

Local preferences, status trends, and economic contributions of key medicinal and aromatic plants (MAPs) in community forests of Kavrepalanchowk district, Nepal

Pradeep Raj Sitaula^{1,3}, Pratibha Sharma², Krishna Prasad Oli¹

¹Central Department of Environmental Science, Tribhuvan University, Kirtipur, Kathmandu, Nepal

²Department of Chemistry, Biochemistry and Physics, South Dakota State University, Brookings, SD, USA

³Department of Mathematics and Statistics, South Dakota State University, Brookings, SD, USA

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Abstract—Medicinal and aromatic plants (MAPs) are vital for rural livelihoods and biodiversity in Nepal's Himalayan region, yet unsustainable harvesting threatens many species despite community forestry efforts. This study examines local preferences, conservation status trends, and economic contributions of major MAPs in seven community forests of Kavrepalanchowk district, central Nepal. Data were collected through household surveys (n=55), focus group discussions, key informant interviews, and preference ranking exercises in 2007–2008. The Friedman two-way ANOVA test validated ranking differences ($\chi^2 = 24.299$, $df = 8$, $p = 0.002$). Results identified Sugandhawal (*Valeriana jatamansi*), Pakhanved (*Bergenia ciliata*), Chiraito (*Swertia chirayita*), and Kurilo (*Asparagus racemosus*) as the top four preferred species. Status trends showed marked declines over the prior 20 years due to overexploitation, with recent improvements attributed to community management. Only 13% of households collected MAPs, contributing an average of NRs 11,355 (~US\$150 at the time) per collector annually, representing about 6.4% of household income. Market systems were dominated by middlemen, resulting in low collector prices and limited value addition. Findings highlight the potential for domestication and cultivation of high-ranked species to enhance sustainable livelihoods and conservation in community forests. Recommendations include targeted training, inventory-based harvesting, and cooperative marketing to reduce dependency on wild collection and improve equity. This site-specific evidence supports policy for integrating MAPs into community forestry operational plans in mid-hills Nepal.

Keywords: Medicinal and aromatic plants; Community forestry; Non-timber forest products; Preference ranking; Kavrepalanchowk; Nepal; Rural livelihoods

1. INTRODUCTION

Medicinal and aromatic plants (MAPs) represent a vital component of non-timber forest products (NTFPs), supporting biodiversity conservation, primary healthcare, and rural economies worldwide, particularly in biodiversity hotspots like the Himalayas [2, 3]. Globally, the market for medicinal plants and related natural products exceeds US\$200 billion annually, with wild-harvested species dominating supply chains [3]. In mountain regions, MAPs provide essential provisioning services food, medicine, fodder, and cash income while serving as a buffer against economic shocks, climate variability, and agricultural shortfalls [4, 5]. Nepal exemplifies this dynamic, harboring exceptional floral diversity due to its steep elevational gradient (60–8,800 m) and varied climates, from subtropical Terai to alpine zones. The country hosts over 11,971 flowering plant species, with estimates of medicinal and aromatic plants ranging from 819 (Department of Plant Resources, recent updates) to 1,950, including 285 endemics [6, 7]. Approximately 20–25% of Nepal's flora has documented medicinal properties, and 143–300 species enter commercial trade, often destructively harvested from the wild [8, 9]. Annual trade volumes reach 7,000–27,000 tons, valued at US\$11–86 million (inflation-adjusted estimates), with the majority exported raw to India and China [8, 10]. These resources contribute substantially to rural livelihoods, often accounting for 10–50% of household income in mountain districts, particularly for marginalized groups [5, 11, 12]. However, unsustainable collection, habitat degradation, overexploitation, and climate change threaten many species, leading to population declines and biodiversity loss [8, 13].

Community forestry (CF) has emerged as Nepal's flagship program for reversing forest degradation while enhancing local benefits. Since the 1990s, over 22,000 Community Forest User Groups (CFUGs) manage ~2.3 million hectares (~45% of Nepal's forests), promoting sustainable resource use, regeneration, and equitable benefits [14, 15]. CF has improved forest cover, reduced deforestation, and supported NTFP/MAP recovery in many areas through regulated harvesting, plantations, and awareness [16, 17]. Yet challenges persist: middlemen dominate markets, collectors receive low prices, traditional knowledge erodes, and high-value species face pressure despite CF efforts [8, 18]. In mid-hills districts like Kavrepalanchowk adjacent to Kathmandu and

characterized by community-managed forests at 1,000–2,400 m MAPs offer untapped potential for livelihoods and conservation, but site-specific data on preferences, status trends, and economic contributions remain limited [7].

Previous studies highlight preferences for high-value species (e.g., Chiraito, Sugandhawal) aligned with national priorities (HNCC lists), but few integrate preference ranking, statistical validation (e.g., Friedman test), temporal status trends, and household-level economics in CF contexts [19]. This gap hinders targeted domestication, policy refinement, and equitable benefit-sharing.

This study addresses these issues by examining the conservation status, local preferences, and economic prospects of major MAPs in seven community forests of Kavrepalanchowk district. Specific objectives are: (1) to assess the status and management of major medicinal plants; (2) to evaluate their contribution to household economy and market systems; (3) to identify locally preferred MAPs and rank the top four for potential cultivation; and (4) to test preference differences using statistical methods. Findings aim to inform sustainable CF management, cultivation strategies, and policy for enhancing rural livelihoods while conserving Himalayan biodiversity.

2. MATERIALS AND METHODS

2.1 STUDY AREA

The study was conducted in Kavrepalanchowk district, central Nepal (27°20'–27°45'N, 85°25'–85°50'E), located in the mid-hills physiographic zone at elevations of 1,000–2,400 m. The district features subtropical to temperate climates, with community-managed forests covering significant areas under the Community Forestry Program. Seven community forests (CFs) were purposively selected based on documented use of medicinal and aromatic plants (MAPs), active CFUG management, and accessibility. These CFs represent typical mid-hills forests with mixed broadleaf species and understory MAPs.

2.2 SAMPLING AND DATA COLLECTION

Fieldwork was carried out from 2007 to 2008. Seven CFs were selected purposively for their known MAP resources and community involvement. From each CFUG's household registry, 55 households were randomly sampled (proportional allocation where possible) for detailed surveys.

Primary data were collected using a mixed-methods approach. Semi-structured questionnaires were administered to 55 household heads (or knowledgeable members) to gather socioeconomic profiles, MAP collection practices, uses, quantities harvested, income from sales, and market experiences. Focus group discussions (FGDs; n=7, one per CF) were conducted with 8–12 participants each (a mix of collectors, women, and elders) to discuss status trends, preferences, and constraints. Key informant interviews (n=15–20) were held with CFUG committee members, experienced collectors, traditional healers, and local traders to provide in-depth insights on management and trade. Preference ranking involved participants in FGDs and key informants ranking major MAPs using a matrix ranking method. Species were scored based on criteria such as market value, availability, ease of collection, medicinal importance, and demand (following standard ethnobotanical protocols), with the top-ranked species identified through aggregation.

2.3 DATA ANALYSIS

Qualitative data from interviews and FGDs were thematically analyzed for recurring patterns in status trends, market channels, and constraints. Quantitative analysis included descriptive statistics (means, percentages) for socioeconomic variables, collection involvement, and income. Preference ranking involved aggregating scores using a Weighted Average Index (or simple rank summation), with differences in rankings tested for significance through the Friedman two-way analysis of variance (ANOVA) by ranks, a non-parametric test for related samples at a significance level of $p < 0.05$; the test statistic (χ^2), degrees of freedom, and p-value were calculated. Status trends were evaluated by scoring perceived changes in availability over the past 20 years, last 10 years, and current status using a ladder ranking technique (e.g., 1=very low to 10=very high) during FGDs, with mean scores plotted. Economic contribution was determined by calculating annual cash income from MAPs per collector household based on reported sales volumes and prices, expressed as a percentage of total household income from all sources, with currency values in Nepalese Rupees (NRs) at the time of study. Data were managed and analyzed using SPSS and Excel. Ethical considerations included verbal informed consent from participants and assurance of anonymity.

3. RESULTS

3.1 SOCIOECONOMIC PROFILE OF RESPONDENTS

A total of 55 households (HHs) were surveyed across seven community forests in Kavrepalanchowk district, representing a total population of 330 individuals (average HH size ≈ 6). The average age of respondents was 38 years, with 61.81% male and 38.19% female among respondents, though females comprised 53.04% of the total population. Educational attainment was low: 45.45% were illiterate, 31.82% had primary education, 18.18% secondary, and 4.55% higher. Brahmin/Chhetri ethnic groups dominated (≈ 70 –80%), followed by Tamang, Newar, and others. Most HHs (over 80%) relied on mixed agriculture and livestock as primary livelihoods. Food sufficiency from agriculture was limited: 32.73% sufficient for <3 months, 29.09% for 3–6 months, 25.45% for 6–9 months, and 12.73% for >9 months. Average landholding was 9.37 ropani (≈ 0.47 ha), with 52.72% HHs holding 5–10 ropani. Average gross annual HH income was NRs 35,330 ($\approx$ US\$441 at 2008 rates), with 69.08% below NRs 40,000.

Among the economically active population (n=150, aged 16–60), 45.45% were engaged, primarily in agriculture (92%). Only 13.33% were involved in MAP-related activities (14.7% males, 12.19% females).

Table 1: Distribution of respondents and population by gender

Gender	Respondents No	%	Total population of HHs	%
Male	34	61.81	155	46.96
Female	21	38.19	175	53.04
Total	55	100	330	100

3.2 PREFERENCE RANKING OF MAJOR MEDICINAL AND AROMATIC PLANTS

Fifteen respondents (27% of total) ranked nine MAP species based on local criteria (e.g., financial return, ease of cultivation, market demand). A pairwise ranking matrix was aggregated, and ranks were validated statistically.

The top four preferred species were:

1. Sugandhawal (*Valeriana jatamansi*) – mean rank 6.93
2. Pakhanved (*Bergenia ciliata*) – mean rank 6.13
3. Chiraito (*Swertia chirayita*) – mean rank 5.73
4. Kurilo (*Asparagus racemosus*) – mean rank 5.40

Other ranks: Timur (*Zanthoxylum armatum*) 4.13 (VII), Bojho (*Acorus calamus*) 4.87 (V), Alaichi (*Amomum subulatum*) 4.27 (VI), Dhasingare (*Gaultheria fragrantissima*) 3.60 (IX), Thulo okhati (*Astilbe rivularis*) 3.93 (VIII).

Table 2: Final ranking of medicinal and aromatic plants

Symbol	MAPs	Mean Rank	Final ranking
S1	Sugandhawal (<i>Valeriana jatamansi</i>)	6.93	I
S2	Chiraito (<i>Swertia chirayita</i>)	5.73	III
S3	Thulo okhati (<i>Astilbe rivularis</i>)	3.93	VIII
S4	Pakhanved (<i>Bergenia ciliata</i>)	6.13	II
S5	Timur (<i>Zanthoxylum armatum</i>)	4.13	VII
S6	Kurilo (<i>Asparagus racemosus</i>)	5.40	IV
S7	Alaichi (<i>Amomum subulatum</i>)	4.27	VI
S8	Bojho (<i>Acorus calamus</i>)	4.87	V
S9	Dhasingare (<i>Gaultheria fragrantissima</i>)	3.60	IX

The Friedman two-way ANOVA by ranks confirmed significant differences in preferences ($\chi^2 = 24.299$, $df = 8$, $p = 0.002$; $N=15$).

3.3 STATUS TRENDS OF PREFERRED MAPS

Perceived availability was assessed using a ladder scoring method (1 = worst condition, 10 = best) during focus group discussions, comparing 20 years ago (≈ 1988), 10 years ago (≈ 1998), and current (2008).

Overall mean scores: 6.92 (20 years ago), 5.30 (10 years ago), 6.38 (current), indicating decline followed by partial recovery attributed to CFUG management. Species-specific trends showed similar patterns, with Kurilo improving most due to private cultivation.

Table 3: Status of medicinal plants in the study area – mean scores

MPs	Scientific name	Time periods		
		20 years ago	10 years ago	Now
Sugandhawal	<i>Valeriana jatamansi</i>	7.4	5.3	7.0
Pakhanved	<i>Bergenia ciliata</i>	7.2	6.0	6.13
Chiraito	<i>Swertia chirayita</i>	6.91	5.25	6.08
Kurilo	<i>Asparagus racemosus</i>	6.72	4.66	6.33
Mean score		6.92	5.30	6.38

Natural occurrence of MAPs was noted in 70% of cultivated sites, mostly in marginal lands.

3.4 HOUSEHOLD INVOLVEMENT IN MAP COLLECTION AND USES

Only 20% of HHs collected MAPs for sale or subsistence, with 13.33% of economically active individuals involved. Collection was seasonal (post-monsoon), opportunistic, and primarily by women and youth. Major uses: local medicine (e.g., Chiraito for fever, Pakhanved for urinary issues) and sale to traders. Quantities were small (a few kg/season/species). Abundance in CFs: Sugandhawal most frequent (WAI 0.71), followed by Pakhanved (0.65), Chiraito (0.56), Kurilo (0.47), Bojho (0.23).

3.5 ECONOMIC CONTRIBUTION AND MARKET SYSTEMS

Among involved individuals, average annual income from MAPs was NRs 11,355/person (Sugandhawal NRs 3,000, Pakhanved NRs 1,855, Chiraito NRs 4,000, Kurilo NRs 2,500). This represented $\approx 6.4\%$ of their total income (Sugandhawal 15%, Pakhanved 3.3%, Chiraito 8.6%, Kurilo 5.4%). For involved HHs, MAP income could potentially reach 32% of average HH income (NRs 35,330) if fully active, but competition might reduce this.

Market channels were informal and middlemen-dominated: collectors sold at low farm-gate prices (e.g., Sugandhawal NRs 80-100/kg, Chiraito NRs 130-150/kg) to local traders, who supplied wholesalers in Kathmandu or India. No value addition or cooperatives were reported. Constraints: unscientific harvesting, low awareness, price fluctuations, transportation issues.

Table 4: Average income from major MAPs per involved person

Species	Scientific name	Avg. income/person (Nepali Rupees)
Sugandhawal	<i>Valeriana jatamansi</i>	3000
Pakhanved	<i>Bergenia ciliata</i>	1855
Chiraito	<i>Swertia chiraita</i>	4000
Kurilo	<i>Asparagus racemosus</i>	2500
Total		11355

3.6 CONSTRAINTS AND PROSPECTS

Key constraints and prospects for MAPs utilization in the study area's community forests were identified through focus group discussions (n=7), key informant interviews (n=15–20), and field observations. The primary constraints encompass a range of interconnected challenges that hinder effective MAP management and economic benefits. Local communities often lack awareness and knowledge about the importance of MAPs, including proper harvesting techniques and resource identification, which leads to resource depletion and reduced motivation for sustainable activities. Institutional support is limited, with gaps in technology for domestication, training programs, and coordination between Community Forest User Groups (CFUGs) and line agencies such as the District Forest Office (DFO). Market and trade issues further exacerbate the situation, characterized by unorganized systems dominated by middlemen, secretive business practices, price manipulation resulting in low farm-gate prices for collectors, and inadequate marketing infrastructure or information. Policy and regulatory hurdles include unscientific royalty rates, procedural delays of 15–21 days for permits and leaving notes, bans on unprocessed exports, absence of intellectual property rights (IPR) on innovations, and multiple check posts (up to 38), all of which increase trading costs and discourage legal channels. Socioeconomic factors compound these problems, such as small landholdings, low education levels among the population, a lack of enterprise-oriented activities, insufficient financial support and transparency in collection and trade, and no legal mechanisms for addressing MAP-related offenses. Finally, random and unregulated access to resources makes it difficult for local collectors to compete globally. These constraints and their economic implications are summarized in Table 5.

Table 5: Summary of MAP sub-sector constraints and economic implications

Constraint	Economic Implication
Unscientific royalty rates	Decrease in royalty; discourages collectors
Procedural delays (15–21 days)	Legal trade channels scarce
No intellectual property rights	Competition with global market difficult
Banned collection/export without processing	Legal route difficult
Collection permit required	Big traders manipulate harvesters
Lack of technology/market info	Resource degradation; no good price to collectors
Hidden/secret business nature	Informal amounts expanded; consumers pay high for final products
Various check posts (e.g., 38 total)	Trading cost high

Despite these constraints, several prospects offer pathways for improvement and sustainable development. Economic gains are promising, with potential for employment generation, household income support such as the average NRs 11,355 per person per year from MAPs and the utilization of poor or degraded wastelands for cultivation. Market access is facilitated by nearby hubs like Banepa and Kathmandu, where middlemen currently play a role in trade, alongside a gradual shift toward modern, scientific systems that incorporate value-added processing and sales. Institutional support can be leveraged through local NGOs and INGOs initiating market linkages, as well as opportunities arising from WTO accession, patents, foreign investment, and advancements in media and IT for greater awareness. Conservation and social benefits are also evident, as addressing challenges could enhance biodiversity protection, bolster traditional medicinal systems like Ayurveda, and involve unskilled or semi-skilled individuals in productive activities. Furthermore, competitiveness can be strengthened via cost-benefit analyses, productivity information, and a diverse array of traders that promote fair competition and income generation.

A SWOT analysis reveals the internal and external factors influencing MAP utilization. Strengths include the availability of resources in community forests and natural areas, low-cost labor, the presence of some domesticated species such as Chiraito and Sugandhawal, the potential for wasteland improvement, and the global acceptance of Ayurveda. Weaknesses mirror the constraints outlined earlier, such as awareness gaps and unorganized trade. Opportunities align with the prospects, encompassing employment creation and improved market access. Threats involve resource degradation and habitat loss due to competition, erosion of traditional knowledge and bio-piracy risks, manipulation of local communities, and the absence of rehabilitation measures.

4. DISCUSSION

The findings from this study underscore the evolving status of medicinal and aromatic plants (MAPs) in Kavrepalanchowk district, highlighting both opportunities and challenges in community-managed forests. Community Forest User Groups (CFUGs) have played a pivotal role in improving forest conditions, contributing to the partial recovery of MAP populations observed in recent years. The district's topographic and climatic variations from subtropical to temperate zones at 1,000–2,400 m create diverse niches for MAP distribution, enhancing economic potential due to proximity to Kathmandu's markets. This adjacency facilitates trade but also intensifies pressure on resources. Major species identified include *Taxus wallichiana*, *Valeriana jatamansi*, *Swertia chirayita*, *Nardostachys grandiflora*, *Gaultheria fragrantissima*, *Bergenia ciliata*, *Asparagus racemosus*, lichen species, and *Rheum australe*, with the top four preferred Sugandhawal (*V. jatamansi*), Pakhanved (*B. ciliata*), Chiraito (*S. chirayita*), and Kurilo (*A. racemosus*) showing significant local value. Status trends reveal a decline over the past 20 years (mean score 6.92 to 5.30 over 10 years), attributed to overexploitation, deforestation, and population pressure, followed by stabilization or improvement (current mean 6.38) linked to CFUG regulations and awareness. This pattern aligns with a study [19] in Dhading district, where similar species occurred in marginal lands and faced depletion, and recent assessments in Nepal's mid-hills showing recovery through community management [20, 21]. However, ongoing threats like habitat degradation and climate change could reverse gains, as seen in projections for species like *Arisaema costatum* [6].

Collection and trade of MAPs remain integral to rural livelihoods, providing primary healthcare and supplementary income, yet practices are largely unsustainable. In the study area, only 13.33% of economically active individuals engage in MAP activities, with seasonal, opportunistic harvesting primarily by women and youth. This reflects broader Himalayan patterns where marginalized groups depend on NTFPs for 10–50% of income [5, 12]. Local uses e.g., Chiraito for fever, Pakhanved for urinary issues underscore cultural relevance, supporting 80% of rural healthcare needs [22]. However, premature and destructive

harvesting (e.g., whole-plant extraction) exacerbates resource pressure, driven by lack of knowledge and economic urgency [23]. Ethnicity influences involvement, with families from Brahmin/Chhetri and Tamang groups participating, but low farm-gate prices due to middlemen dominance limit benefits [24]. Market channels are informal, with collectors receiving NRs 80–150/kg for top species, far below wholesale values in Kathmandu or India. This mirrors national issues where unorganized trade and secrecy expand informal economies, with consumers paying high for processed products [9, 18].

The average income of NRs 11,355 per collector (6.4% of household income) is modest compared to high-potential areas like Darchula (NRs 40,000/year) or Dolpa (NRs 50,000/year from Yarshagumba), where cultivation boosts earnings [25, 26]. Scaling involvement could elevate MAP contributions to 32% of household income, but competition and degradation risks must be managed. Preference rankings, validated by the Friedman test ($p=0.002$), prioritize species with high market demand, medicinal value, and cultivation ease, aligning with national priorities. The top four match HNCC criteria (e.g., high demand, short rotation, ethnobotanical importance) and NMPB standards (e.g., local uses, agro-ecology suitability) [17]. Comparisons with regional variations in mid-hills (Chiraito, Tejpat) is highlighted in a study [27], emphasizing site-specific strategies. Globally accepted systems like Ayurveda further elevate these species' economic potential [28].

Socially and economically, MAPs are vital, with community forests (1.22 million ha managed by >14,000 FUGs, benefiting 1.65 million households) [29] harboring diverse resources e.g., 227 medicinal species in 31 CFs [25]. They support poverty alleviation as off-farm income for the poor, utilizing marginal lands without large investments. Recent estimates show MAPs contributing 1.03% to Karnali's GDP and 0.02% nationally, undervalued without full ethnobotanical integration [12]. However, constraints like poor information, administrative gaps, and monopoly trading threaten sustainability [30]. Cultivation offers a pathway, as demonstrated in Darchula and Dolpa, but adoption is low due to knowledge deficits only a few households cultivate Chiraito in the study area.

Management practices face threats from overexploitation and weak regulation, risking biodiversity loss [30]. Human activities and environmental factors exacerbate vulnerabilities for species like *Dactylorhiza hatagirea* [21]. Sustainable harvesting, as outlined in Nepal's MAP roadmap [8], is essential to prevent declines. Limitations of this study include the 2007–2008 data age, small sample ($n=55$), and reliance on perceived trends—future work should incorporate longitudinal monitoring and GIS mapping. Overall, integrating MAPs into CF operational plans could enhance livelihoods while conserving Himalayan biodiversity [15, 17].

5. CONCLUSION AND RECOMMENDATIONS

MAPs play a key role in Nepal's economy, but rural collectors receive low benefits due to middlemen and policy gaps. In the study area, top preferred MAPs are Sugandhawal, Pakhanved, Chiraito, and Kurilo, with declining status reversing recently via CFUGs. Only 13% are involved in MAP activities, contributing 6.4% to income. Improved technology and markets can enhance benefits. To optimize the conservation and utilization of MAPs, cultivation of the top four species should be encouraged for both conservation purposes and export potential. Community Forest User Groups (CFUGs) need to conduct regular resource inventories and awareness programs to promote sustainable practices. District Forest Offices (DFOs) and non-governmental organizations (NGOs) should provide targeted trainings and exposure tours to build local capacity. Enterprises can be developed through micro-loans to foster value addition and entrepreneurship. NGOs and international NGOs (INGOs) must be actively involved as stakeholders to support implementation. District-level MAP action plans should be prepared to guide coordinated efforts, while policies need to be communicated effectively to grassroots levels. Media platforms can be utilized to disseminate information for cultivators, and processing units should be established to improve market value. Additionally, poor communities should be granted access to government land for cultivation, ensuring that all stakeholders are included in policy development to achieve equitable and sustainable outcomes.

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