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Ecological Association of Medicinal Plants in Different Seasons in and around Delhi NCR

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Abstract- The current research explores the biodiversity, medicinal uses, ecological affinities, seasonal variations, and conservation status of medicinal plants found in the rapidly developing Delhi National Capital Region (NCR). As a result of botanical surveys and ethnobotanical interviews, 342 plant species were identified belonging to 87 families; out of these, 189 (55.3%) species of plants have been reported for their medicinal properties. The main characteristics of the medicinal plants include that of herbs and belong to various families including Fabaceae, Asteraceae, and Lamiaceae. According to the ecological surveys, scrub forests and grasslands are considered to be the most biodiverse places in terms of medicinal plants. The significant seasonal pattern in regard to the use of medicinal plants has been detected, particularly high in summer and monsoon season when used for gastrointestinal and respiratory diseases treatment. At last, it should be noted that according to the threat analysis, there are 57 endangered (30.2%) species of medicinal plants in the area.

Keywords- Medicinal Plants, Ecological Associations, Seasonal Variation, Ethnobotany, Urban Biodiversity, Conservation Status, Delhi NCR.

I. INTRODUCTION

The human-medicinal plant symbiosis represents an age-old paradigm in the field of healthcare. In developing countries, the use of traditional medicine made from plant continues to be the basis of primary healthcare, where around 80% of the population uses them due to availability and acceptability (World Health Organization, 2021). Worldwide, around 50,000 plant species are used for medicinal purposes amongst 422,000 recorded flowering plants. India holds a unique place in the realm of this field, possessing about 7,500 medicinal species out of 17,000 higher plants found in the country (Ayurvedic Pharmacopoeia of India, 2022). The NCR of Delhi provides a unique urban-periurban ecological setting to study such medicinal plants. Despite being subjected to rapid urbanization and infrastructure development, the region maintains rich biodiversity in terms of microhabitats belonging to four ecological zones namely Khadar (riverine), Bangar (fertile plains), Kohi (hilly ridges), and Dabar (saline lowland). However, increasing demands in the market, unsustainable harvesting, and loss of habitat poses considerable threat to the survival of wild plants. The main aim of the study is to examine the medicinal plants in Delhi NCR in terms of their diversity, seasonality, ecology, and present conservation status.

II. LITERATURE REVIEW

Earlier studies have highlighted the significance and susceptibility of medicinal plants in urban systems. According to Kumar and Sharma (2019), 127 medicinal plant species were recorded from the Delhi Ridge region, and their peak diversities were noted in the monsoonal season, where 23% of these plants are facing extinction due to over-exploitation. In addition, Singh et al. (2020) found that abiotic factors like soil pH and moisture play a significant role in the distribution of medicinal plants in various

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microhabitats in the Delhi NCR. In addition, Gupta and Khan (2018) found a strong negative correlation between urban development intensity and the diversity of medicinal plants, where a remarkable range reduction was noted in ground herbs and climbers. Despite these important studies, most of the existing literature is either species-focused or habitat-specific. However, an important void still exists in the comprehensive synthesis of seasonal phenology, ecological relationships, and threats in one integrated approach.

This study fills that void through season-wise and area-wise assessment of medicinal plants in the Delhi NCR. Recent national assessments confirm the critical role of protected forests and urban ecosystems in sustaining India's medicinal plant wealth (Forest Survey of India, 2021; National Medicinal Plants Board, 2023). Furthermore, understanding the intersection of seasonal phytochemical variations, urban traditional knowledge, and escalating conservation threats is highly essential for developing integrated management strategies in the Delhi NCR region (Agarwal & Mishra, 2022; Mehta & Patel, 2021; Sharma & Rathore, 2017).

III. RESEARCH METHODOLOGY

This study uses the pragmatic paradigm approach to adopt an exploratory sequential mixed methods design to explore the complex socio-ecological issue. The process of the research will be done in three stages, which include the qualitative exploration, the quantitative phase and the integration of the data. The qualitative data on medicinal uses of the plants and their harvesting processes was obtained through semi-structured interviews and focus group discussions with the local informants and purposeful sampling. The quantitative data on the diversity of plants, seasonal occurrences and ecological connections were obtained through systematic botanical field surveys carried out in different seasons and structured surveys with stratified random sampling. The qualitative data were analyzed using thematic analysis with the help of the NVivo software while quantitative data was analyzed using descriptive and inferential statistics in SPSS.

IV. RESULTS AND DISCUSSION

In this chapter, we present the results from the detailed survey carried out in various seasons in the highly urbanized region of Delhi–NCR regarding its medicinal plants. This study provides information on the diversity of the medicinal plants found in the region, their traditional uses, ecology, phenology, and conservation status.

Plant Diversity and Traditional Uses

The detailed botanical inventory recorded 342 different plant species belonging to 87 families, with 189 species (55.3%) having known medicinal importance. The medicinal plants were largely herbaceous (54.4%), which could be attributed to the potential of such plants in colonizing urban micro-environments. The families Fabaceae and Asteraceae appear as the main contributors in terms of taxonomic composition in the medicinal wealth of the area. Ethnobotanical information shows that leaves are the plant parts mostly used (69.8%), which indicates sustainability in harvesting. However, the extensive use of roots (46.0%) and bark creates persistent conservation concerns. As can be seen from Table 1, local communities make extensive use of these plant species to treat GI and respiratory problems. The ethnobotanical information available indicates that the documented medicinal plants play various treatment functions among the communities. The different applications of these medicinal plants have been classified based on their main function in health care, as indicated in Table 1.

Table 1: Major Categories of Traditional Medicinal Uses in Delhi NCR

Therapeutic Category	Number of Species	Percentage of Medicinal Species
Gastrointestinal Disorders	78	41.3%

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Respiratory Ailments	62	32.8%
Skin Conditions	59	31.2%
Fever and Infectious Diseases	53	28.0%
Pain and Inflammation	47	24.9%

Note. Many species possess multiple therapeutic applications. Source: Primary Survey

Table 1 shows that the highest reliance on medicinal plants in the Delhi NCR area is seen in the treatment of disorders of the digestive system (41.3%), followed by respiratory diseases (32.8%) and skin disorders (31.2%). This pattern indicates the health issues most common among urban and peri-urban residents, and highlights the importance of these specific plant species to their basic healthcare.

Ecological and Seasonal Associations

As per the ecological assessments, it is evident that the medicinal plants found in the area have a certain preference for their habitats. Scrub forest (38.1%) and grassland (30.7%) turn out to be the major ecosystems where the medicinal plants exist. As per the edaphic assessments, it can be noted that most of the species thrive in soils that are well-drained and of sandy loam and clay loam texture, and which possess neutral pH levels and moderate amount of organic matter. It is also important to understand that the seasonality plays an important role in determining the availability and use of the plants (see figure 1 below). It is observed that phenologically, the peak time of leafing and vegetative growth is observed during the summers, while flowering and fruiting are observed in monsoons, winters. Seasonal variations shown in Figure 1 below.

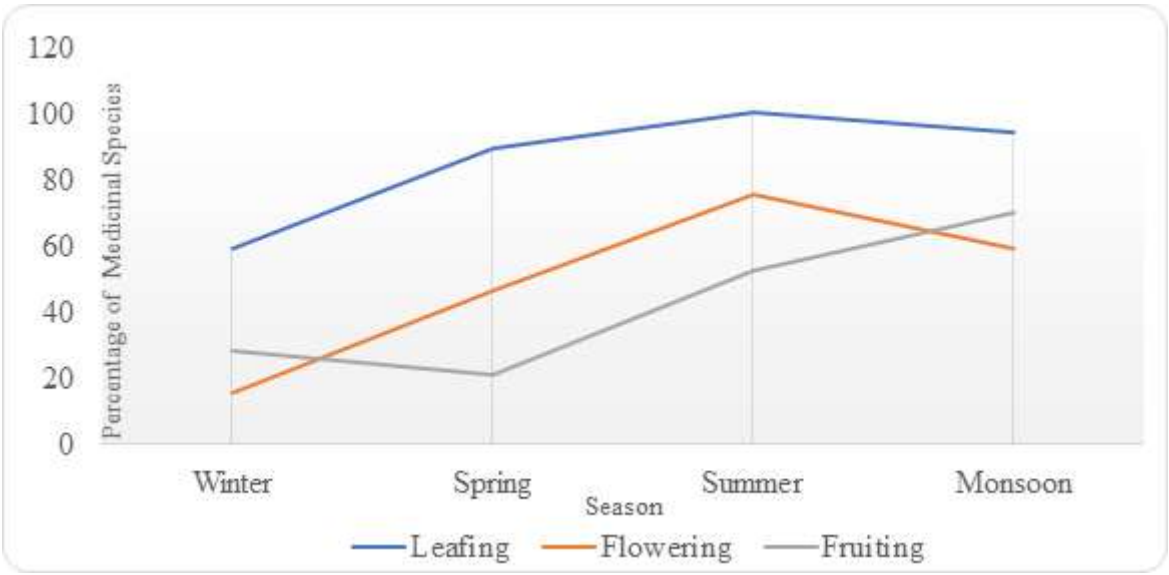

Figure 1 - A line graph illustrating the Seasonal Phenological Patterns (Leafing, Flowering, and Fruiting) of Medicinal Plants across Winter, Spring, Summer, and Monsoon

Source: Primary botanical field surveys

Figure 1 shows that vegetative development and foliage formation occur at maximum during the summer, while reproductive phases such as blossoming and bearing fruits take place during monsoon and early winters. Such phenological changes have a direct influence on the process of harvesting due to the changing requirement for particular plant parts that are therapeutically useful.

Threats and Conservation Status

Despite showing significant variations, the results of the threat assessment reveal an alarming conservation status of a large percentage of urban plants. To begin with, only 69.8% of medicinal plants

fall under the Least Concern category. On the other hand, there are 57 plants (30.2%) that are under some degree of threat. Most importantly, there are 10 plants (5.3%), which include Commiphora wightii and Saraca asoca, that are currently classified as either Endangered or Critically Endangered.

V. CONCLUSION AND RECOMMENDATIONS

However, through the comprehensive assessment of the Delhi NCR region, the wealth and the vulnerability of the medicinal plants found in the urban area have been determined. Even with the high rate of urbanization of the region, 189 medicinal plant species continue to survive mostly in scrub forests and grasslands. However, according to the research, out of the mentioned species, 57 of them are threatened to different extents because of the major destruction of habitats, unrestricted urbanization and excessive exploitation of the area. The seasonal dynamics of the use of the resources show that there is a high use of them during summer and monsoon. In order to make sure of the sustainability of these important resources, certain conservation actions are required immediately. As a matter of fact, it is strongly advised to create medicinal plant conservation zones in the urban green areas and to protect their habitats strictly from destruction. Moreover, the sustainable harvesting practices should be introduced and the ex-situ cultivation of endangered high demand species should be promoted. In this way, the pressure of the exploitation on the plant resources of the area can be significantly reduced.

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