village Battal of study area. Three-four saplings were brought from the location of its existence and planted in the home garden where all the saplings survived and propagated themselves well. The pictures of the plant were taken from the study site as well as after their propagation.

Ajuga integrifolia is an herbaceous species being recognized for its anti-diabetic properties and in treating skin disorders. The plants were observed in the open field along the side lines of the fields. The leaf of the plant was frequently being used (chewed) by the locals to treat diabetes in the study area hence giving some relief as it serves the purpose of having safe herbal remedy. Two-three plantlets were collected from the area of its existence and planted in the home garden for its conservation, use and propagation. The plant showed very good results as it propagated at a faster rate.

Gloriosa superba is another important medicinal plant that is endangered (Shankar and Mishra 2011), Critically endangered (Yadav and Pandya, Ade and Rai, Ritu Mahajan 2015 (IUCN). A very small number of individuals were located from the study site. Though the use of this plant was not spread among the respondents, it is an important medicinal plant and is in threatened category so needs to be conserved.

Another important plant species that needs conservation practices is *Litsea glutinosa* that is also under threat category. Endangered (IUCN, Rabena 2010), Least concerned (IUCN 2019), very rare and vulnerable in Bangladesh (Haque, Uddin, Saha, Mazid, & Hassan, 2014), and critically endangered in Andhra Pradesh State of India (Reddy & Reddy, 2008). Critically endangered (Tiwari *et al.*, 2017). The distribution of plant is extremely sparse. Powdered leaves and bark are tied to treat bone fracture pains both

in humans and animals. Powder is also taken with milk to treat internal body pains. The small plantlet was collected from the area and planted in the botanical garden and home garden. Initially the plant flourished well but later on they get dry and wither off. Proper conservation practices are needed to conserve this medicinal plant.

Acorus calamus commonly known as *Barain* is an important medicinal plant. The rhizome is given to children for licking in case of having intestinal worms and pinworms. It is effective against cold and cough. Leaf juice mixed with 'Bala' applied to head of children in case he cries too much, elderly mostly call this condition as 'Shiramm'. Rhizome is rubbed and applied to gums and teeth to relieve toothache. It is also applied on wounds of animals.

A viable future for the preservation of ecologically and culturally important plant species is provided by the fusion of participatory conservation techniques with ethnobotanical knowledge. The species under study here demonstrate the close ties that exist between the local population and their surroundings and the pressing need to preserve both ecological and cultural heritage. For effective conservation and sustainable development, it is essential to acknowledge and promote this interdependent system.

Since the study area is a protected area there is limited or either no overexploitation of the plant resources. Even though, while documenting the medicinal plant species, some of the species were found in segregated or in scarce distribution. Some of the plants were noted under some threat categories which were taken into consideration for conservation practices and efforts were made to plant these wild species in different locations viz. botanical gardens, home gardens and distribution to various institutions for its proper conservation and propagation.

5. Summary and Conclusion

Conclusion

The present research work entitled “Ethnobotanical studies from the Surinsar-Mansar Wildlife Sanctuary, Jammu and Kashmir (UT), India was carried out from 2020-2025 to document the ethnomedicinal wealth of the said region. The study was carried out with the objective of documenting and analyzing the traditional plant-based knowledge of the local and tribal inhabitants. This study represents the first comprehensive attempt to explore and record the ethnomedicinal wealth of this protected area, where no previous systematic work has been reported. Extensive field surveys were carried out in different seasons to collect data through questionnaires, interviews, discussions, and participatory observations with traditional healers, elders, and local communities residing in and around the sanctuary. A rich diversity of medicinally important plant species was documented, reflecting the deep interrelationship between people and their surrounding flora. The documented plants were identified, their vernacular names and modes of utilization recorded, and their ethnomedicinal applications categorized according to ailments treated. The findings not only highlight the cultural significance and traditional wisdom associated with local plant use but also emphasize the urgent need for conservation of this valuable ethnobotanical heritage in light of modernization and changing socio-economic dynamics. The study thus provides a baseline reference for future pharmacological validation, conservation strategies, and sustainable utilization of plant resources in the Surinsar–Mansar area.

In the present study, ethnobotanical information regarding plant species was gathered from the local as well as the tribals inhabiting in the sanctuary area. The data gathered was then subjected to quantitative indices viz. use value (UV), informant consensus factor (Fic), Fidelity level (FL%), Cultural importance index (CI), to find out the culturally important plant, homogeneity of knowledge, most preferred plant species to cure a particular ailment and most wide and diverse usage of plant species by people

respectively. Five species were selected for performing antimicrobial activity and five for analyzing the nutritional value based on the high use value. Efforts were made for conserving some medicinally important, rarely distributed and threatened plant species.

The findings of the study revealed that the locals and tribals were well versed of the ethnobotanical knowledge of plants and were utilizing the species effectively for curing various ailments in the area under study. They have a wealth of traditional knowledge about identifying and using different plant species for ethnoveterinary, culinary, and medicinal uses. They have been able to maintain important ethnobotanical knowledge that has been passed down orally through the generations because of their strong ties to the forests. However, due to inadequate transportation facilities and poor road connectivity, many of these communities remained geographically isolated. They are further forced to rely mostly on locally accessible plant resources to meet their daily health and livelihood demands due to limited access to markets, contemporary healthcare, and veterinary services. This reliance highlights the cultural importance of using native plants as well as the pressing necessity to preserve and record this indigenous knowledge before it is lost to neglect and modernization.

Summary

1. The present study recorded 236 taxa having ethnobotanical importance belonging to 206 genera and 77 families after gathering information from a total of 306 informants viz. *Dogras* (men 196; women 33), *Gujjars* (26; 23) and *Bakerwals* (19; 9).
2. Analysis of variance (ANOVA) showed that age of men and women informants in both the tribal population didn't vary significantly. However, the age of the men was significantly (ANOVA: $F = 11.08$; $P = 0.001$) higher than the women informants among *Dogras*. The other two attributes, education and knowledge of ethnobotanical plants didn't vary between the men and women informants for all the three ethnic groups.

SUMMARY AND CONCLUSION

3. The three groups exhibited traditional uniqueness influenced by differences in religion, habitation, livelihood, and even the type of livestock they owned. There is a significant overlap in the ethnomedical plant species that the two cultures use (*Dogras* and *Gujjars*) as a result of their close interaction, which strengthens their cultural and ecological linkages while *Bakarwals* seldom come into contact with either the *Dogras* or the *Gujjars*.
4. Out of 236 species, 231 were angiosperms, 3 were pteridophytes, 1 was gymnosperm and 1 was fungi. Out of 231 angiosperms, 212 were dicots and 19 were monocots.
5. Fabaceae, Lamiaceae and Asteraceae with 28 genera and 30 species, 16 genera and 18 species and 12 genera and 13 species respectively, were the most dominant families.
6. Herbs were the most dominant lifeforms represented by 51.7% species followed by trees (25.4%), shrubs (11.9%) and climbers (10.6%).
7. Leaves (39.3%) were the most frequently utilized among all the plant parts.
8. Decoction (46.4%) was the most popular approach for the preparation of herbal drugs followed by paste (30%), powder (20%), juice (10%).
9. A total of five different aspects of ethnobotanical uses of plants viz. ethnomedicinal, ethnoveterinary, wild edible, plant based traditional products, and miscellaneous uses of plants have been studied in the present work.
10. Out of the total 236 recorded species, 210 were ethnomedicinal plants, 27 were ethnoveterinary, 74 were wild edibles, 30 were utilized for fodder and fuelwood, 18 were plants used in making utility products and 44 were having miscellaneous uses.
11. The maximum number of plants (207 species) were recorded by the *Dogras* followed by *Gujjars* (111) and *Bakarwals* (73). *Dogras* recorded 97 unique plants, shared 68 species with both the *Gujjars* and *Bakarwals*, 40 species with *Gujjars* only, and 02 species with *Bakarwals* only. Both the *Gujjars* and *Bakarwals* didn't recorded any unique species, and only 03 species were shared between them.
12. The maximum use value (UV) for the ethnomedicinal plants was recorded for

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Tinospora cordifolia (Willd.) Hook.f. & Thom. (UR = 291; UV = 0.95), *Justicia adhatoda* L. (UR = 280; UV = 0.92). Other significant species having higher use values were *Azadirachta indica* A. Juss. (UR = 226; UV = 0.74) and *Phyllanthus emblica* L. (UR = 226; UV = 0.74), *Terminalia bellirica* Edgew. (UR = 203; UV = 0.66), *Ocimum tenuiflorum* L. (UR = 162; UV = 0.53) and *Aegle marmelos* (L.) Corrêa (UR = 141; UV = 0.52).

13. The highest citations/use reports (UR = 2004) and plant species (118) was recorded for the digestive disorder category while skin ailments with (UR = 1257) and plant species (94), respiratory disease with (UR = 919) and plant species (40), other ailments (UR = 654) and plant species (49) and musculoskeletal (UR = 582) plant species (35).
14. The informant consensus factor (Fic) values ranging between 0.69 to 0.96 were found to be high for all the disease categories which indicate high degree of knowledge sharing and homogeneity of knowledge among the respondents. High Fic value plants have strong potential for the isolation of bioactive compounds and the development of novel drugs based on traditional medicinal wisdom. The highest Fic (0.96) was recorded for ear disorders having 25 URs treated by 2 plant species (*Oxalis corniculata* L. and *Achyranthes aspera* L.) and lowest for cardiovascular diseases 6 URs treated by 3 plant species.
15. *Achyranthes aspera*, *Chenopodium album*, *Ficus palmata* are new records from Jammu province of JKUT that are helpful in treating Cancer.
16. The present study recorded a very high number of plant species (74 species) that exhibited 100% fidelity level for one or the other disease category that indicates the unanimous agreement among informants regarding their use for particular disease.
17. The fidelity level (FL) of *Xylosma longifolia* Clos was recorded as 100% in digestive diseases category from the study area which is the first and new record from JKUT. There is no report of having 100% FL for this plant to our knowledge.
18. A literature survey of ethnobotanical studies from Jammu & Kashmir did not reveal any published report documenting *Mangifera indica* L., *Melilotus indica* (L.) All.,

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Paeonia emodi Royle, *Poranopsis paniculata* (Roxb.) Roberty, or *Dolomiaea costus* (Falc.) Kasana & A.K.Pandey with a fidelity level of 100% in the treatment of musculoskeletal disorders hence are new report from JKUT.

19. Among medicinal plants the highest cultural value (CI = 1.19) was recorded for *Justicia adhatoda* L. as it was having multiple utilities like in relieving fever, improving vigor, cough, headache, stomach ache, constipation, flatulence, vomiting, as toothbrush and many more depicting its wide and diverse usage.
20. The most representative families of ethnoveterinary plants from the study area were Fabaceae (5 genera, 5 species), Lamiaceae (3, 3), Asteraceae (2, 2), and Euphorbiaceae (2, 2).
21. *Phlomis superba* (Royle ex Benth.) Kamelin & Makhm., *Vitex negundo* L., *Cassia fistula* L., and *Acorus calamus* L., with 0.199, 0.141, 0.108, and 0.101 use-values respectively, were the most frequently used ethnoveterinary species.
22. A number of plant species were recorded having new reports from JKUT like *Ichnocarpus frutescens* (L.) W.T.Aiton recorded 100% FL for eye related problems in animals is new record from JKUT best to our knowledge. The use of *Achyranthes aspera* roots in powdered form which are given to animals for their easy delivery process is a new record from JKUT. Fruit of *Aegle marmelos* (L.) Corrêa when given along with the feed increases milk yield in cattle is new record from study area of JKUT. Sliced plant of *Ajuga integrifolia* Buch.-Ham. ex D.Don is kept overnight in water and given to animals in treating gout is also not mentioned in earlier literature reports.
23. From the present research it is recorded that the tribals viz. *Gujjars* and *Bakerwals* were well acquainted with the plants used in ethnoveterinary practices. They keep some of the plant remedies from higher altitudinal regions to treat their livestock so that it can be given at the time of emergency while on migration route.
24. Sharp decline in shepherding profession due to the change in lifestyle of younger

generations as they don't want to do more laborious work. Modern facilities adopted by them may lead to the loss of traditional knowledge pertaining to ethnoveterinary usage of plants that needs to be documented at the earliest before it gets lost forever.

25. The sanctuary's varied topography, which includes rocky slopes, hilly terrain, and thick forest cover, supports a variety of plant species with distinctive adaptive traits. Numerous fragrant and medicinal plants, many of which are still little understood by scientists, find perfect homes in its diverse terrain and microclimatic conditions. Because of its protected status, there is less human disturbance, which increases the chance of coming across unique and uncommon species with untapped medicinal potential. Therefore, rigorous ethnobotanical documentation and phytochemical screening of the local flora can make a substantial contribution to both the discovery of promising leads for future medication development and the conservation of biodiversity.
26. The highest CI was recorded for *Aegle marmelos* (0.40) in religious category which is in accordance with the previous studies conducted by various workers from different locations.
27. A number of species viz. *Pinus roxburgii* Sarg., *Impatiens balsamina* L., *Butea monosperma* (Lam.) Kuntze, *Dodonaea viscosa* Jacq., and *Citrus pseudolimon* Tanaka were having miscellaneous uses from the study area and some were the new reports like many local and tribal women often use the spine of *Ziziphus jujuba* (L.) Gaertn. as ear and nose pins in the early stages following ear and nose piercings. This should be acknowledged as an example of how creatively traditional communities use the resources at their disposal for both decorative and functional purposes. *Lespedeza juncea* (L.f.) Pers. twigs were made into small brooms for cleaning purposes.
28. The locals and tribals of the study area use a large number of WEPs for meeting their dietary and nutritional requirements which were categorized into four usage categories viz. plants cooked as vegetable, eaten as raw, as preserved food and as chutney.
29. Some plant species are consumed due of their therapeutic properties. Plant species

such as *Aegle marmelos*, *Amaranthus blitum* L., *Carrisa spinarum* L., *Coccinia grandis* (L.) Voigt, *Cordia dichotoma* G.Forst., *Psidium guajava* L., *Pueraria tuberosa* (Roxb. ex Wild.) DC., *Syzygium cumini* (L.) Skeels, *Momordica charantia* L., *Morus alba* L., *Murraya koengii*, (L.) Spreng., *Terminalia chebula* Retz., and others are consumed as food or in combination with food.

30. Tribals during their migration have to rely on WEPs as their dietary requirements for which the ethnobotanical knowledge is significant, but it faces several challenges that threaten its survival. The younger generations don't have enough knowledge pertaining to WEPs due to loss of interest, modernization and easy access to market food etc.
31. Some of the wild edible plant species like *Malva pusilla* Sm., *Lathyrus aphaca* L., *Medicago sativa* L., *Oxalis corniculata* L. etc which were once widely cooked and consumed as vegetables due to their abundance are now missing in their diet due to loss of the traditional knowledge. It may also be attributed to the over-exploitation, habitat loss and climatic conditions.
32. The traditional knowledge pertaining to WEPs from the study site have not been documented earlier and getting diminished with the deaths of knowledgeable older generations. In light of the obvious threat to traditional knowledge in the future, there was a dire need to document and preserve these WEPs before they get entirely lost.
33. *Artocarpus lacucha* Buch.-Ham., *Aegle marmelos*, *Syzygium cumini*, *Malva pusilla*, *Amaranthus blitum*, *Carissa spinarum*, *Chenopodium album* L., *Ficus palmata* L., *Medicago sativa* L. etc are a few underutilized but nutrient-dense plant species that have enormous potential to support sustainable and healthy living. Despite being typically neglected in contemporary agriculture and diets, these species are historically recognized for their edible portions and therapeutic advantages. Promoting their large-scale cultivation and consumption can enhance nutritional security, diversify food supplies, and promote ecological sustainability. While preserving priceless genetic and cultural legacy, incorporating these plants into regional farming systems and

community nutrition initiatives can help improve livelihood prospects.

34. Some of the plant species like, *Phoenix dactylifera* L., *Tripedium benghalense* (Retz.) H.Scholz, *Opuntia dilenii* (L.) Mill., *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb., *Leuceanea leucocephala* (Lam.) de Wit etc. were utilized to make plant based traditional products such as sitting tools, frame of beds, agricultural tools, ropes, pestle and mortar, brooms, palanquin, spinning wheel etc by the locals and tribals for their sustainable living.
35. The traditional knowledge of plant-based products held by tribal communities is a treasury of eco-friendly practices and cultural heritage.
36. Five plant species viz. *Acorus calamus* L., *Vitex negundo* L., *Dodonaea viscosa* L., *Litsea glutinosa* (Lour.) C.B.Rob., and *Adiantum caudatum* L. were chosen based on their high use value. The antibacterial activity was tested against several microbes, including *Enterococcus coli*, *Staphylococcus aureus*, and *Enterococcus faecalis*. Every microbe was examined for methanolic, n-hexane, and chloroform extract. Among these, *Acorus calamus* and *Dodonaea viscosa* were found to contain more potent antimicrobial compounds, especially in methanol and n-hexane extracts. The activity of these compounds depends on the polarity and concentration of the solvent, making them promising candidates for additional phytochemical characterisation and possible antimicrobial agent development. Additionally, when tested against *Proteus mirabilis* and *Serratia marcescens*, the n-hexane and chloroform extract of *Dodonaea viscosa* shown notable inhibitory effects.
37. The nutritional value analysis was conducted for five selected plant species viz. *Woodfordia fruticosa* (L.) Kurz, *Phlomis superba* (Royle ex Benth) Kamelin & Makhm., *Bauhinia variegata* L., *Citrus medica* L. and *Malva pusilla*. Among them *Malva pusilla* showed higher energy content followed by *Bauhinia variegata* and *Woodfordia fruticosa* with energy values as 298.52 kcal/100 g, (197.8 kcal/100 g) and (170.04 kcal/100g) respectively.
38. Nutritional analysis of *Phlomis superba* was novel record.

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39. There is little to no overexploitation of the plant resources because the research area is a protected area. Even so, some of the medicinal plant species were determined to have a limited or segregated distribution during the documentation process. *Phlomis superba*, *Ajuga integrifolia* Buch.-Ham. ex D.Don, *Apteranthes tuberculata* (N.E.Br.) Meve & Liede, *Litsea glutinosa*, *Zingiber roseum* (Roxb.) Roscoe, *Hellinia speciosa* (J.Koenig) S.R.Dutta, *Saraca asoca* (Roxb.) W.J.de Wilde, and other medicinally significant, rare, and endangered plant species were dispersed and planted for propagation and conservation in different college campuses, in home garden, and at Lovely Professional University.
40. The current study's findings indicate that the traditional plant-based knowledge held by the local and tribal groups is rapidly disappearing. Due in large part to modernization, shifting lifestyles, and a decreased reliance on natural resources, younger generations are becoming less interested in learning about and following the ancient ethnobotanical traditions. The precious indigenous knowledge that has been passed down orally through the generations is seriously threatened by this decrease. Therefore, before this ancient wisdom is lost forever, it is crucial to record, preserve, and validate it scientifically. In addition to protecting these communities' ecological and cultural history, these initiatives will lay the foundation for future studies and the sustainable use of plants.

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Annexure-I

Publications

1. **Bhagat**, N., Upadhyay, H., Manhas, R.K., & Gupta, S.K. (2022). Wild Edible Plants of Purmandal block of District Samba, J&K (UT), India”. *Ethnobotany Research and Applications*, 24:12, 1-19.
2. **Bhagat**, N., Nanda, R., Manhas, R.K., & Upadhyay, H. (2025). New Population report of critically endangered *Phlomis superba* from Samba and Udhampur districts of Union Territory of Jammu and Kashmir, India. *Journal of Threatened taxa*.

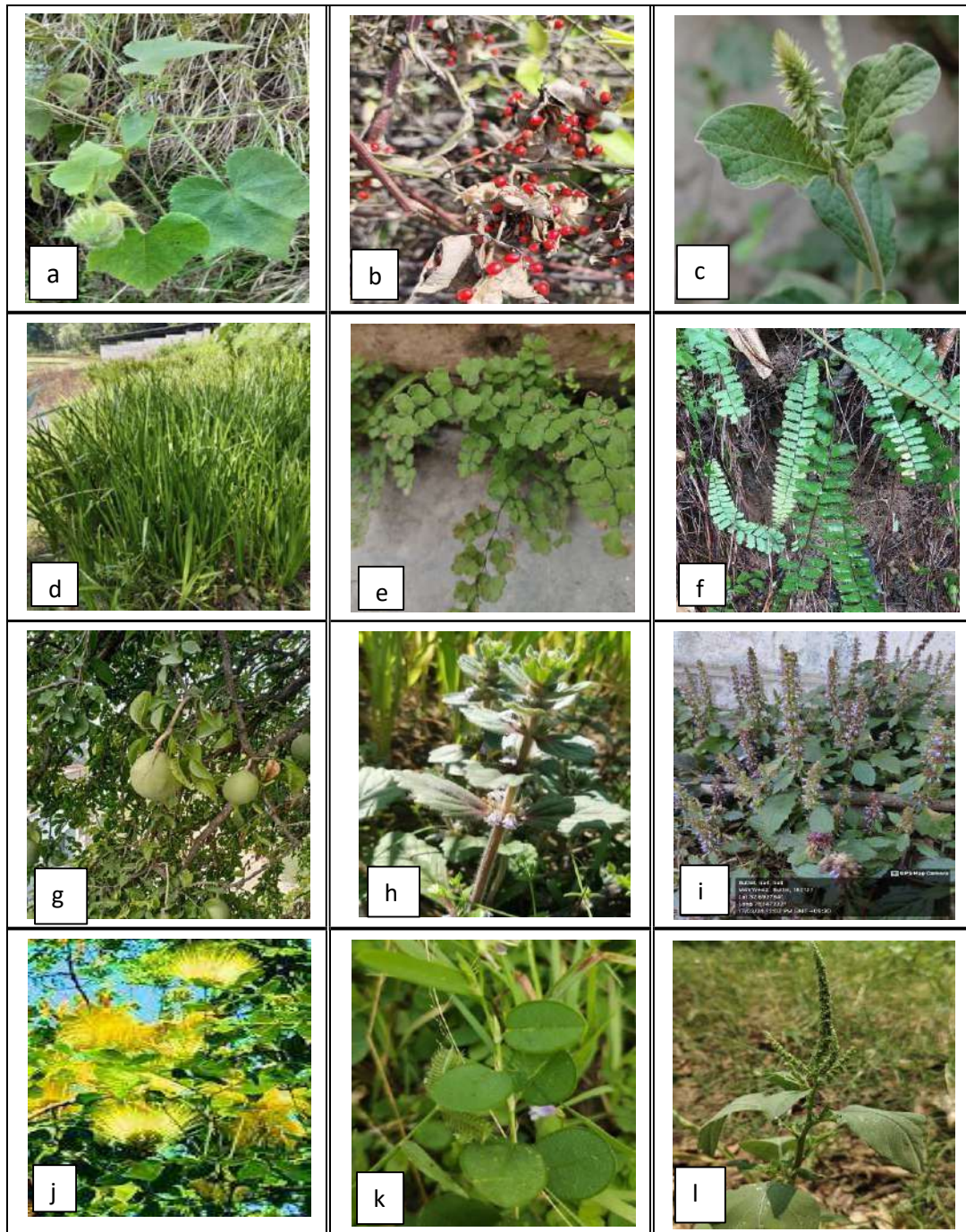
Papers presented in conferences.

1. Poster presentation on the topic entitled “Ethnomedicinal plants of Chota Kashi, scared village of samba district, Jammu and Kashmir, (UT), India in International Conference on Sustainability: Life on Earth 2021, (ICS, LOE, 2021) held on 17-18th December, 2021 organized by Department of Botany and Zoology, School of Bioengineering and Biosciences, and Institute of Forest Productivity, Ranchi, Jharkhand at Lovely Professional University, Punjab, India.
2. Oral Presentation on the topic “Wild Edible Plants of Purmandal block of District Samba, J&K (UT), India, in International Conference on Technology, Innovation and Management for Sustainable Development, (TIMS, 2022) held on 25-26th March, 2022 organized by ITM University, Gwalior.
3. Poster Presentation on the topic “Potential Ethnomedicinal Plants for Promoting Human Health from Surinsar-Mansar Wildlife Sanctuary, JKUT, India in International Conference on Current Trends in Toxicology & 43rd Annual Meeting of Society of Toxicology, India, 2024 (STOX 2024): Human Health and Environmental Safety, held on 16-18th October 2024 organized by School of Bioengineering and Biosciences in collaboration with Society of Toxicology (STOX), India, at Lovely Professional University, Punjab.

Workshop attended:

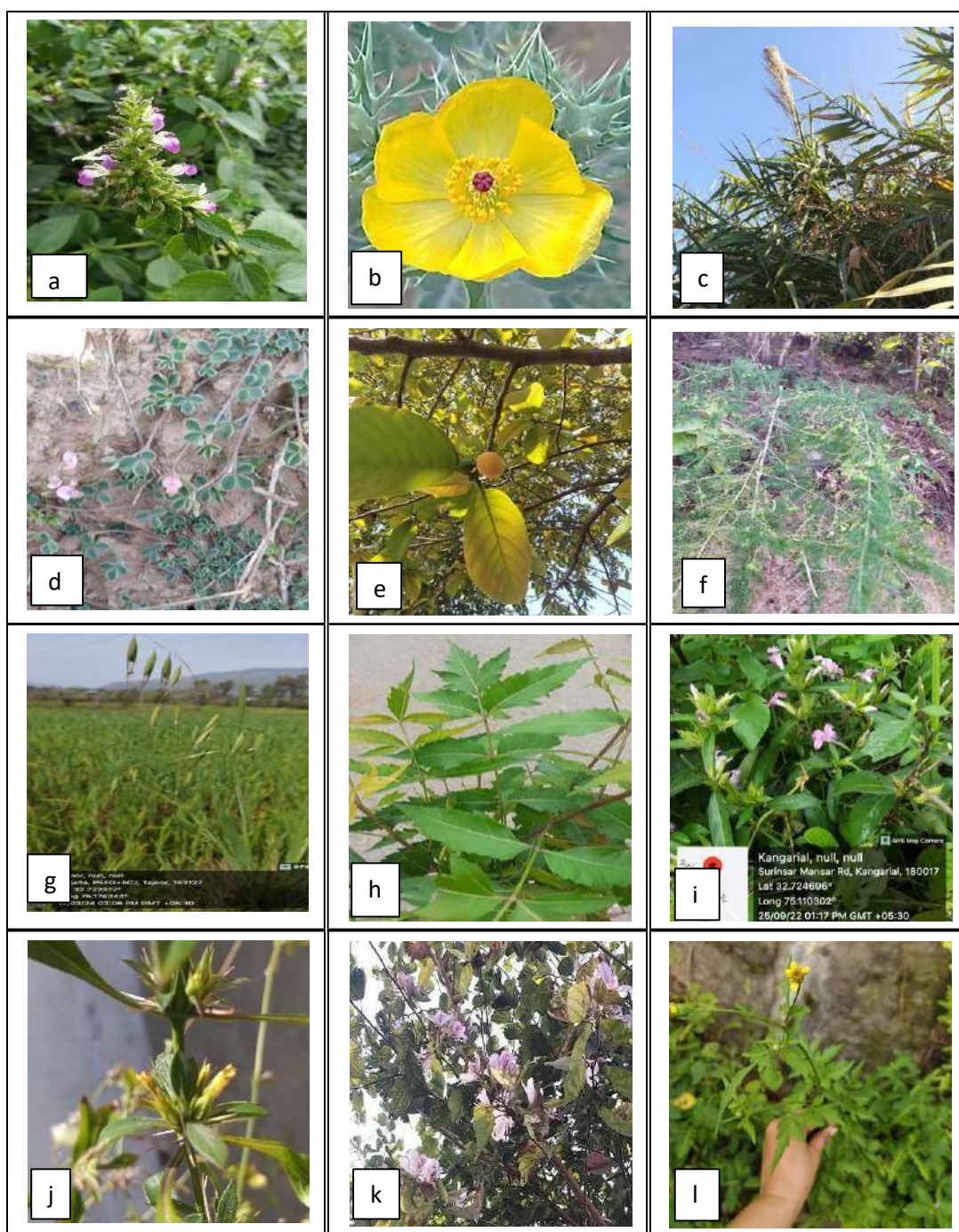
1. National Workshop on ethnobotany “Exploring the Cultural Connections to Plant Life’ organized by Jammu, Kashmir and Ladakh Chapter, Society of Ethnobotanists, Department of Botany, University of Jammu, Jammu from 28th -30th November, 2025.

PLATE-I



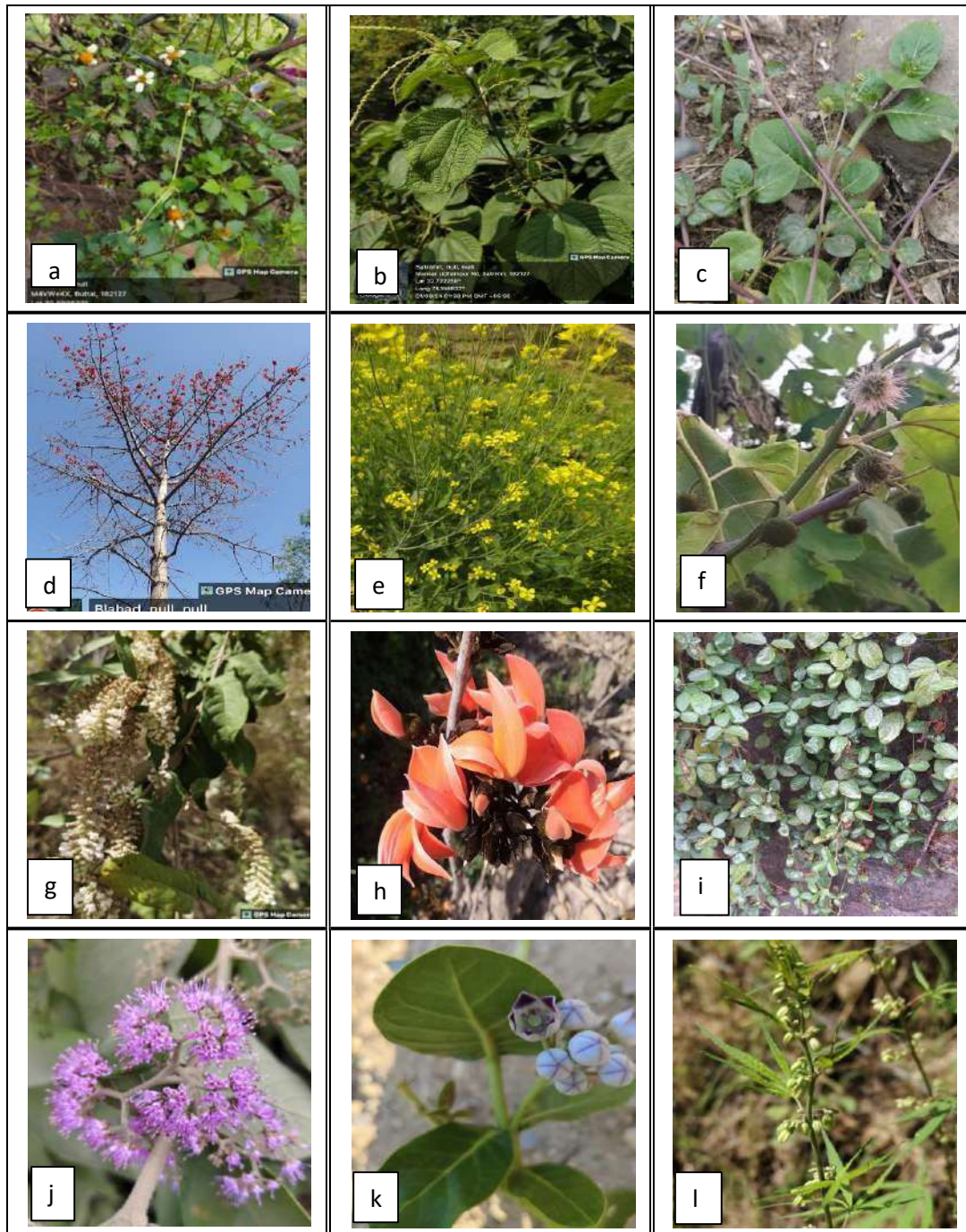
- a) *Abelmoschus moschatus* Medik. (b) *Abrus precatorius* L. (c) *Achyranthes aspera* L. (d) *Acorus calamus* L. (e) *Adiantum capillus-veneris* L. (f) *Adiantum caudatum* L. (g) *Aegle marmelos* (L.) Corrêa (h) *Ajuga integrifolia* Buch. -Ham. ex D. Don (i) *Ajuga macrosperma* Wall. ex Benth. (j) *Albizia lebbek* (L.) Benth. (k) *Alysicarpus monilifer* (L.) DC. (l) *Amaranthus blitum* L.

PLATE-II



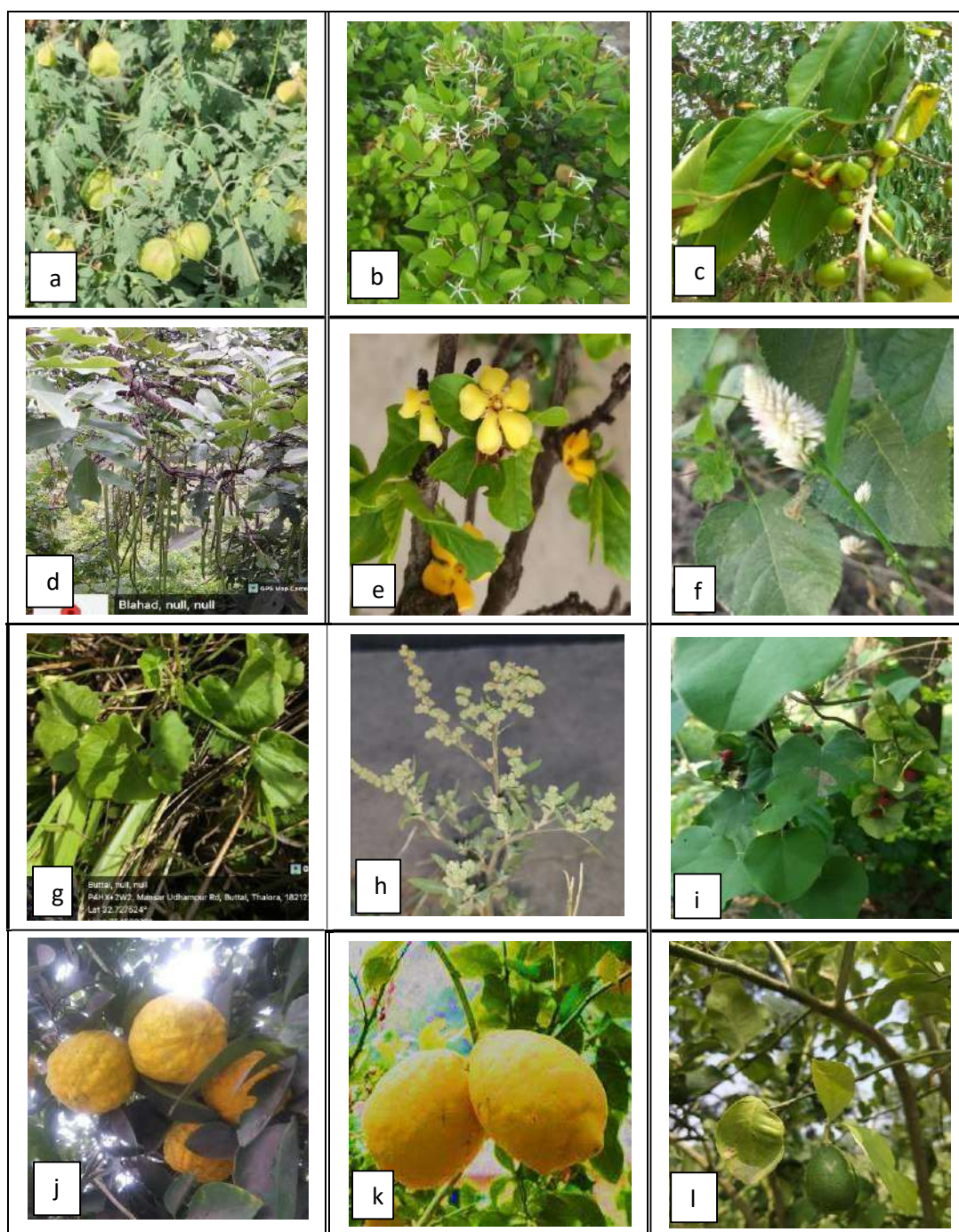
(a) *Anisomeles indica* (L.) Kuntze (b) *Argemone mexicana* L (c) *Arundo donax* Forssk. (d) *Argyrobium roseum* (Camb) Jaub&Spach (e) *Artocarpus lacucha* Buch. -Ham (f) *Asparagus racemosus* Willd (g) *Avena sativa* L. (h) *Azadiracta indica* A.Juss. (i) *Barleria cristata* L (j) *Barleria prionitis* L (k) *Bauhinia variegata* L. (l) *Bidens bipinnata* L.

PLATE-III



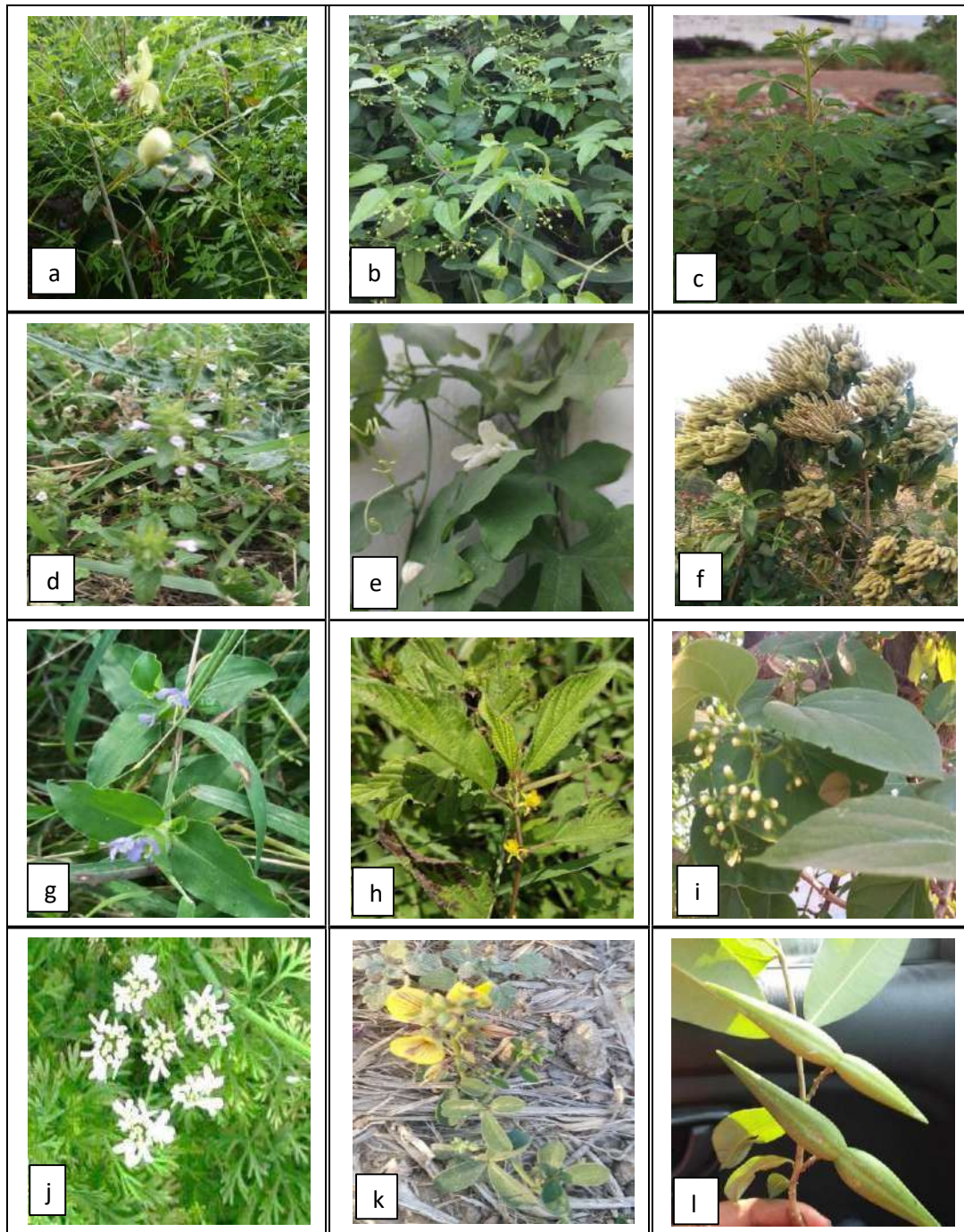
(a) *Bidens pilosa* L. (b) *Boehmeria virgata* (G.Forst.) Guill. (c) *Boerhavia diffusa* L. (d) *Bombax ceiba* L. (e) *Brassica campestris* L. (f) *Broussonetia papyrifera* (L) L'Hér ex Vent (g) *Buddleja asiatica* Lour (h) *Butea monosperma* (Lam.) Kuntze (i) *Cajanus scarabaeoides* (L) Thou (j) *Callicarpa macrophylla* Vahl (k) *Calotropis procera* (Aiton) W.T.Aiton (l) *Cannabis sativa* L.

PLATE-IV



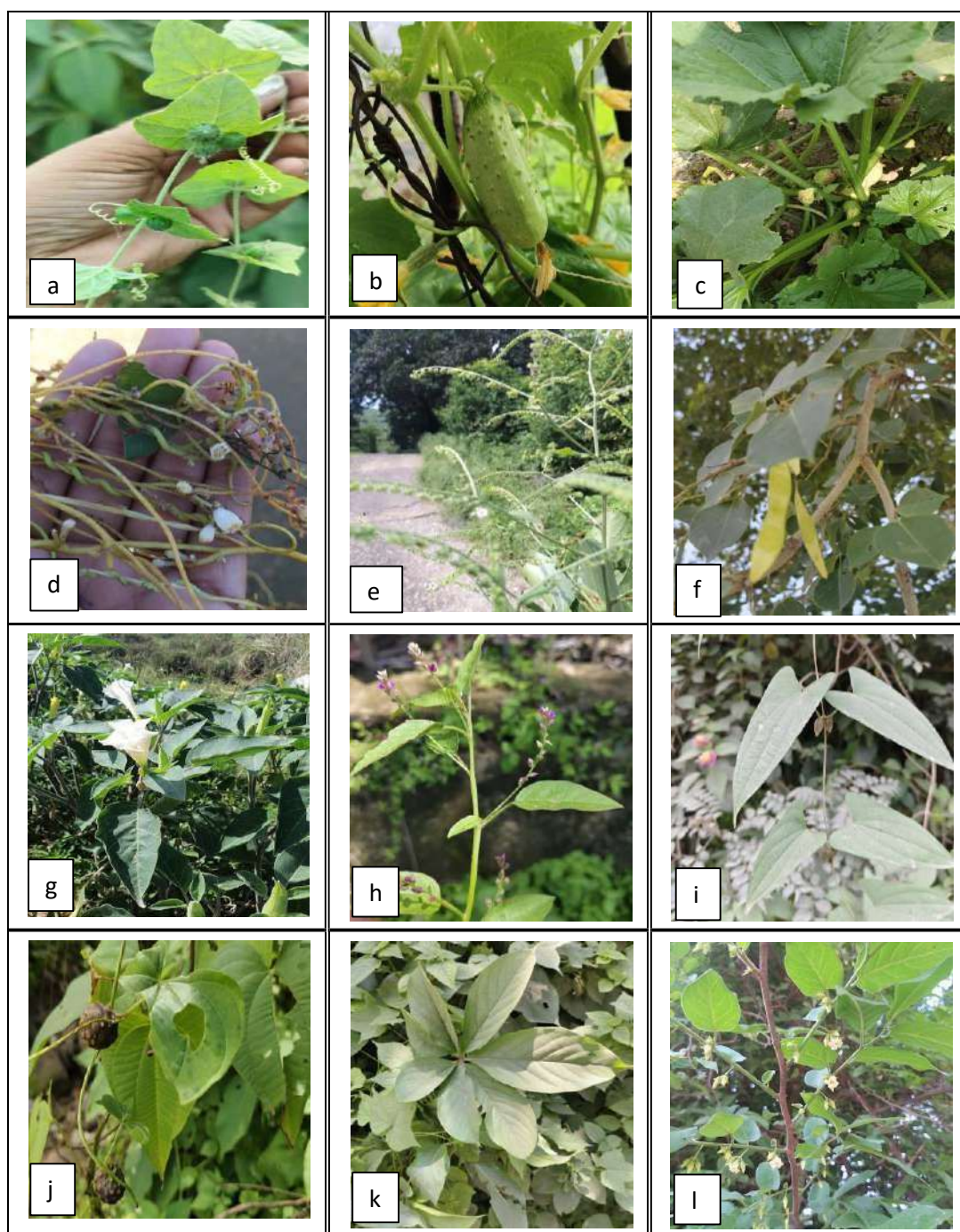
- (a) *Cardiospermum helicacabum* L. (b) *Carissa spinarum* L. (c) *Casearia tomentosa* Roxb (d) *Cassia fistula* L (e) *Catunaregam spinosa* (Thunb.) Tirveng. (f) *Celosia argentea* L. (g) *Centella asiatica* (L) Urb (h) *Chenopodium album* L (i) *Cissampelos pareira* L (j) *Citrus medica* L. (k) *Citrus pseudolimon* (l) *Citrus × limon* (L.) Osbeck

PLATE-V



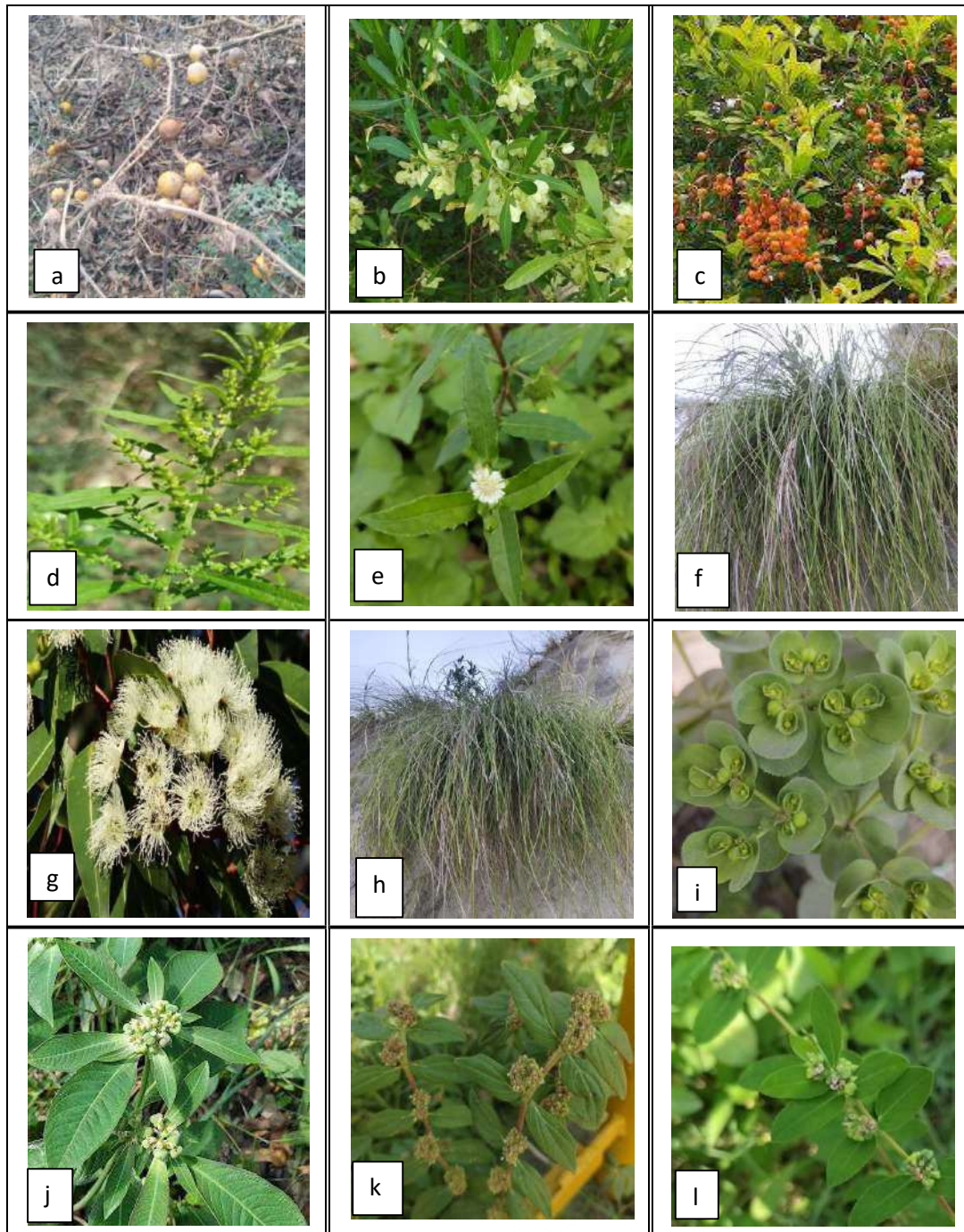
(a) *Clematis barbellata* Edgew. (b) *Clematis gouriana* Roxb. ex-DC. (c) *Cleome viscosa* L. (d) *Clinopodium nepeta* (L.) Kuntze (e) *Coccinia grandis* (L.) Voigt (f) *Coelebrookea oppositifolia* Sm (g) *Commelina benghalensis* L. (h) *Corchorus aestuans* L. (i) *Cordia dichotoma* GForst (j) *Coriandrum sativum* L. (k) *Crotolaria medicaginea* Lam (l) *Cryptolepis buchananii* R.Br. ex Roem. & Schult.

PLATE-VI



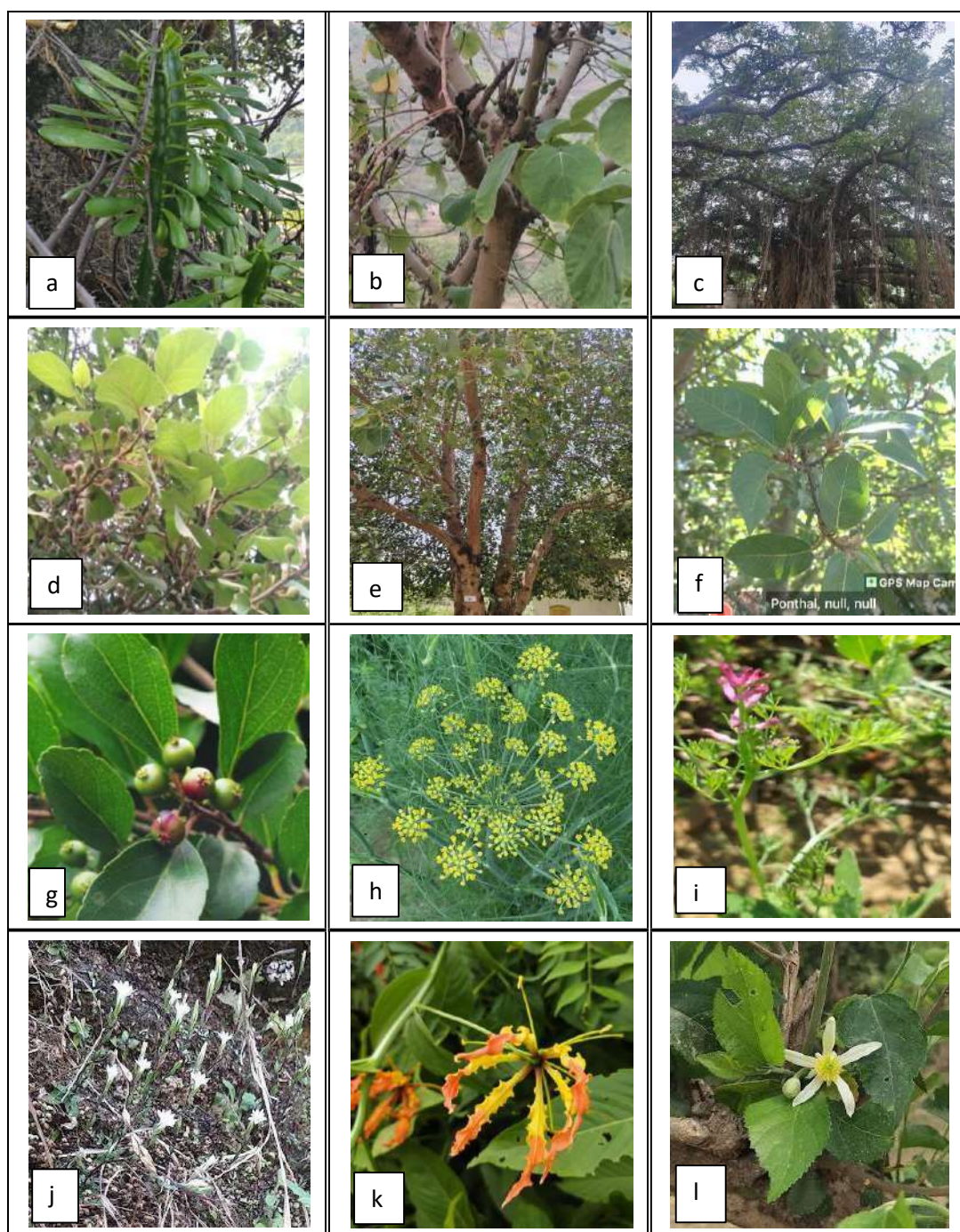
(a) *Cucumis maderaspatanus* L. (b) *Cucumis sativus* L. (c) *Cucurbita pepo* L. (d) *Cuscuta cassyoides* Nees ex Engelm. (e) *Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex-Brand. (f) *Dalbergia sissoo* Roxb. ex-DC. (g) *Datura stramonium* L. (h) *Digera muricata* (L.) Mart. (i) *Dioscorea belophylla* (Prain) Voigt ex Haines (j) *Dioscorea bulbifera* L. (k) *Dioscorea pentaphylla* L. (l) *Diospyros diversilimba* Merr & Chun

PLATE-VII



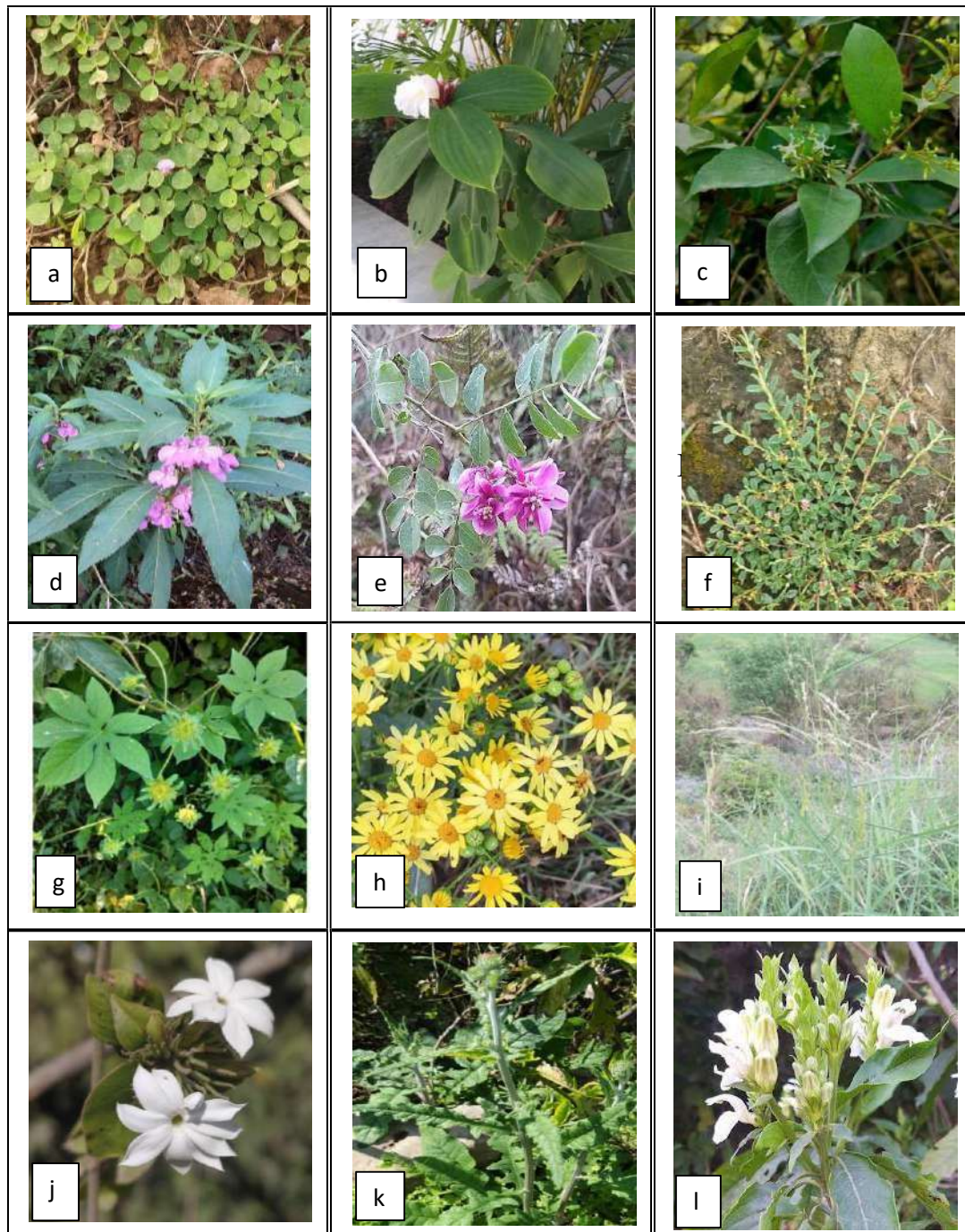
(a) *Diplocyclos palmatus* (L.) C.Jeffrey (b) *Dodonaea viscosa* Jacq. (c) *Duranta erecta* L (d) *Dysphania ambrosioides* (L.) Mosyakin & Clemants (e) *Eclipta prostrata* (L.) L. (f) *Erioscirpus comosus* (Wall.) Palla (g) *Eucalyptus globulus* Labill (h) *Eulaliopsis binata* (Retz.) C.E.Hubb. (i) *Euphorbia helioscopia* L (j) *Euphorbia heterophylla* L. (k) *Euphorbia hirta* L (l) *Euphorbia hypericifolia* L.

PLATE-VIII



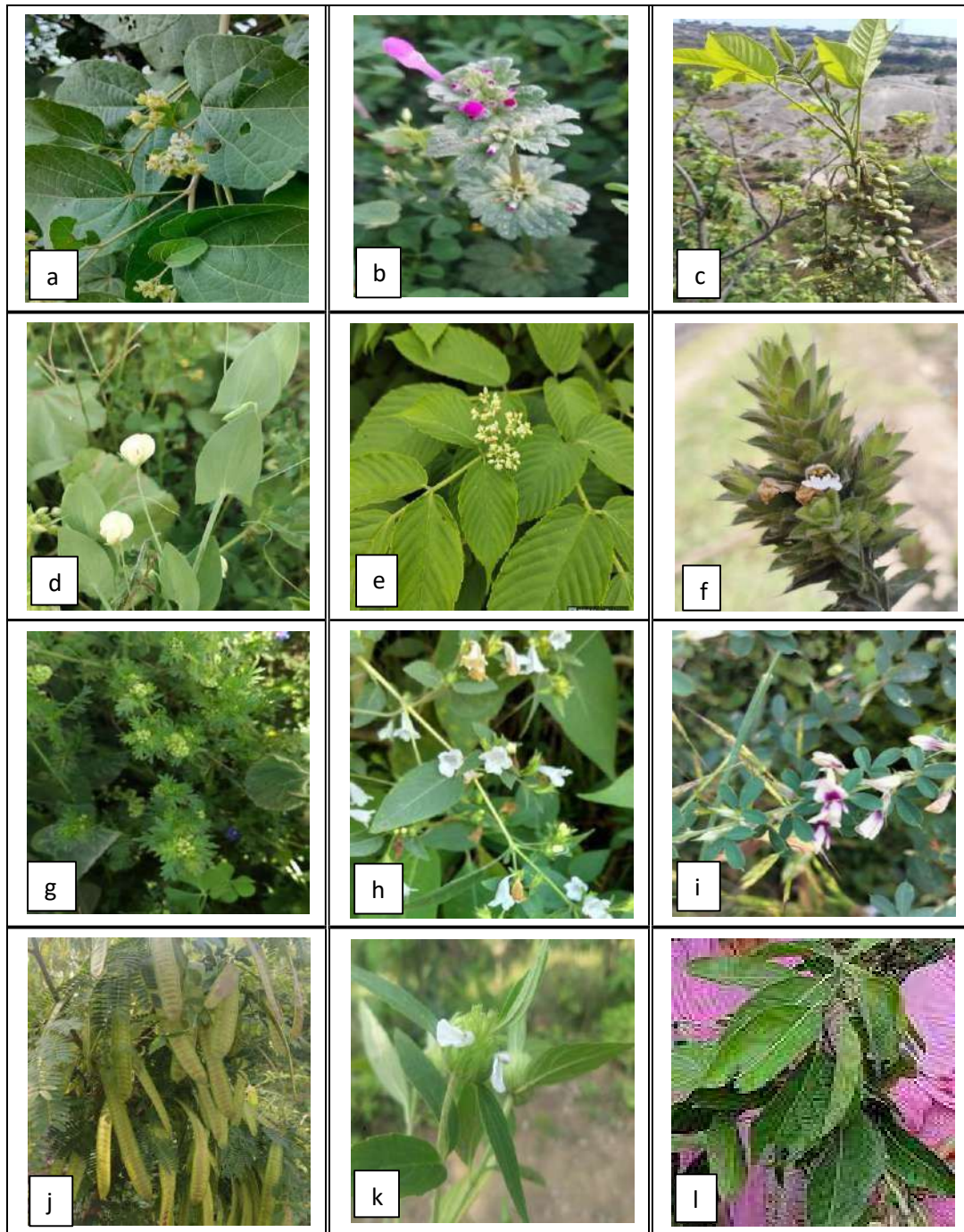
(a) *Euphorbia royleana* Boiss. (b) *Ficus auriculata* Lour. (c) *Ficus benghalensis* L. (d) *Ficus palmata* Forssk (e) *Ficus populifolia* Vahl (f) *Ficus racemosa* L (g) *Flacourtia indica* (Burm.f.) Merr. (h) *Foeniculum vulgare* Mill (i) *Fumaria indica* (Hausskn.) Pugsley (j) *Gentiana decemfida* Buch. -Ham. ex D.Don (k) *Gloriosa superba* L. (l) *Grewia optiva* J.R.Drumm. ex Burret

PLATE-IX



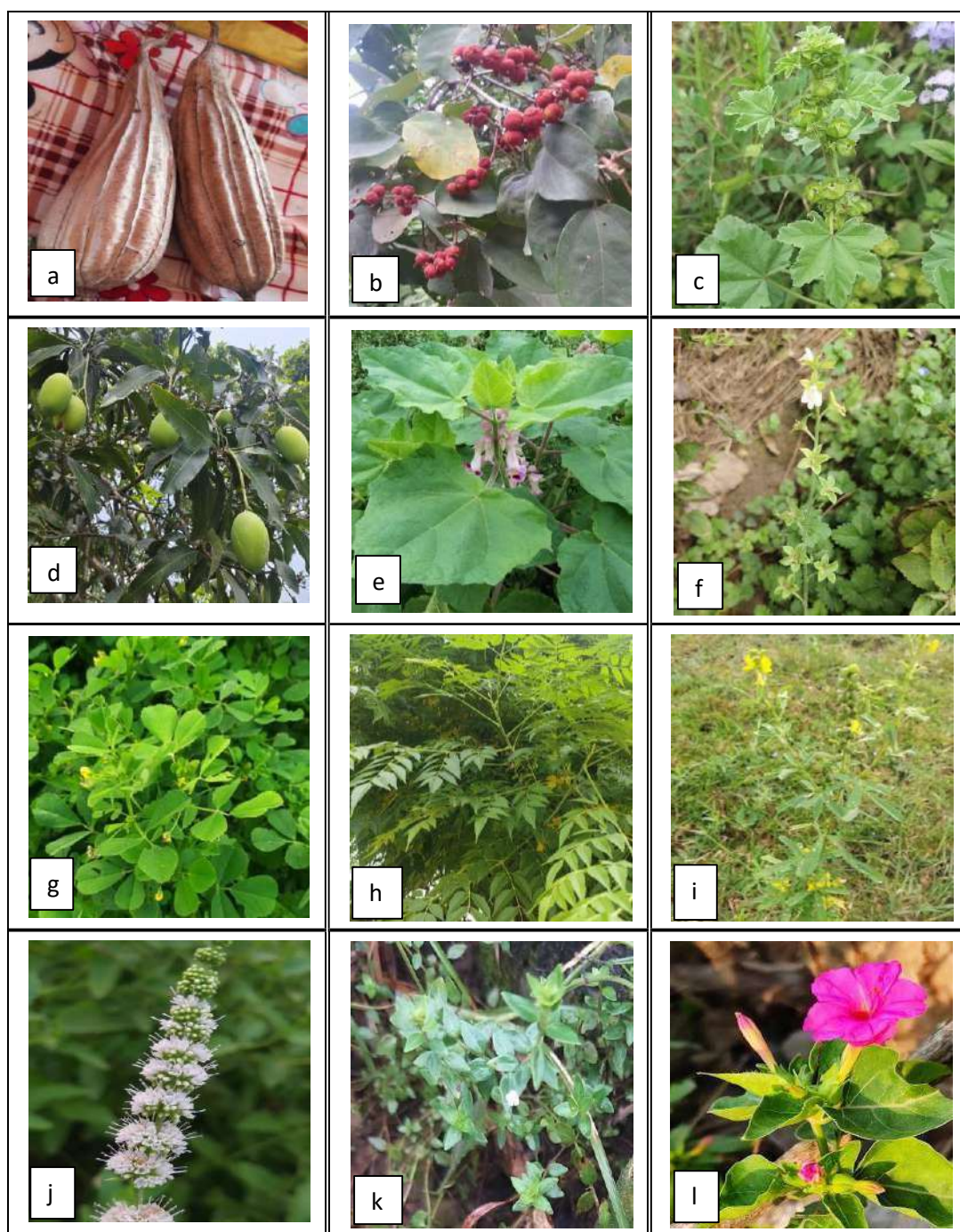
- (a) *Grona heterophylla* (Willd.) H.Ohashi & K.Ohashi (b) *Hellenia speciosa* (J.Koenig) S.R.Dutta (c) *Ichnocarpus frutescens* (L.) W.T.Aiton (d) *Impatiens balsamina* L. (e) *Indigofera cassioides* Rottler ex DC. (f) *Indigofera linifolia* (Lf) Retz (g) *Ipomoea pes-tigridis* L (h) *Jacobaea nudicaulis* (Buch. -Ham. ex D.Don) B.Nord. (i) *Janochloa antidotalis* (Retz.) Zuloaga & Delfini (j) *Jasminum multiflorum* (Burm.f.) Andrews (k) *Jurinea heteromalla* (D.Don) N.Garcia, Herrando & Susanna (l) *Justicia adhatoda* L

PLATE-X



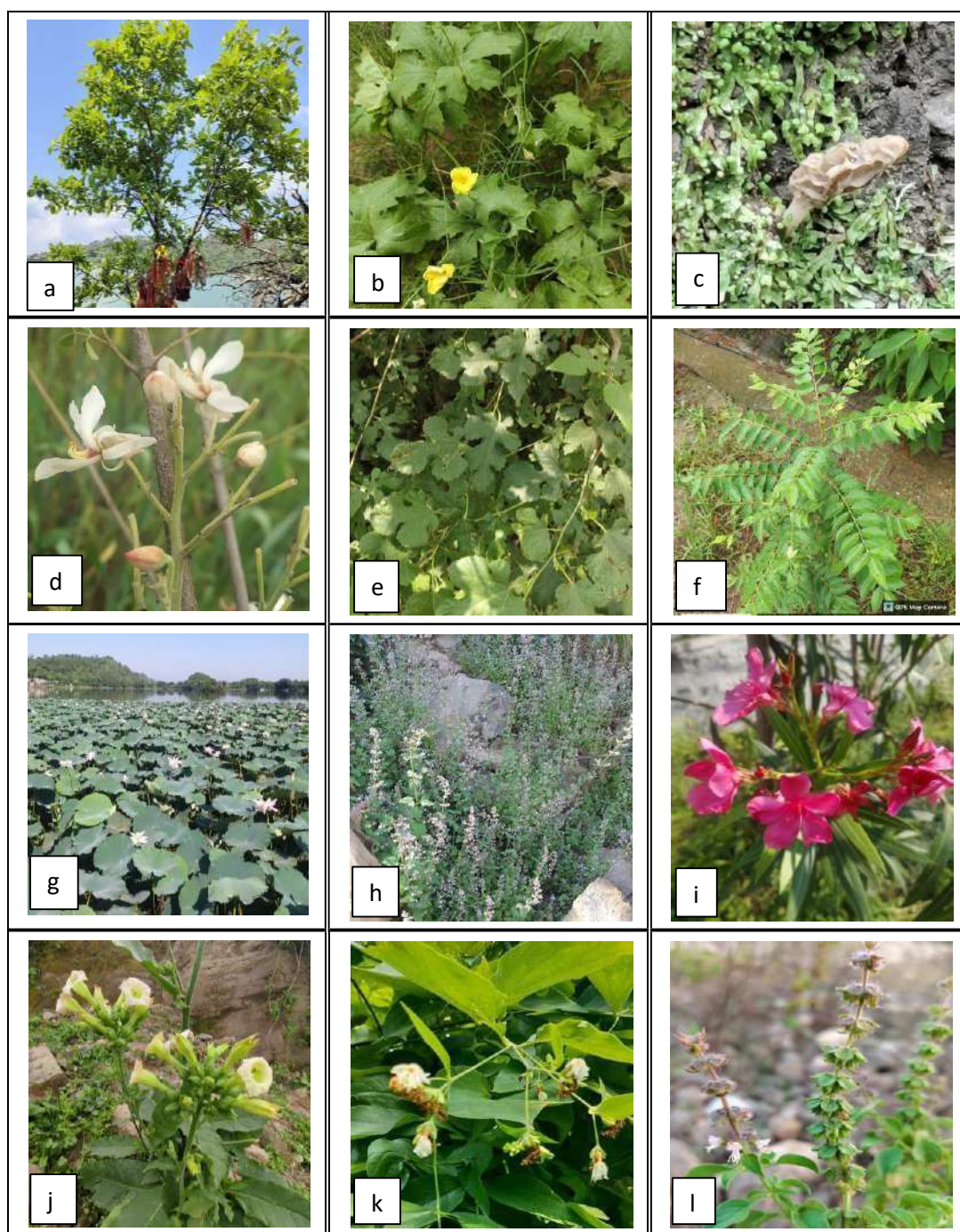
(a) *Kydia calycina* Roxb. (b) *Lamium amplexicaule* L. (c) *Lannea coromandelica* (Houtt.) Merr. (d) *Lathyrus aphaca* L (e) *Leea asiatica* (L) Ridsdale (f) *Lepidagathis cuspidata* Nees (g) *Lepidium didymum* L (h) *Leptodermis lanceolata* Wall. (i) *Lespedeza juncea* (Lf) Pers (j) *Leucaena leucocephala* (Lam) de Wit (k) *Leucas aspera* (Willd) Link (l) *Litsea glutinosa* (Lour) CBRob

PLATE-XI



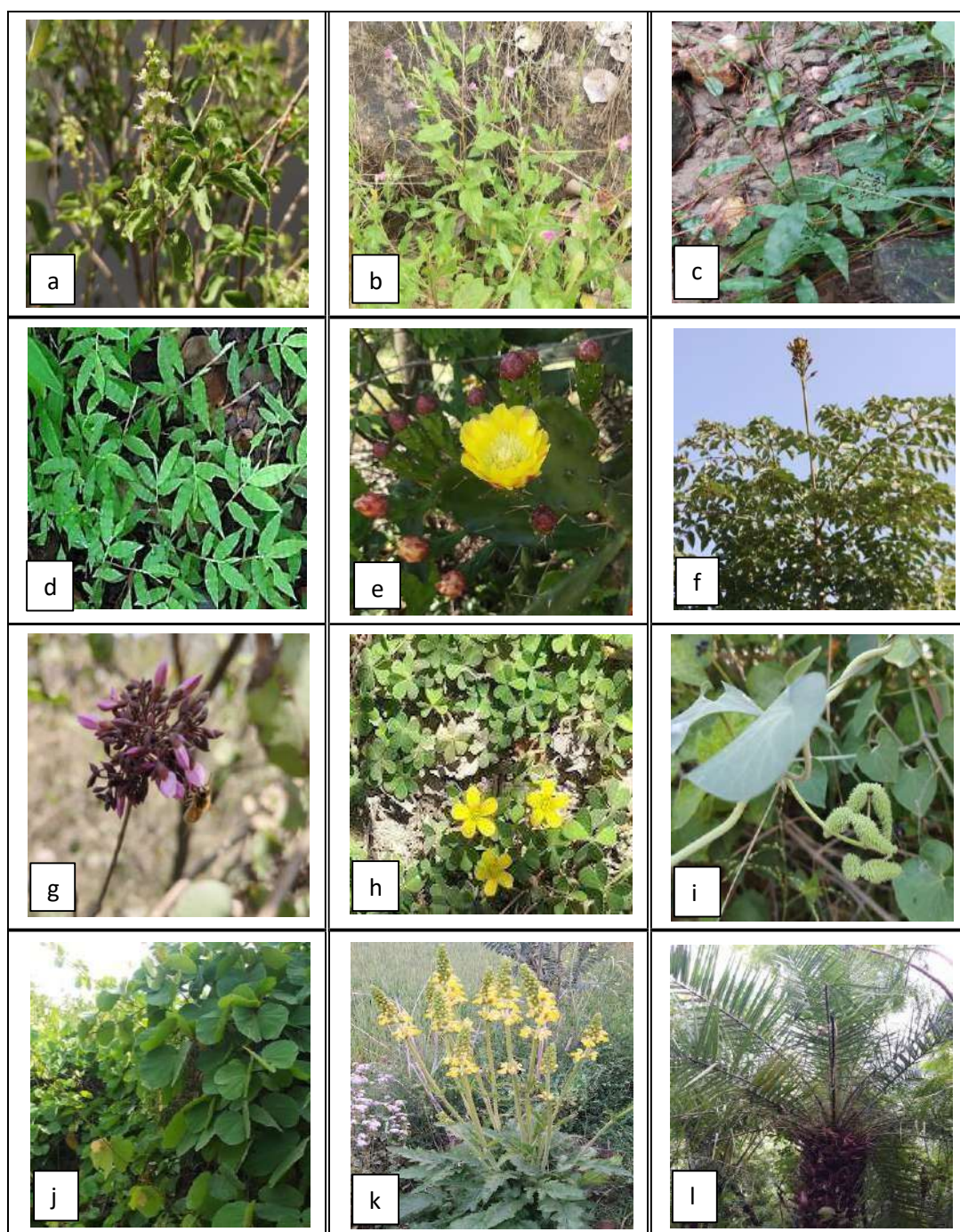
(a) *Luffa aegyptiaca* Mill (b) *Mallotus philippensis* (Lam) MüllArg (c) *Malva pusilla* Sm (d) *Mangifera indica* L (e) *Martynia annua* L (f) *Mazus pumilus* (Burm.f.) Steenis (g) *Medicago sativa* L (h) *Melia azedarach* L (i) *Melilotus indicus* (L) All (j) *Mentha spicata* (k) *Micromeria biflora* (Buch-Ham ex DDon) (l) *Mirabilis jalapa* L

PLATE-XII



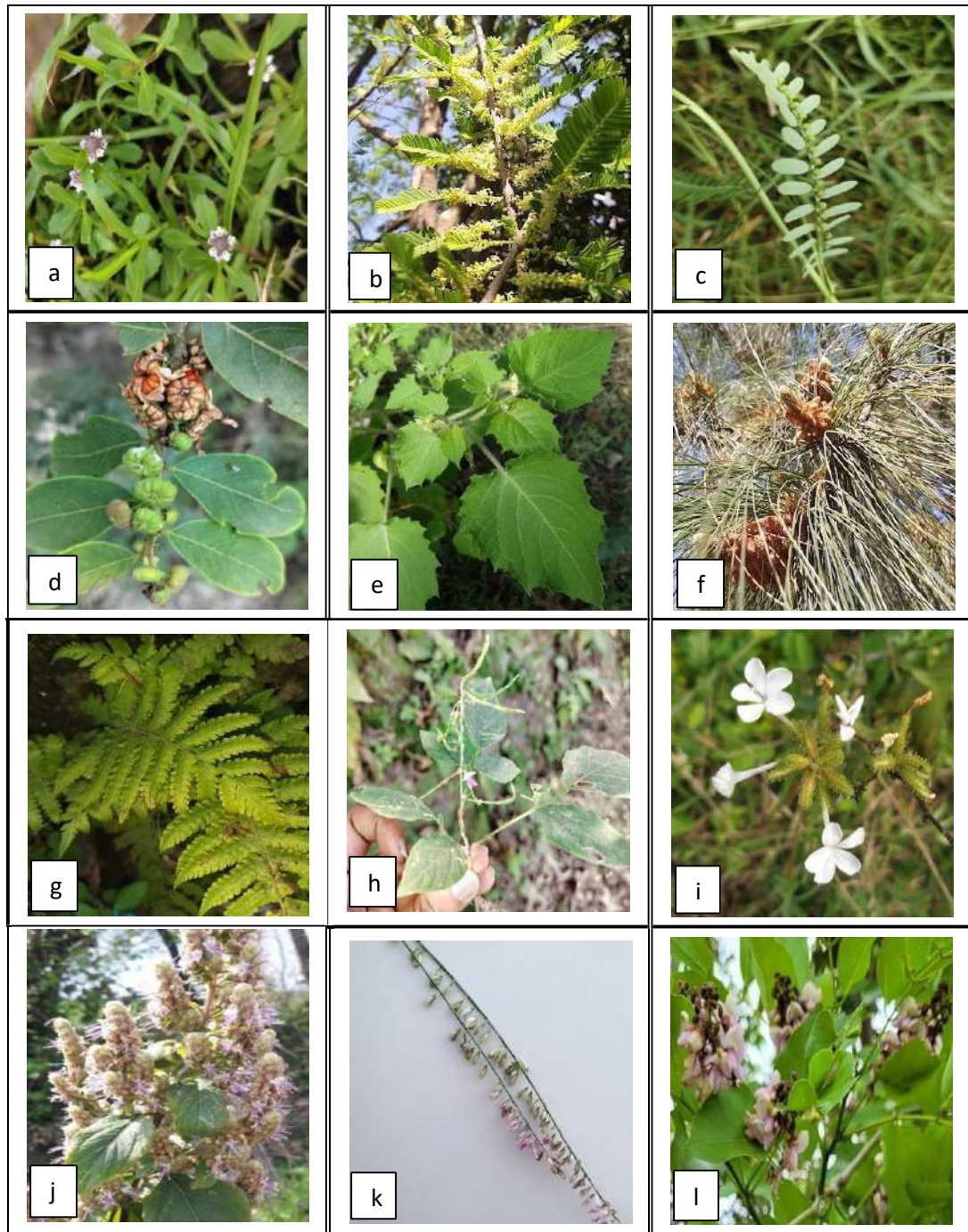
(a) *Mitragyna parvifolia* (Roxb.) Korth. (b) *Momordica charantia* L (c) *Morchella esculenta* fr. (d) *Moringa oliefera* Lam (e) *Morus alba* L (f) *Murraya koenigii* (L.) Spreng. (g) *Nelumbo nucifera* Gaertn. (h) *Nepeta hindostana* (B.Heyne ex Roth) Haines (i) *Nerium indicum* L (j) *Nicotiana tabacum* L (k) *Nyctanthes arbor-tristis* L (l) *Ocimum americanum* L

PLATE-XIII



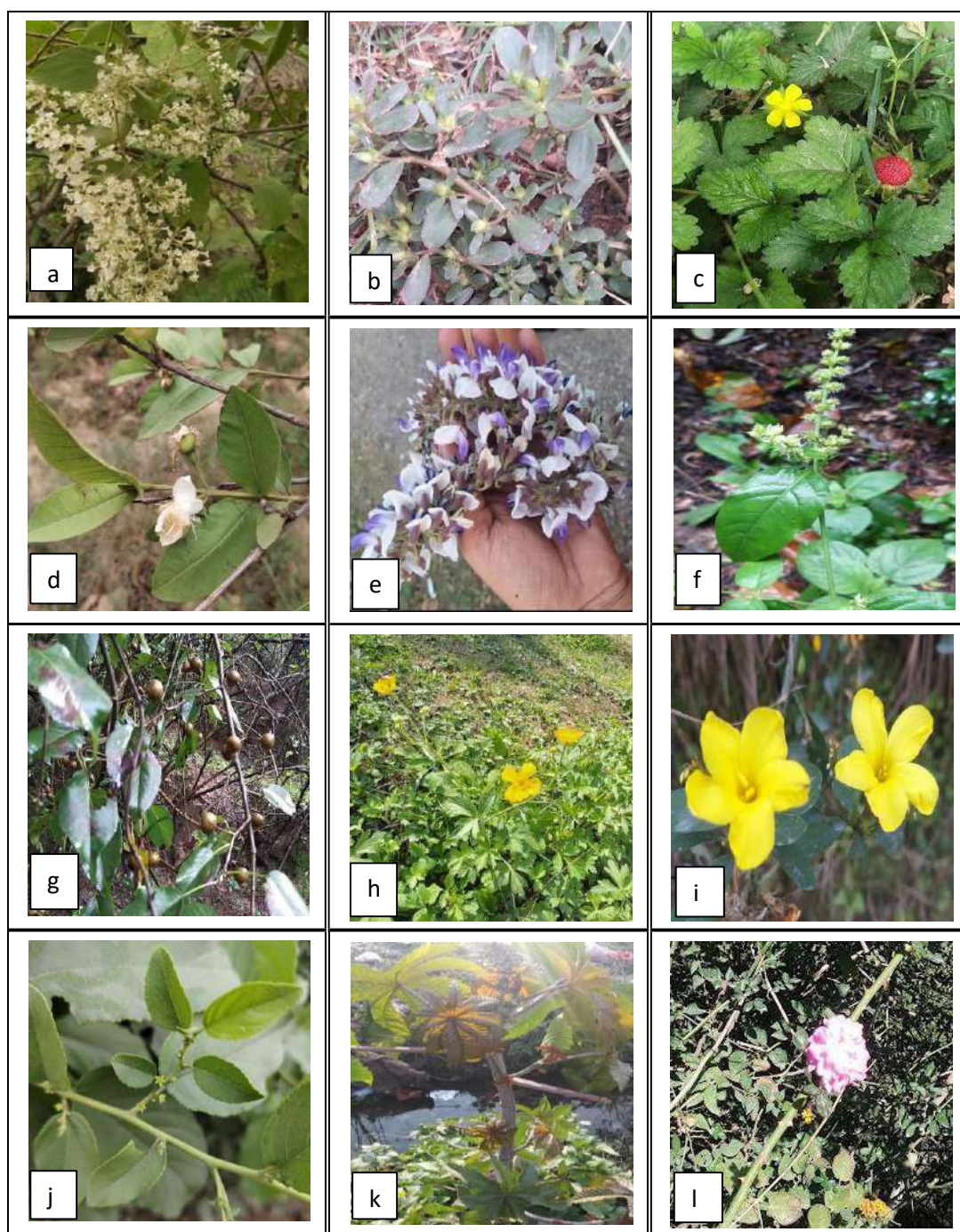
(a) *Ocimum tenuiflorum* L (b) *Oenothera rosea* L'Hér. ex Aiton (c) *Oplismenis compositus* (L.) P.Beauv. (d) *Oplismenus burmannii* (Retz.) P.Beauv. (e) *Opuntia tuna* (L.) Mill. (f) *Oroxylum indicum* (L.) Kurz (g) *Ougeinia oojeinensis* (Roxb) Hochr (h) *Oxalis corniculata* L. (i) *Pergularia daemia* (Forssk.) Chiov. (j) *Phanera vahlii* (Wight & Arn) Benth (k) *Phlomis superba* (Royle ex Benth.) Kamelin & Makhm. (l) *Phoenix dactylifera* L.

PLATE-XIV



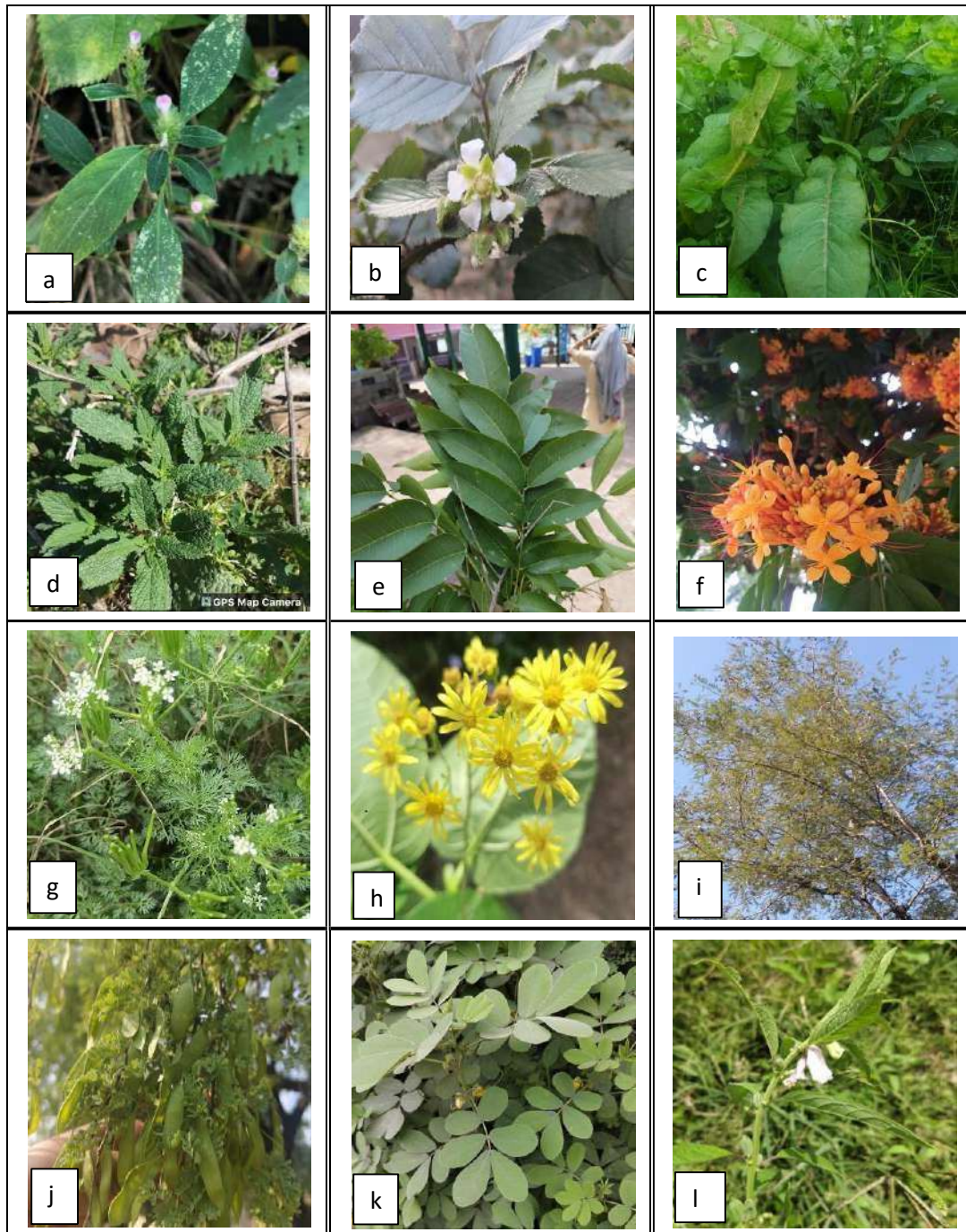
(a) *Phyllanthus nodiflorus* (L.) Greene (b) *Phyllanthus emblica* L. (c) *Phyllanthus urinaria* L. (d) *Phyllanthus velutinus* (Wight) Müll.Arg. (e) *Physalis angulata* L. (f) *Pinus roxburghii* Sarg. (g) *Pityrogramma calomelanos* (L.) Link (h) *Pleurolobus gangeticus* (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi (i) *Plumbago zeylanica* L. (j) *Pogostemon benghalensis* (Burm.f.) Kuntze (k) *Polygala abyssinica* R.Br. ex Fresen. (l) *Pongamia pinnata* (L.) Pierre

PLATE-XV



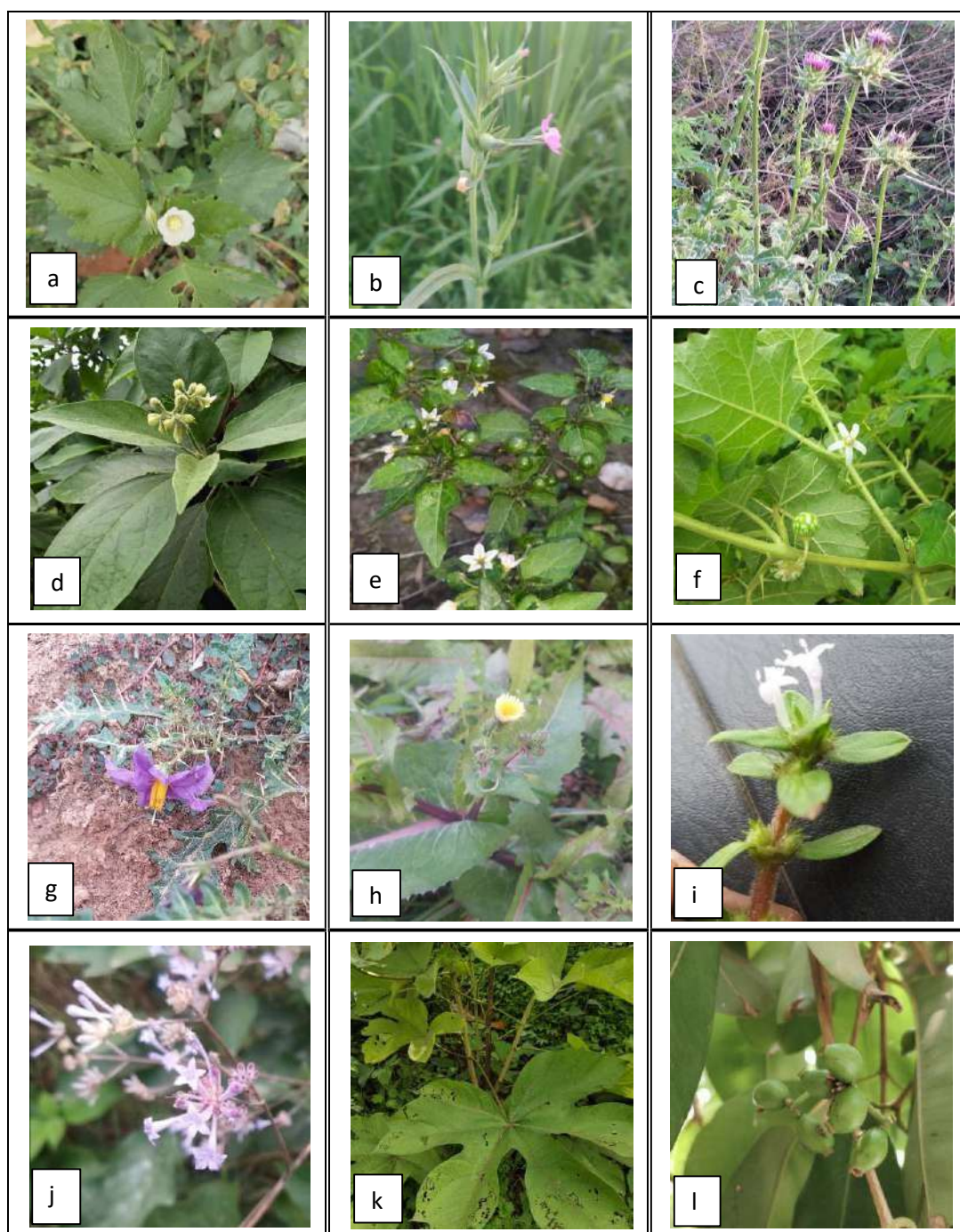
(a) *Poranopsis paniculata* (Roxb.) Roberty (b) *Portulaca oleracea* L. (c) *Potentilla indica* (Andrews) Th.Wolf (d) *Psidium guajava* L (e) *Pueraria tuberosa* (Roxb ex Wild) DC (f) *Pupalia lappacea* (L.) Juss. (g) *Pyrus pashia* Buch. -Ham. ex D.Don (h) *Ranunculus sceleratus* L. (i) *Reinwardtia indica* Dumort (j) *Rhamnus triquetra* (Wall.) Brandis (k) *Ricinus communis* L. (l) *Rosa macrophylla* Lindl.

PLATE-XVI



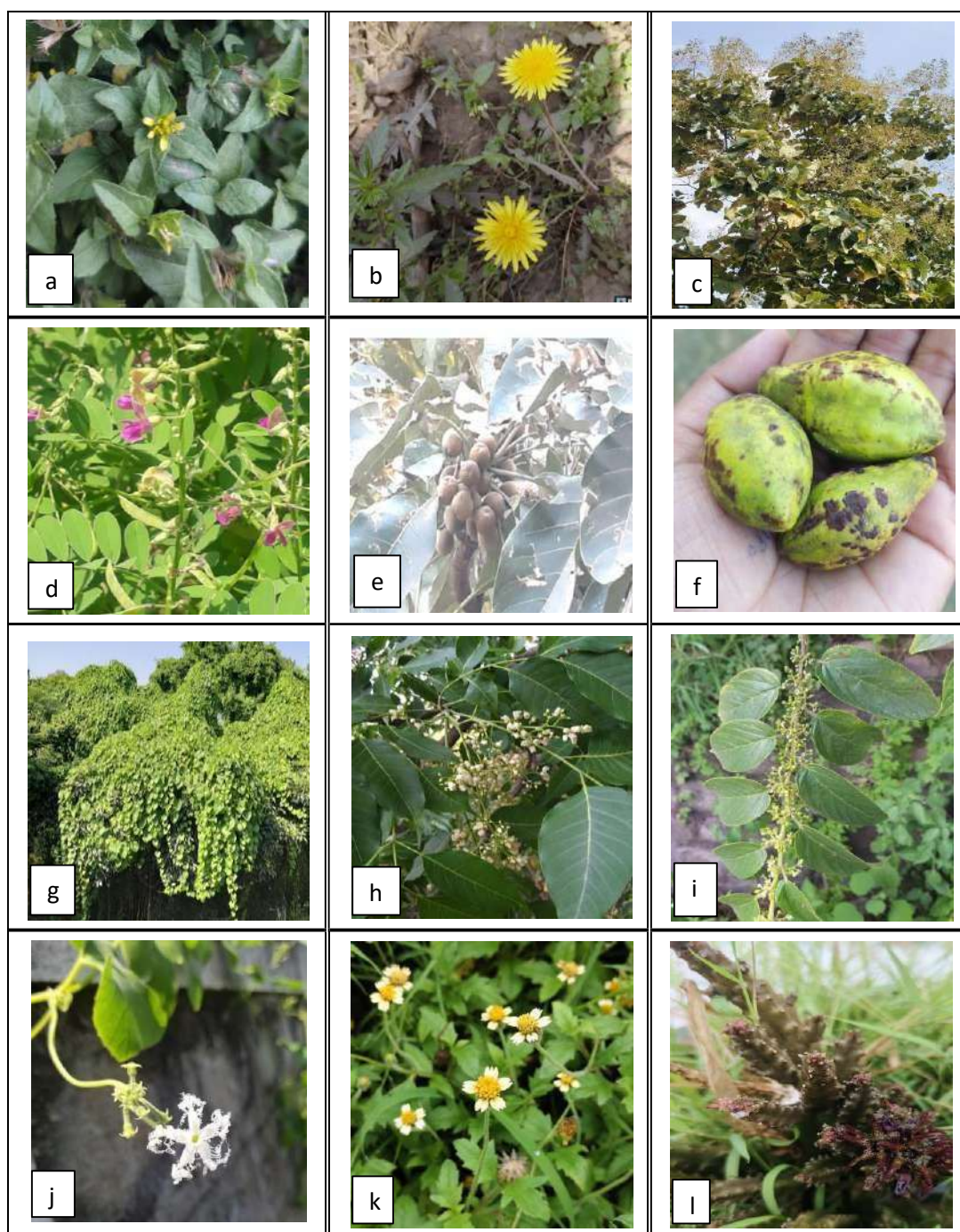
(a) *Rostellularia procumbens* (L.) Nees (b) *Rubus ellipticus* Sm (c) *Rumex dentatus* L. (d) *Salvia plebeia* R.Br. (e) *Sapindus mukorossi* Gaertn. (f) *Saraca asoca* (Roxb.) W.J.de Wilde (g) *Scandix-pecten veneris* L (h) *Packera aurea* (L.) Á.Löve & D.Löve (i) *Senegalia catechu* (L.f.) P.J.H.Hurter & Mabb. (j) *Senegalia modesta* (Wall.) P.J.H.Hurter (k) *Senna tora* (L.) Roxb. (l) *Sesamum indicum* L.

PLATE-XVII



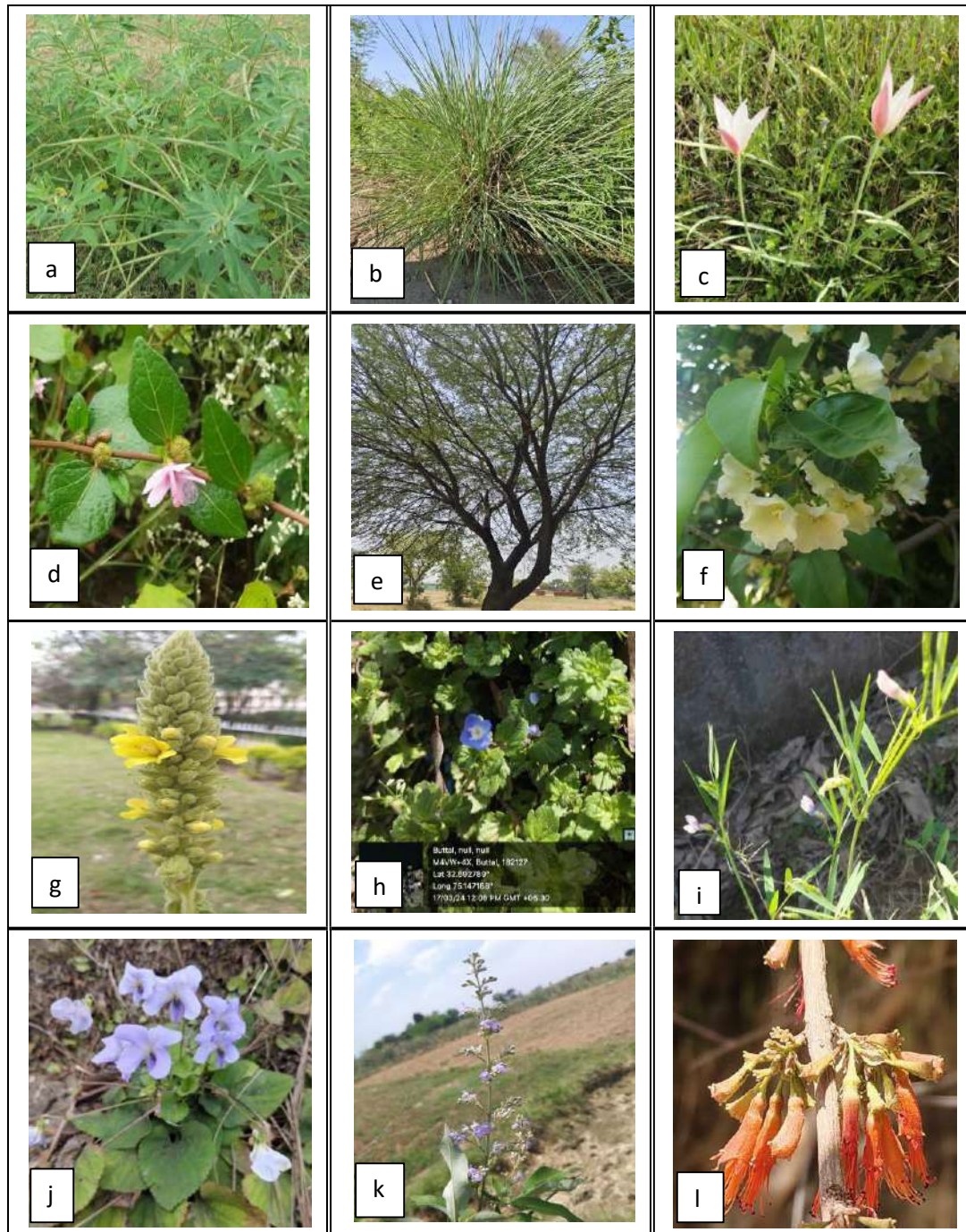
(a) *Sida cordata* (Burm.f.) Borss.Waalk. (b) *Silene conoidea* L. (c) *Silybum marianum* (L.) Gaertn. (d) *Solanum erianthum* D.Don (e) *Solanum nigrum* L. (f) *Solanum viarum* Dunal (g) *Solanum virginianum* L. (h) *Sonchus asper* (L.) Hill (i) *Spermacoce articularis* L.f. (j) *Spermadictyon suaveolens* Roxb. (k) *Sterculia villosa* Roxb. ex Sm. (l) *Sygygium cumini* (L) Skeels

PLATE-XVIII



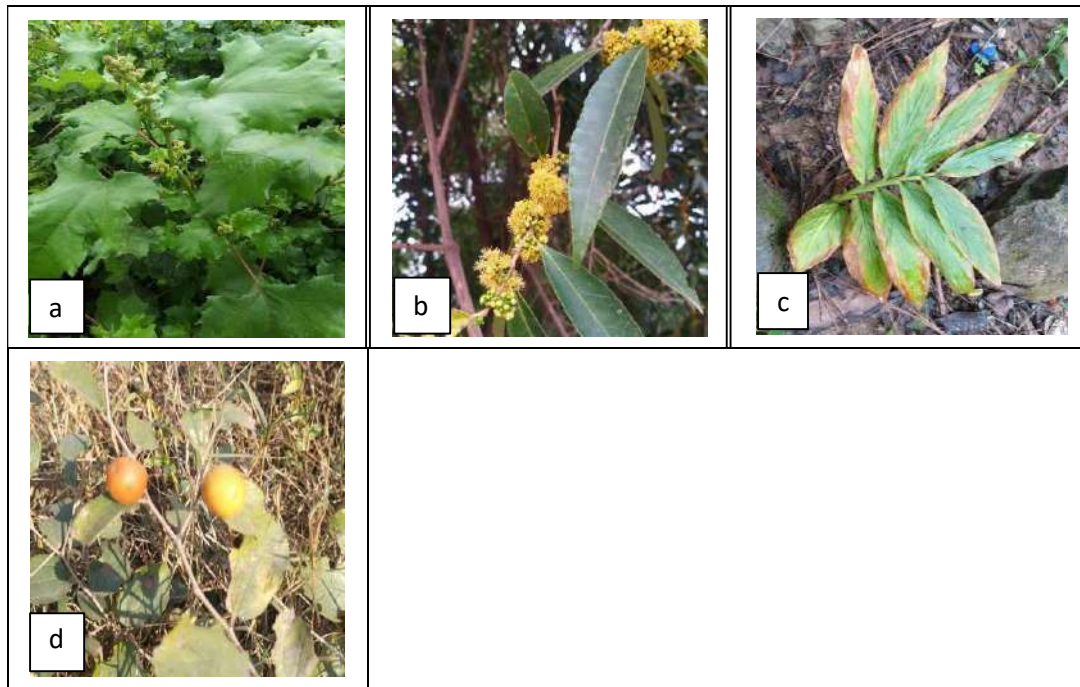
(a) *Synedrella nodiflora* (L.) Gaertn. (b) *Taraxacum* sect. *Taraxacum* F.H.Wigg. (c) *Tectona grandis* Lf (d) *Tephrosia purpurea* (L.) Pers. (e) *Terminalia bellirica* (Gaertn) Roxb (f) *Terminalia chebula* Retz. (g) *Tinospora cordifolia* (Willd.) Hook.f. & Thomson (h) *Toona ciliata* M.Roem. (i) *Trema politoria* (Planch.) Blume (j) *Trichosanthes cucumerina* L. (k) *Tridax procumbens* L. (l) *Apteranthes tuberculata* (N.E.Br.) Meve & Liede

PLATE-XIX



(a) *Trigonella foenum-graecum* L. (b) *Tripidium bengalense* (Retz.) H.Scholz (c) *Tulipa clusiana* Redouté (d) *Urena lobata* L. (e) *Vachellia nilotica* (L.) P.J.H.Hurter & Mabb. (f) *Vallaris solanacea* (Roth ex Roem. & Schult.) Kuntze (g) *Verbascum thapsus* L. (h) *Veronica persica* Poir. (i) *Vicia hirsuta* (L.) Gray (j) *Viola canescens* Wall. (k) *Vitex negundo* L. (l) *Woodfordia fruticosa* (L.) Kurz

PLATE-XX



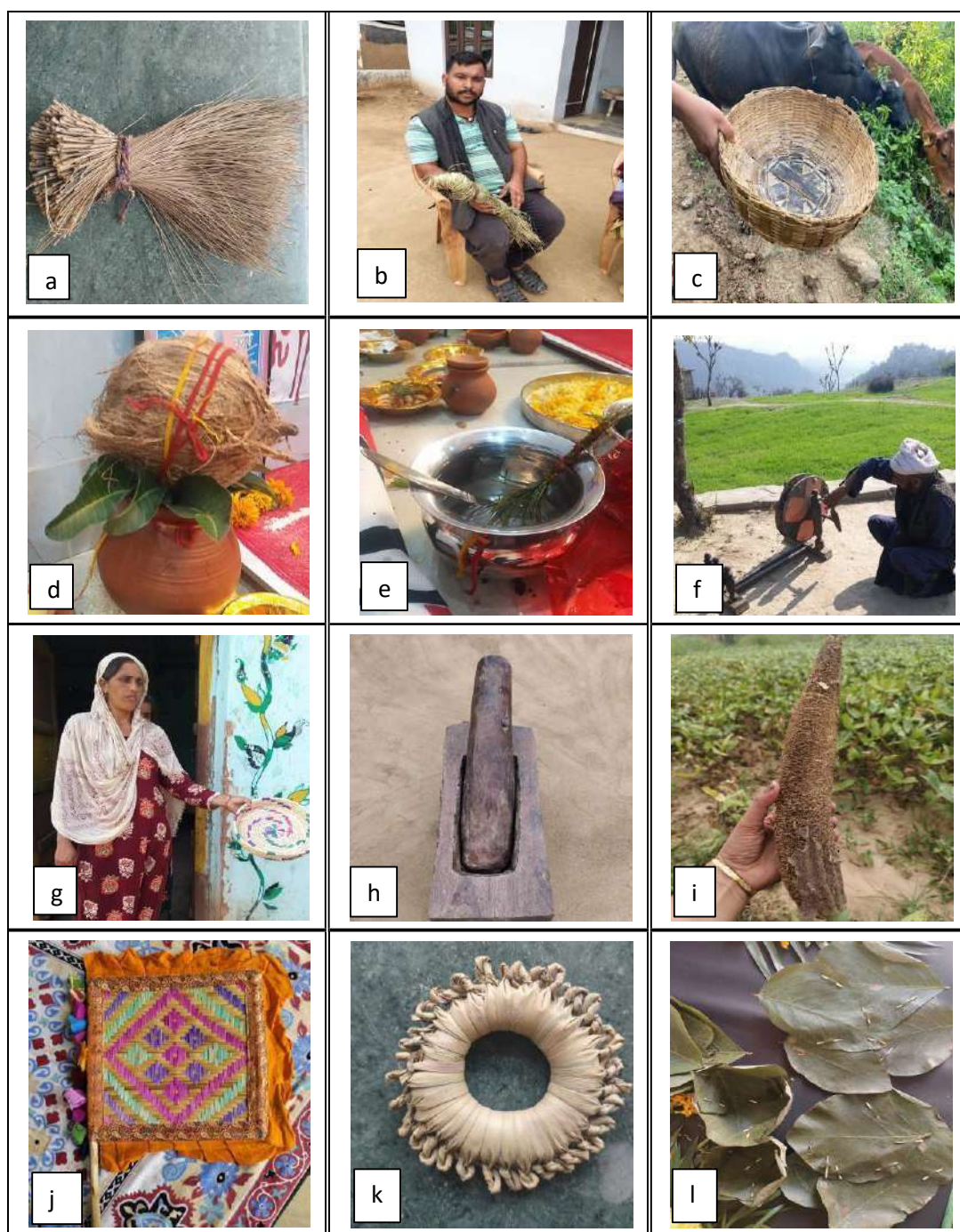
(a) *Xanthium stromarium* L (b) *Xylosma longifolia* Clos (c) *Zingiber roseum* (Roxb.) Roscoe
(d) *Zizypus jujuba* (L) Gaertn

PLATE-XXI



(a) Broom made from leaves of *Phoenix dactylifera* (b) Spade (c) small sitting tool made from wood of *Bombax ceiba* (d-e) support to grass cutting machine and roof made from wood of *Dalbergia sisoo* (f) household items made from bamboo (g) broom made from *Trepedium benghalensis* (h) boundary made from bamboo and *Toona ciliata* (i) *Thaapi* made from the wood of *Dodonea viscosa* (j) tribals weaved the threads and mats from their sheep flocks (k) roof made from *Trepedium benghalensis* (l) roof of shed made from twigs of *Dodonea viscosa*

PLATE-XXII



- (a) Small broom made from needles of *Pinus roxburgii* (b) rope made from *Eriosema comosus* leaves (c) basket made from Bamboo (d-e) leaves of *Mangifera indica* and *Cynodon dactylifera* used for religious purposes (g) (h) pestle and mortar made from *Dalbergia sisoo* wood (i) Sponge of *Luffa aegyptica* (j) *Pakhii* made from *Trepidium benghlensis* (k) traditional 'Binna' made from *Phoenix dactylifera* leaves (l) pattals and duns made from *Butea monosperma* leaves

PLATE-XXIII



Fig a-l Interaction with the tribal people during the field visit

PLATE-XXIV



PLATE-XXV

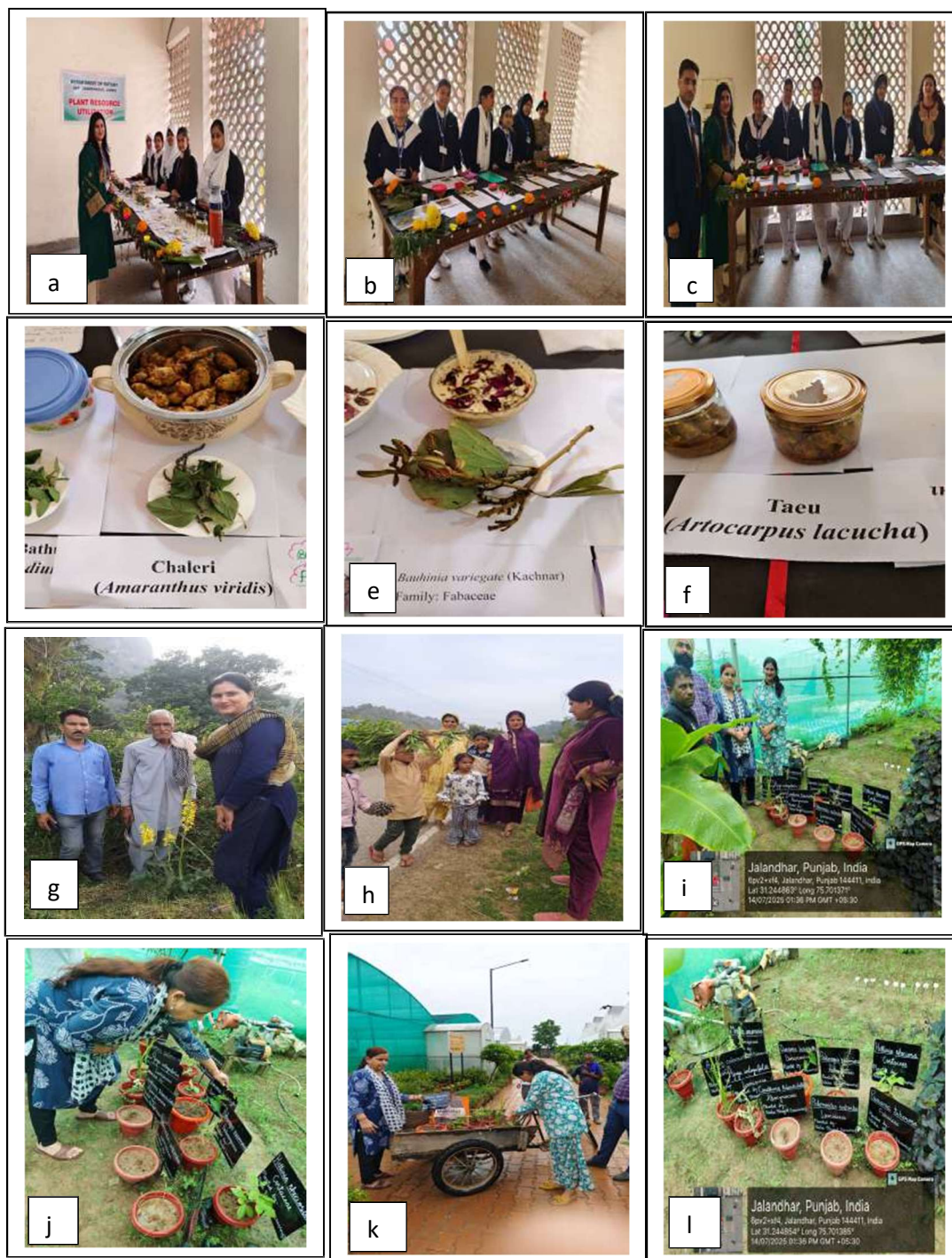


PLATE-XXVI



(a-g) Plants under conservation viz. *Hellinia speciosa*, *Phlomoides superba*, *Ajuga integrifolia*, *Litsea glutinosa*, *Viola canescens*, *Acorus calamus* and *Apteranthes tuberculata* (h-l) distribution of medicinal plants in various higher education institutions of Jammu.

PLATE-XXVII



(a-f) awareness programme organized for students (g-h) conservation awareness to local people (i-l) plantation of important plants inside Lovely Professional University campus