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Quantitative Ethnobotanical Assessment of Medicinal Plants in a Buffer Village of the Bromo Tengger Semeru Conservation Area, East Java, Indonesia

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Article

Keywords: ethnobotany, medicinal plants, Tengger community, highland ecosystems, life on lands

Posted Date: November 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10829988/v1

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Additional Declarations: No competing interests reported.

Abstract

This study provides a quantitative ethnobotanical assessment of medicinal plants used by the local community of Argosari Village, a buffer area of the Bromo Tengger Semeru Conservation Area in East Java, Indonesia. Despite the region's high biodiversity, systematic documentation of local ethnomedicinal knowledge remains limited. Data were collected through semi structured interviews, direct field observations, and taxonomic identification of reported species. Species Use Value (SUV), Family Use Value (FUV), Fidelity Level (FL), and Plant Part Value (PPV) were applied to evaluate the cultural importance and utilization patterns of the recorded taxa. A total of 23 medicinal plant species belonging to 17 families were identified, with Asteraceae emerging as the most represented family. Leaves were the most frequently used plant part (61%), reflecting both cultural preference and ecological sustainability. Apium graveolens L. exhibited the highest SUV (0.4333), whereas several species demonstrated high FL values (100%), indicating strong informant consensus for specific therapeutic uses. These findings highlight a well preserved ethnomedicinal system grounded in traditional ecological knowledge and resource-conscious harvesting practices. The study contributes a baseline dataset useful for conservation planning, sustainable resource management, and future pharmacological investigations in one of East Java's ecologically significant highland regions.

1. Introduction

The relationship between humans and plants has shaped traditional medical practices for centuries, forming the foundation of many modern therapeutic discoveries [1], [2]. Ethnobotanical research plays a critical role in documenting this knowledge, particularly as traditional practices and local biodiversity face increasing pressures from environmental change and cultural shifts [3]. In many regions, the gradual loss of indigenous ecological knowledge parallels the decline of biological diversity, underscoring the urgency of systematic ethnobotanical documentation [4], [5].

Indonesia, acknowledged as one of the world's principal biodiversity hotspots, is characterized by an extraordinary richness of vascular plants, which represents 15.5% of the global total [6], [7]. Despite being the most densely populated island in the country, Java continues to exhibit substantial floral diversity, including an estimated 10,000 species recognized for their longstanding medicinal applications [8], [9], [10]. The Bromo Tengger Semeru (BTS) conservation area in East Java represents a crucial ecological landscape, supporting a diverse array of montane plant species and culturally significant plant species, which exceed 600 in number [11], [12]. Empirical evidence indicates that specific botanical families frequently dominate these areas; for example, vegetation surveys in similar highland ecosystems identify Asteraceae, Rubiaceae, and Poaceae as the most ecologically significant groups within the community structure. Local communities residing in the buffer zones surrounding the conservation area, such as Argosari Village, uphold longstanding traditions of using indigenous plants to treat common ailments. These practices are influenced by geographical isolation, limited access to formal medical facilities, and the strong cultural identity of the Tengger ethnic group [11], [12]. The buffer village surrounding this conservation area, heavily relies on local plant resources due to their geographic isolation, cultural traditions, and limited access to formal healthcare services.

Despite the ecological significance of the BTS region, there is a notable lack of quantitative ethnobotanical studies examining medicinal plant use within its buffer communities [13]. Current research offers only a limited perspective on species diversity and cultural practices, highlighting a gap in understanding how local communities utilize and prioritize medicinal plants in their daily healthcare routines. Furthermore, little information is available regarding the relative cultural importance of these species, the level of consensus among informants, or the sustainability of existing harvesting practices, data that is crucial for effective conservation planning and potential pharmacological exploration.

This study seeks to address existing gaps by conducting a quantitative ethnobotanical assessment of medicinal plants utilized by the community of Argosari Village. By employing established indices such as Species Use Value (SUV), Family Use Value (FUV), Fidelity Level (FL), and Plant Part Value (PPV), we aim to evaluate the cultural significance, usage patterns, and ecological implications of local medicinal plant knowledge. The results will contribute to a foundational dataset that

supports biodiversity conservation, enhances community-based resource management, and guides future phytochemical and pharmacological research in one of East Java's most unique highland ecosystems.

2. Materials and Methods

2.1. Study Area and Population

The study was conducted in Argosari Village, Senduro District, Lumajang Regency, East Java, Indonesia (112.5°–113.22° E and 7.52°–8.23° S). Situated on the southeastern slopes of Mount Semeru, the village serves as a strategic buffer zone for the Bromo Tengger Semeru National Park (BTSNP) (Fig. 1).

Characterized by a rugged altitudinal gradient ranging from 2,000 to 2,400 meters above sea level (masl), Argosari is among the highest settlements in the region [14], [15]. This elevation places the study site within a transition zone between upper montane tropical rainforest and subalpine ecosystems, a climatic profile that fosters high levels of specialized biodiversity and endemic montane vegetation.

Argosari is primarily inhabited by the Tengger ethnic group, an indigenous community renowned for maintaining distinct cultural and agricultural traditions. According to official statistics data in 2025 Senduro District Census, the village has a total population of 3,425 inhabitants (1,726 males; 1,699 females) [16]. The local economy is predominantly agrarian; the majority of the population are smallholder farmers or agricultural laborers, the latter being the largest occupational cohort with 1,523 individuals.

The agricultural landscape is dominated by high-altitude horticultural crops, specifically vegetables and fruits. Additionally, the cultivation of perennial plantation crops, such as coffee (*Coffea* spp.) and clove (*Syzygium aromaticum*), provides significant economic value and serves as a primary source of household income [17]. This close proximity to the forest edge and the community's reliance on land-based livelihoods underscore the deep-seated relationship between the Tengger people and their local botanical resources.

2.2. Data Collection

Data were collected through semi-structured and structured interviews with community members knowledgeable about medicinal plants, a common method in ethnobotanical research [17], [18]. About 10% of household heads (60 informants) were interviewed to gather information on local medicinal plant species, focusing on their uses, parts utilized, preparation and processing methods [18], [19], [20]. All informants were male and ranged in age from 16 to over 55 years, with specific age distributions provided. All interviewed household heads were male, reflecting prevailing local norms, values, and traditional systems that are rooted in a patriarchal cultural framework [21]. A structured questionnaire was used for consistency in data collection. Informants were identified using a snowball sampling technique, beginning with the selection of a key informant an individual recognized as having substantial influence and knowledge within the community. Subsequent participants were recruited based on recommendations from earlier respondents [22].

2.3. Taxonomic Identification and specimen preparation

Taxonomic identification was performed to confirm the plant specimens reported during the interview process [23]. Herbarium preparation was undertaken to produce dried specimens to support and validate species determination [24]. Herbarium techniques were applied exclusively to taxa that could not be readily identified in the field. All specimens and photographic records were formally identified at the Laboratory of Plant Bioscience and Biotechnology, Institut Teknologi Sepuluh Nopember, using local determination keys.

Plant material was collected only where a species could not be identified reliably in situ. The plants concerned grow in and around the settlements of Argosari Village, and several of them are wild species gathered from the surrounding environment. Collection of all material was authorised by the Indigenous Community of Argosari Village, Regional Secretary

under the Government of Lumajang Regency, East Java Province (Research Permit No. 800/427.72/2025, dated 27 August 2025).

Formal identification of all specimens and supporting documentation, including field photographs, was carried out at the Laboratory of Plant Bioscience and Biotechnology, Institut Teknologi Sepuluh Nopember (ITS), using local determination keys. The resulting identifications were then checked against regional taxonomic references, namely authenticated voucher specimens previously identified by botanists and held at Herbarium Bandungense (School of Life Sciences and Technology, Institut Teknologi Bandung) and Herbarium Bogoriense (National Research and Innovation Agency, BRIN). This verification was un-dertaken with the assistance of the resident botanists at both herbaria, and the reference numbers of the voucher specimens consulted are reported in Table 1.

Plant material collected during the field survey was identified to species and verified by direct comparison with the reference voucher collections held at Herbarium Bandungense (FIPIA), and Herbarium Bogoriense (BO). The comparisons were made on site with the help of the curatorial botanists at each herbarium, who confirmed the identifications. Both collections already held complete, reliably determined vouchers for every taxon recorded here, so no new specimens were deposited; instead, each species was cross-referenced to the reference number of its corresponding voucher in these collections.

Fieldwork followed the relevant institutional, national, and international guidelines for research on wild plants. To avoid any impact on local vegetation and biological resources, we sampled only those species that could not be determined in situ, and took the minimum quantity of material needed to prepare a herbarium specimen. The conservation status of every recorded species was checked against the IUCN Red List of Threatened Species, the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia (No. P.106/MENLHK/SETJEN/KUM.1/12/2018); none of the species recorded is listed as threatened or subject to trade restriction.

2.4. Disease Classification

Reported health conditions were categorized into seven principal functional groups based on local usage and clinical relevance [20], [25]: 1) Gastrointestinal (GI): Diarrhea, nausea, gastric disturbances, dysentery, and appetite loss; 2) Dermatological (DO): Wounds, burns, rashes, boils, and ectoparasitic infections; 3) Urogenital and Gynecological (UGP): Menstrual irregularities, infertility, sexual dysfunction, and diuretic/aphrodisiac applications; 4) Skeletomuscular (SD): Joint and muscle-related disorders; 5) Internal Medicine (IM): Chronic conditions including diabetes, hypertension, and neoplasms (cancers/tumors); 6) Respiratory and ENT (RT): Asthma, sinusitis, sore throat, epistaxis, and dental ailments; 7) Other (OT): General conditions such as motion sickness.

2.5. Ethics Approval and Informed Consent

This study was based entirely on interview surveys with members of the Argosari village community. No human tissue samples were collected or used at any stage, and no clinical or biomedical intervention was involved. All methods were carried out in accordance with the relevant guidelines and regulations.

Approval to conduct the interview survey was granted by the Indigenous Community of Argosari Village, Regional Secretary under the Government of Lumajang Regency, East Java Province, through Research Permit No. 800/427.72/2025, issued on 27 August 2025. The permit sets out the protocols the research team was required to observe, namely compliance with the regulations in force in Lumajang Regency and Argosari Village; with the norms, customary practices, and local wisdom of the indigenous community; with research ethics, including the consent of the indigenous community and of every participating informant; with the conservation of the local environment and biological resources throughout the study; and with the re-quirement to coordinate with the Argosari Village Government and other relevant parties during fieldwork.

Before each interview, the purpose and scope of the research were explained to the participant in Bahasa Indonesia and in the local Tengger dialect, and informed consent was obtained from every participant. Participation was voluntary, informants were free to decline or withdraw at any point, and no personally identifying information is reported. Traditional knowledge shared by the community is presented in aggregate form only, in keeping with the community's rights over its own knowledge.

2.6. Data Analysis

To evaluate the cultural importance of medicinal plants and the level of informant consensus, the collected data were analyzed using several quantitative ethnobotanical indices. All calculations were performed using Microsoft Excel for Windows 11.

Species Use Value (SUV)

The Species Use Value (SUV) was calculated to determine the relative importance of each medicinal plant species within the community [26]. The formula applied was:

$$SUV = \frac{\sum UV_{is}}{(n_i)}$$

1

Where *UVi* represents the total number of uses mentioned by each informant for a specific species, and *ni* is the total number of informants interviewed. A high *SUV* suggests that a species is highly significant and has a broad range of therapeutic applications within the local culture.

Family Use Value (FUV)

To assess the medicinal importance of entire botanical families, the Family Use Value (FUV) was employed [27]:

$$FUV = \frac{\sum SUV_s}{(n_s)}$$

2

In this equation, ∑SUV is the sum of the Use Values for all species belonging to a specific family, and n is the total number of species within that family reported by the informants. This metric identifies which botanical families are most representative in the local pharmacopeia [28].

Fidelity Level (FL)

The Fidelity Level (FL) was calculated to identify the species most preferred for treating specific ailment categories. This index expresses the percentage of informants who claim the use of a plant for the same major purpose (Dougnon et al., 2021). The FL value can be calculated using the following equation:

$$FL\,(\%) = \frac{Np}{N} x\ 100$$

3

Where Np is the number of informants who independently cited the use of a species for a specific primary ailment, and N is the total number of informants who mentioned the plant for any use. High FL values (approaching 100%) indicate a high degree of consensus on the therapeutic efficacy of a species for a particular condition [29].

Plant Part Value (PPV)

To quantify the frequency of use for different plant parts (e.g., leaves, roots, bark), the Plant Part Value (PPV) was calculated as follows:

$$PPV\,(\%) = \frac{\sum RU_{(Plant\ Part)}}{\sum RU} x\ 100$$

4

Where ∑RU (plant part) is the total number of reports for a specific plant part (stems, leaves, roots, fruits, bark, and flowers), and ∑RU is the total number of reports for all parts of the species. This index highlights the pressure exerted on different plant organs and provides insight into the sustainability of harvesting practices [30].

3. Results

3.1. Medicinal Plant Use Overview

We found 23 medicinal plant species from 17 families that the Argosari community uses for primary health care (see Table 1). The Asteraceae family was the most common, which shows that it is widely available and thought to be effective in montane agroecosystems. Several taxa were mentioned for more than one type of illness, which shows that they have a wide range of ethnomedicinal uses and are very important in their cultures (e.g., *Phytolacca icosandra* L., *Acanthus ilicifolius* L., *Apium graveolens* L. (Table 1).

Therapeutic applications encompassed seven functional categories, with the highest concentration of species addressing internal medical (IM) conditions (e.g., hypertension, diabetes), followed by respiratory/oral (RT) and gastrointestinal (GI) disorders. Dermatological (DO) and musculoskeletal (SD) issues were also frequently treated, mainly with topical or mechanically assisted preparations. This distribution shows how important traditional remedies are for treating chronic and recurring conditions where acces to formal care is limited.

The fact that these species can be used for many different things shows how important they are to the Argosari community for ethnomedicine. The recurrent reference to particular plants across diverse therapeutic classifications indicates a wider perceived efficacy and cultural significance, in contrast to species restricted to a singular ailment.

Table 1
Utilization and identification of medicinal plant species (by ailment category) in Argosari Village

Specified Disease Name	Plant Family	Plant Species	Common Name	Conservation Status			Ref. No.	
				A	B	C	FIPIA	BO
Hypertension	Asteraceae	*Sonchus arvensis* L.	sow thistle	NE	not listed	not protected	7522	BO – 1653125
	Apiaceae	*Apium graveolens* L.	celery	LC	not listed	not protected	1107	BO – 1633903
Fever	Asteraceae	*Gymnanthemum amygdalinum* (Delile) Sch.Bip.	river bittertea/ African bitterleaf	LC	not listed	not protected	ASDI 127	-
	Acanthaceae	*Sonchus asper* (L.) Hill.	spiny sowthistle	LC	not listed	not protected	7097	BO – 1292971
Diabetes	Brassicaceae	*Brassica rapa* L.	wild turnip	DD	not listed	not protected	8710	BO – 1415493
	Fabaceae	*Mucuna pruriens* L.	velvet bean	NE	not listed	not protected	1050	BO – 1715993
Anemia	Amaranthaceae	*Phytolacca icosandra* L.	tropical pokeweed	LC	not listed	not protected	3362	BO – 1794841
Wounds & Infection	Asteraceae	*Ageratina riparia* (Regel) R.M.King & H.Rob.	mistflower	NE	not listed	not protected	4	BO – 1458199
	Acanthaceae	*Sonchus asper* (L.) Hill.	spiny sowthistle	LC	not listed	not protected	7097	BO – 1292971
Eczema & Itching	Convolvulaceae	*Ipomoea indica* (Burm.) Merr.	blue morning glory	NE	not listed	not protected	108	BO – 1686025
	Polygonaceae	*Rumex nepalensis* Spreng.	Nepal doc	NE	not listed	not protected	S.N.	BO – 1499167
	Polygonaceae	*Rumex crispus L.*	yellow dock	LC	not listed	not protected	S.N.	BO – 1496677
	Asteraceae	*Artemisia vulgaris* L.	common mugwort	LC	not listed	not protected	293	BO – 1477528
Skin Disease / Ulcer	Euphorbiaceae	*Euphorbia pulcherrima* Willd. ex Klotzsch	poinsettia	LC	not listed	not protected	824	BO – 1690292
Cough & Common Cold	Dennstaedtiaceae	*Pteridium aquilinum (*L.) Kuhn	common bracken	LC	not listed	not protected	-	BO – 1531611
	Euphorbiaceae	*Jacobaea maritima* Jacq.	silver ragwort	NE	not listed	not protected	6845	-

Note: Conservation status follows IUCN Red List Category (A); CITES Convention Appendices (B); Regulation of the Minister of Environment and Forestry of the Republic of Indonesia, No. P.106/MENLHK/SETJEN/KUM.1/12/2018 (C). NE: Not Evaluated; LC: Least Concern; DD: Data Deficient. Ref. No.: Reference numbers based on herbarium specimen checks at the Herbarium Bandungense (FIPIA) and the Herbarium Bogoriense (BO).

Specified Disease Name	Plant Family	Plant Species	Common Name	Conservation Status			Ref. No.	
				A	B	C	FIPIA	BO
Mouth Ulcer (Sprue)	Amaryllidaceae	*Allium ascalonicum* L.	shallot/wild onion	NE	not listed	not protected	8196	BO-1370532
Asthma	Lamiaceae	*Ajuga reptans* L.	common bugle	LC	not listed	not protected	2273	BO – 1828957
Sore Throat	Asteraceae	*Tagetes erecta* L.	marigold	NE	not listed	not protected	574	BO – 1288769
Joint Pain (Rheumatism)	Lythraceae	*Cuphea carthagenensis* (Jacq.) J.F.Macbr.	false heather	NE	not listed	not protected	PNW 304	BO – 1965737
	Amaranthaceae	*Phytolacca icosandra* L.	tropical pokeweed	LC	not listed	not protected	3362	BO – 1794841
Muscle Soreness	Asteraceae	*Sonchus arvensis* L.	sow thistle	NE	not listed	not protected	7522	BO – 1653125
	Euphorbiaceae	*Jacobaea maritima* Jacq.	silver ragwort	NE	not listed	not protected	6845	-
Digestive Disorders	Malvaceae	*Hibiscus rosa-sinensis* L.	Chinese hibiscus	NE	not listed	not protected	1677	BO – 1761446
	Apiaceae	*Apium graveolens* L.	celery	LC	not listed	not protected	1107	BO – 1633903
Constipation / Liver	Amaranthaceae	*Phytolacca icosandra* L.	tropical pokeweed	LC	not listed	not protected	3362	BO – 1794841
Stomachache	Asteraceae	*Bellis perennis* L.	sea holly	LC	not listed	not protected	5066	-
Headache	Amaryllidaceae	*Allium ascalonicum* L.	shallot/wild onion	NE	not listed	not protected	8196	BO – 1370532
Insomnia & Anxiety	Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn	common bracken	LC	not listed	not protected	-	BO – 1531611
Immunity (Infection)	Asteraceae	*Ageratina riparia* (Regel) R.M.King & H.Rob.	mistflower	NE	not listed	not protected	4	BO – 1458199
	Asteraceae	*Ageratum houstonianum Mill.*	mistflower	NE	not listed	not protected	42	BO – 1476369
Traditional Detox	Lamiaceae	*Ajuga reptans* L.	common bugle	LC	not listed	not protected	2273	BO – 1828957
	Solanaceae	*Capsicum frutescens* L.	rainbow chili	LC	not listed	not protected	260	BO – 1912162

Note: Conservation status follows IUCN Red List Category (A); CITES Convention Appendices (B); Regulation of the Minister of Environment and Forestry of the Republic of Indonesia, No. P.106/MENLHK/SETJEN/KUM.1/12/2018 (C). NE: Not Evaluated; LC: Least Concern; DD: Data Deficient. Ref. No.: Reference numbers based on herbarium specimen checks at the Herbarium Bandungense (FIPIA) and the Herbarium Bogoriense (BO).

3.2. Ethnobotany Indices (SUV, FUV, FL)

Quantitative ethnobotany indices showed that different taxa and families had different cultural meanings (Table 2). Species Use Value (SUV) varied widely, with *Apium graveolens* L. having the highest SUV. This means that it was used a lot and for many different things. This prominence likely comes from the fact that people know it has health benefits, especially for controlling blood pressure and keeping general health [31], [32]. A few other species, like *Acanthus ilicifolius* L., *Ageratina riparia* (Regel) R.M. King & H. Rob., *Artemisia vulgaris* L., and *Ajuga reptans* L., had moderately high SUV values, which makes sense given how easy they are to find and use. On the other hand, some species had low SUV, such as *Bidens pilosa* L., *Bellis perennis* L., *Gymnanthemum amygdalinum* (Delile) Sch.Bip., *Ipomoea indica* (Burm.) Merr., *Euphorbia pulcherrima* Willd. ex Klotzsch, *Mucuna pruriens* L., *Rumex crispus* L. The low SUV indicates limited citation frequency and possibly restricted medicinal applications within the community [33]. Ethnobotanical research indicates that plants exhibiting elevated SUV values are generally employed more extensively for prevalent ailments, whereas those with diminished values frequently fulfill specialized or lesser-known functions [30]. This may be attributable to factors such as restricted availability, insufficient transmission of traditional knowledge, or a preference for alternative species deemed more effective [30].

Family Use Value (FUV) analysis showed that families had different ways of prioritizing medicines. Families like Brassicaceae, Convolvulaceae, and Fabaceae had the highest FUV (1.000), even though they only had one species each. This indicates a high level of use and consistent cultural recognition of these particular taxa. On the other hand, Apiaceae (FUV = 0.433) had a lot of value, mostly because *Apium graveolens* L. was cited a lot. For Asteraceae, the moderate FUV (0.633 for *Tagetes erecta* L.) shows that the family is taxonomically diverse in the area, but the medicinal knowledge is not evenly spread across its species.

These distribution patterns indicate that the ethnomedicinal significance in the BTS region is influenced by ecological visibility, cultural familiarity, and perceived therapeutic effectiveness. Species with a high SUV usually have a lot of access and are used to treat common diseases. On the other hand, a high FUV shows that there is a strong taxonomic consensus in the community. These culturally ingrained taxa constitute the essence of the local pharmacopeia and are prioritized for forthcoming phytochemical and pharmacological validation [34], [35].

The Fidelity Level (FL) shows how much people agree on which species is best for treating a certain type of illness [36]. FL values in this study went from 11.54% to 100% (Table 2). Eight species, including *Bidens pilosa* L., *Bellis perennis* L., *Gymnanthemum amygdalinum* (Delile) Sch.Bip., *Brassica rapa* L., *Ipomoea indica* (Burm.) Merr., *Euphorbia pulcherrima* Willd. ex Klotzsch, *Mucuna pruriens* L., *and Rumex nepalensis* Spreng., had a full consensus (FL = 100%). These high values mean that these taxa are only used for certain medical purposes and are seen as the main medicinal resources in the Tengger community. Species exhibiting elevated FL are prioritized as high-probability candidates for biopharmacological validation and should be incorporated into local conservation frameworks [37], [38].

Intermediate FL values (33.33%–50%), seen in species like *Tagetes erecta L*., *Cuphea hyssopifolia* Kunth., and *Sonchus arvensis* L., show that traditional knowledge is not always the same. This may arise from numerous therapeutic applications or disparities in knowledge transmission across generations [39], [40], [41]. On the other hand, *Apium graveolens* L. (11.54%) and *Phytolacca icosandra* L. (14.29%) had the lowest FL values. These low percentages don't mean that these species don't have any medicinal value. Instead, they suggest that these species are generalist remedies that can be used for a wide range of problems instead of just one main one. Additionally, lower FL values may reflect limited knowledge dissemination or reduced prominence of certain species in local medicinal practices [42], [43]. High-FL species are sought after for drug discovery, but these low-FL adaptable plants are still very important to the strength of community-based healthcare and should be given the same amount of attention in biocultural preservation efforts.

Table 2
Ethnobotanical indices (SUV, FUV, FL) for recorded species in Argosari Village.

Family	Species Name	Common Name	Ethnobotany Indices		
			SUV	FUV	FL
Amaranthaceae	*Phytolacca icosandra* L.	tropical pokeweed	0,117	0,117	14,290
Amaryllidaceae	*Allium ascalonicum* L.	shallot/wild onion	0,133	0,133	25,000
Apiaceae	*Apium graveolens* L.	celery	0,433	0,433	11,540
Asteraceae	*Ageratina riparia* (Regel) R.M.King & H.Rob.	mistflower	0,233	0,633	14,290
	Bidens pilosa L.	beggarticks	0,017		100,000
	Bellis perennis L.	common daisy	0,017		100,000
	Tagetes erecta L.	marigold	0,033		50,000
	Sonchus arvensis L.	sow thistle	0,050		33,330
	Sonchus asper (L.)Hill.	Spiny sowthistle	0,233		21,430
	Artemisia vulgaris L.	common mugwort	0,233		14,290
	Gymnanthemum amygdalinum (Delile) Sch.Bip.	river bitter-tea/ African bitterleaf	0,017		100,000
Brassicaceae	*Brassica rapa* L.	wild turnip	0,017	0,017	100,000
Convolvulaceae	*Ipomoea indica* (Burm.) Merr.	blue morning glory	0,017	0,017	100,000
Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn.	common bracken	0,217	0,217	15,380
Euphorbiaceae	*Jacobaea maritima* Jacq.	silver ragwort	0,033	0,017	50,000
	Euphorbia pulcherrima Willd. ex Klotzsch	poinsettia	0,017		100,000
Fabaceae	*Mucuna pruriens* L.	velvet bean	0,017	0,017	100,000
Lamiaceae	*Ajuga reptans* L.	common bugle	0,233	0,233	14,290
Lythraceae	*Cuphea hyssopifolia* Kunth.	false heather	0,033	0,033	50,000
Malvaceae	*Hibiscus rosa-sinensis* L.	Chinese hibiscus	0,050	0,050	33,330
Polygonaceae	*Rumex nepalensis* Spreng.	Nepal doc	0,033	0,050	100,000
	Rumex crispus L.	curled dock	0,017		50,000
Solanaceae	*Capsicum frutescens L.*	tabasco pepper	0,050	0,050	33,330

3.3. Plant Part Value (PPV) and Ecological Sustainability

The Plant Part Value (PPV) analysis (Fig. 2) found that leaves were the main medicinal part (61%), which is in line with what is common in Indonesia and around the world [44]. Two things make this choice: biochemical potency and ecological resilience. Leaves behave as metabolic bio-factories, gathering a wide range of beneficial secondary metabolites that can be easily isolated. Also, collecting leaves is more sustainable than collecting roots or bark, which destroys the plant. This is because it allows for quick biomass regeneration and makes sure that the medicinal source will be around for a long time [45], [46], [47].

Flowers (14%) and rhizomes (12%) are the second most important groups, which is interesting. Floral consumption is sometimes underreported in such research; yet, its significance in this context indicates a unique cultural specialization within the BTS region. On the other hand, the lesser use of bulbs, stems, and fruits (2%–4%) is probably due to seasonal limitations or the difficulties of getting active ingredients from lignified or protected tissues.

Processing Techniques and Therapeutic Optimization

In Argosari Village, decoction/boiling is the most common way to prepare food (40%) (Fig. 3). This method is popular because it works well to break down tough plant cell walls so that polar chemicals like alkaloids and flavonoids can be released into water [48]. The boiling procedure is not only important for extraction efficiency, but it is also an important stage in thermal sanitization. It lowers the number of microbes and makes the medicines safer [49].

Some examples of exterior uses are grinding or pounding (20%), producing a paste (18%), and putting it on the skin (12%). They account for half of the recorded uses. This high percentage means that people have a good traditional understanding of how transdermal absorption can be used to treat skin and localized musculoskeletal disorders [50], [51]. On the other hand, eating raw materials (4%) or unprocessed juices (6%) directly is not frequent. This is presumably because they taste bad (for example, they are quite bitter) or because people are trying to be safe and avoid the possible toxicity of raw phytochemicals [52]. These methods together show a systematic set of traditional knowledge that has been improved for safety and effectiveness in therapy [52].

4. Discussion

4.1. Biocultural Significance and Taxonomic Selection

The documentation of 23 medicinal species from 17 families indicates that Argosari Village possesses a curated and culturally embedded ethnomedicinal system. Asteraceae is common over the world because it can grow in many different environments and has high quantities of beneficial secondary metabolites such sesquiterpene lactones, flavonoids, and phenolic acids [53], [54]. Our findings support past studies done in Indonesia and the Southeast Asian highlands that show that a mix of phytochemical richness and environmental visibility is the main factor that affects plant selection. Also, the fact that cures for internal and chronic illnesses are given priority shows that people in places with limited access to official healthcare rely on traditional medicine on purpose [55].

4.2. Conservation Implications

From a conservation standpoint, the high leaf harvesting rate (PPV 61%) signifies a rather sustainable resource utilization approach that promotes biomass regeneration [52]. However, species with high SUV and FL values, which show that people really like them and keep using them, may be under pressure to be taken from certain areas. This underscores the imperative for community-based monitoring and domestication techniques to prevent the over-exploitation of these well accepted taxa [3], [56].

4.3. Pharmacological Validation and Bioprospecting Potential

The medicinal assertions made by the Tengger community are strongly supported by documented phytochemical profiles. For instance:

- *Apium graveolens* L.: flavonoids (apigenin, luteolin) and phthalides with recognized antihypertensive and anti-inflammatory effects [35], [57].
- Asteraceae Taxa (*Ageratina riparia* (Regel) R.M.King & H.Rob., *Gymnanthemum amygdalinum* (Delile) Sch.Bip.: contains a lot of sesquiterpene lactones and alkaloids that have been shown to be good for your health and fight germs [58], [59].
- *Mucuna pruriens* L.: Contains L-DOPA, giving it a neuropharmacological basis for its historic use [60].

- *Brassica rapa* L.: increased glucosinolate concentrations associated with metabolic and chemopreventive attributes [61], [62].

When we combine ethnobotanical indicators (SUV, FUV, and FL) with these biochemical profiles, we get a solid foundation for focused bioprospecting. Species with high consensus values may represent promising candidates for targeted compound isolation, mechanism-of-action studies, and toxicity evaluation [63], [64]. At the same time, conservation planning must accompany pharmacological exploration to prevent bioprospecting-driven overharvesting. Future research should therefore integrate phytochemical screening, quantitative metabolite analysis, ecological population assessments, and cultivation trials to ensure that drug discovery efforts align with biodiversity sustainability and community-based resource management [65].

5. Conclusions

This study underscores the selective and adaptive characteristics of the ethnomedicinal system in Argosari Village, where traditional knowledge is deeply integrated with the high biodiversity of Bromo Tengger Semeru region. There is a strong cultural agreement on certain taxa, especially those in the Asteraceae family. This shows how important these species are as functional pillars of local primary healthcare. Our results show that current harvesting methods, which mostly use leaves, are mostly sustainable and show a deep understanding of plant resources. Future research must emphasize the pharmacological validation of widely accepted species and perform ecological population evaluations to ensure long-term biocultural sustainability and policy development.

Abbreviations

The following abbreviations are used in this manuscript:

SUV	Species Use Value
FUV	Family Use Value
FL	Fidelity Level
UV	Use Value

Declarations

Conflicts of Interest:

The authors declare no conflicts of interest.

Funding:

This research is funded by the Indonesian Endowment Fund for Education (LPDP) on behalf of the Indonesian Ministry of Higher Education, Science and Technology and managed under the EQUITY Program (Contract No. 4299/B3/DT.03.08/2025 & No 3029/PKS/ITS/2025).

Author Contribution

E.Z., A.P.D.N., and W.M. conceived and designed the experiments. I.T., M.A.R.R., Y.N.W., and D.P.P. performed the experiments. I.T., M.A.R.R., M., T.N., and H.P. analyzed the data. B.S.D. and K.M. contributed reagents, materials, and

analysis tools. I.T. wrote the first draft of the manuscript. E.Z., A.P.D.N., T.N., W.M., M.A.R.R., M., B.S.D., K.M., H.P., Y.N.W., M.U.B., and D.P.P. reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

Acknowledgement

The authors would like to sincerely thank the local community of Argosari Village for their cooperation and for sharing their valuable knowledge during the fieldwork. This research is funded by the Indonesian Endowment Fund for Education (LPDP) on behalf of the Indonesian Ministry of Higher Education, Science and Technology and managed under the EQUITY Program.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to ethical considerations and the protection of participants' information and traditional knowledge, but relevant data are available from the corresponding author on reasonable request.

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Figures

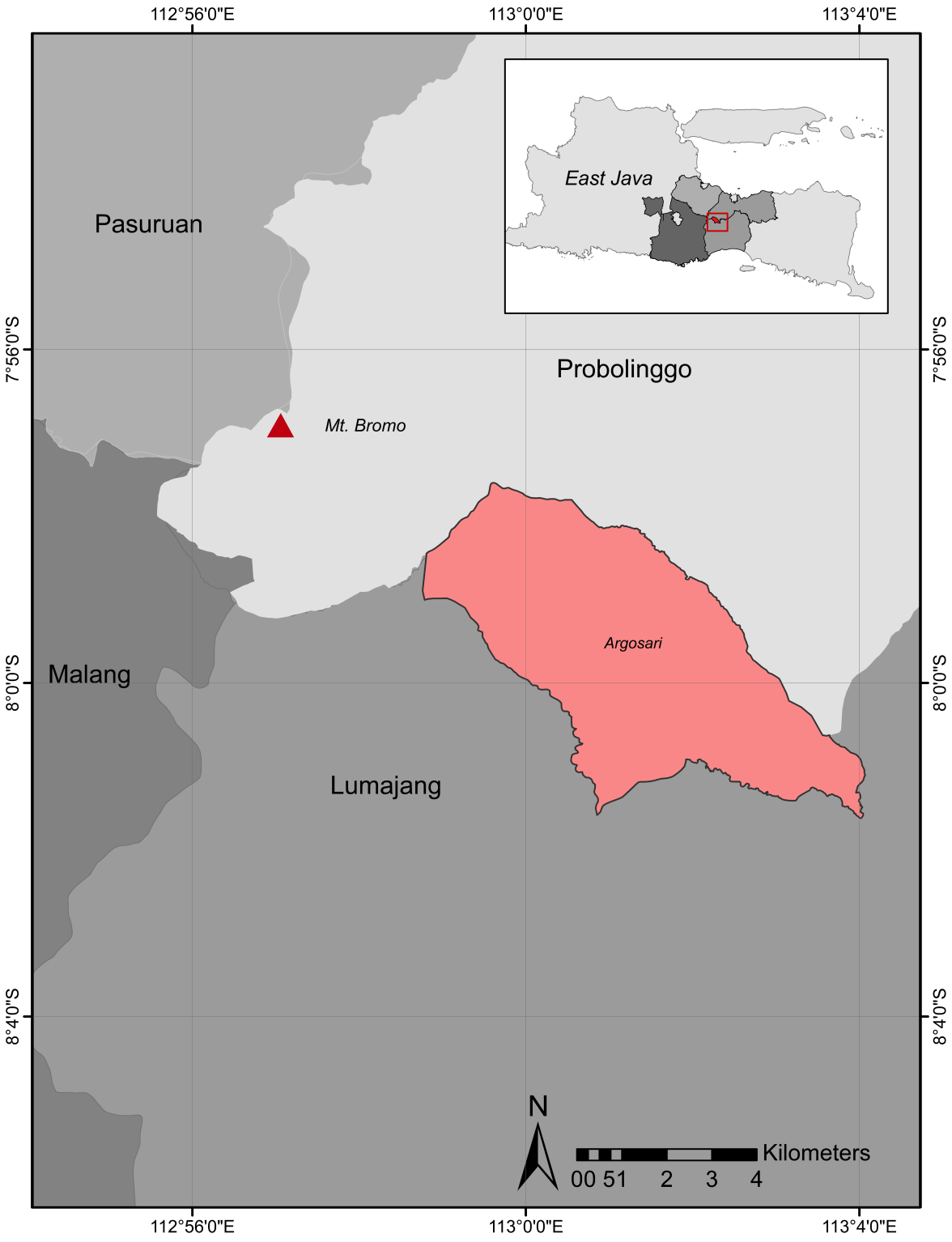

Figure 1

Location of the study area. Argosari village (A, red color) is located within the Bromo Tengger Semeru

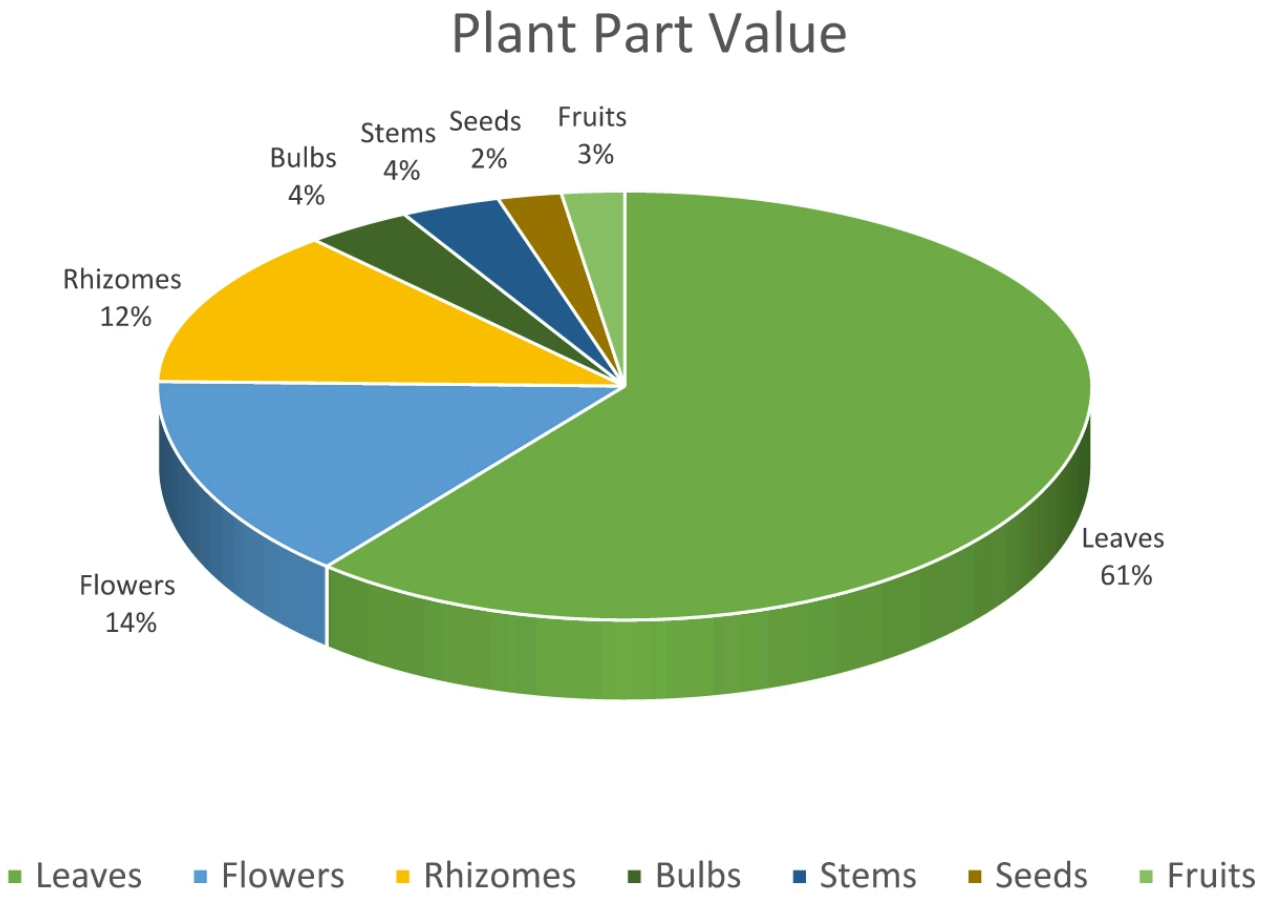

Figure 2

Distribution of medicinal plant parts used for preparing herbal medicine in Argosari Village, Indonesia.

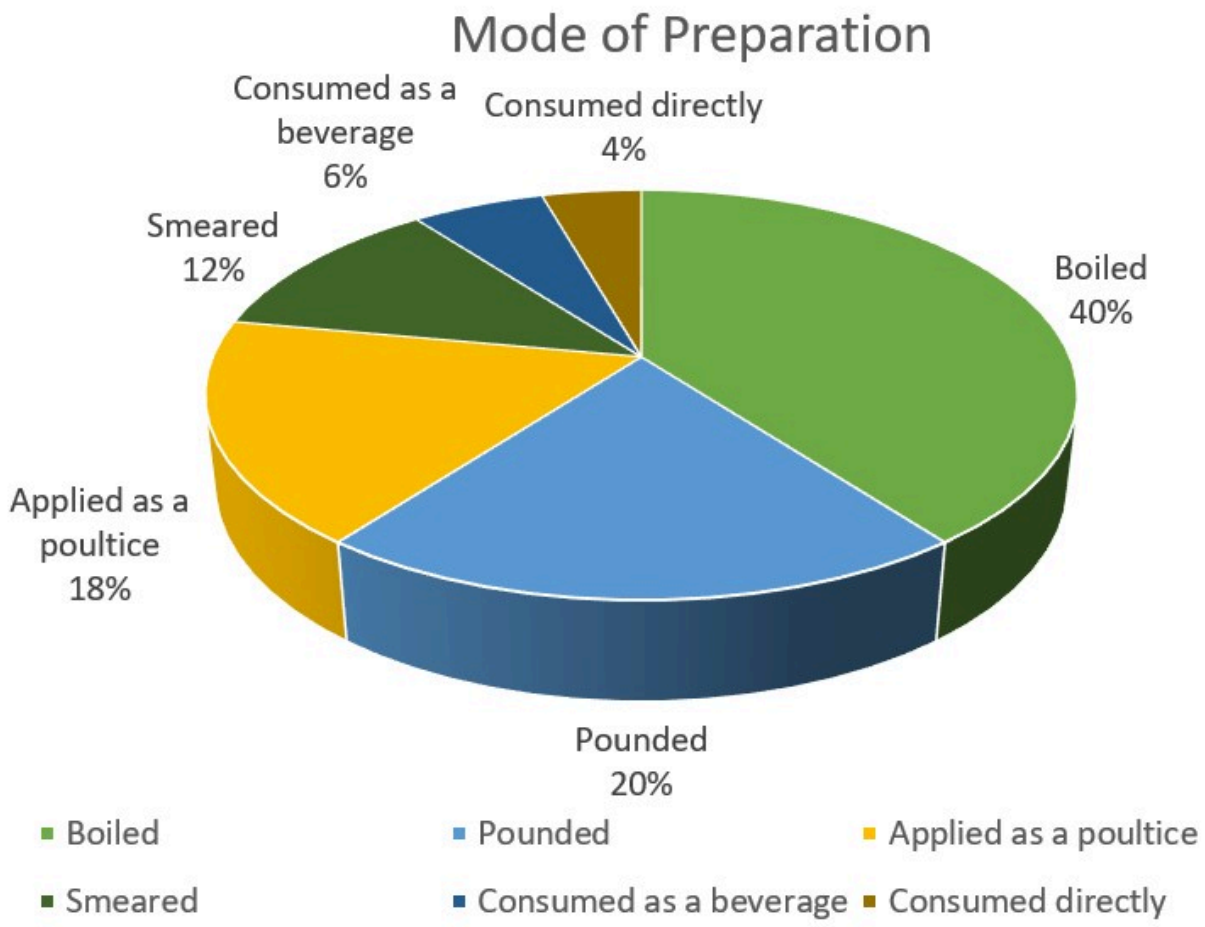

Figure 3

Mode of preparation of the medicinal plants used by the people of Tengger in Argosari village, Indonesia.

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