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Ethnobotanical knowledge of edible plants in a karst landscape of Gawang Hamlet, Ketro Village, Pacitan District, Indonesia

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Abstract. *Safitri RN, Hanum U, Pratiwi VMR, Hermawan WG, Nurcahyati M, Budiharta S, Setyawan AD. 2025. Ethnobotanical knowledge of edible plants in a karst landscape of Gawang Hamlet, Ketro Village, Pacitan District, Indonesia. Intl J Trop Drylands 9: 85-97.* Karst ecosystems pose significant agricultural challenges due to shallow soils, poor water retention, and rugged terrain; however, local communities have developed adaptive food systems rooted in traditional knowledge. This ethnobotanical study documented the diversity and utilization of edible plants in Gawang Hamlet, Ketro Village, Pacitan District, East Java, Indonesia, and assessed their cultural significance using the Relative Frequency of Citation (RFC) index. Data were collected from 60 informants through structured questionnaires, interviews, and field observations. A total of 65 edible plant species from 36 families were recorded, dominated by vegetables (47.0%), spices (24.2%), fruits (21.2%), and staple foods (7.6%). The most frequently cited species were *Manihot esculenta* (RFC=0.95), *Curcuma longa*, and *Arachis hypogaea*. Fruits and leaves were the most utilized parts, and shrubs and herbs dominated the growth forms. Quantitative analysis was conducted using the RFC index, and patterns of species multifunctionality were visualized through a heatmap and a Venn diagram to highlight overlapping use categories. The high species diversity and multifunctionality reflect local ecological adaptation and are closely tied to socio-demographic factors such as gender, age, and occupation. Importantly, home gardens were found to function as hubs of subsistence, biodiversity conservation, and intergenerational knowledge transfer, underscoring their crucial role in the community. These findings highlight the critical role of traditional agroecosystems in ensuring food security and sustaining cultural and ecological resilience in karst environments.

Keywords: Edible plant, ethnobotany, karst, Pacitan, traditional knowledge

INTRODUCTION

Ethnobotany is a compelling interdisciplinary field that explores the intricate relationships between human societies and plants within their local environments. Rooted in the terms ethnology and botany, ethnobotany investigates how communities, particularly those in rural and indigenous settings, utilize and perceive plants for food, medicine, rituals, shelter, and other cultural purposes (Darmastuti et al. 2024). This discipline not only documents traditional knowledge but also provides valuable perspectives for addressing urgent global issues such as biodiversity loss, climate change adaptation, sustainable food systems, and public health (Walujo 2017; Pei et al. 2020). Through the preservation and analysis of local plant knowledge, ethnobotany contributes to both ecological resilience and cultural continuity (Cahyaningsih et al. 2022).

In many rural parts of Indonesia, ethnobotanical knowledge remains vital for everyday survival. Communities frequently rely on a combination of cultivated and wild plant species to fulfill their food and nutritional needs. This reliance is particularly prominent in areas where conventional agricultural methods are constrained by harsh environmental conditions. One such example is the karst landscape, which is characterized by limestone-dominated geological formations, limited soil fertility, rapid water drainage, and general agricultural inhospitality (Sudarmadji et al. 2013; Kuniansky et al. 2016). These constraints, however, have not deterred local communities from developing adaptive strategies that harness the rich biodiversity of their surroundings.

The homegarden or *pekarangan* system in Indonesia exemplifies an effective model of small-scale agroforestry that is deeply rooted in traditional ecological knowledge. It integrates food crops, medicinal plants, ornamental species, and occasionally livestock in a multifunctional space. In karst regions, these systems are often intensified due to limited agricultural land, turning homegardens into crucial spaces for sustainable food production and ethnobotanical practice (Suryani et al. 2020; Sulistiyowati et al. 2022). The integration of diverse edible plant species in homegardens demonstrates not only local ecological acumen but also a socio-cultural commitment to self-sufficiency, dietary diversity, and resilience in the face of environmental pressures (Setiawan and Qiptiyah 2014).

One of the most compelling cases of such adaptive ethnobotanical practice is found in the Pacitan District of East Java, Indonesia. This district encompasses a significant portion of Java's Southern Mountains, with widespread karst formations shaping its ecology and land use patterns (Jauhari 2020). Within this district, Gawang Hamlet in Ketro Village, Kebonagung Sub-district, stands out as a remote community located in a particularly rugged karst zone. In this hamlet, residents engage in subsistence agriculture using traditional methods, cultivating a variety of vegetables, fruits, spices, and tuber crops in their homegardens and small plots of arable land (Ammar et al. 2021; Cahyaningsih et al. 2022). This localized food system, though modest, reflects a deep knowledge of plant cultivation under ecological stress, as well as a high degree of cultural adaptation.

Although earlier studies have explored ethnobotanical practices in Pacitan District more broadly, there is a notable research gap concerning specific localities like Gawang Hamlet, especially regarding the detailed inventory of edible plants and their cultural relevance (Ammar et al. 2021; Cahyaningsih et al. 2022). This study thus seeks to fill that gap by documenting and analyzing the diversity and use of food plants in Gawang Hamlet. By focusing on a community embedded within one of the district's most environmentally challenging regions, the research offers unique insights into how traditional knowledge and ecological adaptation intersect to sustain local livelihoods.

To achieve this, the present study employs the Relative Frequency of Citation (RFC) index to assess the cultural significance of edible plant species used by the local community. This index helps quantify the importance of each species based on how frequently it is cited by informants, thus providing a proxy for its cultural and practical value. Furthermore, the study explores socio-ecological factors—such as availability, seasonal variation, cultural practices, and perceived utility—that influence plant selection and usage patterns. By doing so, the research not only enriches the ethnobotanical literature from Southeast Asia but also contributes practical knowledge for biodiversity conservation and climate-resilient food strategies in karst landscapes.

MATERIALS AND METHODS

Study area

Geographical location

This study was conducted in Gawang Hamlet, a sub-village located within Ketro Village, Kebonagung Sub-district, Pacitan District, East Java Province, Indonesia (Figure 1). Geographically, Gawang Hamlet is situated at coordinates 8°17′24.9″S and 111°21′20.1″E, with a total area of approximately 234.50 hectares. It lies within the Southern Mountain karst region, which is part of a broader limestone formation extending across the southeastern part of Java Island (Jauhari 2020). This map illustrates the geographical setting of the study site within the karst landscape of the Southern Mountains, highlighting its elevation and terrain complexity. The village is accessible via rural roads and is surrounded by steep hills and karst formations with visible sinkholes and underground streams (Sudarmadji et al. 2013).

Topography and climate

The elevation of Gawang Hamlet ranges from 10 to 750 meters above sea level, characterized by a rugged landscape of limestone hills and limited flat terrain suitable for agriculture. The region experiences a tropical monsoonal climate with distinct dry and wet seasons. Annual rainfall in the area averages around 222.8 mm, and ambient temperatures typically range between 24°C and 27°C. Due to the karst substrate, surface water is scarce, and agricultural activity relies on seasonal rain and traditional soil-conservation practices (Widiyanti and Dittmann 2014; Kuniansky et al. 2016).

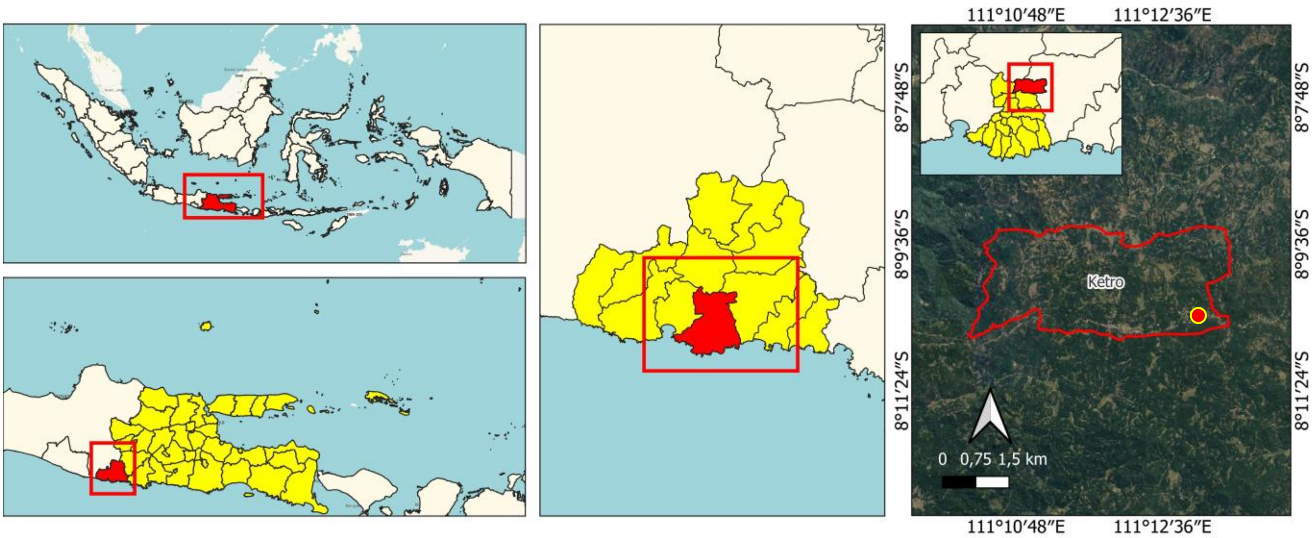

Figure 1. Location map of Gawang Hamlet (●), Ketro Village, Kebonagung Sub-district, Pacitan District, East Java, Indonesia.

Social characteristics

The population of Gawang Hamlet consists mainly of rural Javanese communities engaged in subsistence farming, seasonal labor, and domestic food production. Most households cultivate edible plants in home gardens or nearby plots, forming a deeply rooted local food system. Intergenerational transfer of plant knowledge remains strong, with reliance on locally available resources for daily nutrition. Of the 60 informants surveyed, 70% were women, reflecting their central role in managing household food and health. More than 70% were over 45 years old, indicating the importance of elderly individuals as knowledge holders. Educational attainment was generally low, with the majority completing only primary school. Common occupations included farming (38.3%) and housewifery (36.7%), aligning with a household-based production model. Notably, 90% of informants had lived in the area for over a decade, suggesting that prolonged exposure to the environment fosters deep ecological knowledge. These socio-cultural and ecological factors have produced a resilient, diversified food system rooted in tradition. Gawang Hamlet offers a meaningful example of how rural communities adapt to fragile karst landscapes through culturally embedded, biodiversity-based practices that support both food security and ecological sustainability.

Data collection

Selection of informants and sampling technique

This study used purposive sampling to select 60 informants with specific knowledge relevant to edible plant use, following widely accepted ethnobotanical methods (Etikan et al. 2016). Selection was based on residency, experience in farming or gardening, and familiarity with traditional plant practices. The sample size followed general behavioral research guidelines suggesting 30-500 participants (Roscoe 1975; Tabachnick and Fidell 1996), with an emphasis on demographic diversity and active engagement with food plants.

Data collection instruments

Data were collected using structured questionnaires, semi-structured interviews, and direct field observations. The questionnaires gathered demographic data and detailed information on edible plant use (e.g., names, parts used, preparation methods, usage frequency). Open-ended interviews allowed clarification and narrative insights (Zhang et al. 2016). Observations were used to verify plant species and record morphological features in situ. All instruments were conducted in Javanese and later translated into Indonesian and English.

Inclusion criteria of informants

Informants were eligible if they were at least 17 years old (Hurlock 2006), had lived in Gawang Hamlet for over one year, and actively cultivated or gathered edible plants. Only those with firsthand knowledge were included. Participation was voluntary, ensuring reliable data grounded in ecological familiarity and cultural relevance.

Period and duration of fieldwork

Fieldwork took place in December 2023 during the rainy season, a period conducive to plant growth and identification. The three-week duration allowed ample time for interviews, questionnaire administration, and species verification in home gardens and fields. This timing also aligned with peak agricultural activity in the village.

Plant identification

Identification process

Plant species cited by informants were documented using both vernacular and scientific names. Fresh specimens were directly observed in the field, with photographic documentation when necessary. Cross-verification with multiple informants was used to confirm name accuracy. In ambiguous cases, morphological features such as leaf shape, flower structure, and growth habit were examined in situ and compared with herbarium samples or photographic databases to ensure precise identification.

Use of local and scientific names

Each species was recorded using its local name as spoken in Gawang Hamlet and matched to its scientific equivalent. When multiple vernacular names were used, consensus was reached through triangulation with key informants (e.g., elderly or experienced women). Scientific names followed binomial nomenclature with author citation, and plant families were identified for consistency across the dataset (Table 2).

Taxonomic references

Species names and classifications were verified using global taxonomic databases, including GBIF and POWO. In cases of uncertainty, regional botanical sources such as Backer and Bakhuizen van den Brink (1963-1968), and references from Iskandar et al. (2018) and Ammar et al. (2021) were consulted. Taxonomic updates and synonyms were noted. Unconfirmed species were excluded from quantitative analyses (e.g., RFC) to maintain data reliability.

Data analysis

Qualitative analysis

This study used both qualitative and quantitative approaches to interpret ethnobotanical data. Qualitative analysis explored patterns of plant use, cultural significance, and ecological logic, based on observations, interviews, and open-ended questionnaire responses. Plants were grouped thematically by use (vegetables, spices, fruits, staples), plant parts used, and growth forms to construct interpretive codes.

Quantitative analysis – Relative Frequency of Citation (RFC)

Quantitatively, the Relative Frequency of Citation (RFC) index was applied to assess each species' cultural importance:

RFC = FC/N

Where,
FC : Number of informants who mentioned a species
N : Total number of informants (N = 60)

RFC values range from 0 to 1, with higher values indicating broader recognition and use (Tardío and Pardo-de-Santayana 2008; Bano et al. 2014; Silalahi et al. 2018).

Interpretation and classification of results

Based on RFC scores, species were categorized as: high (≥0.30), moderate (0.10-0.29), or low (<0.10) importance. To aid interpretation, data were visualized using a heatmap (by use category) and a Venn diagram (to show multifunctionality and category overlap), highlighting key species in the local food system.

RESULTS AND DISCUSSION

Socio-demographic characteristics of informants

A total of 60 informants participated in this ethnobotanical study, all of whom were residents of Gawang Hamlet, Ketro Village, Pacitan District. They were selected based on their local knowledge and direct experience in cultivating and utilizing edible plants in home gardens or fields. The demographic profile of the participants reflects the composition of rural communities in karst areas. It provides insight into how traditional plant knowledge is distributed across gender, age, education, and occupation. As shown in Table 1, the majority of respondents were female (70%), highlighting the significant role of women in managing household food systems and preserving ethnobotanical knowledge. This finding is consistent with previous studies that emphasize women's central role in food preparation and knowledge transmission (Cao et al. 2020). The age distribution was dominated by individuals over 45 years old, including 28.3% aged above 65, indicating that much of the local plant knowledge resides within the older generation.

In terms of education, most informants had limited formal schooling, with 40.0% completing only primary school and 13.3% having never attended school. Despite this, their ecological and practical understanding of edible plant species was remarkably rich, illustrating the strength of orally transmitted knowledge systems. The primary occupations were farming (38.3%) and housewifery (36.7%), consistent with the agrarian lifestyle of the community. Most participants (90.0%) had lived in the hamlet for over ten years, which reinforces the reliability and depth of their knowledge about local plant resources.

This demographic profile illustrates that edible plant knowledge in Gawang Hamlet is embedded in lived experience and intergenerational transmission, with women and the elderly acting as key custodians of ecological heritage. These socio-ecological attributes are crucial for understanding the patterns of plant selection, use, and conservation in rural karst communities.

Diversity of edible plant species

The ethnobotanical survey in Gawang Hamlet documented a total of 65 edible plant species belonging to 27 botanical families. These species include both cultivated crops and semi-wild plants that are commonly used by the local community for food, spices, fruits, and complementary ingredients. The high diversity of edible plants reflects the community's adaptive strategies to cope with ecological limitations in karst landscapes and highlights their deep reliance on local biodiversity for daily subsistence. The most represented families based on the number of species recorded were Fabaceae (11 species), followed by Zingiberaceae, Cucurbitaceae, and Solanaceae (each with 6 species), Amaryllidaceae (5 species), Myrtaceae (3 species), and Rutaceae (2 species). These families are well known for their multipurpose species, offering a wide range of edible parts such as fruits, leaves, seeds, tubers, rhizomes, and bulbs.

The dominant species in terms of usage frequency and multifunctionality include *Manihot esculenta* (cassava), *Curcuma longa* (turmeric), *Arachis hypogaea* (peanut), and *Zingiber officinale* (ginger), which show the highest RFC values (≥0.40). These species are primarily classified as staple, spice, or complementary foods and are valued for their adaptability to nutrient-poor karst soils and seasonal water availability. The wide variety of edible plant species recorded reflects the community's ecological knowledge and adaptive strategies in managing a diverse agroecosystem under karst conditions. These findings are reinforced by the quantitative results of the Relative Frequency of Citation (RFC) analysis presented in the following section.

Table 1. Socio-demographic characteristics of informants in Gawang Hamlet, Pacitan District, East Java, Indonesia (N=60)

Parameter	Category	Frequency (n)	Percentage (%)
Gender	Male	18	30.0
	Female	42	70.0
Age Group (years)	15-25	3	5.0
	26-35	5	8.3
	36-45	10	16.7
	46-55	10	16.7
	56-65	15	25.0
	>65	17	28.3
Education level	Not attending school	8	13.3
	Primary school	24	40.0
	Junior high school	14	23.3
	Senior high school	14	23.3
Length of Residence	<5 years	2	3.3
	5-10 years	4	6.7
	>10 years	54	90.0
Occupation	Farmer	23	38.3
	Housewife	22	36.7
	Trader	5	8.3
	Other (laborer, student, etc.)	10	16.7

Table 2. List of edible plants used by the Gawang Hamlet community, Pacitan, Indonesia along with their local names, scientific names, growth forms, plant parts used, and utilization modes

Local name	Common name	Scientific name	Family	Growth form	Used part(s)	Use category	RFC
Singkong	Cassava	*Manihot esculenta* Crantz	Euphorbiaceae	Shrub	Tuber, leaf	Staple, vegetable	0.95
Kunyit	Turmeric	*Curcuma longa* L.	Zingiberaceae	Herb	Rhizome	Spice	0.45
Kacang tanah	Peanut	*Arachis hypogaea* L.	Fabaceae	Herb	Seed	Complementary	0.43
Jahe	Ginger	*Zingiber officinale* Roscoe	Zingiberaceae	Herb	Rhizome	Spice	0.40
Kacang panjang	Yardlong bean	*Vigna unguiculata* (L.) Walp.	Fabaceae	Shrub	Fruit	Vegetable	0.38
Lengkuas	Galangal	*Alpinia galanga* (L.) Willd.	Zingiberaceae	Herb	Rhizome	Spice	0.35
Pisang	Banana	*Musa* sp.	Musaceae	Tree	Fruit	Fruit	0.33
Ubi jalar	Sweet potato	*Ipomoea batatas* (L.) Lam.	Convolvulaceae	Tuber	Tuber	Staple	0.30
Terong	Eggplant	*Solanum melongena* L.	Solanaceae	Shrub	Fruit	Vegetable	0.29
Bayam	Amaranth	*Amaranthus* sp.	Amaranthaceae	Herb	Leaf	Vegetable	0.28
Pepaya	Papaya	*Carica papaya* L.	Caricaceae	Tree	Leaf, fruit	Vegetable, fruit	0.33
Daun kelor	Drumstick tree	*Moringa oleifera* Lam.	Moringaceae	Tree	Leaf	Vegetable	0.26
Sawi	Mustard greens	*Brassica juncea* (L.) Czern.	Brassicaceae	Herb	Leaf	Vegetable	0.25
Kangkung	Water spinach	*Ipomoea aquatica* Forssk.	Convolvulaceae	Herb	Leaf	Vegetable	0.25
Kecipir	Winged bean	*Psophocarpus tetragonolobus* (L.) DC.	Fabaceae	Shrub	Fruit	Vegetable	0.24
Jagung	Maize	*Zea mays* L.	Poaceae	Grass	Seed	Staple	0.22
Talas	Taro	*Colocasia esculenta* (L.) Schott	Araceae	Tuber	Tuber	Staple	0.21
Ubi kelapa	Purple yam	*Dioscorea alata* L.	Dioscoreaceae	Tuber	Tuber	Staple	0.21
Kemangi	Basil	*Ocimum basilicum* L.	Lamiaceae	Herb	Leaf	Spice	0.20
Cabai merah	Red chili pepper	*Capsicum annuum* L.	Solanaceae	Shrub	Fruit	Spice	0.19
Jambu biji	Guava	*Psidium guajava* L.	Myrtaceae	Shrub	Fruit	Fruit	0.18
Nangka	Jackfruit	*Artocarpus heterophyllus* Lam.	Moraceae	Tree	Fruit	Fruit	0.18
Jeruk nipis	Key lime	*Citrus aurantiifolia* (Christm.) Swingle	Rutaceae	Shrub	Fruit	Fruit	0.17
Belimbing	Starfruit	*Averrhoa carambola* L.	Oxalidaceae	Tree	Fruit	Fruit	0.17
Jambu air	Water apple	*Syzygium aqueum* (Burm.fil.) Alston	Myrtaceae	Tree	Fruit	Fruit	0.17
Sirsak	Soursop	*Annona muricata* L.	Annonaceae	Tree	Fruit	Fruit	0.16
Delima	Pomegranate	*Punica granatum* L.	Lythraceae	Shrub	Fruit	Fruit	0.15
Markisa	Passionfruit	*Passiflora edulis* Sims	Passifloraceae	Climber	Fruit	Fruit	0.14
Bawang putih	Garlic	*Allium sativum* L.	Amaryllidaceae	Herb	Bulb	Spice	0.14
Bawang merah	Shallot	*Allium cepa* L.	Amaryllidaceae	Herb	Bulb	Spice	0.14
Serai	Lemongrass	*Cymbopogon citratus* (DC.) Stapf	Poaceae	Grass	Stem	Spice	0.13
Kayu manis	Cinnamon	*Cinnamomum burmannii* (Nees & T.Nees) Blume	Lauraceae	Tree	Bark	Spice	0.13
Tomat	Tomato	*Solanum lycopersicum* L.	Solanaceae	Shrub	Fruit	Vegetable	0.13
Timun	Cucumber	*Cucumis sativus* L.	Cucurbitaceae	Vine	Fruit	Vegetable	0.13
Petai	Stink bean	*Parkia speciosa* Hassk.	Fabaceae	Tree	Seed	Vegetable	0.12
Pete cina	River tamarind	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Tree	Seed	Vegetable	0.12
Lombok kecil	Bird's eye chili	*Capsicum frutescens* L.	Solanaceae	Shrub	Fruit	Spice	0.11
Seledri	Celery	*Apium graveolens* L.	Apiaceae	Herb	Leaf	Vegetable	0.11
Lamtoro	Lead tree	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Shrub	Seed	Vegetable	0.10
Paprika	Bell pepper	*Capsicum annuum* L. (Paprika)	Solanaceae	Shrub	Fruit	Vegetable	0.10
Kapri	Garden pea	*Pisum sativum* L.	Fabaceae	Herb	Fruit	Vegetable	0.10
Kacang hijau	Mung bean	*Vigna radiata* (L.) R.Wilczek	Fabaceae	Herb	Seed	Vegetable	0.10
Kacang kedelai	Soybean	*Glycine max* (L.) Merr.	Fabaceae	Herb	Seed	Vegetable	0.09
Kacang merah	Common bean	*Phaseolus vulgaris* L.	Fabaceae	Herb	Seed	Vegetable	0.09
Bawang daun	Leek	*Allium fistulosum* L.	Amaryllidaceae	Herb	Leaf	Vegetable	0.09
Bawang batak	Chinese onion	*Allium chinense* G.Don	Amaryllidaceae	Herb	Leaf	Spice	0.08
Ciplukan	Ground cherry	*Physalis angulata* L.	Solanaceae	Herb	Fruit	Fruit	0.08
Cengkeh	Clove	*Syzygium aromaticum* (L.) Merr. & L.M.Perry	Myrtaceae	Tree	Flower	Spice	0.08
Salak	Snake fruit	*Salacca zalacca* (Gaertn.) Voss	Arecaceae	Tree	Fruit	Fruit	0.08
Kelapa	Coconut	*Cocos nucifera* L.	Arecaceae	Tree	Fruit	Fruit	0.08
Semangka	Watermelon	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Cucurbitaceae	Vine	Fruit	Fruit	0.07
Melon	Melon	*Cucumis melo* L.	Cucurbitaceae	Vine	Fruit	Fruit	0.07
Mentimun suri	Cantaloupe	*Cucumis melo* var. *reticulatus*	Cucurbitaceae	Herb	Fruit	Fruit	0.07
Labu siam	Chayote	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	Vine	Fruit	Vegetable	0.07
Labu kuning	Pumpkin	*Cucurbita moschata* (Duchesne) Duchesne ex Poir.	Cucurbitaceae	Vine	Fruit	Vegetable	0.06
Oyong	Angled luffa	*Luffa acutangula* (L.) Roxb.	Cucurbitaceae	Vine	Fruit	Vegetable	0.06
Terung pipit	Turkey berry	*Solanum torvum* Sw.	Solanaceae	Shrub	Fruit	Vegetable	0.06
Daun singkil	Blue glory	*Clerodendrum serratum* Spreng.	Lamiaceae	Shrub	Leaf	Vegetable	0.05
Lenglen	Asthma-plant	*Euphorbia hirta* L.	Euphorbiaceae	Herb	Leaf	Vegetable	0.05
Jahe merah	Red ginger	*Zingiber officinale* var. *rubrum*	Zingiberaceae	Herb	Rhizome	Spice	0.05
Kunyit putih	White turmeric	*Curcuma zedoaria* (Christm.) Roscoe	Zingiberaceae	Herb	Rhizome	Spice	0.05
Kencur	Aromatic ginger	*Kaempferia galanga* L.	Zingiberaceae	Herb	Rhizome	Spice	0.05
Kecombrang	Torch ginger	*Etlingera elatior* (Jack) R.M.Sm.	Zingiberaceae	Herb	Flower	Spice	0.05
Jeruk purut	Kaffir lime	*Citrus hystrix* DC.	Rutaceae	Shrub	Leaf	Spice	0.05
Beluntas	Indian camphorweed	*Pluchea indica* (L.) Less.	Asteraceae	Shrub	Leaf	Vegetable	0.05

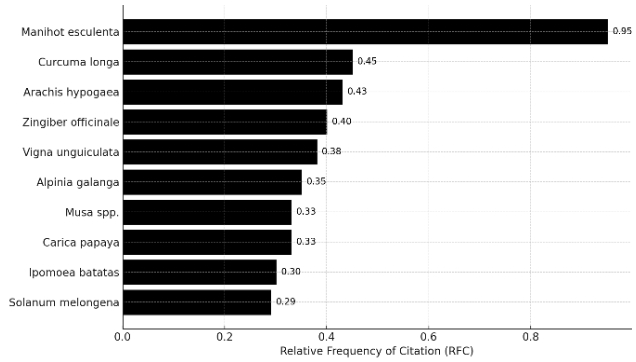

Figure 2. Relative Frequency of Citation (RFC) values for the most frequently used edible plant species in Gawang Hamlet, Pacitan, Indonesia (N=65 species)

Cultural relevance and species dominance based on Relative Frequency of Citation (RFC) values

The cultural relevance of edible plant species in Gawang Hamlet was assessed using the Relative Frequency of Citation (RFC) index, which quantifies how frequently each species was mentioned by informants. Among 65 recorded species, RFC values ranged from 0.05 to 0.95, reflecting variation in familiarity and importance within the local food system. Plants with higher RFC scores tend to be widely used, multifunctional, and deeply embedded in household practices. As shown in Figure 2, the most frequently cited species include *M. esculenta*, *C. longa*, *A. hypogaea*, *Z. officinale*, and *Vigna unguiculata* (yardlong bean), indicating their central role in the community's food culture.

Manihot esculenta was the most frequently cited species (RFC = 0.95), valued for its edible tubers and leaves, drought resistance, and year-round availability. Other species with high RFC values included *C. longa* (turmeric, 0.45), *A. hypogaea* (peanut, 0.43), *Z. officinale* (ginger, 0.40), and *V. unguiculata* (yardlong bean, 0.38). These plants are cultivated in most home gardens and used in daily meals, often also fulfilling medicinal or ritual roles.

Moderate RFC values (0.10-0.29) were recorded for species such as *Solanum melongena* (eggplant) and *Ipomoea batatas* (sweet potato), commonly consumed but with more limited seasonal or contextual use. Species with low RFC values (<0.10), such as *Punica granatum* and *Citrullus lanatus*, were used more sporadically or for specific purposes. These variations highlight functional diversity and help identify priority species for food security and conservation.

Species dominance is shaped by a combination of ecological suitability, cultural preference, and practical utility. High-RFC species typically thrive in the shallow, well-drained soils of karst landscapes. Rhizomatous species like *C. longa* and ginger are suited to these conditions and widely valued for both cooking and traditional medicine. Similarly, *M. esculenta* is highly adaptable, easy to cultivate, and offers dual use of tubers and leaves.

Morphological traits also contribute to species dominance. Most frequently used plants are herbs and shrubs, favored for their compact growth, ease of management, and short growing cycles—advantages in land-limited, rocky karst settings. Climbing vegetables like *V. unguiculata* and *Psophocarpus tetragonolobus* (winged bean) are grown along fences or trellises, optimizing space and yielding nutritious harvests.

Multifunctionality further enhances species importance. Plants like *M. esculenta*, *Carica papaya* (papaya), and *Cocos nucifera* (coconut) serve various dietary, medicinal, and cultural purposes, increasing their value in everyday life and ensuring their continued cultivation. Such species often appear in multiple use categories—staples, vegetables, fruits, or spices—demonstrating their integrative roles in household food systems.

Overall, RFC values and species dominance patterns reveal a culturally grounded, ecologically adaptive food system. These species form the core of subsistence strategies in Gawang Hamlet, supporting food sovereignty and resilience in a fragile karst environment.

Parts of plants used

The edible plant species identified in this study are used in various forms depending on the part of the plant that is traditionally consumed. Understanding which parts are most frequently used provides insight into both culinary practices and the ecological roles of these plants in rural households. The analysis revealed that the most commonly used plant part was the fruit, followed by leaves, tubers, rhizomes, flowers, stems, and seeds.

As shown in Figure 3.A, fruits were the most frequently utilized plant parts, comprising approximately 32.6% of reported uses. This reflects their widespread availability, palatability, and ease of consumption with minimal processing. Leaves accounted for 23.6% and were commonly prepared as vegetables or herbal components in soups, stir-fries, and traditional side dishes. Tubers and rhizomes, such as those from *M. esculenta* and *C. longa*, contributed 15.7% and 18.0%, respectively, underscoring their importance in ensuring caloric intake and traditional culinary flavoring. Other plant parts such as seeds (10.1%), bulbs (4.5%), flowers (2.2%), stems (1.1%), and bark (1.1%) were also reported, indicating the diverse functional uses of edible plants in the community. This distribution highlights the adaptive strategies of local households in utilizing multiple plant parts to fulfill nutritional needs, optimize seasonal availability, and support food security under ecologically constrained conditions.

These findings highlight the multifunctional nature of local plant species and their importance in household nutrition and food variety. The relatively high proportion of leaf and flower use reflects the community's reliance on fresh, leafy greens and floral components as accessible and seasonal food sources. Meanwhile, rhizomes and tubers contribute to energy intake and are often preserved or processed for longer-term consumption. The pattern of plant part usage also aligns with regional culinary traditions in Java, where young leaves, tuberous roots, and aromatic rhizomes are key elements in daily diets and food culture (Walujo 2017; Cahyaningsih et al. 2022).

Growth forms of edible plants

The 65 edible plant species identified in this study represent a variety of morphological growth forms, reflecting the ecological adaptability and multifunctionality of species cultivated or harvested by the community. Classification by growth form helps to understand how space, seasonality, and plant architecture influence planting strategies in karst home gardens.

As illustrated in Figure 3.B, the majority of edible plants in Gawang Hamlet were categorized as herbs (31.8%) and shrubs (22.7%), followed by trees (21.2%), vines (9.1%), and tuberous plants (4.5%). Other growth forms included grasses (3.0%), climbers (3.0%), and palms (3.0%). This distribution indicates that small to medium-sized species with compact or trailing growth habits dominate home garden cultivation. Such forms are likely favored for their adaptability to spatially constrained karst environments, ease of propagation, and rapid yield cycles. The figure highlights the community's ecological strategies in organizing vertical and horizontal planting spaces, allowing for efficient resource use and resilience in shallow-soil landscapes typical of karst systems.

Shrubs and herbs, such as *Capsicum annuum*, *C. longa*, and *A. hypogaea* are especially valued for their compact form and high productivity within a short cultivation period. Tree species such as *Musa* spp. (banana) and *Artocarpus heterophyllus* (jackfruit) contribute fruits and shade, while grasses like *Zea mays* (corn) serve as staple crops.

The diversity of growth forms supports ecological resilience and spatial layering in traditional home gardens, a common feature of sustainable subsistence systems in Southeast Asia (Iskandar et al. 2018; Cahyaningsih et al. 2022). It also highlights the strategic use of vertical and horizontal planting space in karst environments where arable land is limited.

Utilization categories of edible plants

The edible plant species identified in Gawang Hamlet were classified into four major categories based on their primary use: vegetables, spices, fruits, and staple foods. This categorization reflects local dietary patterns and functional differentiation of plants in home gardens and surrounding environments.

Vegetables

Vegetables were the most dominant use category among edible plants in Gawang Hamlet, comprising 28 species from various families and plant parts. These include leafy greens, shoots, immature fruits, and edible flowers, which are commonly consumed boiled, sautéed, or fresh. Their prominence reflects the community's reliance on fast-growing, short-cycle species suited to limited space and poor soils in karst home gardens. Figure 4 shows the ten most frequently cited vegetable species, including *Vigna unguiculata*, *Amaranthus sp.*, and *Carica papaya* (young leaves), underscoring the dietary importance of leafy and fruiting plants.

Commonly cultivated vegetables included *S. melongena*, *V. unguiculata*, *P. tetragonolobus*, *Moringa oleifera* (drumstick tree), *Amaranthus* spp., and *C. papaya* (young leaves). These species are favored for nutritional value, adaptability, and rapid growth. Some, like *M. esculenta*, serve dual purposes—leaves as vegetables and tubers as staple foods.

Vegetables span diverse growth forms, mainly shrubs and herbs, enabling spatial layering and seasonal rotation. This enhances land-use efficiency in fragmented karst landscapes. Home garden vegetables also contribute essential micronutrients and dietary fiber, supporting household nutrition and resilience to food insecurity (Flyman and Afolayan 2006; Bvenura and Sivakumar 2017; Buenavista et al. 2022; Asfaw et al. 2023).

Spices

Spices hold an essential role in the culinary and medicinal traditions of Gawang Hamlet, contributing flavor, aroma, and therapeutic value to daily meals. The study identified 16 spice species—about 24.6% of all documented edible plants—sourced from rhizomes, bulbs, leaves, seeds, bark, and fruits. Most are cultivated in home gardens, while a few are collected from surrounding semi-wild areas.

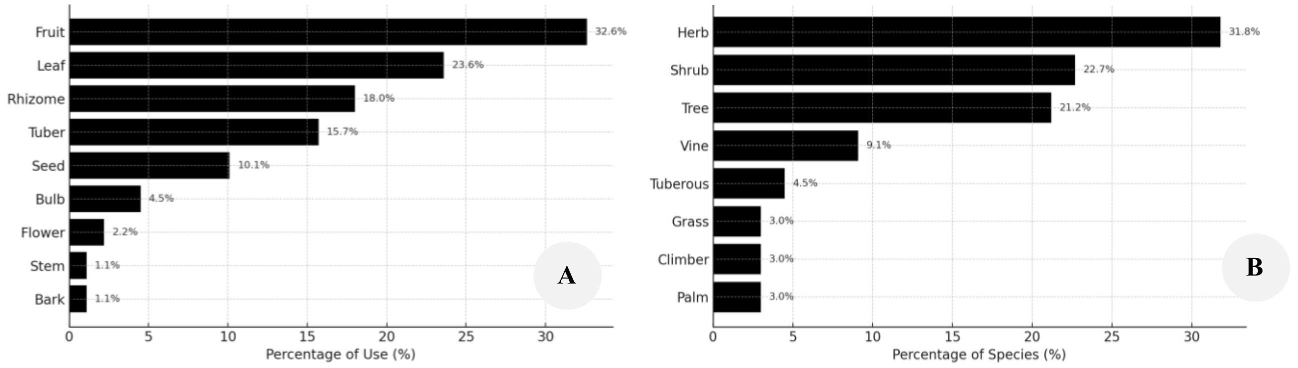

Figure 3. The proportion of A. Plant parts used and B. Growth form among edible species in Gawang Hamlet, Pacitan, Indonesia (N = 65 species)

Figure 5 highlights the most frequently cited species: *C. longa*, *Z. officinale*, and *Alpinia galanga* (galangal). These rhizomatous plants are not only staples in Javanese cuisine but also integral to traditional health practices, demonstrating the blending of culinary and medicinal knowledge in local households (Walujo 2017; Cahyaningsih et al. 2022). Other commonly mentioned spices include *Allium cepa* (shallot) and *Allium sativum* (garlic), each valued for multifunctionality. Rhizomes dominate this category, suited to shallow karst soils and capable of long storage, ensuring year-round access.

Beyond taste, spices often carry ritual and cultural meanings. Their sustained cultivation and use reflect how local communities integrate health, tradition, and daily sustenance through deeply embedded ethnobotanical systems.

Fruits

Fruit-bearing plants represent a significant part of the edible flora in Gawang Hamlet, with 16 species (24.6%) documented. Most fruits are consumed fresh, while others are processed into snacks, cooked dishes, or fermented products. Trees and shrubs are commonly planted along garden edges or within agroforestry systems, serving multiple functions—providing shade, fodder, and aiding soil conservation.

Figure 6 shows the most frequently cited fruit species, including *Musa* spp. (banana), *C. papaya*, *Psidium guajava* (guava), *A. heterophyllus*, *Citrus aurantiifolia* (lime), and *Averrhoa carambola* (starfruit). These are valued for their freshness, high vitamin content, and accessibility—especially important for household nutrition and children's diets. Many fruits are seasonal yet integrated into daily meals and traditional culinary practices. Some, like *Musa* spp. and *Citrus* spp., also carry medicinal and cultural significance, used in home remedies and rituals (Iskandar et al. 2018; Cahyaningsih et al. 2022). The strategic placement of fruit trees in outer garden zones reflects local ecological knowledge, optimizing space and ensuring year-round supply, while supporting both dietary diversity and environmental resilience.

Staple foods

Although rice is the dominant staple in Java, households in Gawang Hamlet also cultivate alternative staple crops suited to poor soils and low-input farming. This study identified five key staple species (7.6% of all edible plants): *M. esculenta*, *Dioscorea alata* (yam), *I. batatas*, *Z. mays*, and *Colocasia esculenta* (taro). These species provide essential carbohydrates and dietary energy, often consumed during rice shortages or economic stress.

Figure 7 highlights these rice alternatives, particularly *M. esculenta*, which was the most cited for its drought tolerance, reliable yield, and dual-use (tubers and leaves). Preparation methods include boiling, steaming, and frying. Their cultivation reflects community resilience in adapting to karst soil constraints where cereal crops are less viable. To further illustrate multifunctionality, Figure 8 (heatmap) presents edible species across four main categories—vegetables, spices, fruits, and staples—revealing overlaps in function.

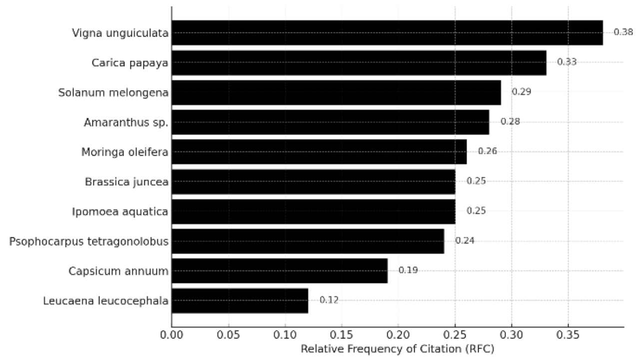

Figure 4. Top 10 vegetable species most frequently cited by informants in Gawang Hamlet, Pacitan, Indonesia (N = 60)

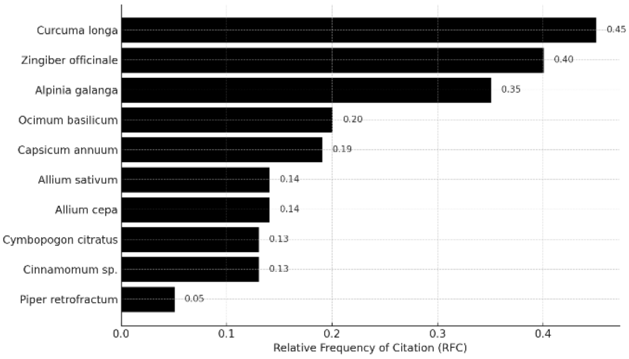

Figure 5. The most frequently cited spice species used in daily cooking in Gawang Hamlet, Pacitan, Indonesia (N = 60)

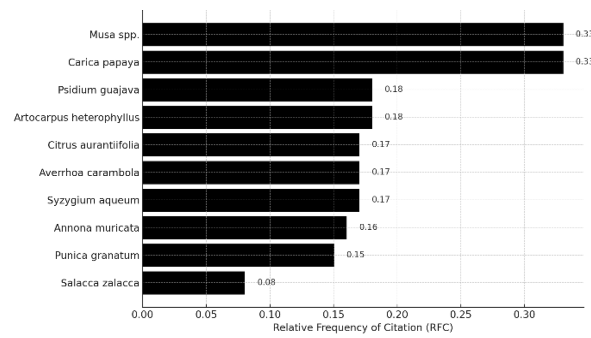

Figure 6. Most commonly consumed fruit species according to informant responses in Gawang Hamlet, Pacitan, Indonesia (N = 60)

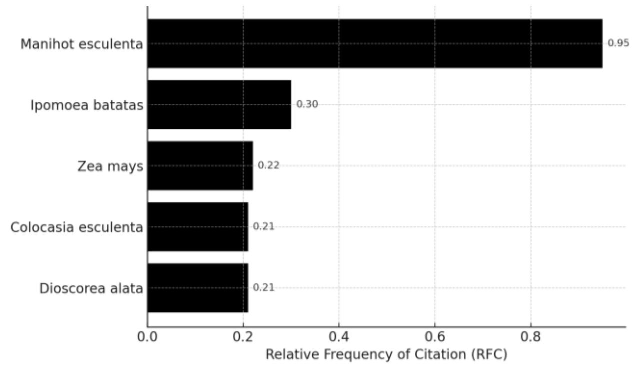

Figure 7. Staple food crops cultivated and consumed by the community of Gawang Hamlet, Pacitan, Indonesia (N=60)

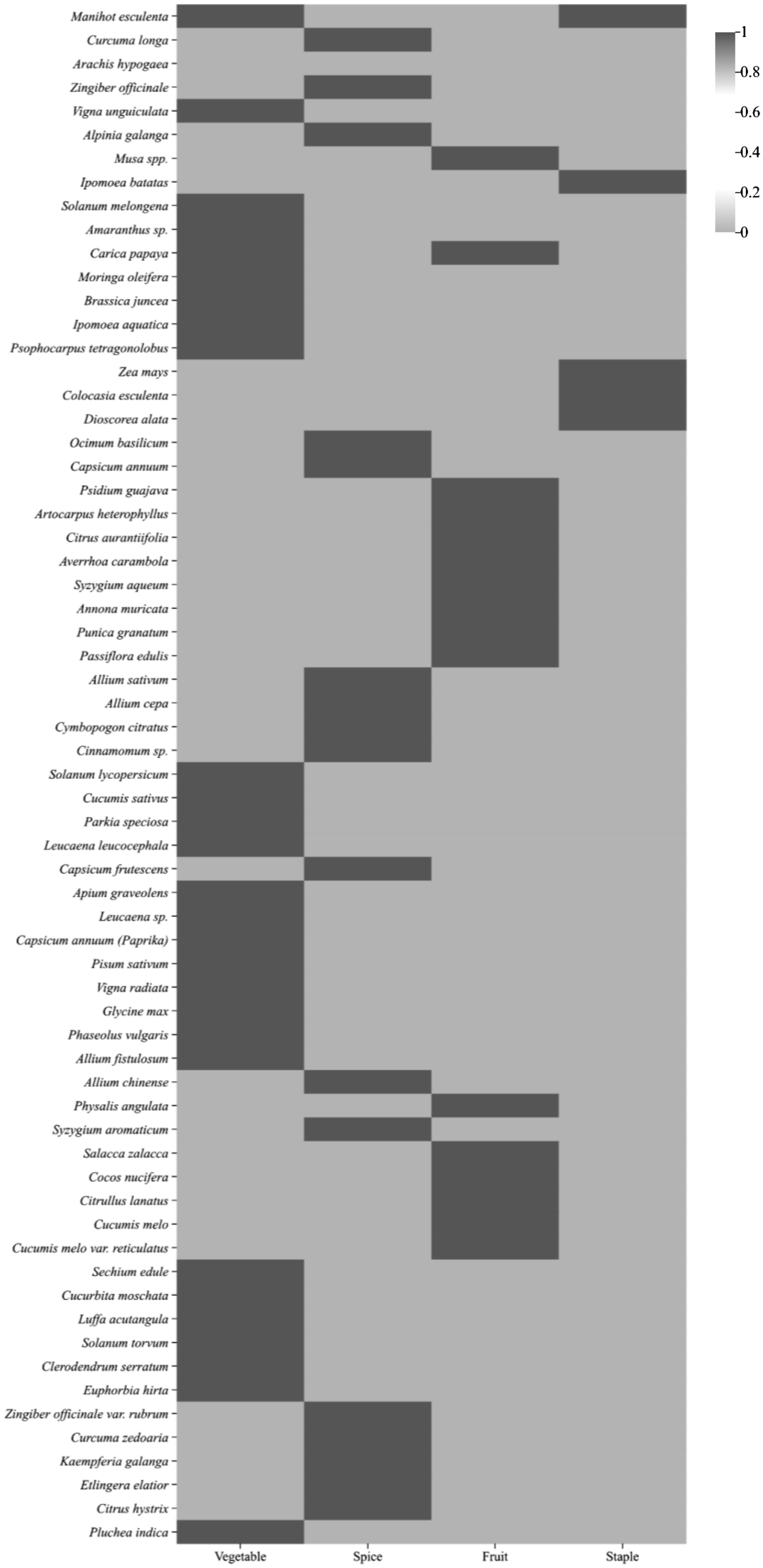

Figure 8. Heatmap showing multifunctional use of selected edible plant species across four primary categories: Vegetables, spices, fruits, and staples

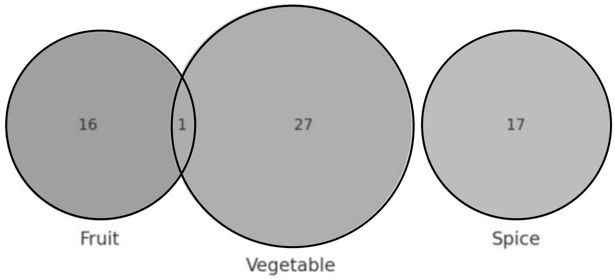

Figure 9. Venn diagram illustrating species with overlapping uses among vegetable, spice, fruit, and staple food categories

Figure 9 (Venn diagram) visually emphasizes species like *M. esculenta* and *C. papaya* that span multiple uses. These visualizations reinforce the importance of multifunctional plants in supporting both food diversity and local food security strategies in Gawang Hamlet.

Discussion

Diversity of edible plant species in karst environments

The findings of this study revealed a high diversity of edible plant species (65 species across 27 families) utilized by the rural community of Gawang Hamlet, a region characterized by karst landforms and marginal agricultural conditions. This diversity reflects a locally adapted food system, where both cultivated and semi-wild species contribute to household subsistence. The rich species assemblage supports the view that home gardens in karst environments function as reservoirs of agrobiodiversity and traditional ecological knowledge (Iskandar et al. 2018; Cahyaningsih et al. 2022).

Karst environments are characterized by shallow soils, irregular water availability, and rocky terrain that hinder conventional agriculture (Kuniansky et al. 2016). Nonetheless, the communities have adapted by cultivating drought-tolerant, fast-growing species suited to poor soils—such as *M. esculenta*, *C. longa*, and *M. oleifera*. The presence of multiple plant functional types (herbs, shrubs, trees, and tubers) supports spatial and seasonal diversification, which is a key element of traditional agroecological strategies (Ammar et al. 2021).

Comparative studies conducted in other karst or mountainous regions offer practical insights into traditional farming systems. In Gunung Kidul, another limestone-dominated area in Java, Sulistiyowati et al. (2022) documented 43 edible plant species maintained in home gardens, with legumes, tubers, and spices being the dominant crops. Similarly, in the karst landscapes of Guangxi, China, Luo et al. (2024) highlighted the reliance of ethnic communities on more than 195 food plant species, many of which are endemic and adapted to shallow-soil conditions. These patterns underscore the significance of traditional agricultural systems in karst zones and reflect the long-term coevolution between local communities and their environments, offering valuable perspectives for agricultural and environmental studies. Similar findings were reported by Silalahi et al. (2018) in Batak Toba homegardens, emphasizing the role of traditional agroecosystems as in situ conservation sites.

Socio-demographic factors and knowledge distribution

Socio-demographic characteristics such as gender, age, education, and occupation significantly influenced the distribution of ethnobotanical knowledge among the informants in Gawang Hamlet. The majority of informants in this study were women (70%), a pattern commonly observed in ethnobotanical research across Southeast Asia. This gender distribution aligns with the role of women as primary food preparers and caretakers of home gardens, placing them in direct contact with edible plants on a daily basis (Silalahi et al. 2018; Cao et al. 2020).

Elderly informants (aged over 55 years) constituted more than half of the sample. They consistently demonstrated a broader and deeper knowledge of edible plant diversity, including species that are seasonally used or have fallen out of general practice. This supports previous findings that traditional ecological knowledge is often concentrated in older generations, who have accumulated experiential knowledge over decades and serve as key knowledge holders within rural communities (Zhang et al. 2016; Walujo 2017). The trend is particularly concerning in areas where agricultural modernization or migration threatens the intergenerational transmission of such knowledge.

The educational level also appeared to influence the nature, but not necessarily the depth, of plant knowledge. Most informants had either no formal education or only completed primary school, yet they exhibited a strong understanding of plant taxonomy (based on vernacular classification), uses, and cultivation practices. This observation reinforces that traditional ecological knowledge is often gained through oral transmission and hands-on experience rather than through formal schooling (Cahyaningsih et al. 2022).

Occupationally, respondents working as farmers or housewives were found to cite more plant species than those engaged in off-farm or informal sector jobs. This indicates a strong relationship between daily proximity to land-based activities and the richness of ethnobotanical knowledge, as previously reported by Ammar et al. (2021) in other rural Javanese communities.

Another determinant was the length of residence: 90% of the informants had lived in the area for more than a decade, suggesting that long-term immersion in the landscape plays a vital role in shaping and sustaining knowledge of plant diversity. In contrast, newcomers or temporary residents often lacked familiarity with semi-wild species or seasonal harvesting patterns.

These findings highlight the importance of socio-demographic context in understanding the structure and transmission of plant-based knowledge. They also suggest that conservation strategies should not only target species and landscapes but also support knowledge holders—particularly women and the elderly—through participatory and inclusive approaches to agroecological development.

Plant parts used and cultural preferences

The study found that the most frequently utilized parts of edible plants in Gawang Hamlet were fruits (32.6%), leaves (23.6%), rhizomes (18.0%), and tubers (15.7%). This pattern indicates a plant-based dietary orientation shaped by accessibility, nutritional value, and culinary versatility. The strong preference for fruits and leaves aligns with Javanese culinary traditions, which emphasize the incorporation of fresh produce into daily meals—such as soups, stir-fried dishes, and raw vegetable assortments (*lalapan*) (Walujo 2017; Cahyaningsih et al. 2022). These plant parts are typically harvested seasonally or continuously from home gardens, reinforcing their central role in sustaining household diets under the environmental constraints of a karst landscape.

Leaves were widely consumed not only from herbaceous plants such as *Amaranthus* spp. and *M. oleifera*, but also from trees and tuberous species including *M. esculenta* and *C. papaya*. These leafy greens are typically rich in micronutrients and function as accessible, low-cost sources of essential vitamins and minerals. In ecologically constrained karst areas—where market access, soil fertility, and irrigation infrastructure are limited—the reliance on locally available foliage contributes significantly to household food security and nutritional adequacy (Pei et al. 2020). This pattern reflects a subsistence strategy grounded in ecological adaptation and traditional culinary practices.

The use of tubers and rhizomes—such as those from *M. esculenta*, *I. batatas*, *C. longa*, and *Z. officinale*—highlights the community's reliance on underground plant organs as key sources of both calories and flavoring agents. These parts are especially valued for their storability, resilience to seasonal fluctuations, and reliability under low-input cultivation systems. Their inclusion in household food planning is critical during periods of rice scarcity or income constraints. This pattern aligns with observations from other mountainous and ecologically marginal regions, where tuber crops frequently function as rice alternatives or dietary supplements (Ammar et al. 2021; Wahyudi et al. 2024). Rhizomes such as *C. longa*, *Z. officinale*, and *A. galanga* are also central to the local flavor profile and are deeply embedded in cultural and medicinal practices. These species are considered essential kitchen items, often propagated vegetatively and maintained in backyard gardens, reflecting both utilitarian and symbolic value in daily life (Iskandar et al. 2018).

The relatively lower citation of seeds and stems may reflect limited availability in home gardens or a cultural preference for fresher, more perishable plant parts such as leaves and fruits. Nonetheless, several seed-based food species—such as *A. hypogaea* and *Phaseolus vulgaris* (common bean)—remain valued for their protein content and nutritional contribution. Their inclusion in mixed-cropping systems within home gardens indicates a complementary yet sustained role in household food production, particularly as plant-based protein sources in predominantly carbohydrate-centered diets.

These patterns indicate that the use of specific plant parts is shaped not only by ecological availability but also by deeply ingrained culinary and cultural norms. The multifunctionality of certain species across multiple use categories (e.g., *M. esculenta* as a vegetable and staple) further underscores the integrative and adaptive knowledge embedded in traditional food systems.

Growth forms and spatial planting strategy

The growth form distribution of edible plants in Gawang Hamlet—dominated by herbs (31.8%), shrubs (22.7%), trees (21.2%), and vines (9.1%), with additional representation from tuberous species (4.5%), grasses (3.0%), climbers (3.0%), and palms (3.0%)—reflects a strategic adaptation to the physical constraints of karst terrain. The predominance of low-lying, fast-growing, and spatially manageable plant types corresponds with the environmental characteristics of limestone landscapes, including thin soil layers, limited arable land, and high rock exposure (Kuniansky et al. 2016). Such growth forms facilitate efficient use of both vertical and horizontal space in home gardens, enabling households to maintain productivity despite ecological limitations.

Shrubs and herbs such as *C. annuum*, *P. tetragonolobus*, and *C. longa* are particularly well-suited to karst soils due to their shallow rooting systems and rapid growth cycles. These species are typically planted near the kitchen or in garden borders, making them easily accessible for daily harvest. The integration of these plants into the microzones of the home garden reflects the community's nuanced understanding of spatial resource optimization.

Tree species, though less dominant, play multifunctional roles. Species such as *Musa* spp. and *A. heterophyllus* are planted at the periphery of home gardens or in field boundaries, where they provide shade, windbreaks, and seasonal fruit. Their placement maximizes the use of vertical space and supports agroforestry layering that mimics natural forest structure (Iskandar et al. 2018).

The inclusion of grasses such as *Z. mays* and lianas like *Passiflora edulis* further enhances the structural diversity of home gardens and supports a multi-tiered planting strategy. Vining vegetables, notably *V. unguiculata*, are commonly trained along fences or simple trellises, allowing households to optimize vertical growing space and sunlight exposure while minimizing competition for limited soil nutrients. This spatial arrangement reflects a practical response to land constraints in karst environments and exemplifies the community's adaptive approach to maximizing productivity within compact garden systems.

This spatial organization is not random but rooted in a long-standing practice of optimizing land function, yield diversity and labor efficiency. Similar strategies have been reported in Batak and Minangkabau home gardens, where vertical layering and multifunctional species selection enhance productivity in small areas (Silalahi et al. 2018). The dominance of shrubs and herbs in Gawang Hamlet is a deliberate agroecological choice that accommodates local topography, household needs, and knowledge transmission. These growth forms reflect not only ecological constraints but also a refined, spatially intelligent cultivation system embedded in the local culture, a tradition that deserves our utmost respect.

Cultural importance based on RFC analysis

The Relative Frequency of Citation (RFC) analysis revealed that several species hold central positions in the food system of Gawang Hamlet due to their high frequency of mention and multifunctional uses. *M. esculenta*, with an RFC value of 0.95, emerged as the most culturally important species. Its prominence is rooted not only in its role as a carbohydrate source but also in its flexibility: the tuber is a staple food, while the leaves are regularly consumed as vegetables. This dual utility enhances its perceived and actual value in household food security, particularly in environmentally marginal areas such as karst lands.

Other highly cited species include *C. longa*, *A. hypogaea, Z. officinale*, and *V. unguiculata*. These plants serve multiple roles—as food, spice, traditional medicine, and cultural symbols. *C. longa* and ginger are not only key flavoring agents but also integral to health rituals and postpartum care, as noted in Javanese and broader Southeast Asian ethnomedicine (Walujo 2017; Cahyaningsih et al. 2022).

High RFC values indicate more than the frequency of use; they reflect collective memory, intergenerational transmission, and symbolic familiarity. Plants with high RFCs are often embedded in oral knowledge, rituals, and seasonal practices, forming part of the community's cultural identity. These findings are consistent with studies by Tardío and Pardo-de-Santayana (2008), which emphasize that RFC can serve as a proxy for cultural salience beyond purely utilitarian value.

Another critical factor influencing species prominence in Gawang Hamlet is their multifunctionality. Plants that fulfill multiple roles—such as *M. esculenta*, utilized both as a staple and a leafy vegetable; *Musa* spp. (banana), valued as both a fruit and a ritual offering; and *C. nucifera* (coconut), used for food, oil extraction, and ceremonial purposes—tend to hold more central positions within local agroecosystems and cultural practices. This multifunctionality not only enhances their practical value but also strengthens their cultural salience, ensuring continued cultivation and transmission of knowledge across generations (Silalahi et al. 2018).

Moreover, species with high Relative Frequency of Citation (RFC) values often serve as vital linkages between ecological resilience and cultural continuity. Their proven adaptability to the challenging conditions of karst soils—alongside their enduring roles in local diets, rituals, and daily practices—positions them as focal species within both subsistence systems and cultural identity. Recognizing these taxa as culturally keystone species provides a conceptual framework for integrated conservation strategies that honor the interdependence of biological diversity and cultural heritage. Such an approach may enhance the effectiveness and local relevance of biodiversity conservation and rural development initiatives.

Implications for food security and conservation

The ethnobotanical knowledge and plant diversity documented in Gawang Hamlet offer critical insights into how rural communities in ecologically fragile karst landscapes secure their food needs. The reliance on 65 edible plant species—including vegetables, spices, fruits, and staples—demonstrates a diversified subsistence strategy that buffers households against food shortages, climate variability, and market dependency. This biodiversity-centered approach plays a crucial role in sustaining daily nutrition, culinary diversity, and cultural heritage.

From a food security perspective, species such as *M. esculenta*, *I. batatas*, and *Z. mays* serve as important carbohydrate sources beyond rice, providing dietary flexibility during periods of scarcity. The consistent use of leafy vegetables like *M. oleifera*, *Amaranthus* spp., and papaya leaves contributes to micronutrient sufficiency, particularly among lower-income households. These plants are typically cultivated in home gardens or nearby fields, ensuring both accessibility and affordability.

The spatial arrangement and selection of growth forms—shrubs, herbs, and trees—further enhance resilience by enabling year-round harvests and diversified yields. This agroecological configuration, supported by traditional knowledge, reflects a low-input, high-efficiency system that can be sustained without chemical fertilizers or irrigation—an essential trait in karst zones characterized by limited water and shallow soils (Kuniansky et al. 2016).

In terms of conservation, the cultivation and continued use of locally adapted plant species represent in situ conservation practices that preserve both genetic and cultural diversity. Home gardens function as living repositories for landraces, semi-domesticated species, and neglected crops, many of which are absent from formal conservation systems. This finding supports arguments for integrating traditional farming systems into broader biodiversity management and rural development strategies (Iskandar et al. 2018).

Furthermore, knowledge holders—particularly women and elderly community members—play a central role in sustaining this agro-biodiversity. Protecting their roles, voices, and access to land and resources is, therefore, fundamental to both food sovereignty and long-term conservation. Development interventions aimed at improving rural livelihoods or food systems should recognize and build upon this embedded ecological knowledge base.

The multifunctionality of key edible plant species was further demonstrated through visual analysis. As illustrated in the heatmap (Figure 8), several species—most notably *M. esculenta* and *C. papaya*—were utilized across multiple food categories, such as vegetables, staples, and fruits. This overlap emphasizes their high functional value within the local food system. The Venn diagram (Figure 9) reinforces this observation by clearly delineating species shared among the vegetable, fruit, and spice categories. Although most species are specific to a single use group, multifunctional species like *M. esculenta* and *C. papaya* occupy intersections, reflecting their integrative role in household food strategies. These multifunctional taxa not only enhance dietary diversity but also contribute to resilience in karst environments, where agricultural land is limited and ecological conditions are challenging.

This study documented 65 edible plant species in the karst landscape of Gawang Hamlet, Pacitan, Indonesia, reflecting a diverse and culturally embedded food system. Key species such as *M. esculenta*, *C. longa*, and *M. oleifera* had high RFC values, indicating their nutritional, culinary, and symbolic importance. Shrubs and herbs dominated, with multifunctional uses and strategic home garden organization adapted to karst conditions. Socio-demographic factors—especially gender and age—influence knowledge transmission, with women and elders serving as key custodians. The findings underscore the role of traditional agroecosystems in food security and in situ conservation. Supporting local knowledge and community practices is vital for sustaining agrobiodiversity in rural marginal areas.

REFERENCES

Ammar LA, Kurniawati B, Anggorowati D, Cahyaningsih AP, Setyawan AD. 2021. Ethnobotanical study of the medicinal plant by local communities in karst area of Pacitan District, East Java, Indonesia. Intl J Trop Drylands 5 (2): 84-93. DOI: 10.13057/tropdrylands/t050205.

Asfaw A, Luleka E, Bekele T, Debella A, Tessema S, Meresa A, Debebe E. 2023. Ethnobotanical study of wild edible plants and implications for food security. Trees For People 14: 100453. DOI: 10.1016/j.tfp.2023.100453.

Backer CA, Bakhuizen van den Brink RC. 1963-1968. Flora of Java (Spermatophytes only). Vol. I–III. N.V.P. Noordhoff, Groningen.

Bano A, Ahmad M, Hadda TB, Saboor A, Sultana S, Zafar M, Khan MPZ, Arshad M, Ashraf MA. 2014. Quantitative ethnomedicinal study of plants used in the skardu valley at high altitude of Karakoram-Himalayan range, Pakistan. J Ethnobiol Ethnomed 10: 43. DOI: 10.1186/1746-4269-10-43.

Buenavista DP, Molle EM, McDonald M. 2022. Any alternatives to rice? Ethnobotanical insights into the dietary use of edible plants by the Higaonon tribe in Bukidnon Province, the Philippines. Reg Sustain 3 (2): 95-109. DOI: 10.1016/j.regsus.2022.04.002.

Bvenura C, Sivakumar D. 2017. The role of wild fruits and vegetables in delivering a balanced and healthy diet. Food Res Intl 99: 15-30. DOI: 10.1016/j.foodres.2017.06.046.

Cahyaningsih AP, Arifiani KN, Aprilia DN, Setyawan AD. 2022. Ethnobotanical study of the non-medicinal plant by village communities in the karst area of Pacitan, East Java, Indonesia. Intl J Trop Drylands 6 (1): 1-10. DOI: 10.13057/tropdrylands/t06101.

Cao Y, Li R, Zhou S, Song L, Quan R, Hu H. 2020. Ethnobotanical study on wild edible plants used by three trans-boundary ethnic groups in Jiangcheng County, Pu'er, Southwest China. J Ethnobiol Ethnomed 16: 66. DOI: 10.1186/s13002-020-00420-1.

Darmastuti SA, Nazar IA, Setyawan AD. 2024. Plant diversity and its use in Javanese urban home garden: An ethnobotanical study in Central Java, Indonesia. Asian J Ethnobiol 7 (1): 32-42.DOI: 10.13057/asianjethnobiol/y070104.

Etikan I, Musa SA, Alkassim RS. 2016. Comparison of convenience sampling and purposive sampling. Am J Theor Appl Stat 5 (1): 1-4. DOI: 10.11648/j.ajtas.20160501.11

Flyman MV, Afolayan AJ. 2006. The suitability of wild vegetables for alleviating human dietary deficiencies. S Afr J Bot 72 (4): 492-497. DOI: 10.1016/j.sajb.2006.02.003.

Hurlock EB. 2006. Psikologi Perkembangan Suatu Pendekatan Sepanjang Rentang Kehidupan. Erlangga, Jakarta. [Indonesian]

Iskandar BS, Johan I, Budi I, Ruhyat P. 2018. Traditional markets and diversity of edible plant trading: Case study in Ujung Berung, Bandung, West Java, Indonesia. Biodiversitas 19 (2): 437-452. DOI: 10.13057/biodiv/d190211.

Jauhari A. 2020. Pemanfaatan SIG untuk pemetaan kawasan produksi komoditas unggulan tanaman pangan di Kabupaten Pacitan. J Reg Rural Dev Plan (Jurnal Perencanaan Pembangunan Wilayah dan Perdesaan) 4 (3): 154-171. DOI: 10.29244/jp2wd.2020.4.3.154-171. [Indonesian]

Kuniansky EL, Weary DJ, Kaufmann JE. 2016. The current status of mapping karst areas and availability of public sinkhole-risk resources in karst terrains of the United States. Hydrogeol J 24 (3): 613-624. DOI: 10.1007/s10040-015-1333-3.

Luo B, Tong Y, Liu Y, Zhang Y, Qin Y, Hu R. 2024. Ethnobotanical insights into the traditional food plants of the Baiku Yao community: a study of cultural significance, utilization, and conservation. J Ethnobiol Ethnomed 20 (1): 52. DOI: 10.1186/s13002-024-00691-y.

Pei S, Alan H, Wang Y. 2020. Vital roles for ethnobotany in conservation and sustainable development. Plant Divers 42 (6): 399-400. DOI: 10.1016/j.pld.2020.12.001.

Roscoe JY. 1975. Fundamental Research Statistic for The Behavioural Science. Holt Rinehart and Wington, New York.

Setiawan H, Qiptiyah M. 2014. Kajian etnobotani masyarakat adat suku Moronene di Taman Nasional Rawa Aopa Watumohai. Jurnal Penelitian Kehutanan Wallacea 3 (2): 107-117. DOI: 10.18330/jwallacea.2014.vol3iss2pp107-117. [Indonesian]

Silalahi M, Nisyawati N, Anggraeni R. 2018. Studi etnobotani tumbuhan pangan yang tidak dibudidayakan oleh masyarakat lokal Sub-etnis Batak Toba, di Desa Peadungdung Sumatera Utara, Indonesia. Jurnal Pengelolaan Sumberdaya Alam dan Lingkungan 8 (2): 241-250. DOI: 10.29244/jpsl.8.2.264-270. [Indonesian]

Sudarmadji, Haryono E, Adji TN, Widyastuti M, Harini R, Nurjani E, Cahyadi A, Nugraha H. 2013. Ekologi Lingkungan Karst Indonesia: Menjaga Asa Kelestarian Kawasan Karst Indonesia. Deepublish, Yogyakarta. [Indonesian]

Sulistiyowati E, Setiadi S, Haryono E. 2022. Food traditions and biodiversity conservation of the Javanese Community in Gunungkidul Karst, Yogyakarta Province, Indonesia. Biodiversitas 23 (4): 2080-2092. DOI: 10.13057/biodiv/d230443.

Suryani S, Nurjasmi R, Fitri R. 2020. Pemanfaatan lahan sempit perkotaan untuk kemandirian pangan keluarga. Jurnal Ilmiah Respati 11 (2): 93-102. DOI: 10.52643/jir.v11i2.1102. [Indonesian]

Tabachnick BG, Fidel LS. 1996. Using Multivariate Statistics, Third Edition. Harper Collins College Publisher, New York.

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: A comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econ Bot 62: 24-39. DOI: 10.1007/s12231-007-9004-5.

Wahyudi, Djitmau DA, Dwiranti F, Sagrim M, Manuhua D. 2024. Roles of local food and knowledge of indigenous communities during pandemic COVID-19 at three districts across West Papua Province, Indonesia. Asian J Ethnobiol 7 (1): 1-12. DOI: 10.13057/asianjethnobiol/y070101.

Walujo EB. 2017. Sumbangan ilmu etnobotani dalam memfasilitasi hubungan manusia dengan tumbuhan dan lingkungannya. Jurnal Biologi Indonesia 7 (2): 61-69. [Indonesian]

Widiyanti W, Dittmann A. 2014. Climate change and water scarcity adaptation Strategies in the area of Pacitan, Java Indonesia. Procedia Environ Sci 20: 693-702. DOI: 10.1016/j.proenv.2014.03.083.

Zhang L, Chai Z, Zhang Y, Geng Y, Wang Y. 2016. Ethnobotanical study of traditional edible plants used by the Naxi people during droughts. J Ethnobiol Ethnomed 12: 39. DOI: 10.1186/s13002-016-0113-z.