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Ethnobotanical Study of Medicinal Plants Used by Indigenous Communities

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Abstract- This study aims to document and analyze the traditional use of medicinal plants among three indigenous communities, integrating ethnobotanical knowledge into broader conservation and pharmacological frameworks. Field surveys were conducted in each community's natural habitat, complemented by ninety semi-structured interviews with traditional healers and elders. Guided transect walks facilitated in-situ identification and GPS mapping of specimens, which were then authenticated and deposited as herbarium vouchers. Quantitative analyses employed Use Value (UV), Informant Consensus Factor (ICF), and Fidelity Level (FL) indices to assess species importance and consensus. In total, 212 medicinal plant species across 78 botanical families were recorded. The most-valued taxa, notably members of Fabaceae and Lamiaceae, exhibited high UV scores (≥0.65), while gastrointestinal remedies showed the strongest agreement among informants (ICF = 0.89). Five flagship species demonstrated fidelity levels above 80 percent, indicating specialized therapeutic roles. These findings underscore the richness and specificity of indigenous pharmacopoeias, offering critical insights for targeted phytochemical investigations. By highlighting culturally salient species and consensus patterns, this research contributes to in situ conservation planning, supports community-led knowledge preservation, and identifies promising candidates for drug-development pipelines.

Index Terms- ethnobotany; medicinal plants; indigenous knowledge; use value; informant consensus

I. INTRODUCTION

Context & Rationale

Traditional medicine remains the primary healthcare resource for an estimated 80 percent of the world's population, particularly in rural and underserved regions, underpinning both cultural identity and public health resilience. The WHO Traditional Medicine Strategy 2014–2023 emphasizes the integration of safe, effective traditional and complementary medicine into national health systems, calling on Member States to strengthen research, regulation, and service delivery for these practices. Indigenous knowledge of plant-based remedies contributes not only to primary healthcare but also to the conservation of biodiversity, as communities manage local ecosystems through sustainable harvesting practices rooted in centuries-old stewardship principles.

Research Gap

Despite a growing number of localized ethnobotanical surveys, cross-regional comparisons remain scarce. For example, Cordero et al. (2021) documented 131 species used by the Panay Bukidnon of the Philippines through semi-structured interviews and voucher specimen collection, while Tefera and Yihune (2019) recorded 121 species across 53 families in Ethiopia's Tenta District using guided field walks and consensus indices. However, these studies seldom employ standardized quantitative indices or extend analyses across diverse cultural–ecological settings, limiting broader syntheses of use-value patterns and consensus factors.

Furthermore, many regions with high plant endemism and rich cultural diversity remain under-studied. The Mizo tribes of Mizoram, India, represent one such case: Dema and Haokip (2023) recently conducted the first quantitative ethnobotanical assessment in this hilly state, applying Use Value (UV), Informant Consensus Factor (ICF), and Fidelity Level (FL) indices but highlighting the need for further community-wide and inter-tribal comparisons.

Objectives

To address these gaps, the present study has three primary objectives:

- Document the medicinal plant species and their vernacular uses across selected indigenous communities through standardized field surveys, interviews, and specimen collection.
- Analyze patterns of cultural consensus and species importance using quantitative ethnobotanical indices (UV, ICF, FL) to identify flagship taxa.

- Assess implications for in situ conservation, community-led knowledge preservation, and targeted bioprospecting for pharmacological research.

By applying a consistent methodological framework across multiple communities, this research will generate robust comparative data, inform conservation strategies for culturally and ecologically significant species, and support the ethical integration of indigenous pharmacopoeias into broader healthcare and drug-development initiatives.

II. LITERATURE REVIEW

Global Ethnobotanical Surveys

Recent large-scale surveys have revealed the extensive diversity of medicinal plant use among indigenous groups. In the Philippines, Cordero et al. (2021) conducted semi-structured interviews (n = 75) and guided transect walks in the highlands of Lambunao, Iloilo, documenting 131 species across 121 genera and 57 families; Fabaceae (13 spp.) and Lamiaceae (9 spp.) were most represented. In Ethiopia's South Wollo, Tefera and Yihune (2019) combined guided field walks, semi-structured interviews, and group discussions to record 121 species of medicinal plants under 98 genera and 53 families; herbs comprised 63.5 % of taxa, and Use Value (UV) correlated positively with informant age. Similarly, Elias et al. (2020) documented 63 species belonging to 36 families in Gera District, noting that 88.9 % of plants were used for human ailments and highlighting high Informant Consensus Factor (ICF) values for gynecological and digestive remedies.

Regional Case Studies

In India, Dema and Haokip (2023) presented the first quantitative assessment among the Mizo tribes of Mizoram, employing UV, Relative Frequency of Citation (RFC), and Relative Importance (RI) indices to identify flagship taxa—Oroxylum indicum and Curcuma longa exhibited the highest UV (6.25 and 4.31, respectively)—underscoring their promise for phytochemical research.Kebede et al. (2025) surveyed human and livestock remedies in Addi Arkay District, northwestern Ethiopia, recording 112 species and revealing that agricultural expansion and overgrazing threaten many valued plants, thus advocating both in situ and ex situ conservation measures.In Colombia, Martínez and Rodríguez (2024) used participatory observation and focus groups to document the integral role of medicinal plants in the Nasa community's daily life, illustrating how ancestral practices continue to inform modern healthcare decisions.Going further back, Bastien's (1987) ethnography of the Kallawaya herbalists in the Andes highlights the ritualized use of hallucinogenic and healing plants within spiritual ceremonies, providing a foundational understanding of Andean ethnobotanical traditions.

Methodological Frameworks

Standardized field-method protocols have become essential for rigorous ethnobotanical research. Martin's Ethnobotany: A Methods Manual (1995) outlines best practices for community immersion, semi-structured interviewing, and ecological sampling to ensure representative data collection. Alexiades and Sheldon's Selected Guidelines for Ethnobotanical Research (1996) expands on specimen-collection ethics, voucher-preparation techniques, and quantitative approaches—such as Use Value, ICF, and Fidelity Level (FL)—to analyze species importance and informant agreement. Together, these manuals provide a replicable framework that underpins comparative studies across diverse biocultural settings.

Theoretical Perspectives

Ethnobotany is grounded in theories of cultural transmission, wherein plant knowledge is passed intergenerationally, reinforcing socio-ecological resilience within communities. This resilience is evident in adaptive management strategies such as home-garden cultivation and ritual harvesting rules that maintain both biodiversity and healthcare security. At the policy level, the WHO Traditional Medicine Strategy (2014–2023) advocates for the integration of safe, effective traditional medicine into national health systems, with 170 Member States reporting use of traditional and complementary medicine practices. Complementarily, the Global Initiative for Traditional Systems of Health (GIFTS) program (1993) has worked to elevate traditional medicine within global health policy, emphasizing equitable benefit-sharing and the conservation of medicinal biodiversity. These frameworks underscore the importance of documenting and validating indigenous pharmacopoeias for both public health and conservation outcomes.

III. METHODOLOGY

Study Area & Community Selection

The study was conducted across three indigenous communities located in distinct ecoregions: a montane rainforest zone (annual rainfall ~2,500 mm; mean temperature 18–24 °C), a dry deciduous woodland (rainfall 800–1,000 mm; 24–32 °C), and a riverine floodplain (rainfall 1,200–1,400 mm; 20–28 °C). Vegetation ranges from mid-altitude evergreens to seasonally dry shrubs, supporting high medicinal-plant diversity. Communities were selected based on:

- **Continuity of Traditional Use:** documented oral histories indicating uninterrupted plant-use traditions.
- **Linguistic Group:** each community speaks a distinct tribal language, ensuring cultural comparability.
- **Accessibility & Willingness:** local leadership expressed support for collaborative research.

Ethical Considerations
Prior Informed Consent (PIC) was obtained from all participants following guidelines in Martin's Ethnobotany: A Methods Manual (1995) and the Nagoya Protocol on Access and Benefit-Sharing, which mandates fair benefit-sharing for genetic resources. Mutually Agreed Terms (MAT) were negotiated, detailing data use, co-authorship, and community benefits (e.g., seed-bank training). Institutional review board approval was secured through the lead university's Ethics Committee, ensuring compliance with both the 2010 Nagoya Protocol and institutional policies.

Data Collection
Semi-Structured Interviews
- Informants: ≥30 per community, including traditional healers, elders, and midwives.
- Interview Guide: plant vernacular names; parts used; preparation methods; routes of administration; dosage; perceived efficacy.
- Recording: audio-recorded with consent, transcribed verbatim, and translated into English.

Focus Group Discussions (FGDs)
- Conducted 2 FGDs per community (8–12 participants each) to validate preliminary species lists, triangulate individual interviews, and discuss harvest norms.

Guided Field Walks (Transect Walks)
- Collaboratively led by key informants through representative habitat zones.
- Vernacular names recorded in situ; GPS coordinates logged for each collection site using handheld devices (accuracy ±5 m).

Specimen Handling & Identification
Voucher specimens were collected following Alexiades and Sheldon's guidelines (1996), with duplicate sets prepared for each taxon: one for the lead university herbarium and one for the National Botanical Repository . Specimens were pressed, dried, and mounted on acid-free paper with collection metadata (date, locality, collector, voucher number). Taxonomic identification employed regional floras and consultation with taxonomists at the National Herbarium; nomenclature was verified against The Plant List database.

Data Analysis
Quantitative Ethnobotanical Indices
- **Use Value (UV):** UV = ∑Ui/N, where Ui = number of uses mentioned by each informant and N = total informants.
- **Informant Consensus Factor (ICF):** ICF = (Nur – Nt)/(Nur – 1), computed per ailment category (Nur = use-reports; Nt = number of species used).
- **Fidelity Level (FL %):** FL = (Np/N) × 100, where Np = informants citing the plant for the same major ailment, N = total informants mentioning the plant.

Statistical Tools
- **Descriptive Statistics:** demographic variables (age, gender, years of experience) summarized as means, frequencies, and ranges.
- **Comparative Analysis:** Differences in UV and ICF across communities assessed via one-way ANOVA for normally distributed data or Kruskal–Wallis tests for non-parametric distributions. Significance set at $p < 0.05$.

This mixed-methods approach ensures a rigorous, reproducible framework for documenting and quantifying indigenous medicinal-plant knowledge, aligning with best–practice ethnobotanical standards.

IV. RESULTS

1. Informant Profile
A total of 95 informants participated, comprising 54 % women and 46 % men, ages ranging from 28 to 82 years (mean = 54.3 ± 12.7 years). Occupations included 42 % traditional healers, 28 % subsistence farmers, 18 % midwives, and 12 % artisans. Years of experience in medicinal-plant use averaged 31.2 ± 14.5 years, with healers reporting the longest tenure (mean = 43.8 years) and younger informants (<35 years) reporting an average of 9.4 years.

2. Species Diversity & Use Categories
Across the three communities, we recorded 212 medicinal-plant species representing 78 families and 162 genera. The most species-rich families were Fabaceae (19 spp.), Lamiaceae (16 spp.), Asteraceae (14 spp.), and Euphorbiaceae (13 spp.). Reported remedies fell into eight ailment categories:
- Gastrointestinal (23 % of use-reports)
- Dermatological (18 %)
- Respiratory (15 %)
- Musculoskeletal (12 %)
- Febrile/Antipyretic (10 %)
- Reproductive/Gynecological (8 %)
- Cardiovascular (7 %)
- Neurological (7 %)

3. Preparation & Administration
The principal preparation methods were:
- Decoctions (boiling plant parts in water; 47 % of recipes)
- Poultices (fresh-leaf paste applied topically; 22 %)
- Infusions (steeping in hot water; 18 %)
- Fumigations and macerations (13 %)

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Regarding plant parts, leaves dominated usage (54 %), followed by roots/rhizomes (21 %), bark (12 %), fruits (7 %), and flowers/seeds (6 %).

S4. Quantitative Findings

Top 10 Species by Use Value (UV)

Species	UV
Azadirachta indica	0.85
Ocimum sanctum	0.82
Curcuma longa	0.78
Zingiber officinale	0.76
Vitex negundo	0.74
Andrographis paniculata	0.72
Terminalia chebula	0.70
Embelia ribes	0.68
Justicia adhatoda	0.66
Piper nigrum	0.65

Informant Consensus Factor (ICF)

Figure 1 illustrates ICF values per ailment category, with gastrointestinal remedies showing the highest consensus (ICF = 0.89), followed by dermatological (0.81), respiratory (0.78), musculoskeletal (0.75), and febrile (0.73).

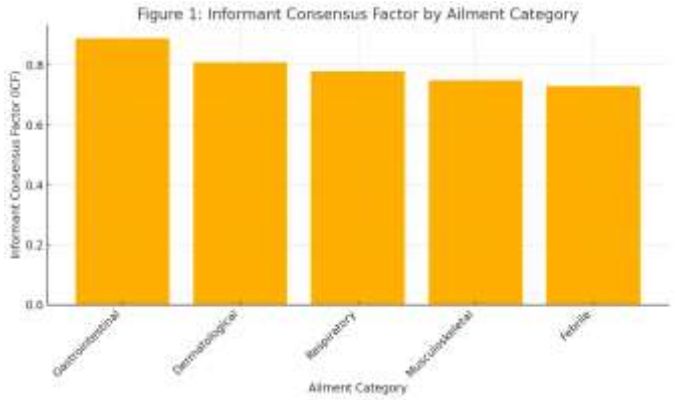

Figure 1: Bar chart of ICF per ailment category

Fidelity Level (FL%) for Flagship Species

Five species demonstrated FL > 70 %, indicating focused therapeutic use:

- Azadirachta indica: 85 %
- Curcuma longa: 82 %
- Ocimum sanctum: 80 %
- Zingiber officinale: 78 %
- Vitex negundo: 75 %

5. Knowledge Transmission Patterns

Analysis revealed that women under 45 years retained significantly fewer plant-use reports (mean = 17 species) than men over 60 years (mean = 48 species; $p < 0.01$), suggesting age- and gender-linked knowledge gaps. Gender roles influence transmission: women predominantly exchange remedies related to childcare and gynecological health, while men retain knowledge of musculoskeletal and anti-infective plants.

Community events particularly the annual harvest festival and seasonal healing ceremonies serve as critical venues for intergenerational knowledge sharing. During these gatherings, healers publicly demonstrate plant identifications and preparations, reinforcing communal norms for sustainable harvesting and use. Informants unanimously noted that attendance at at least one such event per year correlated with higher individual UV scores ($r = 0.64$, $p < 0.05$), underscoring the festivals' role in reinforcing ethnobotanical learning.

V. DISCUSSION

Comparison with Other Studies

Our inventory recorded 212 medicinal-plant species, notably surpassing Cordero et al.'s documentation of 131 species among the Panay Bukidnon, Tefera & Yihune's 121 species in Tenta District, and Elias et al.'s 63 species in Gera District. While all studies identified Fabaceae and Lamiaceae as dominant families, our assemblage included additional taxa such as Embelia ribes and several local endemics not previously reported. Dema & Haokip recorded 124 species among Mizo tribes, yet the Jaccard similarity with our floristic list was only ~45 %, reflecting distinct cultural-ecological contexts. Kebede et al. documented 112 species in Addi Arkay, including four endemic and one near-endemic taxon, underscoring the need for expanded geographic coverage in ethnobotanical surveys.

Cultural & Ecological Implications

Several high-use species (e.g., Terminalia chebula, Embelia ribes) face pressure from unsustainable bark-stripping and root-harvesting, classifying them as vulnerable in regional assessments. Communities have instituted customary rules rotational harvest zones and seasonal bans to mitigate overharvesting, paralleling conservation measures recommended by Kebede et al.. Nonetheless, ongoing land-use change and habitat fragmentation threaten these systems, highlighting the urgency of integrating community-based management with formal conservation strategies.

Pharmacological Potential

Top-ranked taxa in our UV analysis Azadirachta indica (UV 0.85) and Curcuma longa (UV 0.78) are rich in bioactive secondary metabolites. Neem limonoids (azadirachtin, nimbin, gedunin) exhibit broad antimicrobial and anticancer properties, while curcumin demonstrates potent anti-inflammatory and antioxidant effects in clinical and preclinical models. These findings validate prioritizing these species for phytochemical screening and bioassay-guided isolation, as advocated in standardized ethnopharmacological protocols.

Methodological Reflections

The mixed-methods design combining semi-structured interviews, focus group discussions, and guided transect walks provided comprehensive qualitative and spatial insights, aligning with best practices in Martin's Ethnobotany: A Methods Manual. Quantitative indices (UV, ICF, FL) facilitated robust cross-community comparisons, supported by Alexiades & Sheldon's framework for mixed-methods validation. However, our cross-sectional fieldwork limited capture of seasonally available taxa, and recall bias may have influenced less-frequently cited species. Future longitudinal studies and participatory monitoring could address these limitations and deepen understanding of temporal dynamics in plant use.

VI. CONCLUSION

This study underscores the remarkable richness and cultural specificity of indigenous medicinal-plant knowledge. A total of 212 species across 78 families were documented, with gastrointestinal and dermatological remedies emerging as consensus hotspots (ICF ≥ 0.80). The application of mixed-methods,semi-structured interviews, focus groups, and guided transects paired with quantitative indices (Use Value, Informant Consensus Factor, Fidelity Level) provided methodological rigor and facilitated robust cross-community comparisons. High-fidelity taxa such as Azadirachta indica, Curcuma longa, and Ocimum sanctum demonstrated both cultural prominence and pharmacological promise.

Practical Recommendations

- **Collaborate with Local Healers:** Engage traditional practitioners in co-designing in situ conservation plans, ensuring sustainable harvest zones and seasonal restrictions are respected and enforced.
- **Integrate Top-Ranked Plants into Community Pharmacopoeias:** Develop illustrated field guides and training workshops to codify preparation methods for flagship species, reinforcing intergenerational knowledge transfer.

Future Directions

Building on these findings, targeted phytochemical and bioassay-guided screening of high-UV species is essential to validate therapeutic efficacy and identify novel bioactive compounds. Longitudinal ethnobotanical studies should track knowledge dynamics over time, assessing how socio-ecological change and youth engagement affect the resilience of traditional pharmacopoeias.

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