Diversity and ethnobotany of useful plants in Bandar Pusaka, Aceh Tamiang District, Indonesia

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Research

Abstract

Background: Plants, both wild and cultivated, contribute significantly to global food security and have a considerable impact on human health and well-being by delivering various ecosystem services. However, modernization and urbanization keep altering human lifestyles, resulting in an erosion of traditional knowledge concerning the use of plants for various purposes. This study aimed to investigate the diversity of useful plant species and their utilization by local people in Bandar Pusaka, Aceh Tamiang District, Indonesia.

Methods: The ethnobotanical study was carried out in ten villages, in the Bandar Pusaka subdistrict, i.e. Pengidam, Bengkelang, Batu Bedulang, Babo, Perupuk, Serba, Pantai Cempa, Rantau Bintang, Aras Sembilan, and Blang Kandis villages. The ethnobotanical survey was carried out from July to August 2023 and included 306 randomly selected informants. The ethnobotanical investigation uses semi-structured questionnaires to gather information on the traditional knowledge of useful plants. Plant specimens were collected and identified in Universitas Samudra.

Results: A total of 2,088 individual plants representing 276 species and 81 families were recorded in the study areas. In terms of frequency of citation, 121 taxa were cited by 75% or more of the interviewed people, and 9 taxa were very rarely cited. *Musa x paradisiaca* L., *Mangifera indica* L., *Cocos nucifera* L., *Durio zibethinus* L., *Garcinia mangostana* L., *Curcuma longa* L., *Kaempferia galanga* L., *Zingiber officinale* Roscoe, *Annona muricata* L., and *Ananas comosus* (L.) Merr. are the ten most cited useful plants in the study area. A total of 14 use categories delivered by plants were most commonly for medicine (111 species), ornament (100), food (96), fodder (30), ritual (14), beverages (13), building materials (11), fuelwood (9), agricultural

tools, fencing, and herbicide (6 each), handicraft (4), and shade plant (2). Indigenous knowledge of useful plants was significantly associated with villages, age groups, and educational levels.

Conclusions: Bandar Pusaka sub-district has a diverse range of useful plants, but only a small proportion has been used by local people, particularly wild plants. Promotion and domestication of useful plants should be a primary concern in the Bandar Pusaka sub-district to take advantage of their nutritional value and potential economic value. Moreover, enhancing local peoples' abilities and expertise in recognizing, gathering, and preparing various useful plants is critical, since, in addition to promoting their household income, it may contribute to sustaining biodiversity and traditional knowledge.

Keywords: Biodiversity; ecosystem services; indigenous knowledge; Aceh Tamiang

Abstrak

Latar Belakang: Tumbuhan, baik liar maupun budidaya, memberikan kontribusi signifikan terhadap ketahanan pangan global dan mempunyai dampak besar terhadap kesehatan dan kesejahteraan manusia melalui penyediaan berbagai jasa ekosistem. Meskipun demikian, modernisasi dan urbanisasi telah mengubah gaya hidup manusia yang mengakibatkan terkikisnya pengetahuan tradisional terkait pemanfaatan tumbuhan untuk berbagai keperluan. Penelitian ini bertujuan untuk mengetahui keanekaragaman jenis tumbuhan berguna dan pemanfaatannya oleh masyarakat lokal di Bandar Pusaka, Kabupaten Aceh Tamiang, Indonesia.

Metode: Kajian etnobotani dilakukan pada sepuluh desa di kecamatan Banar Pusaka, meliputi Desa Pengidam, Bengkelang, Batu Bedulang, Babo, Perupuk, Serba, Pantai Cempa, Rantau Bintang, Aras Sembilan, dan Blang Kandis. Survei etnobotani dilakukan pada Juli hingga Agustus 2023 dan melibatkan 306 responden yang dipilih secara acak. Investigasi etnobotani menggunakan kuesioner semi-terstruktur untuk mengumpulkan informasi tentang pengetahuan tradisional tentang tumbuhan berguna. Spesimen tumbuhan dikumpulkan dan diidentifikasi di Universitas Samudra.

Hasil: Sebanyak 2.088 individu tumbuhan yang mewakili 276 jenis dan 81 suku tumbuhan telad ditemukan di lokasi penelitian. Berkaitan dengan frekuensi kutipan, 121 taksa telah dikutip oleh 75% atau lebih dari orang yang diwawancarai, dan 9 taksa sangat jarang dikutip. *Musa x paradisiaca* L., *Mangifera indica* L., *Cocos nucifera* L., *Durio zibethinus* L., *Garcinia mangostana* L., *Curcuma longa* L., *Kaempferia galanga* L., *Zingiber officinale* Roscoe, *Annona muricata* L., dan *Ananas comosus* (L .) Merr. merupakan sepuluh tumbuhan berguna yang paling banyak dikutip di lokasi studi. Sebanyak 14 kategori kegunaan tumbuhan telah diiidentifikasi dengan kategori yang paling banyak untuk obat (111 spesies), diikuti dengan tanaman hias (100), makanan (96), pakan ternak (30), ritual (14), minuman (13), bahan bangunan (11), kayu bakar (9), alat pertanian, pagar, dan herbisida (masing-masing 6), kerajinan tangan (4), dan tanaman peneduh (2). Pengetahuan masyarakat lokal mengenai tanaman bermanfaat secara signifikan berhubungan dengan desa, kelompok umur, dan tingkat pendidikan.

Kesimpulan: Kecamatan Bandar Pusaka memiliki beragam jenis tumbuhan bermanfaat, namun hanya sebagian kecil yang dimanfaatkan oleh masyarakat setempat, khususnya untuk tumbuhan liar. Promosi dan domestikasi tumbuhan berguna harus menjadi perhatian utama di Kecamatan Bandar Pusaka agar dapat memanfaatkan nilai gizi dan potensi nilai ekonominya. Selain itu, meningkatkan kemampuan dan keterampilan masyarakat lokal dalam mengenali, mengumpulkan, dan menyiapkan berbagai jenis tumbuhan berguna sangatlah penting, karena selain meningkatkan pendapatan rumah tangga, aktivitas ini juga dapat berkontribusi terhadap pelestarian keanekaragaman hayati dan pengetahuan tradisional.

Kata kunci: Biodiversitas; jasa lingkungan; pengetahuan asli; Aceh Tamiang

Background

Humans have long interacted with nature, relying on a variety of plant resources to meet their daily needs. Approximately 7,000 plant species are cultivated or collected for food or medicinal purposes from natural vegetation (Ghane *et al*. 2010). Regardless, only less than 30 species are intensively cultivated, accounting for more than 90% of global food production (Misra *et al*. 2008). On the other hand, as the global population grows, consequently increases the food demand, exposing the vulnerable to food availability and accessibility (Denny *et al*. 2017; Grimaccia & Naccarato 2019; Pakravan-Charvadeh *et al*. 2021). In addition, persistent poverty, unequal resource distribution, conflict, climate change, and natural disasters all contribute to global food insecurity (Khakpour *et al*. 2021; Pakravan-Charvadeh *et al*. 2021). Approximately 900 million people worldwide are undernourished, indicating that they lack sufficient calories (FAO 2012). Inadequate access to nutritious and affordable foods harms both physical health and social and economic development and leads to malnutrition,

which can affect the immune system, slow physical and cognitive development, and increase disease and infection risk (Dipasquale *et al*. 2020). In addition to the direct health consequences, inadequate food security also affects mental health, productivity, and economic stability (Ae-Ngibise *et al*. 2021).

Plants, both wild and cultivated, contribute significantly to global food security and have a considerable impact on human health and well-being. Wild plants contribute to ensuring food security by providing a rich source of genetic diversity (Salgotra & Chauhan 2023), which is necessary for generating crop varieties that are more resilient to pests, diseases, and changing environmental circumstances. They contribute to the development of pharmaceuticals and traditional medicines (Navia *et al*. 2021; Suwardi *et al*. 2021), which offer potential remedies for various diseases. Wild plants also provide opportunities for recreation, outdoor activities, and nature-based therapies, promoting both mental and physical well-being (Coventry *et al*. 2021). Despite the fact that wild plants provide significant benefits for local communities in terms of sustainable livelihoods, many of them are underutilized (Suwardi *et al*. 2022). Cultivated plants, on the other hand, are an important source of nutrition and sustenance for human populations (El-Ramady *et al*. 2022; Ramaidani & Navia 2022; Suwardi & Navia 2023), solving food security challenges. They are the core of agricultural systems, supplying a consistent and abundant supply of nutritious food, fiber, fuel, and other essential resources. Moreover, both wild and cultivated plants improve the aesthetic value of landscapes, contribute to cultural heritage, and foster a sense of connection with nature (Tribot *et al*. 2018).

Biodiversity loss is a significant threat in terms of providing a source of high-quality genetic material to improve various crop varieties ensuring food security. Biodiversity loss disturbs the delicate web of ecological interactions (Sandor *et al*. 2022), resulting in the extinction of important plant species that contribute to a diverse and resilient food system. Modernization and urbanization, on the other hand, keep altering human lifestyles, resulting in an erosion of traditional knowledge concerning the use of plants for various purposes (Navia *et al*. 2021; Sujarwo *et al*. 2014). Traditional knowledge, which is deeply rooted in indigenous and local communities, has vital insights regarding sustainable agriculture practices, crop diversification, and natural resource management (Singh & Sureja 2008). Traditional knowledge erosion, combined with biodiversity loss, contributes to insufficient food production, limited dietary diversity, malnutrition, and increased vulnerability to health disorders. Understanding and valuing the diverse contributions of useful plants is essential for sustainable land management, resilient and secure food systems, promoting human well-being, conservation activities, and overall ecosystem and human society resilience. Bandar Pusaka District is one of the regions that borders the Leuser Ecosystem area and has a high biodiversity. This condition has an impact on local people's practices of using both wild and cultivated plants as a source of food and medication in their daily lives. However, until today, this community knowledge has not been researched. This study aimed, therefore, to investigate the diversity of useful plant species and their utilization by local people in the Bandar Pusaka, Aceh Tamiang District, Indonesia.

Materials and Methods

Study area

This study was conducted in ten villages in the Bandar Pusaka sub-district (04°02’36,00”- 04°20’43,00” N, 97°43’51,00” - 98°00’53,00’’ E, 50 – 700 m a.s.l.), Aceh Tamiang, Indonesia, including Pengidam, Bengkelang, Batu Bedulang, Babo, Perupuk, Serba, Pantai Cempa, Rantau Bintang, Aras Sembilan, and Blang Kandis villages (Figure 1). These areas have a tropical humid climate with a dry season that lasts from January to July and a rainy season that lasts from August to December. The average annual rainfall is 179 mm, with an average of 18 rainy days. The average temperature is around 20.1℃, with an average humidity of 80%. The topography is generally mountainous and hilly, and the area is characterized by a cropping system dominated by rice and vegetables (BPS Aceh Tamiang Regency 2022). This study focused on the Gayo People in the Bandar Pusaka sub-district. The livelihood of the Gayo people is mostly gardening and raising animals.

Ethnobotanical survey

The ethnobotanical survey was carried out from July to August 2023. The sample size was calculated using the Cochran sample size formula (Bartlett *et al*. 2001):

$$n = \frac{N}{1 + N\,(e)^2}$$

Where, n = sample size; N = total number of ≥ 15-year-olds across all villages; e = maximum variability or margin of error 5 % (0.05); 1 = the probability of an event occurring.

$$n = \frac{668}{1 + 7668\,(0.05)^2} = 306$$

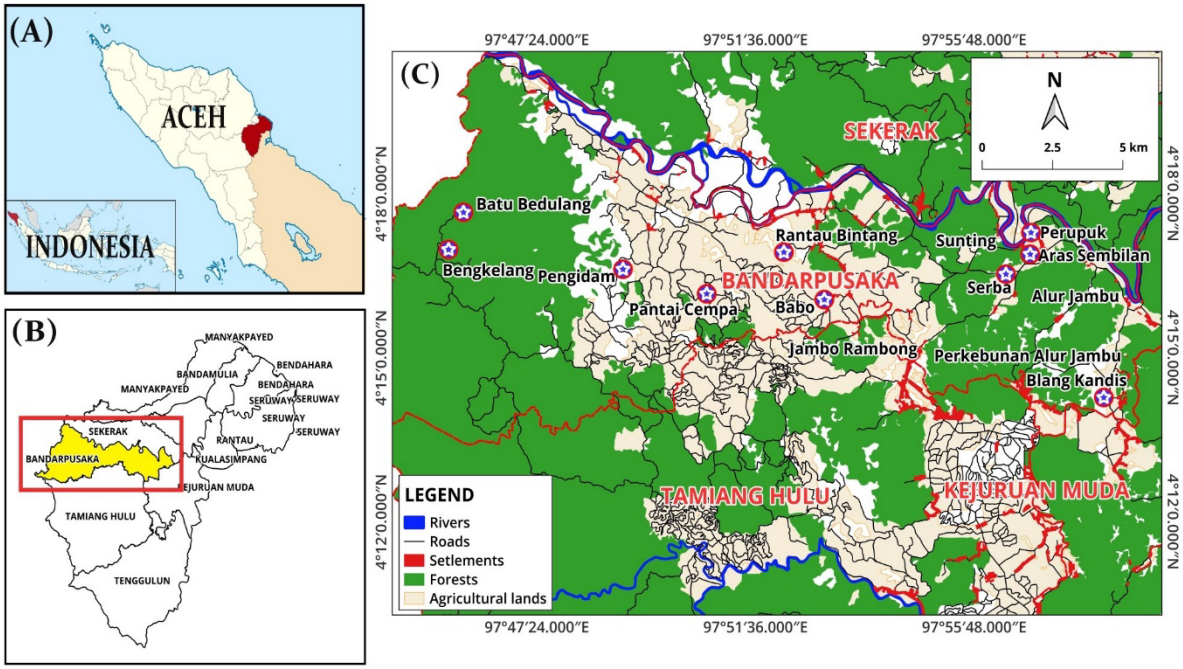

Figure 1. Shows the site of the studied area. (A) The map shows the location of Aceh province; (B) The map shows the location of the Aceh Tamiang District; (C) The map highlights the Bandar Pusaka sub-district and (✪) the site of the study

A total of 306 interviewees (129 men and 177 women) were selected from the district using a random sampling method. The ages of the informants ranged from 15 to 68 (Table 1). The ethnobotanical study employs semi-structured questionnaires to collect information on the traditional knowledge of useful plant species, such as their local names, use, plant parts used, method of preparation and consumption, and transfer knowledge. Prior to conducting interviews, the aims of the study were communicated to informants, and their agreement was obtained. Plant samples were gathered as part of the survey. The voucher specimens were identified in the Biology laboratory at Universitas Samudra, Aceh, Indonesia. Plants of the World Online (https://powo.science.kew.org/) was used to update the botanical name.

Data analysis

The data were analyzed using descriptive statistics, relative frequency citation, and preference ranking. Ethnobotanical data were organized using Microsoft Excel spreadsheets.

Relative Frequency Citation (RFC)

The ethnobotanical data was assessed using a relative frequency citation (RFC) index (Vitalini *et al*. 2013):

$$RFC = FC/N \ (0 < RFC < 1)$$

RFC represents the local relevance of each species and is derived by dividing the frequency of citation (FC) by the total number of informants participating in the study (N), without considering use categories.

Use Value (UV)

The use-value (UV) represents the relative importance of each plant species used by the informants in the research range. The recommended formula for calculating the use-value was used (Tardio & Pardo-de-Santayana 2008):

$$UV = \sum \frac{U_i}{N}$$

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) was calculated to assess the importance of each use category as well as the consistency of information among the study's sampled informants following Cornara *et al*. (2014).

$$ICF = \frac{Nur - Ns}{Nur - 1}$$

Jaccard Similarity Index

To assess the similarities in plant species between the study areas, the Jaccard Similarity Index was employed following Jaccard (1908):

$$JI = Sc/Sx + Sy$$

where:

Sx = the number of WEF species known from site X

Sy = the number of WEF species known from site Y

Sc = the number of WEF species common to both sites

The Chi-square tests were used to compare indigenous knowledge and gender groups, and Kruskal-Wallis tests were used to compare indigenous knowledge and villages, age, and education level. IBM-SPSS ver. 21 software was used for the statistical analysis.

Table 1. Socio-demographics of informants

Variable	Village									
	PG	BG	BB	BO	PC	PR	SB	RB	AS	BK
Gender										
Men	11	9	11	31	18	8	6	11	3	21
Women	16	12	10	48	17	9	11	18	6	30
Age										
15-24	4	3	4	12	6	2	3	4	1	8
25-34	5	4	4	16	4	3	3	6	2	11
35-44	6	4	5	18	5	4	4	5	2	9
45-54	5	3	5	14	8	5	4	6	2	14
55-64	5	5	2	12	9	2	2	5	1	6
65-74	2	2	1	7	3	1	1	3	1	3
Education										
No education	3	2	3	8	7	2	3	8	2	11
Elementary school	4	9	6	21	7	5	6	6	2	12
Junior High School	9	5	7	22	8	4	4	8	3	17
Senior High School	9	3	4	23	11	5	3	6	1	10
Higher Education	2	2	1	5	2	1	1	1	1	1

Note: Village: PG = Pengidam; BG = Bengkelang; BB = Batu Bedulang; BO = Babo; PC = Pantai Cempa; PR = Perupuk; SB = Serba; RB = Rantau Bintang; AS = Aras Sembilan; BK = Blang Kandis

Results

Diversity of useful plants

A total of 2,088 individual plants representing 276 species and 81 families were documented in the study areas. Of the 276 species recorded, 189 (68.48%) species were cultivated and 87 (31.52%) were wild (Table 2). The majority of plants are herbs (30.8%), followed by shrubs (29.7%), trees (28.6%), climbers (5.8%), grass (4%), and vine (1.1%). Asteraceae accounted for 6.47% of all species, followed by Araceae and Lamiaceae (5.4% in each), Euphorbiaceae and Poaceae (4.32% in each), and Fabaceae (3.96% in each) (Figure 2). The most common plants cited by informants in the study areas were *Musa x paradisiaca* L. (RFC = 0.99), *Mangifera indica* L. (RFC = 0.98), *Cocos nucifera* L. (RFC = 0.97), *Durio zibethinus* L. (RFC = 0.96), *Garcinia mangostana* L. (RFC = 0.95), *Kaempferia galanga* L. (RFC = 0.95), and *Zingiber officinale* Roscoe (RFC = 0.95).

Utilization of useful plants

A total of 276 useful plants were documented in the study area. The study findings found a total of 14 use categories delivered by plants were most commonly for medicine (111 species), ornament (100), food (96), fodder (30), ritual (14), beverages (13), building materials (11), fuelwood (9), agricultural tools, fencing, and herbicide (6 each), handicraft (4), and shade plant (2).

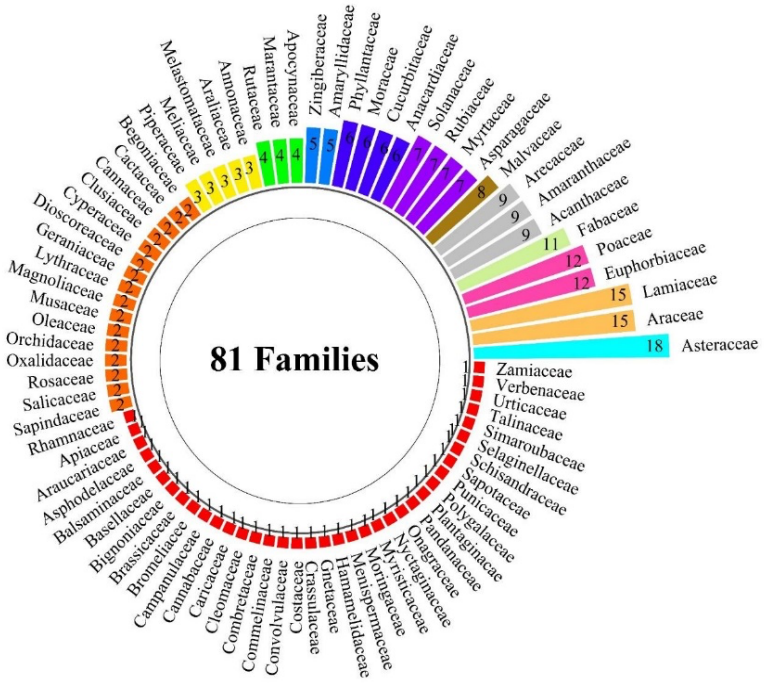

Figure 2. Species composition in the study area

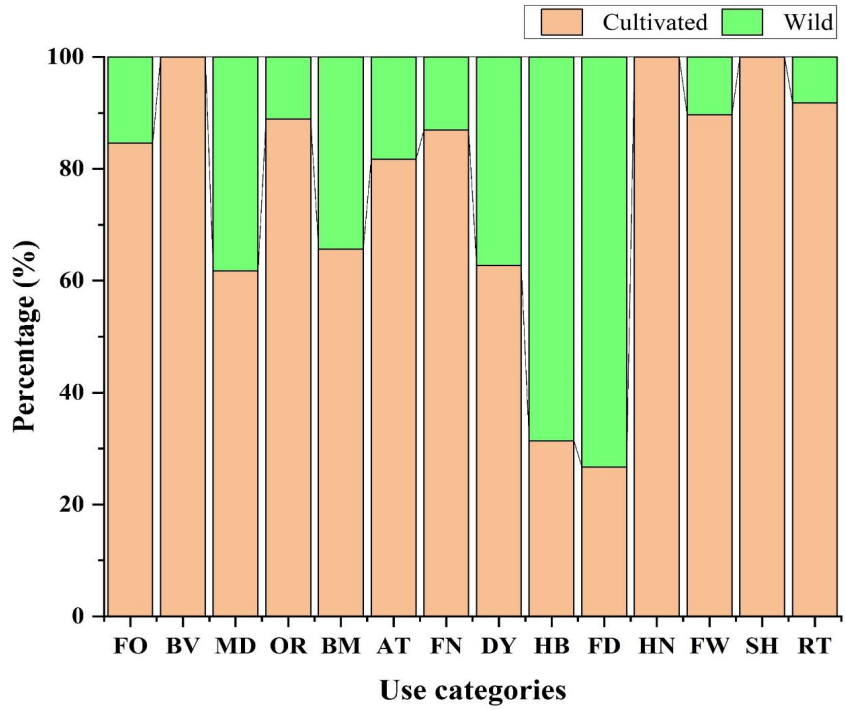

Figure 3. Distribution of 33,603 use reports across useful plants of different use categories in the Bandar Pusaka sub-district. **Use categories:** FO = Food; BV = Beverages, MD = Medicine; OR = Ornament; BM = Building materials; AT = Agricultural tools; FN = Fencing; DY = Dyes; HB = Herbicide; FD = Fodder; HN = Handicraft; FW = Fuelwood; SH = Shade; and RT = Ritual

The findings showed different use categories between cultivated and wild plants, with cultivated plants being distributed fairly evenly across a range of uses (Figure 3). In terms of plant parts used, leaves account for 48.66% of all plant parts used, followed by fruits (21.49%), flowers (16.12%), stem (5.97%), whole plants (2.69%), tuber (2.09%), rhizome (1.49%), root (0.90%), and seed (0.60%). The findings showed that different plant parts had been used, with fruits being distributed fairly evenly across a range of uses (Figure 4).

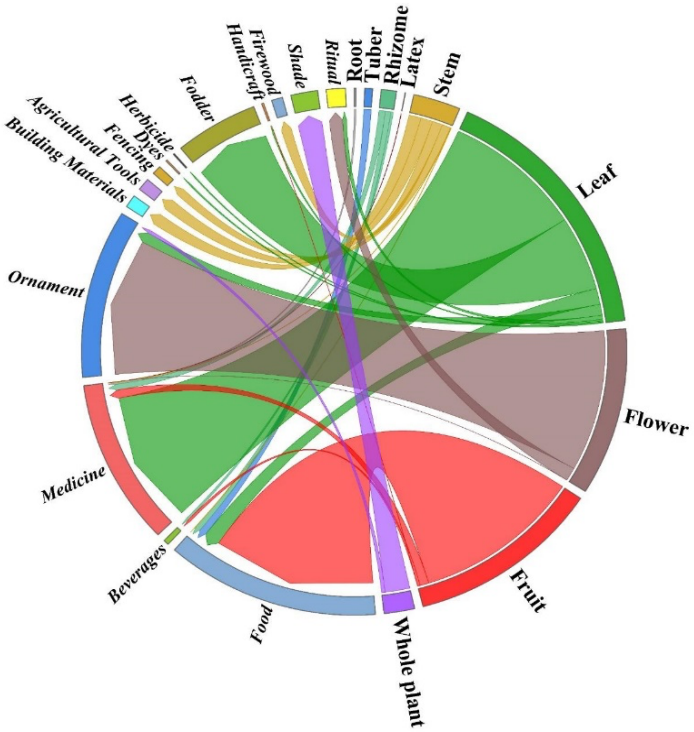

Figure 4. Distribution of 33,603 use reports across 10 villages, 9 plant parts used, and 14 different use categories in the Bandar Pusaka subdistrict.

Local importance values

The Use Value (UV) was determined based on the variety of uses of a species by each person and the number of people who use it. The findings showed that the UV of the food source species varied from 0.36 to 3.40. The most important species with the highest UV are *Zingiber officinale* (UV = 1.48), *Garcinia atroviridis* (UV = 1.44), *Curcuma longa* (UV = 1.39), *Durio zibethinus* (UV = 1.37), *Carica papaya* (UV = 1.31), *Citrus × limon* (UV = 1.27), *Kaempferia rotunda* (UV = 1.26), *Psidium guajava* (UV = 1.25), *Kaempferia galanga* (UV = 1.19), *Bergera koenigii* (UV = 1.16), *Illicium verum* (UV = 1.11), *Alpinia galanga* (UV = 1.08), and *Cymbopogon citratus* (UV = 1.04) (Table 2). Furthermore, as a source of ritual plant engagement, the community used a variety of species, including *Cananga odorata.* The ICF values ranged from 0.967 to 0.994. The highest ICF value (0.995) was for food services, while the lowest was for fencing services (0.967) (Table 3).

Table 3. Use categories of plants in the study area and the informant consensus factor

Use categories	Number of use-report	Number of species	ICF value
Food	17035	96	0.994
Beverages	702	13	0.983
Medicine	5048	111	0.978
Ornament	6943	100	0.986
Building Materials	454	11	0.978
Agricultural Tools	246	6	0.980
Fencing	153	6	0.967
Dyes	51	2	0.980
Herbicide	166	6	0.970
Fodder	1560	30	0.981
Handicraft	149	4	0.980
Fuelwood	252	9	0.968
Shade	53	2	0.981
Ritual	791	14	0.984

Table 2. List of useful plants in the study area

Family	Botanical name	Vernacular name	Growth Habit	Status	Plant part used	Use(s)	RFC	UV
Acanthaceae	*Andrographis paniculata* (Burm.f.) Nees	Sambiloto	Herb	Cultivated	Le	Leaves are used as medicine	0.48	0.29
	Asystasia gangetica (L.) T.Anderson	Ara Sungsang	Herb	Wild	Le	Leaves are used as fodder	0.42	0.16
	Barleria cristata L.	Daun Madu	Herb	Cultivated	Le	Leaves are used as medicine	0.26	0.19
					Fl	Flowers are used as an ornament		
	Clinacanthus nutans (Burm.f.) Lindau	Belalai Gajah	Herb	Cultivated	Le	Leaves are used as medicine	0.22	0.12
					Wp	Whole plants are used as fencing		
	Graptophyllum pictum (L.) Griff.	Puding Hitam	Shrub	Wild	Le	Leaves are used as medicine	0.31	0.05
	Eranthemum pulchellum Andrews	Gandarusa	Shrub	Cultivated	Le	Leaves are used as medicine	0.63	0.08
	Nicoteba betonica (L.) Lindau	Nika	Shrub	Cultivated	Fl	Flowers are used as ornament	0.36	0.11
	Ruellia tuberosa L.	Bunga Ungu	Herb	Cultivated	Le	Leaves are used as medicine	0.34	0.20
					Fl	Flowers are used as an ornament		
	Thunbergia erecta (Benth.) T.Anderson	Bunga Kenop	Shrub	Cultivated	Fl	Flowers are used as ornament	0.72	0.15
Amaranthaceae	*Achyranthes aspera* L.	Jarong	Herb	Wild	Le	Leaves are used as medicine	0.49	0.11
	Alternanthera brasiliana (L.) Kuntze	Bayam Ungu	Herb	Cultivated	Le	Flowers are used as ornament	0.67	0.18
	Alternanthera ficoidea (L.) P.Beauv.	Kriminil	Herb	Cultivated	Le	Flowers are used as ornament	0.62	0.25
	Alternanthera philoxeroides (Mart.) Griseb.	Bayam Dempo	Herb	Cultivated	Le	Flowers are used as an ornament	0.61	0.28
	Amaranthus hybridus L.	Bayam Sekop	Herb	Cultivated	Le	Young leaves are boiled and used as vegetables	0.64	0.91
	Amaranthus spinosus L.	Bayam Duri	Herb	Wild	Le	Leaves are used as medicine	0.22	0.96
					St	Stem is used as a food		
	Celosia argentea L	Bocoro	Herb	Cultivated	Fl	Flowers are used as ornament	0.49	0.26
	Gomphrena globosa L.	Bunga Matahari	Herb	Cultivated	Fl	Flowers are used as an ornament	0.56	0.39
	Iresine diffusa Humb. & Bonpl. ex Willd.	Bayam Merah	Herb	Cultivated	Fl	Flowers are used as ornament	0.57	0.43
Amaryllidaceae	*Crinum asiaticum* L.	Bakung	Herb	Wild	Fl	Flowers are used as an ornament	0.63	0.65
	Hippeastrum puniceum (Lam.) Voss	Amarilis	Herb	Cultivated	Fl	Flowers are used as an ornament	0.79	0.76
	Hymenocallis littoralis (Jacq.) Salisb.	Lili Air Mancur	Herb	Cultivated	Fl	Flowers are used as an ornament	0.64	0.51
	Urceolina amazonica (Linden ex Planch.) Christenh. & Byng	Lili Putih	Herb	Cultivated	Fl	Flowers are used as an ornament	0.77	0.66
	Zephyranthes rosea Lindl.	Lili hujan merah jambu	Herb	Cultivated	Fl	Flowers are used as an ornament	0.81	0.46
Anacardiaceae	*Anacardium occidentale* L.	Jambu Monyet	Tree	Cultivated	Le	Leaves are used as fodder	0.85	0.88
					St	Stem is used as building materials		

					Fr	Fruits are eaten raw as food		
	Mangifera caesia Jack	Binjai	Tree	Cultivated	Le	Leaves are used as fodder	0.59	0.83
					St	Stem is used as fuelwood		
					Fr	Fruits are eaten raw as food or juice as beverages		
	Mangifera foetida Lour.	Bacang	Tree	Cultivated	Le	Leaves are used as fodder	0.92	0.92
					St	Stem is used as fuelwood		
					Fr	Fruits are eaten raw as food or juice as beverages		
	Mangifera indica L.	Mangga	Tree	Cultivated	Le	Leaves are used as fodder	0.98	0.98
					St	Stem is used as fuelwood		
					Fr	Fruits are eaten raw as food or juice as beverages		
	Mangifera odorata Griff.	Kweni	Tree	Cultivated	Le	Leaves are used as fodder	0.90	0.58
					St	Stem is used as fuelwood		
					Fr	Fruits are eaten raw as food or juice as beverages		
	Spondias dulcis Parkinson	Kedondong	Tree	Cultivated	Le	Leaves are used as fodder	0.52	0.23
					Fr	Fruits are eaten raw as food		
Annonaceae	*Annona muricata* L.	Sirsak	Tree	Cultivated	Le	Leaves are used as medicine	0.94	0.84
					Fr	Fruits are eaten raw as food or juice as beverages		
	Cananga odorata (Lam.) Hook.f. & Thomson	Kenanga	Tree	Cultivated	Fl	Flowers are used as ornament and ritual	0.76	0.51
	Monoon longifolium (Sonn.) B.Xue & R.M.K.Saunders	Glodokan	Tree	Cultivated	Le	Leaves are used as ornament	0.53	0.10
Apiaceae	*Centella asiatica* (L.) Urb.	Tapak kuda	Herb	Wild	Le	Leaves are used as vegetables and medicine	0.68	0.90
Apocynaceae	*Adenium obesum* (Forssk.) Roem. & Schult.	Kemboja	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.33	0.15
	Catharanthus roseus (L.) G.Don	Bunga Rutu-rutu	Shrub	Cultivated	Le	Leaves are used as medicine	0.77	0.49
					Fl	Flowers are used as an ornament		
	Plumeria pudica Jacq.	Kamboja	Tree	Cultivated	Fl	Flowers are used as ornament and ritual	0.34	0.40

	Tabernaemontana divaricata (L.) R.Br. ex Roem. & Schult.	Mondokaki	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.38	0.32
Araceae	*Anthurium andraeanum* Linden ex André	Kuping Gajah	Tree	Cultivated	Fl	Flowers are used as an ornament	0.91	0.06
	Anthurium plowmanii Croat	Bunga Ekor	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.82	0.09
	Caladium bicolor (Aiton) Vent.	Keladi	Herb	Cultivated	Fl	Flowers are used as an ornament	0.66	0.33
	Colocasia esculenta (L.) Schott	Talas	Herb	Cultivated	Tu	Tubers are boiled and consumed as food	0.68	0.94
	Dieffenbachia seguine (Jacq.) Schott	Daun Bahagia	Herb	Cultivated	Le	Leaves are used as an ornament	0.59	0.15
	Epipremnum aureum (Linden & André) G.S.Bunting	Sirih gading	Herb	Cultivated	Le	Leaves are used as an ornament	0.48	0.07
	Epipremnum pinnatum (L.) Engl.	Ekor Naga	Herb	Cultivated	Le	Leaves are used as an ornament	0.85	0.05
	Philodendron erubescens K.Koch & Augustin	Sri Rejeki	Climber	Cultivated	Le	Leaves are used as an ornament	0.22	0.13
	Spathiphyllum cochlearispathum (Liebm.) Engl.	Tulip	Herb	Cultivated	Le	Leaves are used as an ornament	0.89	0.25
	Spathiphyllum wallisii Regel	Lili Perdamaian	Herb	Cultivated	Le	Leaves are used as an ornament	0.74	0.10
	Syngonium podophyllum Schott	Singonium	Herb	Wild	Le	Leaves are used as an ornament	0.51	0.03
	Thaumatophyllum xanadu (Croat, J.Boos & Mayo) Sakur., Calazans & Mayo	Raja Congo	Herb	Cultivated	Le	Leaves are used as an ornament	0.75	0.10
	Typhonium blumei Nicolson & Sivad.	Keladi Tikus	Herb	Wild	Le	Leaves are used as an ornament	0.27	0.10
	Xanthosoma sagittifolium (L.) Schott	Kimpul	Herb	Wild	Tu	Tubers are boiled and consumed as food	0.34	0.58
	Zamioculcas zamiifolia (G.Lodd.) Engl.	Daun Dollar	Herb	Cultivated	Le	Leaves are used as medicine	0.53	0.29
Araliaceae	*Heptapleurum arboricola* Hayata	Daun Wali Songo	Shrub	Cultivated	Le	Leaves are used as an ornament	0.79	0.09
	Polyscias fruticosa (L.) Harms	Daun Kedondong	Shrub	Wild	Le	Leaves are used as medicine and ornament	0.57	0.13
	Polyscias guilfoylei (W.Bull) L.H.Bailey	Daun Berlangkas	Shrub	Cultivated	Le	Leaves are used as medicine and ornament	0.62	0.21
Araucariaceae	*Araucaria columnaris* (G.Forst.) Hook.	Bunga Terumbu	Tree	Cultivated	Le	Leaves are used as an ornament	0.56	0.32
Arecaceae	*Adonidia merrillii* (Becc.) Becc.	Pinang Putri	Tree	Cultivated	Le	Leaves are used as an ornament	0.57	0.26
	Areca catechu L.	Pinang	Tree	Cultivated	St	Stem is used as building materials	0.87	0.81
					Fr	Fruits are used as food, medicine, and ritual		
	Arenga pinnata (Wurmb) Merr.	Aren	Tree	Cultivated	Fr	Fruits are used as food	0.84	0.31

	Cocos nucifera L.	Kelapa	Tree	Cultivated	Ro	Roots are used as handicraft	0.97	0.88
					St	Stem is used as building materials		
					Le	Leaves are used as handicraft		
					Fr	Fruits are used as food, medicine, and ritual		
	Phoenix reclinata Jacq.	Palem Senegal	Tree	Cultivated	Wp	Whole plants are used as ornament	0.57	0.13
	Rhapis excelsa (Thunb.) A.Henry	Palem Jari	Tree	Cultivated	Wp	Whole plants are used as ornament	0.63	0.09
	Rhopalostylis sapida H.Wendl. & Drude	Nikau	Tree	Cultivated	Wp	Whole plants are used as ornament	0.63	0.08
	Salacca zalacca (Gaertn.) Voss	Salak	Tree	Cultivated	Fr	Fruits are eaten raw as food	0.83	0.15
	Wodyetia bifurcata A.K.Irvine	Palem ekor Tupai	Tree	Cultivated	Wp	Whole plant are used as ornament	0.53	0.06
Asparagaceae	*Cordyline fruticosa* (L.) A.Chev.	Andong	Shrub	Cultivated	Le	Leaves are used as medicine and ornament	0.82	0.13
	Dracaena angustifolia (Medik.) Roxb.	Daun Suji	Shrub	Cultivated	Le	Leaves are used as food, ritual, and ornament	0.82	0.35
	Dracaena reflexa Lam.	Song India	Shrub	Cultivated	Le	Leaves are used as an ornament	0.75	0.06
	Dracaena sanderiana Mast.	Bambu Rejeki	Shrub	Cultivated	Le	Leaves are used as an ornament	0.68	0.03
	Dracaena suffruticosa (N.E.Br.) Byng & Christenh.	Bambu Jepang	Shrub	Cultivated	Le	Leaves are used as an ornament	0.69	0.05
	Dracaena surculosa Lindl.	Debu Emas	Shrub	Cultivated	Le	Leaves are used as an ornament	0.73	0.06
	Dracaena trifasciata (Prain) Mabb.	Lidah Mertua	Herb	Cultivated	Le	Leaves are used as medicine and ornament	0.86	0.12
Asphodelaceae	*Dianella tasmanica* Hook.f.	Lili	Shrub	Cultivated	Le	Leaves are used as an ornament	0.91	0.09
Asteraceae	*Ageratum conyzoides* L.	Bandotan	Herb	Wild	Le	Leaves are used as a medicine	0.15	0.26
	Artemisia vulgaris L.	Lokat mala	Herb	Wild	Le	Leaves are used as an ornament	0.31	0.20
	Bidens pilosa L.	Ajeran	Herb	Wild	Le	Leaves are used as an ornament	0.38	0.24
	Centratherum punctatum Cass.	Kancing Lurah	Shrub	Wild	Le	Leaves are used as a medicine	0.49	0.15
	Chromolaena odorata (L.) R.M.King & H.Rob.	Siam	Herb	Wild	Le	Leaves are used as vegetables, medicine, herbicide, and fodder	0.48	0.63
	Cyanthillium cinereum (L.) H.Rob.	Sawi Langit	Shrub	Wild	Le	Leaves are used as a medicine	0.49	0.12
	Emilia sonchifolia (L.) DC.	Tempuh Wiyang	Shrub	Wild	Le	Leaves are used as an medicine	0.45	0.07

	Erigeron karvinskianus DC.	Maroon Daisy	Shrub	Wild	Le	Leaves are used as medicine and ornament	0.79	0.17
	Erigeron sumatrensis Retz.	Situduh Langit	Shrub	Wild	Le	Leaves are used as an medicine	0.47	0.14
	Galinsoga quadriradiata Ruiz & Pav.	Rumput Liar Kuning	Shrub	Wild	Le	Leaves are used as herbicide and fodder	0.03	0.24
	Gymnanthemum amygdalinum(Delile) Sch.Bip.	Daun Afrika	Shrub	Wild	Le	Leaves are used as medicine	0.28	0.10
	Gynura japonica (Thunb.) Juel	Luntas	Herb	Wild	Le	Leaves are used as medicine	0.24	0.59
					Fl	Flowers are used as an ornament		
	Mikania micrantha Kunth	Sembung Rambat	Climber	Wild	Le	Leaves are used as medicine	0.72	0.29
	Pluchea indica (L.) Lees.	Beluntas	Shrub	Wild	Le	Leaves are used as medicine	0.79	0.36
					Fl	Flowers are used as an ornament		
	Sonchus arvensis L.	Tempuyung	Herb	Wild	Le	Leaves are used as medicine	0.68	0.10
	Synedrella nodiflora (L.) Gaertn.	Jotang kuda	Herb	Wild	Le	Leaves are used as herbicide	0.58	0.10
	Zinnia elegans Jacq.	Kembang Kertas	Shrub	Cultivated	Le	Leaves are used as medicine and ornament	0.87	0.54
	Zinnia haageana Regel	Kembang Zinia	Shrub	Cultivated	Le	Leaves are used as medicine and ornament	0.65	0.47
Balsaminaceae	*Impatiens balsamina* L.	Pacar air	Herb	Cultivated	Fl	Flowers are used as an ornament	0.87	0.35
Basellaceae	*Basella alba* L.	Binahong, bayam	Herb	Wild	Le	Leaves are used as medicine	0.53	0.04
Begoniaceae	*Begonia cucullata* Willd.	Riang-riang	Herb	Cultivated	Le	Leaves are used as medicine and ornament	0.68	0.47
	Begonia rex Putz.	Haring	Herb	Cultivated	Le	Leaves are used as medicine and ornament	0.23	0.47
Bignoniaceae	*Mansoa alliacea* (Lam.) A.H.Gentry	Stepanot Ungu	Vine	Cultivated	Fl	Flowers are used as an ornament	0.76	0.35
Brassicaceae	*Rorippa indica* (L.) Hiern	Sawi Lemah	Shrub	Wild	Le	Young leaves are used as food	0.37	0.15
Bromeliaceae	*Ananas comosus* (L.) Merr.	Nenas	Shrub	Cultivated	Le	Leaves are used as medicine, ornament, and handicraft	0.94	0.95
					Fr	Fruits are used as food		
Cactaceae	*Epiphyllum oxypetalum* (DC.) Haw.	Bunga Wijaya	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.54	0.34
	Opuntia cochenillifera (L.) Mill.	Kaktus Centong	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.42	0.66
Campanulaceae	*Hippobroma longiflora* (L.) G.Don	Bunga Kitolod	Herb	Wild	Le	Leaves are used as medicine	0.81	0.11
Cannabaceae	*Trema orientale* (L.) Blume	Bengkirei	Tree	Wild	St	Stem is used as agricultural tools, building materials, and firewood	0.71	0.71

					Le	Leaves are used as medicine		
					Fr	Fruits are used as food		
Cannaceae	*Canna × hybrida* Rodigas	Bunga Tasbih	Herb	Cultivated	Fl	Flowers are used as an ornament	0.80	0.60
	Canna indica L.	Bunga Tasbih	Herb	Cultivated	Fl	Flowers are used as an ornament	0.85	0.98
Caricaceae	*Carica papaya* L.	Pepaya	Shrub	Cultivated	Le	Leaves are used as vegetables and medicine	0.92	1.31
					Fl	Flowers are used as vegetables		
					Fr	Unripe fruits are used as vegetables, while ripe fruits are eaten raw as food or juice as beverages		
Cleomaceae	*Cleome rutidosperma* DC.	Maman Lanang	Herb	Wild	Le	Leaves are used as herbicide	0.71	0.06
Clusiaceae	*Garcinia atroviridis* Griff. ex T.Anderson	Asam Glugur	Tree	Cultivated	Fr	Fruits are used as spices and medicine	0.94	1.44
	Garcinia mangostana L.	Manggis	Tree	Cultivated	Fr	Fruits are used as food and medicine	0.95	0.80
Combretaceae	*Combretum indicum* (L.) DeFilipps	Ceguk	Vine	Wild	Le	Leaves are used as medicine	0.69	0.08
					Fl	Flowers are used as medicine		
Commelinaceae	*Tradescantia spathacea* Sw.	Nanas Kerang	Shrub	Cultivated	Le	Leaves are used as an ornament	0.67	0.44
Convolvulaceae	*Decalobanthus mammosus* (Lour.) A.R.Simões & Staples	Bidara	Vine	Cultivated	Le	Leaves are used as medicine	0.51	0.47
					Fr	Fruits are used as food and medicine		
Costaceae	*Hellenia speciosa* (J.Koenig) S.R.Dutta	Pacing Tawar	Shrub	Wild	Le	Leaves are used as vegetables and medicine	0.81	0.33
Crassulaceae	*Kalanchoe pinnata* (Lam.) Pers.	Cocor Bebek	Herb	Cultivated	Le	Leaves are used as medicine and ornament	0.75	0.78
Cucurbitaceae	*Cucurbita maxima* Duchesne	Labu Kuning	Climber	Cultivated	Le	Leaves are used as vegetables and medicine	0.88	0.98
					Fr	Fruits are used as food and medicine		
	Luffa acutangula (L.) Roxb.	Gambas	Climber	Cultivated	Fr	Fruits are used as vegetables	0.87	0.75
	Luffa aegyptiaca Mill.	Blustru	Climber	Cultivated	Fr	Fruits are used as vegetables	0.82	0.89
	Sicyos edulis Jacq.	Labu Siam	Climber	Cultivated	Fr	Fruits are used as vegetables	0.86	0.39
	Zehneria guamensis (Merr.) Fosberg	Markisa	Climber	Wild	Fr	Fruits are used as food	0.78	0.36

	Cucumis melo L.	Melon	Climber	Cultivated	Fr	Fruits are used as food	0.89	0.94
Cyperaceae	*Cyperus rotundus* L.	Teki	Grass	Wild	Le	Leaves are used as fodder	0.69	0.11
	Rhynchospora berteroi (Spreng.) C.B.Clarke	Lalang	Herb	Wild	Le	Leaves are used as medicine and fooder	0.53	0.25
Dioscoreaceae	*Dioscorea alata* L.	Uwi	Climber	Cultivated	Tu	Tubers are boiled and consumed as food	0.89	0.94
	Dioscorea hispida Dennust.	Gadung	Climber	Cultivated	Tu	Tubers are boiled and consumed as food	0.69	0.36
Euphorbiaceae	*Acalypha australis* L.	Anting-anting	Herb	Wild	Le	Leaves are used as medicine and food	0.55	0.33
	Acalypha hispida Burm.f.	Ekor kucing	Shrub	Cultivated	Le	Leaves are used as medicine	0.48	0.80
					Fl	Leaves are used as medicine and ornament		
	Acalypha wilkesiana Müll.Arg.	Sablo	Shrub	Cultivated	Le	Leaves are used as medicine	0.64	0.08
	Euphorbia hirta L.	Patikan Kebo	Shrub	Wild	Le	Leaves are used as medicine and fodder	0.66	0.14
	Euphorbia neriifolia L.	Patah Tulang	Tree	Cultivated	Le	Leaves are used as ornament	0.73	0.36
	Euphorbia tithymaloides L.	Sigsag	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.83	0.37
	Excoecaria cochinchinensis Lour.	Sambang Darah	Shrub	Cultivated	Le	Leaves are used as medicine and ornament	0.88	0.58
	Jatropha curcas L.	Jarak Pagar	Shrub	Cultivated	Le	Leaves are used as medicine	0.59	0.11
	Jatropha multifida L.	Jarak	Shrub	Cultivated	Le	Leaves are used as medicine	0.57	0.08
	Jatropha podagrica Hook.	Jarak	Shrub	Cultivated	Le	Leaves are used as medicine	0.26	0.06
	Manihot esculenta Crantz	Ubi Kayu	Shrub	Cultivated	Tu	Tubers are boiled and consumed as food	0.91	0.99
					Le	Leaves are boiled and consumed as vegetables		
	Ricinus communis L.	Jarak	Shrub	Cultivated	Le	Leaves are used as medicine	0.47	0.08
Fabaceae	*Adenanthera pavonina* L.	Saga	Tree	Cultivated	St	Stem is used as agricultural tools, building material, firewood	0.53	0.79
					Le	Leaves are used as fodder		
					Wp	Whole plants are used as shade		
	Archidendron jiringa (Jack) I.C.Nielsen	Jengkol	Tree	Cultivated	Fr	Fruits are used as food	0.86	0.65
	Calopogonium mucunoides Desv.	Kacang Asu	Climber	Wild	Fr	Fruits are used as food	0.37	0.25

					Le	Leaves are used as fodder		
	Erythrina subumbrans (Hassk.) Merr.	Dadap Serep	Tree	Cultivated	Le	Leaves are used as medicine	0.74	0.16
	Erythrina variegata L.	Dadap	Tree	Cultivated	St	Stem is used as fencing	0.18	0.18
					Le	Leaves are used as medicine		
	Gliricidia sepium (Jacq.) Kunth	Gamal	Tree	Cultivated	Le	Leaves are used as fodder	0.85	0.12
	Pachyrhizus erosus (L.) Urb.	Bengkoang	Climber	Cultivated	Tu	Tubers are used as food	0.72	0.39
					Le	Leaves are used as medicine		
	Parkia speciosa Hassk.	Petai	Tree	Cultivated	Le	Leaves are used as fodder	0.89	0.68
					Fr	Fruits are used as food		
	Pterocarpus indicus Willd.	Angsana	Tree	Cultivated	Le	Leaves are used as medicine	0.63	0.17
					Fl	Flowers are used as an ornament		
	Leucaena leucocephala (Lam.) de Wit	Petai cina	Tree	Cultivated	St	Stem is used as firewood	0.45	0.99
					Le	Leaves are used as fodder and medicine		
					Fr	Fruits are used as food		
					Sd	Seeds are used as medicine		
					Wp	Whole plants are used as shade		
	Tamarindus indica L.	Asam Jawa	Tree	Cultivated	Fr	Fruits are used as spices	0.83	0.98
Geraniaceae	*Pelargonium × hybridum* (L.) L'Hér.	Geranium	Herb	Cultivated	Le	Leaves are used as medicine	0.81	0.06
	Pelargonium zonale (L.) L'Hér.	Geranium	Herb	Cultivated	Le	Leaves are used as medicine	0.62	0.07
Gnetaceae	*Gnetum gnemon* L.	Melinjo	Tree	Cultivated	Le	Young leaves are used as vegetables	0.84	0.19
					Fr	Fruits are used as food		
Hamamelidaceae	*Loropetalum chinense* (R.Br.) Oliv.	Serut Merah	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.38	0.06
Lamiaceae	*Clerodendrum chinense* (Osbeck) Mabb.	Melati susun	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.65	0.14
	Clerodendrum indicum (L.) Kuntze	Genje	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.39	0.13
	Clerodendrum thomsoniae Balf.f.	Nona makan sirih	Shrub	Cultivated	Fl	Flowers are used as ornament and ritual	0.76	0.28
	Coleus amboinicus Lour.	Jintan	Shrub	Wild	Le	Leaves are used as medicine	0.87	0.08
	Coleus argentatus (S.T.Blake) P.I.Forst. & T.C.Wilson	Daun Bangun-Bangun	Shrub	Wild	Le	Leaves are used as medicine	0.78	0.11
	Coleus scutellarioides (L.) Benth.	Miana	Shrub	Cultivated	Le	Leaves are used as medicine	0.82	0.18
	Hyptis capitata Jacq.	Rumput Knop	Shrub	Wild	Le	Leaves are used as medicine	0.64	0.08
	Leucas aspera (Willd.) Link	Lenglengan	Herb	Wild	Le	Leaves are used as medicine	0.77	0.12

	Ocimum basilicum L.	Kemangi	Herb	Cultivated	Le	Leaves are used as vegetables, medicine, and ornament	0.81	0.42
	Ocimum tenuiflorum L.	Ruku-ruku	Herb	Cultivated	Le	Leaves are used as vegetables, medicine, and ornament	0.83	0.65
	Orthosiphon aristatus (Blume) Miq.	Kumis Kucing	Herb	Cultivated	Le	Leaves are used as medicine	0.71	0.20
					Fl	Flowers are used as an ornament		
	Perilla frutescens var. *Crispa* (Thunb.) H.Deane	Daun Perilla	Herb	Wild	Le	Leaves are used as medicine	0.82	0.05
	Persea americana Mill.	Alpukat	Tree	Cultivated	Fr	Fruits are juiced and used as beverages	0.63	0.04
	Plectranthus purpuratus Harv.	Sigresing	Shrub	Cultivated	Wp	Whole plants are used as fencing	0.83	0.04
	Salvia japonica Thunb.	Daun Sage	Herb	Cultivated	Le	Leaves are used as medicine	0.87	0.11
Lythraceae	*Cuphea hyssopifolia* Kunth	Bunga Taiwan	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.44	0.19
	Lawsonia inermis L.	Daun pacar	Shrub	Cultivated	Fl	Flowers are used as an ornament and ritual	0.88	0.32
Magnoliaceae	*Magnolia × alba* (DC.) Figlar	Cempaka putih	Tree	Cultivated	Fl	Flowers are used as an ornament and ritual	0.92	0.20
	Magnolia champaca (L.) Baill. ex Pierre	Cempaka kuning	Tree	Cultivated	Fl	Flowers are used as an ornament and ritual materials	0.86	0.18
Malvaceae	*Ceiba pentandra* (L.) Gaertn.	Kapuk Randu	Tree	Cultivated	Le	Leaves are used as fodder	0.84	0.40
					Fr	Fruits are used as handicraft		
	Corchorus aestuans L.	Yute	Shrub	Wild	Le	Leaves are used as vegetables	0.34	0.31
	Durio oxleyanus Griff.	Durian Daun	Tree	Wild	St	Stem is used as building materials and fencing	0.83	0.66
					Fr	Fruits are eaten raw		
	Durio zibethinus L.	Durian	Tree	Cultivated	St	Stem is used as building materials and fencing	0.96	1.37
					Fr	Fruits are eaten raw		
	Hibiscus rosa-sinensis L.	Kembang Sepatu	Shrub	Cultivated	Le	Leaves are used as medicine	0.91	0.44
					Fl	Flowers are used as an ornament		
	Malvaviscus arboreus Dill. ex Cav.	Sepatu Kuncup	Shrub	Wild	Le	Leaves are used as medicine	0.86	0.18
	Sida rhombifolia L.	Seleguri	Shrub	Wild	Le	Leaves are used as medicine	0.76	0.22
	Theobroma cacao L.	Coklat	Tree	Cultivated	Fr	Fruits are used as beverages	0.88	0.15

Marantaceae	*Goeppertia ornata* (Linden) Borchs. & S.Suárez	Bunga Belang	Herb	Cultivated	Le	Leaves are used as an ornament	0.37	0.26
	Goeppertia rufibarba (Fenzl) Borchs. & S.Suárez	Bunga Ungu	Herb	Cultivated	Le	Leaves are used as an ornament	0.43	0.08
	Maranta arundinacea L.	Garut	Herb	Cultivated	Tu	Tubers are boiled and used as food	0.68	0.26
	Stromanthe thalia (Vell.) J.M.A.Braga	Meranti Bali	Herb	Cultivated	Le	Leaves are used as an ornament	0.41	0.07
Melastomataceae	*Bellucia pentamera* Naudin	Jambu monyet	Tree	Wild	Fr	Fruits are eaten raw	0.64	0.98
	Melastoma malabathricum L.	Sengganen	Shrub	Wild	Le	Leaves are used as medicine	0.81	0.84
					Fr	Fruits are eaten raw		
	Miconia crenata (Vahl) Michelang.	Sengganen bulu	Shrub	Wild	Le	Leaves are used as medicine	0.19	0.09
Meliaceae	*Azadirachta indica* A.Juss.	Mimba	Tree	Cultivated	Le	Leaves are used as medicine and herbicide	0.76	0.22
	Lansium domesticum Corrêa	Lansat	Tree	Cultivated	Fr	Fruits are eaten raw	0.89	0.51
	Toona ciliata M.Roem.	Suren	Tree	Cultivated	St	Stem is used as a building material and agricultural tools	0.89	0.29
Menispermaceae	*Cyclea barbata* Miers	Cincau	Climber	Wild	Le	Leaves are used as vegetables, dyes, and medicine	0.79	0.18
Moraceae	*Artocarpus altilis* (Parkinson) Fosberg	Sukun	Tree	Cultivated	St	Stem is used as agricultural tools, building material, and firewood	0.82	0.50
					Le	Leaves are used as fodder		
					Fr	Young fruits are used as vegetables or fried as a snack		
	Artocarpus heterophyllus Lam	Nangka	Tree	Cultivated	St	Stem is used as agricultural tools, building material, and firewood	0.94	0.59
					Le	Leaves are used as fodder		
					Fr	Young fruits are used as vegetables		
					Sd	Seeds are fried and consumed as a snack		
	Dorstenia elata Gardner	Tusuk Konde	Herb	Cultivated	Fl	Flowers are used as an ornament	0.37	0.09
	Ficus punctata Thunb.	Dolar Rambat	Tree	Wild	Fr	Fruits are eaten raw	0.33	0.17
	Morus nigra L.	Murbei Hitam	Tree	Wild	Fr	Fruits are eaten raw	0.76	0.16
	Streblus asper Lour.	Serut	Tree	Wild	Le	Leaves are used as medicine	0.22	0.05

Moringaceae	*Moringa oleifera* Lam.	Kelor	Tree	Cultivated	Le	Leaves are used as medicine and pesticides	0.86	0.25
Musaceae	*Musa acuminata* Colla	Pisang Kepok	Shrub	Cultivated	Fr	Fruits are eaten raw	0.89	0.33
	Musa x paradisiaca L.	Pisang	Shrub	Cultivated	Fr	Fruits are eaten raw	0.99	0.98
Myristicaceae	*Myristica fragrans* Houtt.	Pala	Tree	Wild	Fr	Fruits are used as spices and medicine	0.35	0.46
Myrtaceae	*Psidium guajava* L.	Jambu Biji	Tree	Cultivated	St	Stem is used as agricultural tools	0.91	1.25
					Le	Leaves are used as medicine		
					Fr	Fruits are eaten raw or juiced as a beverage		
	Syzygium aqueum (Burm.f.) Alston	Jambu Air	Tree	Cultivated	Fr	Fruits are eaten raw	0.65	0.98
	Syzygium australe (J.C.Wendl. ex Link) B.Hyland	Pucuk Merah	Tree	Cultivated	Fr	Fruits are eaten raw	0.18	0.36
	Syzygium cumini (L.) Skeels	Jambu keling	Tree	Cultivated	Fr	Fruits are eaten raw	0.89	0.61
	Syzygium malaccense (L.) Merr. & L.M.Perry	Jambu Bol	Tree	Cultivated	Fr	Fruits are eaten raw	0.79	0.94
	Syzygium myrtifolium Walp.	Pucuk Merah	Tree	Cultivated	Le	Leaves are used as ornament	0.29	0.23
					Wp	Whole plants are used as fencing		
	Syzygium polyanthum (Wight) Walp.	Daun Salam	Tree	Cultivated	Le	Young leaves are used as spices and condiments	0.79	0.66
Nyctaginaceae	*Mirabilis jalapa* L.	Bunga Pukul Empat	Herb	Cultivated	Fl	Flowers are used as an ornament	0.89	0.25
Oleaceae	*Jasminum officinale* L.	Melati	Shrub	Cultivated	Fl	Flowers are used as an ornament and ritual materials	0.68	0.54
	Jasminum sambac (L.) Aiton	Melati	Shrub	Cultivated	Fl	Flowers are used as an ornament and ritual materials	0.63	0.59
Onagraceae	*Ludwigia hyssopifolia* (G.Don) Exell	Gulma Bayeman	Herb	Wild	Ro	Roots are used as medicine	0.37	0.10
Orchidaceae	*Dendrobium crumenatum* Sw.	Anggrek Merpati	Herb	Cultivated	Fl	Flowers are used as an ornament	0.79	0.07
	Spathoglottis plicata Blume	Anggrek Tanah	Herb	Cultivated	Fl	Flowers are used as an ornament	0.51	0.12
Oxalidaceae	*Averrhoa bilimbi* L.	Belimbing	Tree	Cultivated	Fr	Fruits are used as spices and medicine	0.94	0.47
	Averrhoa carambola L.	Belimbing manis	Tree	Cultivated	Fr	Fruits are eaten raw	0.92	0.76
Pandanaceae	*Pandanus amaryllifolius* Roxb. ex Lindl.	Daun Pandan	Shrub	Cultivated	Le	Leaves are used as spices and condiments, medicine, ritual, dyes, and handicraft	0.87	0.87
Phyllantaceae	*Baccaurea motleyana* (Müll.Arg.) Müll.Arg.	Rambai	Tree	Cultivated	Fr	Fruits are eaten raw	0.92	0.72

	Baccaurea racemosa (Reinw.) Müll.Arg.	Kepundung	Tree	Cultivated	Fr	Fruits are eaten raw	0.65	0.30
	Phyllanthus amarus Schumach. & Thonn.	Meniran	Herb	Wild	Le	Leaves are used as medicine	0.36	0.15
	Phyllanthus tenellus Roxb.	Meniran Merah	Herb	Wild	Le	Leaves are used as medicine	0.27	0.21
	Phyllanthus acidus (L.) Skeels	Cermai	Tree	Cultivated	Fr	Fruits are eaten raw	0.85	0.15
	Phyllanthus niruri L.	Meniran hijau	Herb	Wild	Le	Leaves are used as medicine	0.31	0.23
Piperaceae	*Peperomia caperata* Yunck.	Daun ungu	Herb	Cultivated	Fl	Flowers are used as an ornament	0.41	0.22
	Piper aduncum L.	Sirih	Climber	Wild	Le	Leaves are used as medicine	0.14	0.18
	Piper betle L.	Sirih	Climber	Cultivated	Le	Leaves are used as medicine and ritual	0.89	0.54
Plantaginacae	*Plantago major* L.	Daun sendok	Herb	Wild	Le	Leaves are used as medicine	0.63	0.28
Poaceae	*Axonopus compressus* (Sw.) P.Beauv.	Jakut Pahit	Grass	Wild	Le	Leaves are used as fodder	0.29	0.30
	Cenchrus clandestinus (Hochst. ex Chiov.)	Rumput Kikuyu	Grass	Wild	Le	Leaves are used as fodder	0.58	0.21
	Cymbopogon citratus (DC.) Stapf	Serai	Grass	Cultivated	Le	Leaves are used as condiment, ritual, and medicine	0.92	1.04
	Eragrostis viscosa (Retz.) Trin.	Jukut Karukun	Grass	Wild	Le	Leaves are used as fodder	0.24	0.26
	Imperata cylindrica (L.) P.Beauv.	Alang-alang	Grass	Wild	Le	Leaves are used as fodder	0.41	0.34
	Lophatherum gracile Brongn.	Rumput	Grass	Wild	Le	Leaves are used as fodder	0.55	0.23
	Pleioblastus viridistriatus (Regel) Makino	Bambu Kerdil	Grass	Wild	Le	Leaves are used as fodder	0.54	0.24
	Pogonatherum crinitum (Thunb.) Kunth	Rumput Bambu	Grass	Wild	Le	Leaves are used as fodder	0.35	0.40
	Pseudosasa japonica (Siebold & Zucc. ex Steud.) Makino ex Nakai	Bambu Jepang	Grass	Wild	Le	Leaves are used as fodder	0.49	0.33
	Saccharum officinarum L.	Tebu	Grass	Cultivated	St	Stem are used as beverages	0.89	0.33
	Setaria palmifolia (J.Koenig) Stapf	Rumput setaria	Herb	Wild	Le	Leaves are used as fodder	0.33	0.29
	Sporobolus indicus (L.) R.Br.	Rumput Smutgrass	Herb	Wild	Le	Leaves are used as fodder	0.32	0.23
Polygalaceae	*Polygala paniculata* L.	Balsem	Shrub	Wild	Le	Leaves are used as medicine and fodder	0.11	0.42
Punicaceae	*Punica granatum* L.	Delima	Tree	Cultivated	Fr	Fruits are used as food	0.76	0.21
Rhamnaceae	*Ziziphus mauritiana* Lam.	Bidara	Tree	Wild	Le	Leaves are used as medicine	0.74	0.10
Rosaceae	*Fragaria vesca* L.	Stroberi	Climber	Cultivated	Fr	Fruits are eaten raw	0.67	0.16
	Rosa pendulina L.	Mawar	Shrub	Wild	Fl	Flowers are used as ornament and ritual	0.78	0.44
Rubiaceae	*Edrastima uniflora* (L.) Raf.	Dewandaru	Herb	Wild	Le	Leaves are used as medicine	0.29	0.06
	Ixora coccinea L.	Asoka	Shrub	Cultivated	Fl	Flowers are used as an ornament	0.79	0.25

	Morinda citrifolia L.	Mengkudu	Tree	Cultivated	Fr	Fruits are juiced as beverages and medicine	0.83	0.16
	Oldenlandia corymbosa L.	Rumput mutiara	Herb	Wild	Le	Leaves are used as medicine	0.54	0.06
	Spermacoce remota Lam.	Kancing Palsu	Herb	Wild	Le	Leaves are used as medicine	0.63	0.08
	Uncaria gambir (W.Hunter) Roxb.	Gambir	Tree	Wild	Le	Leaves are used as medicine	0.68	0.14
	Paederia foetida L.	Kentutan	Shrub	Wild	Le	Young leaves are used as vegetables	0.44	0.42
Rutaceae	*Citrus × aurantiifolia* (Christm.) Swingle	Jeruk nipis	Tree	Cultivated	Fr	Fruits are used as spices or juiced as medicine	0.83	0.58
	Citrus × limon (L.) Osbeck	Jeruk Lemon	Tree	Cultivated	Fr	Fruits are used as spices or juiced as beverages or medicine	0.61	1.27
	Citrus maxima (Burm.) Merr.	Jeruk Bali	Tree	Cultivated	Fr	Fruits are eaten raw	0.86	0.90
	Bergera koenigii L. Spreng	Temurui	Tree	Cultivated	Le	Leaves are used as spices and medicine	0.88	1.16
Salicaceae	*Flacourtia rukam* Zoll. & Moritzi	Rukam	Tree	Wild	Fr	Fruits are eaten raw	0.53	0.25
	Homalium ceylanicum (Gardner) Benth.	Dlingsem	Tree	Wild	St	Stem is used as building materials	0.14	0.26
Sapindaceae	*Dimocarpus longan* Lour.	Kelengkeng	Tree	Cultivated	Fr	Fruits are eaten raw	0.73	0.94
	Nephelium lappaceum L.	Rambutan	Tree	Cultivated	Fr	Fruits are eaten raw	0.82	0.99
Sapotaceae	*Manilkara zapota* (L.) P.Royen	Sawo	Tree	Cultivated	Fr	Fruits are eaten raw	0.73	0.99
Schisandraceae	*Illicium verum* Hook.f.	Bunga lawang	Tree	Wild	Fl	Flowers are used as spices and medicine	0.82	1.11
Selaginellaceae	*Selaginella doederleinii* Hieron	Cakar ayam	Shrub	Wild	Fl	Flowers are used as an ornament	0.58	0.12
Simaroubaceae	*Brucea javanica* (L.) Merr.	Pohon makasar	Shrub	Cultivated	Fr	Fruits are used as medicine	0.27	0.09
Solanaceae	*Capsicum frutescens* L.	Cabai Rawit	Shrub	Cultivated	Fr	Fruits are used as spices	0.88	0.99
	Nicandra physalodes (L.) Gaertn.	Lolotuok	Herb	Wild	Fr	Fruits are used as medicine	0.14	0.25
	Solanum lasiocarpum Dunal	Terong asam	Shrub	Wild	Fr	Fruits are used as vegetables	0.87	0.94
	Solanum lycopersicum L.	Tomat	Shrub	Cultivated	Fr	Fruits are used as spices	0.83	0.91
	Solanum melongena L.	Terong Ungu	Shrub	Cultivated	Fr	Fruits are used as vegetables	0.87	0.78
	Solanum nigrum L.	Lenca	Shrub	Wild	Fr	Fruits are used as vegetables	0.85	0.66
	Solanum torvum Sw.	Terong pipit	Shrub	Cultivated	Fr	Fruits are used as vegetables	0.81	0.98
Talinaceae	*Talinum paniculatum* (Jacq.) Gaertn.	Ginseng	Shrub	Cultivated	Ro	Roots are used as medicine	0.66	0.07
Urticaceae	*Pilea microphylla* (L.) Liebm.	Katumpangan	Herb	Wild	Le	Leaves are used as medicine	0.28	0.09
Verbenaceae	*Duranta erecta* L.	Teh-tehan	Shrub	Cultivated	Le	Leaves are used as medicine	0.23	0.11
Zamiaceae	*Zamia furfuracea* L.f. ex Aiton	Zamia	Shrub	Cultivated	Le	Leaves are used as an ornament	0.71	0.09

Zingiberaceae	*Alpinia galanga* (L.) Willd.	Lengkuas	Herb	Cultivated	Rh	Rhizomes are used as spices and medicine	0.93	1.07
	Curcuma longa L.	Kunyit	Herb	Cultivated	Rh	Rhizomes are used as spices and medicine	0.95	1.39
	Kaempferia galanga L.	Kencur	Herb	Cultivated	Rh	Rhizomes are used as spices and medicine	0.95	1.19
	Kaempferia rotunda L.	Kunyit putih	Herb	Cultivated	Rh	Rhizomes are used as spices and medicine	0.78	1.26
	Zingiber officinale Roscoe	Jahe	Herb	Cultivated	Rh	Rhizomes are used as spices and medicine	0.95	1.48

Socio-demographic correlation with indigenous knowledge

The study's findings demonstrate that informants' knowledge of useful plants varies. The average number of species identified by informants in each district ranged from 21.11 ± 10.11 (Rantau Bintang) to 58.26 ± 10.24 (Batu Bedulang). On average, women mentioned more useful plants than men in all study areas (mean of species: 67.12 ± 12.32 and 57.25 ± 11.21, respectively). In addition, the average number of species identified by each educational status of the informant ranged from 21.02 ± 8.39 (Higher Education) to 62.18 ± 10.12 (Senior High School) (Table 4). Species similarity among all regencies compared was expressed by the Jaccard index. The similarity values ranged from 0.358 to 0.732. The highest similarity was found in Batu Bedulang-Bengkelang (JI = 0.732), while the lowest was found in Pantai Cempa-Serba (JI = 0.358) (Figure 5).

Table 4. Comparison of subgroups of informants on their traditional knowledge

Variable	Total informants	The average number of plants identified	Statistical test	*p*-value
Villages			W = 76.114	0.0001
Pengidam	27	51.12 ± 8.41		
Bengkelang	21	54.1 ± 9.21		
Batu Bedulang	21	58.26 ± 10.24		
Babo	79	38.12 ± 9.13		
Pantai Cempa	35	26.1 ± 8.25		
Perupuk	17	27.11 ± 12.84		
Serba	17	36.23 ± 9.11		
Rantau Bintang	29	21.11 ± 10.11		
Aras Sembilan	9	24.13 ± 9.23		
Blang Kandis	51	31.21 ± 12.03		
Gender			χ^2 = 52.301	0.066
Men	129	57.25 ± 11.21		
Women	177	67.12 ± 12.32		
Age			W = 91.024	0.0001
15-24	47	21.02 ± 7.21		
25-34	58	32.18 ± 11.16		
35-44	62	48.25 ± 8.13		
45-54	66	50.21 ± 12.03		
55-64	49	68.11 ± 7.89		
65-74	24	72.02 ± 11.25		
Level of Education			W = 76.201	0.0001
No Education	49	35.29 ± 8.25		
Elementary School	78	41.28 ± 7.82		
Junior High School	87	38.31 ± 10.28		
Senior High School	75	62.18 ± 10.12		
Higher Education	17	21.02 ± 8.39		

Discussion

A total of plant species are used as food plants with *Musa x paradisiaca* being the most cited food species (RFC = 0.99). *Musa x paradisiaca* were common and were extensively listed in all study villages. *Musa x paradisiaca* is one of the most important fruits of rural areas in Indonesia (Iskandar *et al*. 2018), including in the Aceh Tamiang district, and has traditionally been used for a variety of food uses, including desserts of ripe fresh banana fruit, boiled ripe banana fruit (*pisang rebus*), fried ripe banana fruit (*pisang goreng*), and banana crackers (*kripik pisang*). *Musa x paradisiaca* possesses a high fiber content (10.24 mg/100 g) and is an important component of diets that assists the digestive system and facilitates bowel movement, as well as weight management, decreased cardiac risk factors, and gastro-intestinal health (Oyeyinka & Afolayan 2019).

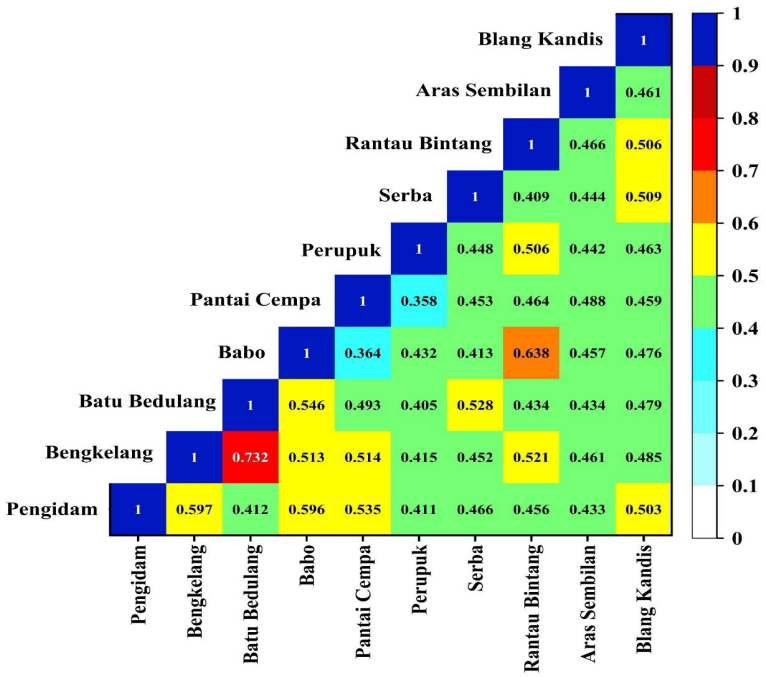

Figure 5. The similarity of useful plants among the ten studied districts as well as their Jaccard Index (JI)

A total of 111 medicinal plants have been recorded from the study area. The leaves were the most commonly used plant parts for medical purposes. Leaves are frequently abundant, accessible, and high in bioactive compounds, such as essential oils, alkaloids, and flavonoids, all of which have medicinal properties (Adeyemo- Salami (2020). Given their wide availability and ease of usage, leaves are used in many traditional medicines (Motti *et al*. 2023). Plants in the Zingiberaceae, particularly *Alpinia galanga, Curcuma longa*, *Kaempferia galanga*, and *Zingiber officinale*, are commonly grown in home gardens or farmlands and used as traditional medicines for diarrhea, rheumatic, sore throat, coughs, fevers, appetite, improve general health, stomachaches, and menstrual problems. Various plants in the Zingiberaceae family are widely utilized as traditional medicinal remedies by Indonesian communities, as well as food flavoring to create a distinctive aroma in cooking (Navia *et al*. 2020; Khairullah *et al*. 2020). *Alpinia galanga* rhizome contains an abundance of phenolic, polyphenols, flavonoids, saponins, phenylpropanoids, glycosides, diarylheptanoids, sesquiterpenes, and diterpenes compounds (Ajay and Vijaykumar 2015; Das *et al*. 2020; Khairullah *et al*. 2020), that possess antibacterial, antifungal, anti-inflammatory, anti-hepatotoxic, antioxidant, immunodulator, anti-diabetic, anti-ulcerative, and anti-allergic activities (Verma *et al*. 2011). This plant is used to effectively treat a wide range of diseases, such as diabetes, bronchitis, heart disease, stomachaches, colic, diarrhea, emesis, indigestion, abdominal pain, vomiting, breathing diseases, rheumatism, and to stimulate appetite (Aljobair 2022; Basri *et al*. 2017; Das *et al*. 2020). Other plants, such as *Ageratum conyzoides*, which grow naturally in home gardens, along roadsides, and in farmlands, are frequently used as traditional medicines for diarrhea, dysentery, wounds, skin problems, and intestinal colic. *Ageratum conyzoides* possesses a wide range of chemical compounds like alkaloids, flavonoids, and some constituents of flavonoids, tannins, saponins, glycosides, resins, and phenols (Amadi *et al*. 2012) and to be used as folk medicine in different countries for treating burns, wounds, skin disorders, headaches, fever, pneumonia, gynecological diseases, leprosy, snakebites, rheumatism, inflammations, stomach ailments like parasites, colic, diarrhea, and dysentery (Baral *et al*. 2022).

Individuals interviewed demonstrated greater knowledge of ornamental plants, recognizing 100 plant species. *Anthurium andraeanum, Dianella tasmanica, Excoecaria cochinchinensis, Impatiens balsamina, Lawsonia inermis, Magnolia × alba, Magnolia champaca, Mirabilis jalapa, Spathiphyllum cochlearispathum,* and *Zinnia elegans* are the top ten ornament plants found in the study area. Given their wonderful shapes and colors, ornamental plants play an essential role in the local populations at the study site by giving aesthetics and alleviating stress. Stress reduction and mental restoration occur when individuals live near green spaces, have a view of plants, or spend time in natural settings (Carrus *et al*. 2015; Watts 2017). The presence of green space in a neighborhood, particularly access to a garden, has been demonstrated to be a strong predictor of stress (Thompson *et al*. 2016). Indeed, the amount of green space in residential areas is associated with residents' overall health (Groenewegen *et al*. 2012). Living in areas with greater green space reduces both mental distress

and boosts well-being (White *et al*. 2013). Plants have been associated with improved emotional and mental health, including reduced anxiety and stress, decreased depression, greater happiness and life satisfaction, post-traumatic stress disorder (PTSD) mitigation, increased creativity, reduced dementia effects, and improved self-esteem (Hall & Knuth 2019).

The highest similarity of useful plants used by local communities was discovered in Batu Bedulang and Bengkelang (JI = 0.732), indicating that indigenous knowledge in those two districts is remarkably comparable. Batu Bedulang and Bengkelang are two villages close to the Gunung Leuser National Park and have an in-depth knowledge of the use of various plants, including wild plants, for multiple purposes, such as food and medicine. They engaged for a long time in understanding how to identify, harvest, and prepare different plants. Meanwhile, ten other villages are located distant from the forest, and the people in these villages tend to produce and use cultivated plants more frequently. As a result, the number of plant species discovered is lower than in Batu Bedulang and Bengkelang villages. In line with several other studies (Adnan *et al*. 2023; Geng *et al*. 2016; Yangdon *et al*. 2022), the association between gender and indigenous knowledge was not statistically significant. Our findings, on the other hand, suggest that informants' age and education level influence their traditional knowledge of useful plants. Informants aged 15 to 24, the majority of whom are in Junior High School, have less traditional knowledge of useful plant usage. This indicates that traditional knowledge has declined in the younger generation and that traditional knowledge transfer across generations is inadequate. It is, therefore, important to promote the use of various plant species, particularly wild plants before this traditional knowledge is lost. Domestication of different important wild species must, on the other hand, initially involve producing these species combined with crops on community farmland, home garden, or orchard. On the other hand, enhancing local peoples' abilities and expertise in recognizing, gathering, and preparing various useful plants is critical, since, in addition to promoting their household income, it may contribute to sustaining biodiversity and traditional knowledge.

Conclusion

Bandar Pusaka sub-district has a diverse range of useful plants, but only a small proportion has been used by local people, particularly wild plants. Promotion and domestication of useful plants should be a primary concern in the Bandar Pusaka sub-district to take advantage of their nutritional value and potential economic value. Moreover, enhancing local peoples' abilities and expertise in recognizing, gathering, and preparing various useful plants is critical, since, in addition to promoting their household income, it may contribute to sustaining biodiversity and traditional knowledge.

Declarations

Ethics approval and consent to participate: All participants provided oral prior informed consent
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Author contributions: ZIN and ABS conceived the study, conducted the data analysis, and wrote the manuscript. PL and A collected and identified plants. N, B, and MY conducted the interview. C significantly contributed to the literature review and revised the manuscript. All authors read, provided feedback on, and approved the final manuscript

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