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Gentiana urnula Perrine photo by Kohmura Masao

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The usage of "et al." in long author lists will also be accepted:

Smith J, Jones M Jr, Houghton L et al. 1999. Future of health insurance. N Engl J Med 965: 325-329. DOI: 10.10007/s002149800025.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in the book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds.). Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta*. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.). Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from the internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. DOI: 10.1038/msb.2008.24. www.molecularsystembiology.com.

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Roles of local food and knowledge of indigenous communities during pandemic COVID-19 at three districts across West Papua Province, Indonesia

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Abstract. *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: 1-12.* The world suffered from the COVID-19 pandemic without exception to local communities in West Papua Province, causing deaths worldwide. During the pandemic, food supply, availability, and distribution were short. Indigenous communities in West Papua Province, Indonesia are surrounded by natural resources providing foods, vegetables, vitamins, and other nutrients for maintaining the human immune system. This research was designed to determine local food diversity, examine the contribution of local foods in fulfilling daily needs, nutrient sources, medicines, and others during the pandemic, and document local community perception of the pandemic COVID-19 among three study areas in West Papua Province. A questionnaire field survey was employed for data collection: 11 villages at three districts in Manokwari, South Manokwari, and Teluk Bintuni were selected to represent coastal, lowland, and mangrove areas. The results indicated that local food provides all daily food needs, offering various ingredients and supporting the livelihood of the local communities. Among the three districts, there are variations in food diversity, but they are similar. Furthermore, 18 plants were consumed as vegetables; 14 plants as carbohydrate sources; 16 plants for fruits, medicinal, herbs, respectively; 13 plants for flavor; Protein and fat-producing plants and animals were 7 of plants and 6 of animal, respectively. They were prepared by boiling, fresh, roasted, burned in a wood fire, and fried gently with cooking oil. These local foods are also the source of house income, offer informal work, and are a source of medicinal plants. When food supply and distribution are scarce everywhere due to the COVID-19 pandemic, the local communities rely on their local foods to maintain their health and immunity. They believe that the COVID-19 virus is a warning from God to humans who always exploit nature without caring for others.

Keywords: COVID-19, local food and knowledge, West Papua

INTRODUCTION

Previuously, Indonesian New Guinea consisted of two provinces, West Papua and Papua Province, which are very rich in terms of flora and fauna biodiversity (Cámara-Leret et al. 2020), cultures, indigenous knowledge as well as local food diversity, traditional recipes, and ethnic diversity (Ananta et al. 2016). Since 2021, this second largest island in Indonesia after Kalimantan has been administrated with four new provinces, namely South Papua, Papua Pegunungan, and Central Papua from Papua Province, and Southwest Papua from the West Papua province, Indonesia. Today, there are six provinces in total. Customary areas and genetic relationships are among the determined factors in dividing the boundary of these four new provinces. It has natural characteristics for its food, vegetables, fruits, houses, and domestic or wild animal consumption (Pattiselanno et al. 2020).

Indonesian New Guinea has various topographies from coast to mountains, mangrove to alpine vegetation, and consuming fishes to wild meat for protein sources, as well as hot in coastal areas to cold in the mountainous areas. Indigenous communities are the local people born and originally from this island having the customary land, while those without customary land are grouped as the local people. They are both the local inhabitants and hereafter designed as the indigenous communities. These indigenous communities live inside, outside, and next to their customary forest or land, cultivating their local foods with simple tools and traditional farming or subsistence agriculture practices (Wahyudi 2014), and these practices are classified as slash-and-burn agriculture (Murdjoko et al. 2022). Most of their local foods are collected from their surrounding forest, cultivated and opened areas classified as secondary forests, practicing subsistence agriculture, slash-and-burn system, and hunting wild meat to get animal protein (Wahyudi 2017).

Local foods are various foods, meals, and drinks consumed by local communities based on their local potential resources and knowledge (*Undang Undang No 18 Tahun 2012 Tentang Pangan* 2012). Local foods have been practiced traditionally by their ancestors for many

generations. Therefore, the local food of the indigenous communities in the coastal areas could be different from those in the mangrove, swamp, and highland areas. West Papua province is inhabited by a diversity of ethnicities, both indigenous and non-indigenous, where the indigenous communities mainly belong to the Arfak tribes, such as Sough, Meyah, Mpur, Wamesa, Sebyar, Irarutu, and the others (Mulyadi et al. 2015). They live from the coastal to the highland areas and consume various foods at their sites. It is approximately 4,514 small to uninhibited islands in which the indigenous people live and rely on their local for their livelihood (Wahyudi et al. 2023). *Sago* is the main staple food of those living in the coastal areas. Fish is the main source of protein and animal fat (Ondikeleuw et al. 2020), while those who live in the mountain area consume sweet potato and potato as their main staple food (Yamamoto et al. 2020) and bush meat for their animal protein and fats (Iyai 2019).

Local knowledge or local wisdom is knowledge practiced by local communities inherited from their ancestors and results of adaptation to their natural condition, and this uniqueness is originally from nature (Sagrim 2022). This knowledge is applied to various livelihood aspects, ranging from crop plantations, food consumption and cultivations, traditional recipes, and utilization of specific plants for medicinal purposes and others (Toansiba et al. 2021; Nainggolan et al. 2022; Ap et al. 2023).

The COVID-19 pandemic has spread out through the globe and West Papua Province without an exception. This global pandemic contributes to difficulties for public transport operations, delivery, health facilities, care shortages, food shortages, and distribution. In contrast, the food shortage, for example, was not applied here in most areas of West Papua Province, both in the towns and villages. It is because of the availability of the local food diversity being planted or cultivated, and even they could be gathered directly from the surrounding resources of the indigenous communities. The local foods are harvested from farming practices, collected from their surrounding customary lands, primary and secondary forests, and used for daily necessities of food, medicine, vegetables, and income (Wahyudi 2017). The indigenous communities practice traditional farming to fulfill their daily nutrition, feed their family, maintain their health and growth, create informal works, generate house income, and make social and cultural obligations to their ancestors and nature. Therefore, this study is designed to investigate and explore the local food diversity at three West Papua Province districts and determine the variety of local food utilization. The local community's perspective on the COVID-19 pandemic roles of local food during this pandemic is recorded.

MATERIALS AND METHODS

Research sites

This research was conducted at three different districts of West Papua Province, Indonesia: Manokwari, South Manokwari, and Teluk Bintuni. The research site at Manokwari District was in the sub-district of North Manokwari, involving three villages: Nuni, Bremi, and Yoom. South Manokwari District consists of two sub-districts: Ransiki and Momiwaren. Two villages in the Ransiki sub-district are Ransiki and Dembek, while Siwi dan Waren were two villages in the Momiwaren Sub-district. Four villages were selected from the Teluk Bintuni District: Inyesta and Tausida were located in the Tuhiba Sub-district, and Atibo and Tihibo Villages represented the Manimeri Sub-district. Research sites are mapped in Figure 1. Number of villages in total were 11. Data were collected during intensive interviews based on a prepared questionnaire; each village has four respondents, or 36 were interviewed. Field visits were also conducted to identify the indigenous communities that cultivated or growing plants in their garden and the cultivation land.

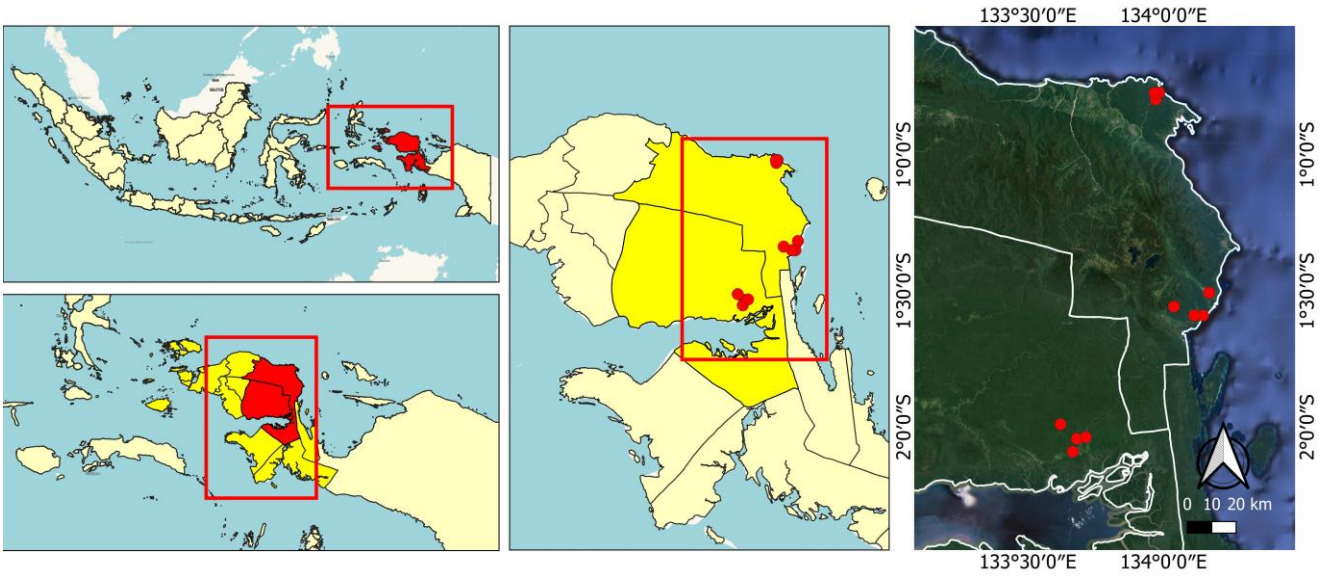

Figure 1. Research sites at three districts of West Papua Province, Indonesia: Manokwari, South Manokwari, and Teluk Bintuni

Description of the research sites

The 11 villages at three different districts and five sub-districts were selected as the research sites. Teluk Bintuni District has natural characteristics close to the mangrove ecosystem, with swamp vegetation partly with dried agricultural practices. Therefore, using a double cabin car, this place can be reached from the capital city of the West Papua province, Manokwari, approximately 6-7 hours with average weather and dried road. South Manokwari District is dominated by lowland vegetation without water access and can be reached from Manokwari city for four hours driving the double cabin car. Manokwari Utara sub-district can be reached from Manokwari city for 1-2 hours with the double cabin car, and this research site is located next to the north coastal areas of Manokwari District. The three research sites depend on the rainfall for watering their agricultural practices.

Procedure

Field survey

The field survey was conducted twice; the first was an initial survey to examine the availability of targeted respondents and local food commodities. This selection of the targeted villages was conducted due to pandemic COVID-19 restrictions and health protocols and procedures. An initial survey was finished, and 11 villages from 3 districts were selected as research sites, as illustrated in Figure 1. The second survey collected the data and pictures and interviewed the selected respondents. During these surveys, personal health protection and general regulations provided by the COVID-19 local task force, including an official letter of COVID-19 declaration, were applied to the researcher teams, the selected respondents, and community members.

Selected respondents

Stratification methods were used to select the respondents according to the social culture rules of the local communities. Traditional leaders, heads of the villages, the young generation (both men and women), and several highly active women involved directly in local food farming, selling and harvesting, and other involvements are selected for respondents. In total, 30 respondents were interviewed: 11 traditional leaders/heads of villages, one cultural leader, and 18 women of various ages. Most of the respondents for the active farming practices, selling and harvesting their local foods, are women.

Data collection

Data collection was conducted with an interview using the prepared questionnaires. Interviews to collect the data were conducted at many places, i.e., houses, yards, balconies, fields, and agriculture fields. Field visits and surveys were also conducted to collect the picture for supporting data and gather more information regarding the actual condition of the agricultural commodities planted and the condition of the field.

Data analysis

Data collected from interviews and field visits were tabulated and presented in tables and charts. Pictures were also used to display or illustrate the field findings of the local community agricultural practices.

RESULTS AND DISCUSSION

Widely acknowledged, food has been covered with various definitions because food is all consumable material originally gathered from nature and processed in the form of solid, liquid, and in between, with the main goal of providing human needs for growing, developing, and maintaining human health. These local foods recorded and reported here are mostly fresh and edible foods harvested from the farming sites of the local communities. Utilizations of the local foods for various food-based main ingredient sources are grouped for vegetables, carbohydrates, fruits, medicinal purposes, protein and fat producing plant and animal, and cooking energy.

The results indicated that local foods ranging from tubers, vegetables, and fruits to wild animal flesh play significant roles in fulfilling the daily ingredients of the local communities during COVID-19 pandemic. These local foods grow naturally, are partly cultivated, and are managed with their farming or slash-burn rotation systems. These daily activities, such as traditional farming, collecting local foods, and other related activities, contribute to keeping the local communities' human body in a steady state of healthiness, maintaining the spirit of optimism, which will automatically create autoimmune system in response to the COVID-19 virus. The local communities believe nature has a natural response mechanism to finish this pandemic.

The following paragraphs elaborate on the diversities of the local foods functioning for vegetables, carbohydrate sources, protein and fat-producing plants and animals, and others. The last paragraph of this section elaborates on the roles of local foods during the COVID-19 pandemic concerning the indigenous communities' perceptions, attitudes, and actions.

Vegetables

The list of plants, their botanical and local names, and parts of plants utilized for vegetables by the local communities at three districts in West Papua Province are tabulated in Table 1.

Table 1 indicates that the indigenous communities at three research sites, Manokwari, South Manokwari, and Teluk Bintuni, had similarities in harvesting and consuming the local foods for vegetable purposes. Therefore, 19 plants are consumed for vegetables, cultivated and harvested from their surrounding environment. The Gnemo, in national terms acknowledged as *melinjo*, *katok*, and *nangka*, were absent at South Manokwari and Teluk Bintuni, respectively. It is probably due to the condition of the traditional farming fields, where both locations are arid, without a population of this plant recorded on the field. Still, this plant is consumed and traded by the local community. The leaf is a major part of the plants (87%) used as vegetables, followed by fruits, flowers, and young stems. These local vegetables are consumed mainly by boiling in hot water and mixed with other vegetables during cooking.

Table 1. List of plants, their botanical and local names, and parts of plants utilized for indigenous communities as vegetables at three districts in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of the Plant Used	Method of Consumption	Research Sites		
				M	MS	TB
Kasbi merah lancip	*Ketela pohon/ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot	Washing, boiled, mixed with others and added with local spice, or fried with gentle oil, mixed with other vegetables, and consumed with carbohydrates	√	√	√
Kasbi merah lancate	*Ketela Pohon/ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot		√	√	√
Kasbi daun putih	*Ketela Pohon/Ubi kayu* (*Manihot esculenta*)	Leaf, young leaf/shoot		√	√	√
Gnemo	*Melinjo* (*Gnetum gnemon*)	Leaves, young fruit, seed bark, nut	Leaf, young fruit, and whole seed barks are boiled in water and mixed with another vegetable; nuts are sold	√	-	-
Gedi daun lancip	*Gedi lancip* (*Abelmoschus manihot*)	Leaf	Boiled and fried with gentle oil and mixed with other vegetables	√	√	√
Gedi daun lebar	*Gedi putih* (*Abelmoschus rhodopetalus*)	Leaf		√	√	√
Gedi daun merah	*Gedi merah* (*Abelmoschus filculneus*)	Leaf		√	√	√
Katok	*Katuk* (*Sauropus androgynus*)	Young leaf	Boiled and mixed with other vegetables	√	-	-
Jantung Pisang	*Jantung pisang* *(Musa* spp).	Male flower/ Bracts	Fried with gentle oil and boiled with other vegetables in mixing	√	√	√
Nangka	*Nangka* (*Artocarpus hetrophyllus)*	Young fruits	Pull the outer fruit skin; the inner part was chopped and boiled with water and other vegetables	√	-	-
Batatas merah	*Ubi jalar merah* (*Ipomoea batatas*)	Young leafs and stem	Washing, boiled, mixed with others and added with local spice, or fried with gentle oil and mixed with other vegetables	√	√	√
Betatas putih	*Ubi jalar putih* (*Ipomoea batatas*)	Young leaf and stems		√	√	√
Pepaya	*Pepaya* *(Carica papaya)*	Leaf	Boiled, mixed with others, and added with local spice, or fried with gentle cooking oil	√	√	√
Pepaya	*Bunga pepaya* (*Carica papaya)*	Flower		√	√	√
Ketimun	*Mentimun* (*Cucumis sativus*)	Fruit	Eat directly for salad	√	√	√
Sawi	*Sawi hijau* *(Brassica chinensis)* var. *parachinensi*	Whole leaf	Boiled and fried gently with cooking oil	√	√	√
Labu	*Labu* (*Cucurbita moschata)*	Leaf, and fruit	Leaves are boiled and fried with cooking oil and others; the fruits are steamed, boiled, and sold rapidly.	√	√	√
Bambu	*Tunas Bambu*/Rebung (*Dendrocalamus* spp., *Gigantochloa* spp.)	*Rebung bambu*	Boiled mixed with other, sold in solid or sliced shape	√	√	√
Bayam	*Bayam* (*Amaranthus dubius, A. tricolor, A. cruentus*)	Leaf	Boiled and fried with gentle oil	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Carbohydrate sources

Carbohydrate is an essential nutrient mainly used for producing energy for daily activities. Naturally, carbohydrates are produced from various cultivated and non-cultivated plants. Terms non-cultivated means that these plant-producing carbohydrates are not planted on a massive scale, using systematic irrigation, intensive labor, and care. However, these plants are planted in a very natural way and harvested with the main purpose of fulfilling the daily needs of the main staple food or carbohydrate of the local and indigenous communities.

Plant-producing carbohydrates planted and used by the local communities at three West Papua Province districts are summarized in Table 2. This table shows that the indigenous communities at three districts have various plant-producing carbohydrates, 14 plants in total, and the two plants were confirmed not being consumed. These plants were not on the list recorded on their agricultural land practices but are growing outside as wild plants. Most of the plants used for carbohydrates are the tuber, followed by the mature fruit. These staple foods are consumed in various methods such as boiling, fried with cooking oil, fresh state, and burned in a wood fire. *Pisang kapuk* and *tanduk*, the two bananas, are consumed by exposure or fire in wood, either in the field or in homes.

Table 2. Local, Indonesian, and botanical names of the plant-producing carbohydrates planted and used by the local communities at three districts in West Papua Province

Local Name	Indonesian and Botanical Names	Part of the Plant Used	Method of Extraction or Consumption	Research Sites		
				M	MS	TB
Kasbi daun merah lancip	*Ketela pohon* (*Manihot esculenta*)	Tuber	Boiled and fried with cooking oil	√	√	√
Kasbi daun merah lancete	*Ketela pohon* (*Manihot esculenta*)	Tuber		√	√	√
Kasbi daun putih lancip	*Ketela pohon* (*Manihot esculenta*)	Tuber		√	√	√
Batatas putih	*Ubi Jalar* (*Ipomoea batatas*)	Tuber		√	√	√
Batatas merah	*Ubi Jalar* (*Ipomoea batatas*)	Tuber		√	√	√
Pisang raja	*Pisang raja* (*Musa paradisiaca*)	Mature fruit	Boiled, fresh consumption	√	√	√
Pisang kapuk	*Pisang kepok* (*Musa acuminata* subsp. *acuminata*)	Mature fruit	Boiled, fried with cooking oil, burned on the wood fire	√	√	√
Pisang Tanduk	*Pisang tanduk* (*Musa acuminata* var. *typica)*	Mature fruit	Boiled, burn in the wood fire	√	√	√
Keladi	*Bete/Keladi* (*Caladium esculenta*)	Tuber		√	√	√
Talas	*Talas* (*Colocasia esculenta*)	Tuber		√	√	√
Ganyong	*Ganyong* (*Canna discolor*)	Tuber	-			
Sagu	*Sagu* (*Metroxylon sagu*)	Starch	Dilluted into hot water or	√	√	√
Sukun	*Sukun* (*Artocarpus altilis*)	Mature fruit	Boiled and fried with cooking oil	√	√	√
Uwi/Gembili	*Uwi/Gembili* (*Dioscorea esculenta*)	Tuber	-			√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 3. Local, Indonesian dan botanical names, and part of various plants producing fruit cultivated and harvested by three different local communities in West Papua

Local Name	Indonesian and Botanical Name	Method of Consumption	Research Sites		
			M	MS	TB
Rambutan	*Rambutan* (*Nephelium lappaceum*)	The flesh of fruits is consumed directly	√	√	√
Durian	*Durian* (*Durio zibethinus*)	The flesh of the fruit is consumed directly	√	√	√
Nangka	*Nangka* (*Artocarpus heterophyllus*)	The flesh of the mature fruit is directly consumed	√	√	√
Langsat	*Langsat* (*Lansium domesticum*)	The flesh of fruit consumed directly	√	√	√
Pepaya	*Papaya* (*Carica papaya*)	The flesh of the mature fruit consumed directly	√	√	√
Pisang Ambon	*Pisang ambon* (*Musa paradisiaca*)		√	√	√
Pisang Nona	*Pisang nona* (*Musa banksii*)		√	√	√
Pisang Raja	*Pisang raja* (*Musa acuminata*)		√	√	√
Alpukat	*Alpukat* (*Persea americana*)		√	√	√
Nanas	*Nanas* (*Ananas comocus*)		√	√	√
Geawas	*Jambu biji* (*Psidium guajava*)		√	√	√
Mangga	*Mangga* (*Mangifera indica*)	The flesh of the mature fruit consumed directly	√	√	√
Jambu monyet	*Jambu* air (*Syzygium aqueum*)		√	-	√
Sirsak	*Sirsak* (*Annona muricata*)		√	√	√
Buah Nona	*Srikaya* (*Annona squamosa*)		√	√	√
Matoa	*Matoa* (*Pometia pinnata*)		√	-	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 4. Plants consumed and used with the purpose of medicinal goals, with their local, Indonesian, and botanical names, recorded from three local communities in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of Plants Used	Application Method	Medicinal Purposes	Research Sites		
					M	MS	TB
Cocor Bebek	*Cocor Bebek* (*Kalanchoe pinnata)*	Leaf	Leaves are washed, crushed, and smeared on the targeted body areas from the fresh wounded, cut, and scratches	Fresh wounds, cuts, and scratches	√	√	√
Batatas merah	*Ubi Jalar* (*Ipomoea batatas*)	Leaf	Young leaves are washed, boiled, fried with gentle oils, and consumed	Diare, menstruation, pain reduction	√	√	√
Jahe	*Jahe* (*Zingiber officinale*)	Rhizome	Washed, sliced, and crushed mixed with other vegetables, drinks, chopped as salad fresh	Cough, body warm-up, cold	√	√	√
Kunyit	*Kunyit* (*Curcuma longa*)	Rhizome	Rhizomes are washed, peeled out of the skin, grated, and extracted with water by squeezing. The extracted water is filtered, poured into the destinated cooking foods, or drunk directly with an addition of honey or lemon	Various local foods ingredients, human immunology, inflammation, menstruation pain killer, bloated stomach, and wound compress	√	√	√
Lengkuas	*Lengkuas* (*Alpinia galanga*)	Rhizome	Washed, sliced, and mixed with the food during cooking	Food flavor, in general	√	√	√
Pare	*Pare* (*Momordica charantia*)	Fruits and young leaf	Chopped the mature fruits, boiled and fried with gentle cooking oil; young leaves are crushed, extracted with cold water, and consumed with honey added	Antimarial purposes were due to its bitterness and phlegm secretion for babies.	√	√	√
Ceplukan	*Ceplukan* (*Physalis angulata*)	Fruits	Consumed mature fruits directly	Inflammation and self-immunology	√	√	√
Jeruk Suanggi	*Sukade* (*Citrus medica*)	Fruit	Sliced and squeezed to collect the water and applied to any fresh food to be cooked; squeeze the skin to get the essential oil for the skin	Source of Citric acid and essential oil for skin protection collected	√	√	√
Jeruk Nipis	*Jeruk nipis* (*Citrus aurantiifolia*)	Fruits	Sliced and squeezed to collect citric acid for beverage flavors, extracted water mixed with warm water and honey, and consumed directly	Beverage and salad flavor, flue and cough, and self-immune system	√	√	√
Jeruk Purut	*Jeruk purut* (*Citrus hystrix*)	Fruit and leaf daun	Mature fruits and young leaves are crushed and mixed with various foods and salads	Various food and salad flavors	√	√	√
Kemangi	*Kemangi* (*Ocimum basilicum*)	leaf and seed	Leaf consumed fresh or mixed directly into a salad or cooking food; seeds are dipped into cold water to swell and mixed with the fruits-beverage	Natural flavor, self-healing, and inflammation	√	√	√
Cabe	*Cabe* (*Capsicum frutescens*)	Fruits	Fresh mature fruits are consumed directly after being mixed with other ingredients	Warming the human body when getting malaria symptoms,	√	√	√
Sereh	*Serai dapur* (*Cymbopogon citratus*)	Stem	Fresh stems boiled with other food during cooking, chopped fresh stems poured with hot water and filtered cold water consumed directly, or added with sugar	Food flavors, immune system, cough and cold recovery, and warm beverage	√	√	√
Giawas	*Jambu biji* (*Psidium guajava*)	Fruit and young leaf	Fruits consumed in fresh and young leaves are chewed and crushed with water to get water extracted and consumed	Source of vitamin C for cold, leaf or its extract for diarrhea recovery	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Fruits

Manokwari, the capital city of West Papua province, is acknowledged as the city of fruits, where the durian, rambutan, and alpukat have unique flavors and textures. These tropical fruits naturally offer various essential ingredients important to humans, such as vitamins, minerals, and fibers. Fruits are enriched with various bioactive compounds serving as natural antioxidants, anti-inflammation, diabetes, and others. The diversity of the fruits, their local, Indonesian dan botanical names, and various plant parts producing fruit cultivated and harvested by the local people in three districts of West Papua Province are tabulated in Table 3.

The variety of the local fruit recorded at three districts was 16, but *Matoa* and *Jambu air* are absent in South Manokwari. This is probably because the selected respondents have no farming lands or these areas without *matoa* and *jambu air* growing. Most local fruits are annual plants with periods or seasons for producing fruits. However, various non-seasoning fruits are capable of producing fruits many times a year, like non-woody plant-producing fruits such as *nanas*, *sirsak*, *buah nona*, papaya, and banana have no seasonal producing fruits, meaning that these plant-producing fruits will produce fruit year-round.

Medicinal plants

The plant has fulfilled all human needs, serving nutrition ingredients, maintaining human health, producing human autoimmune systems, and promoting growth and development. Naturally, these autoimmune systems are acting due to the foods we consume. The consumed plants are widely acknowledged as functional foods, meaning all foods we consume have specific functions for our human body, and foods have various functions as natural drugs.

Plants consumed and used with medicinal goals, with their local, Indonesian, and botanical names, recorded from three districts in West Papua Province are shorted in Table 4.

Table 4 illustrates 13 plants recorded from three districts of West Papua Province utilized for traditional medicine, preventing and curating any health problems, diseases, and health syndromes. These plants are grouped as functional foods consumed in single or combined with the others, and their functionalities are designed for specific purposes or consumed as cooking flavors or aromatic agent producers. *Giawas* and *cocor bebek* are the functional plants used in a fresh state for diarrhea recovery and inflammation, respectively.

Protein and fat-producing plants and animal

Plants and animals produce protein and fat most naturally, classified into vegetable and animal fats. The diversity of the plants and animals producing protein and fat recorded from three districts in West Papua province is shown in Table 5. This table highlights the diversity of the local foods used by the local communities at three districts of West Papua Province for sources of protein and fat from plants and animals. Furthermore, seven plant-producing protein and fats were recorded from three districts, and six animal-producing protein and fat from districts, except for Mangrove crabs, which is only recorded in Teluk Bintuni (TB) District. This is highly related to the natural habitat of mangroves in this area, which are absent both in South Manokwari and Manokwari Utara, mainly on the research sites. Interestingly, the majority of protein and fat collected from the animal is from hunting animals or wild animals, except for domestic chicken (*ayam kampung*).

Cooking energy

Generally, the energy consumption for indigenous communities in West Papua province could be differentiated into energy for electricity and domestic consumption, mainly for kitchen energy or cooking, warming houses, and others. Herewith, energy consumption is more focused on cooking energy or firewood. Home energy for lighting, electronic devices, and others is supplied by the governmental authority for national electricity, even though the official services are short of 6-12 hours, mainly during the night period, and occasionally operate for the whole day and night at the capital city of the district.

Firewood is the indigenous communities' most cooking energy source at three districts. The abundance of woody plants resulting from the shifting cultivations, opening farming land practices, and hunting to the surrounding forest have influenced to support their potential utilization and availability. Firewood is used for cooking energy in the farming field and homes. It is widely acknowledged that kerosene is the most favorable energy for cooking purposes in the Eastern Indonesian archipelago. However, the availability of this non-renewable energy is limited, shortage, and out of stock, and we must be in line to get 5-10 liters, which is time-consuming for most people. This energy is a government subsidiary program for the poorest. Utilizing firewood also produced added values for charcoal, which could be used for another energy and natural soil absorbent and ash for natural fertilizer for the local plants producing foods.

Perceptions, attitudes, and actions of COVID-19

COVID-19 is a global pandemic, and the impacts were systematic to all aspects of human civilizations. Nowadays, these multiple impacts are still being perceived globally in the economic sectors, food and energy productions, distributions, and others. The indigenous communities in West Papua Province experienced this pandemic difficulty living generally in the traditional way, and they were not overwhelmed to react and adapt to these extraordinary conditions. It is in contrast to those living in the modern society or city, where worry, fear, anxiety and other mental health issues dominate their daily life. The indigenous communities' perceptions, attitudes, and actions in responding and adapting to this pandemic COVID-19 are documented to be shared with the others.

Various responses are recorded from the indigenous communities of three districts across West Papua Province, related to their perceptions, attitudes, and actions personally and communally due to COVID-19. These responses are summarized in Table 6.

Table 5. Diversity of the plant and animal producing protein and fat, with their local, Indonesian, and botanical names recorded from three districts in West Papua Province, Indonesia

Local Name	Indonesian and Botanical Names	Parts of the Plant Used	Consumption Method or Preparation	Research Sites		
				M	MS	TB
Plant Group						
Kacang tanah	*Kacang tanah* (*Arachis hypogaea*)	Seed/Peanut	Peanuts consumed while fresh or boiled in hot water	√	√	√
Kacang panjang	*Kacang panjang* (*Vigna cylindrica*)	Seed pod and young pods	Mature or young pods consumed fresh or boiled with another vegetable, fried gently with cooking oil and other vegetables	√	√	√
Buncis	*Kacang buncis* (*Phaseolus vulgaris*)	Pods	Boiled and or fried gently with cooking oil combined with other vegetables		√	√
Buah Merah	*Buah merah* (*Pandanus conoideus*)	Fruits	Seed peeled out from the cobs, boiled with hot water using a pan to collect oil and filtrate	√	√	√
Jagung	*Jagung* (*Zea mays*)	Corncob	Corn boiled, roasted, and cut into small size mixed with other vegetables	√	√	√
Kacang ijo	*Kacang Ijo* (*Vigna radiata*)	Mung beans	Bean boiled and mixed with coconut milk and sugar			√
Kelapa	*Kelapa* (*Cocos nucifera*)	Coconut	Young and mature coconuts are consumed freshly or extracted to collect coconut milk and poured into any cooking food	√	√	√
Animal group						
Kuskus	*Kuskus* (*Spilocuscus papuensis*); (*Phalanger gymnotis*)	Flesh	Flesh extracted from the skin and bone, roasted and boiled to be consumed	√	√	√
Tikus tanah	*Bandikut* (*Isoodon macrourus*)	Flesh	Whole body roasted or boiled and consumed for their meat	√	√	√
Rusa	*Rusa* (*Cervus timorensis*)	Flesh	Extract the flesh, boiled or roasted, for eating meat	√	√	√
Babi	*Babi* (*Sus scrofa* subsp. *domesticus*)	Flesh	Extract the flesh, boiled, or roasted to be consumed	√	√	√
Ayam	*Ayam kampung* (*Gallus gallus* f. *domesticus*)	Flesh	Flash consumed by boiling and roasted	√	√	√
Caraca	Mangrove crap (*Scylla serrata*)	Flesh	Flash consumed by boiling in hot water	-	-	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 6. Various responses were recorded from the indigenous communities at three districts across West Papua Province, Indonesia

Responds	COVID-19 Attributes			Research Sites		
	Perception	Attitudes	Action	M	MS	TB
Causing death	√	-	-	√	√	√
Believe in this pandemic from God	√	-	-	√	√	√
It could be managed and finished naturally	√	-	-	√	√	√
Positive thinking	-	√	√	√	√	√
Calm and not panic	-	√	√	√	√	√
Live normally	-	√	√	√	√	√
Friendly with nature	-	√	√	√	√	√
Consume local food and its ingredients.	-	√	√	√	√	√
COVID-19 safety regulation (health protocol)	-	√	√	√	√	√
Personal health resilience	-	√	√	√	√	√
Local community own resilience	-	√	√	√	√	√
Personal soul/non-physical resilience	-	√	√	√	√	√
Physical resilience	-	√	√	√	√	√
Resilience of inflation or rising prices of the daily basic needs	-	√	√	√	√	√
The resilience of attitude and behavior for collaboration, togetherness, and unitedness	-	√	√	√	√	√
Natural occurrence	√	-	-	√	√	√

Note: M: Manokwari, SM: South Manokwari, TB: Teluk Bintuni

Table 6 illustrates various responses classified for perception, attitudes, and actions recorded from the research sites related to COVID-19. The majority of the respondents positively responded through their perceptions. They acknowledged that the pandemic COVID-19 could cause death to all humans. However, the indigenous community had the deepest relation to their natural surrounding environment, including God, and believed in the natural power of recovery. Their perception also highlights that this pandemic will be recovered naturally.

Related to the attitudes, the indigenous communities majority had positive thinking about this pandemic, living normally and friendly with the surrounding nature, consuming their local foods on the research sites, keeping physical activities in farming land, and were resilient for the personal and communal member. At the same time, collaboration and obeying the local government and COVID-19 safety regulations were essential in preventing and isolating the spread and ending this pandemic. Table 6 also summarizes that the attitudes and actions of the indigenous communities in responding to the COVID-19 pandemic are similar and applied to the three districts across West Papua Province.

Discussion

Local foods and knowledge exist in the indigenous communities at three districts across the West Papua Province: Manokwari, South Manokwari, and Teluk Bintuni. They have contributed to overcoming the difficulty, offensiveness, and boundary restriction period of COVID-19. The local foods combined with the local wisdom of the indigenous community can provide and fulfill the livelihood needs of the local communities for a range of necessities (Zhang et al. 2019), such as carbohydrates, vegetables, vitamins, protein, and fat, as well as the auto human immune system required for personal and communal resilience to COVID-19. Diversity and availability of local food for any consumption needs and times of consumption are the two advantages compared to processed foods supplied from factories or any others or instant or fabricated foods (Afriansyah and Dewiyanti 2020). The local foods also provide multiple benefits to the indigenous communities, from fulfilling their health ingredients and nutrition (Hujairin et al. 2017) to offering extra work to gather an extra household income (Toansiba et al. 2021). Physical exercise, exposure to direct sunlight, and fresh open air are all required to defend the COVID-19 recovery.

Figure 2. Group of sweet potato stems planted by the indigenous community, A. Cuttings of sweet potato stem, B. Growth of the sweet potato cutting

Figure 3. Local recipe for *Garnisun* consisting of leaves of A. Sweet potato and papaya and B. Young leaf of pumpkin or tendril

The local wisdom in cultivating, harvesting, preparing, and consuming the local foods in fresh or processed stages has enriched the diversity and availability and multiplied the essential ingredients and nutritious elements for the local community's health and fitness. In standard methods, a single sweet potato stem is planted on a single hole for optimum growth, development, and production of tubers. However, the indigenous communities have different perspectives, and they are planting sweet potato stems an average of 4 to 5 stems together in a single hole and planting in the dominant sandy soil (illustrated in Figure 2.A-B). Planting more than a single stem on a single hole is probably due to the main concern of the watering system or water unavailability, which relies entirely on rainfall for plant watering. It also sounds logical, makes sense and reasonable that when a single stem is dead, the remaining two or more stems remain to grow, and this probability has been a practice for many generations.

The diversity of the local foods the indigenous communities consume for vegetable purposes at three districts in West Papua Province indicates that the leaves are the dominant part of the plant harvested. These leaves are collected mainly from the plants growing in their surrounding environment and agricultural land practices. Concerning their natural characteristics, these vegetables are rich in nutrients and ingredients required by the human body and health, such as vitamins, minerals, and fiber (Berti and Mulligan 2016). They are the majority annual crops, and 24% of these vegetables belong to seasonal crops such as *labu*, *bayam*, *sawi*, and *ketimun*. These annual crops require less plant care and water demand, and intensive labor or work is optional. This condition is naturally parallel with the availability of agricultural tools, natural characteristics of the research sites, and climate.

The indigenous community also has unique recipes for preparing their vegetable ingredients according to their needs and the availability of the local plants. *Garnisun* is a local-famous name for two vegetables consisting of papaya and sweet potato leaves, as shown in Figure 3.A. The other vegetable in locally high demand is the young leaf of pumpkin or tendril, as illustrated in Figure 3.B.

Garnisun refers to the collectiveness effort or military patrol to combat and maintain conducive situations or security and is applied to the military terminology. In the beginning, it was probably various difficulties with these vegetable recipes. Finally, *Garnisun* was selected to represent the philosophy of combatting any failure condition and maintaining our body for health and fitness. These vegetables are prepared by chopping them into small-thin sizes, washed, and fried in gentle cooking or essential oil with the addition of natural seasoning and flavors depending on the recipe. The general taste and texture are combined bitterness, oiled soft whiteness texture, strong flavors of papaya aromatic, and slippery when swollen. This recipe could be consumed with various traditional sources of carbohydrates or rice and chilled fish.

Figure 4. A. A packet of local foods consisting of boiled taro, sweet potato, vegetables, fish, and pork at the local market close to public transport and B. The flesh of the hunted animals of deer and kangaroos

Figure 5. A. Unripped round firewood material and B. Dried sticks of firewood from mangroves used by the indigenous community at the research sites

The indigenous community at the three districts across West Papua Province had carbohydrates from various sources and plant parts (Bintoro 2020), their sources from tubers, fruits, and starch of their surrounding plants. These whole plants are classified into annual crops, meaning growing and producing carbohydrates yearly (no seasonality). The indigenous community does not consume the two plants known as *ganyong* and *uwi*, they produce carbohydrate plants that grow naturally in their surrounding environment. It is probably due to several reasons, and it could be unrecognized, complicity in preparation, and others. These two local foods could be domesticated and promoted for future food security, mainly potency the local food for food security.

Local foods for the indigenous community act as functional food for their health and fitness. The surrounding environment provides various and never-ending sources of plants potentially utilized for food and beverages. The local foods, in general, are biological ornaments being part of nature willing to support their ecosystem component substances. This situation is also applied to the diversity of fruits and biological matters producing protein and fat consumed by the indigenous community. These potential resources for producing fruits, protein, and fat contribute significantly to the indigenous community's daily livelihood, covering all aspects of health, economy, and society (Cvijanović et al. 2020). A packet of local food recipes and ingredients famous for the local community during traveling is shown in Figure 4. This local food has perfect ingredients and nutrition of carbohydrates, vitamins, minerals, protein, and fat (Sembori and Tanjung 2018). A single traditional food packet is designed to serve a single person, but this could serve more than one person, as illustrated in Figure 4.A. This traditional food packet includes fried and seasoned fish, sweet potato, taro, vegetables, and chili sauce. The protein and fat are frequently replaced with other animal meat, like pork or other meat from hunting wild animals such as deer and kangaroos. The animal flesh collected from the hunted wild animals, deer and kangaroos, is shown in Figure 4.B.

Firewood is still the best option and renewable energy available for the domestic energy needs of the indigenous communities across West Papua Province (Wahyudi et al. 2021). This green energy is easily applied, available at any time required, no additional fabricated material is needed, and less accidental occurrences and everyone can use it. Firewood is biomass or lignocellulosic energy-based, and its abundance in nature is enormous. The indigenous community collects firewood from their surrounding forest or environment without charge. These firewood sources include dead trees, dried branches, residual woody material from land clearing, shifting cultivation, and unproductive trees. A picture of round firewood material available in the research area is presented in Figure 5.A-B.

Concerning the COVID-19 pandemic, most respondents responded that the perceptions, attitudes, and actions collected from the indigenous community at three districts across West Papua Province are similar (Table 6). The main perception of the COVID-19 pandemic is that it can cause death to everyone without exception, but they strongly believe that this pandemic is from God and could be managed and will be finished naturally. This perception indicated that the indigenous communities had complete confidence in adapting to the COVID-19 Pandemic. This confidence of the indigenous communities is actualized in attitudes and actions. Moreover, 12 attitudes and actions are recorded with diverse and deep meanings. These attitudes and actions are an actualization of the local knowledge or wisdom of how the indigenous communities interact and are friendly to their nature, taking care and consuming their local foods (Sagrim et al. 2020) and maintaining their physical and mental health by doing daily and farming activities, follow the COVID-19 safety protocol and obey government pandemic regulations. Besides those facts, the diversity, availability, freshness, and richness of ingredients and nutrition from the local foods consumed always supply the local communities' livelihood needs, energy, and healthiness in natural and sustainable ways (Brunori et al. 2016).

In summary, it is highlighted that the local foods offer major food ingredients and nutrition for the local communities during the COVID-19 pandemic by maintaining their healthiness and fitness. Local food ingredients, complete nutrition facts, and recipes provide extra fulfillment to the local communities' resilience by achieving food security from their local foods. The resiliencies of the local communities are manifested in various perceptions, attitudes, and actions adapted to the COVID-19 pandemic.

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Ethnomedicinal knowledge of Baiga and Gond Tribe and plant diversity in Jagmandal Forest, Mandla, India, with phytosociological diversity and utilization strategies

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Abstract. *Jhariya BL, Pawar M. 2024. Ethnomedicinal knowledge of Baiga and Gond Tribe and plant diversity in Jagmandal Forest, Mandla, India, with phytosociological diversity and utilization strategies. Asian J Ethnobiol 7: 13-21.* In the interior areas of the Mandla District, plants become the source of medicine because of a lack of facilities and remoteness. A medicinal exploration was made to find out the medicinal values of common plants present in the Jagmandal Forest of Mandla District (Mandla, India) during 2020-2023. During the survey, a total of 162 plant species belonging to 64 families were identified as being used for treatment of approximately 43 ailments or therapeutic indications which highest study done so far in the area. It has also been observed that more numbers of medicinal plants were recorded in the family Fabaceae. The majority of plant parts used to prepare treatments for various illnesses were leaves, as evidenced by the fact that leaves were the most often employed component of the plant against various diseases, followed by herbs (42%), trees (33%), climbers (14%), and shrubs (11%). The disease category with the highest ICF value (0.81) was the antiseptic. *Aloe vera*, *Achyranthus aspera*, and *Azadirachta indica* were highly preferred as treatments. More photochemical studies are needed before some of them can be used as drugs to benefit mankind. It is critical to explore, identify, and use new medicinal plants while also assisting in the conservation of existing but threatened species of rare medicinal plants in the area with the support of local communities.

Keywords: Ailments, conservation, local communities, Madhya Pradesh, Mandla, medicinal plant

INTRODUCTION

Forestry provides major and minor forest products and directly and indirectly meets forest dwellers' basic needs. Many communities, mainly those living in tribal-dominated areas, depend upon natural resources for food, materials for construction, firewood, medicines, and other purposes. Moreover, they use various wild plants and have evolved a distinct understanding of the forest's resources. Furthermore, they use diverse wild herbs and have developed a unique awareness of the forest's resources. These rituals, customs, totems, traditions, indigenous healthcare procedures, and other knowledge are passed down through traditional cultures from generation to generation. They are also key to understanding, using, and preserving plant resources. Local people worldwide have always been exceedingly-educated about the plants and other biodiversity on which they rely extensively. The capacity to retain ethnomedicinal traditional knowledge about the history of plants and animals in memory is a God gift for each tribal group's resource person. The tribe used most plant materials to extract forests nearby, including seeds, leaves, tubers, barks, and fruits. The demand for medicinal plants is estimated to be more than USD 14 billion annually, with a projected demand of USD 5 trillion by 2050 (WHO 2002). India has potential markets for medicinal products globally, but at the same time, these medically important plants face severe threats by unregulated and unsustainable harvesting practices. These will also impact the livelihood of dependent tribal communities of the area. In many societies, medicinal plants form the foundation of the healthcare system. Approximately 85% of traditional medicines used for basic healthcare globally are plant-based (Farnsworth et al. 2012). Up to 80% of people worldwide still rely on traditional medicine, and 65% of Indians in rural areas use ayurvedic and medicinal herbs for their basic healthcare demands (WHO 2002; Calderón 2006). Much of this treasure of knowledge is rapidly vanishing, and its potential uses in traditional culture are disappearing. One important concern of ethnomedicinal research is the potential use of plants as medicinal, which is often exclusive to specific communities and linked to the local flora. This knowledge is amassed by experimentation over thousands of years and passed down orally from generation to generation. The present study investigates and documents the medicinal plants as utilized by local communities in Jagmandal and Matiyari Reservoir, Bichhiya block, district Mandla; it also explores the role of weedy plants, especially herbs, which are major components of the traditional health care system and important in floral diversity. An attempt is also made to identify and categorize based on habit and utilization practices of medicinal plants.

MATERIALS AND METHODS

Study area

The Jagmandal forest areas, India consist of three forest ranges, Jagmandal, Bichhiya block, and Ghughri block of East Mandla forest division. These ranges consist of forest areas 24,987.77 ha, 7,410.90 ha, and 34,480.67, respectively. The forest areas also have six forest circles, 32 forest beats, and 124 forest villages. The Gond is the district's most predominant scheduled tribe, although Baiga comes in second, with Pradhan and Kol in third and fourth, respectively. Other tribes, such as Agariya, Andh, Bhaina, Bharia, Bhumia, Paliha, Pando, Pathari, and Saroti, have lower percentages.

Ethics statement and consent to participate

Oral informed consent was obtained before the initiation of data collection in all cases, both at the site level and individually before each interview. Additionally, informants were made aware that our goals were scientific rather than commercial. To participate in this study, participants gave verbal informed consent. They were free to withdraw their consent at any time.

Data collection

Documentation of ethnomedicinal plant data presented in this study was conducted from 2020 to 2022 in Jagmandal forest range villages of Mandla District. Plant specimens identified by standard method (Jain and Rao 1977; Pandey et al. 1991; Mudgal et al. 1997; Singh et al. 2001; Sankara et al. 2023) with their local names were identified with the help of flora of Madhya Pradesh by Verma et al. (1993), native local flora of Jabalpur District by Oommachan and Shrivastava (1996) and available literature. The threatened status of the plants was confirmed with the IUCN Red List and the help of available red data books and publications. Some other researchers who have contributed to the field of ethnobotany as Jain (1963), and Verma et al. (1995), Khan et al. (2008), Kanungo (2016), were also reviewed.

The present course of investigation was conducted through a direct approach involving a field survey in 23 villages situated and scattered in the Jagmandal forest area of the East Mandla forest division, India (Figure 1). They were considered for collecting indigenous tribal knowledge through primary data sources.

Data analysis

The ethnomedicinal survey results were examined using the following criteria: Use Value (UV), Plant Part Value (PPV), Fidelity Level (FL), and Informant Consensus Factor (ICF). The statistical analyses were carried out using Microsoft Excel 2010.

Use Value (UV)

The usage value of species (UV), a quantitative method for determining the relative importance of species known locally, was also determined using the following formula.

$$UV = Ui/N$$

Where Ui denotes the number of use reports indicated by each informant, and N represents the total number of informants questioned for a given plant species. It was estimated using the formula provided by Abe and Ohtani (2003).

Plant Part Value (PPV)

The plant part value (PPV) was determined using the following formula:

$$PPV = RU \text{ plant part}/RU$$

Where RU is the total number of uses recorded for all parts of the plant, and RU plant part is the sum of uses reported for each portion. The portion with the highest PPV is the most popular among the respondents.

Fidelity Level (FL)

Fidelity Level (FL) is the percentage of informants who acknowledged using certain plant species to treat a specific condition in the study location. The FL index is computed using this formula.

$$FL\ (\%) = IP/IU \times 100$$

Where IP is the number of informants who independently reported using a species for the same major ailment, and IU is the total number of informants who referenced the plant for any major ailment.

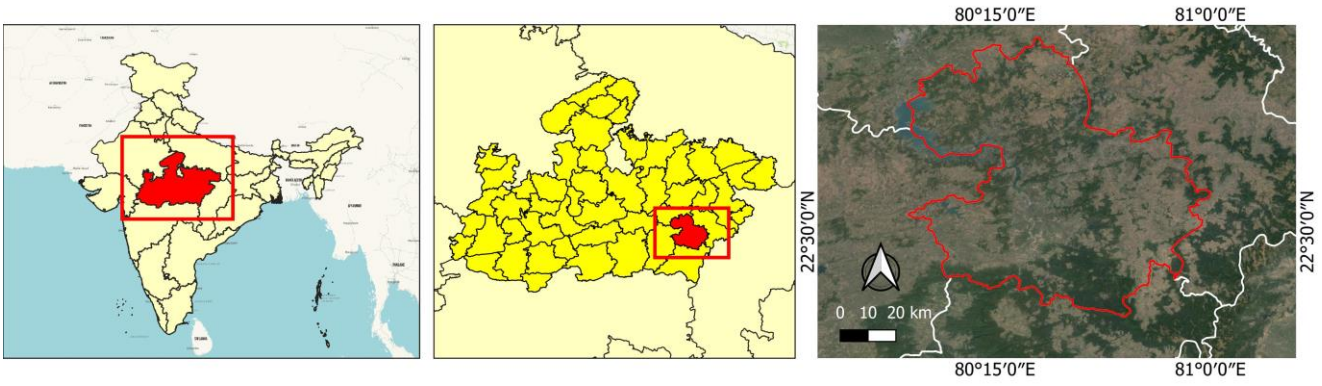

Figure 1. Map of the study area

Informant Consensus Factor (ICF)

It represents informants' consensus regarding using plant species to treat various illnesses (Yabrir et al. 2018).

ICF = (Nur-Nt) / Nur-1

Nur: The number of uses recorded for a certain disease category. Nt: The number of plant species utilized to treat that disease category. The factor's values vary from 0 to 1.

RESULTS AND DISCUSSION

The present investigation documented medicinal plant diversity and the utilization of forest resources in customary practices for curing and treating various diseases. During the investigation, 162 plant species from 60 families were identified as being used to treat around 43 diseases or therapeutic purposes. The Fabaceae family (24) had the most medicinal plants reported, followed by Liliaceae (14), Rubiaceae (8), Zingiberaceae (7), Apocynaceae(6), Asteraceae (6), Malvaceae (6), Cucurbitaceae (5), Caesalpiniaceae (4), Combretaceae (4), Poaceae (4), and Phyllanthaceae (3). Many plant species treat various diseases, including astringency, rheumatism, skin disease, diarrhea, laxatives, jaundice, diabetes, diuretics, purgatives, antidotes, and antipyretics. We attempted to assess the principal plant component useful in therapeutic formulations.

The most common plant types used to make remedies for various ailments were herbs (42%), trees (33%), climbers (14%), and shrubs (11%) (Figure 2). Pandey et al. (1991), Shukla and Pandey (1993), Shukla and Oommachan (1994), Rai et al. (1996), Rai and Nath (2005) and Jhariya (2006) all conducted ethnomedicinal investigations among various tribal populations in Mandla District.

The availability of several plant species for disease therapy may account for a high ICF. Dermatological disorders had the highest ICF value (0.67), followed by respiratory disease (0.63), gastrointestinal disorder (0.61), and fever (0.58) (see Table 1). The highest estimated ICF values imply that informants have the most consensuses about using specific medicinal plant species to treat a given disease. Use value assesses a species' importance to a local community; a higher usage rating indicates that the species is being used more extensively. The use value of a species represents its importance to a community in that location. A high utilization number indicates that the species is being over-exploited. However, a low utilization value may indicate a gradual loss of conventional wisdom on a particular taxon. The current study's utilization value range was 0.01-0.44 for the treatment of astringent (0.44), antipyretic (0.23), antidote (0.19), carminative (0.18), and diarrhea (0.18), as well as aphrodisiac (0.16), plants such as *Achyranthus aspera*, *Aloe vera*, *Azadirachta indica*, *Madhuca longifolia*, *Syzygium cumini*, *Ficus religiosa* and *Cleome viscosa* all have high utilization values. The high-use value species clearly indicate that common species are used to treat common ailments.

The Fidelity Value (FL) is a useful tool for determining which condition a specific species is more effective (see Table 3). For a given plant, an FL of 100% generally means that the same treatment method was reported in all use reports. Furthermore, it is not advisable to discard plants with low FL because doing so could raise the possibility of information gradually disappearing from the planet for future generations.

Periodic surveys and field data were used to compile a list of endemic, rare, and vulnerable medicinal plants. The IUCN red list category and threat assessment procedures for evaluating the status of medicinal plants were applied based on the threat area. Eleven vulnerable species, four near threatened, and six least concern species have been identified from the collected data in Table 2 with names of plant species, families, and aliments.

Table 1. Information Consensus Factor (ICF) of reported plant species against various ailments

Disease Category	Ailments	Nur	Nt	ICF
Blood & Tissue related Disorder	Anemia, Demulcent, Tumor, Diabetes	22	13	0.43
Body Energizers	Brain Tonic, Nutrient,	13	6	0.58
Dermatological Disorder	Antiseptic, Astringent, Emollient, Skin disease	94	32	0.67
Eye Nose mouth Related Disorder	Eye disease, Throat trouble, Ulcer	16	8	0.53
Fever	Antipyretic, Febrifuge, Malarial fever, Plague	30	13	0.59
Gastrointestinal Disorder	Carminative, Cathartic, Diarrhea, Jaundice, Kidney Stones, Laxative, Purgative, Vermifugo, Worms	137	54	0.61
Muscles Tissue	Rheumatism	14	13	0.08
Other	Antidote, Growth of Hair, Sedative	26	15	0.44
Respiratory Disease	Leprosy, Asthma, Cooling, Cough	28	10	0.67
Ureo genital Disorder	Abortifacient, Aphrodisiac, Diuretic, Emmenagogue, Leucorrhoea, Piles, Venerl disease, Sterility	47	27	0.43

Note: Nur: Number of uses reported for a particular disease category. Nt: Number of plant species used to treat that disease category; ICF: Informant Consensus Factor

Table 2. Ethnomedicinal diversity with aliments, botanical name, local name, family name and IUCN Status in Jagmandal Forest Range, Mandla Madhya Pradesh, India

Botanical Name	Family Name	Habit	Local Name	Ailments	IUCN Status
Abelmoschus manihot (L.) Medik.	Malvaceae	Herb	*Van-Bhindi*	Emmenagogue	Not Evaluated
Abrus precatorius L.	Fabaceae	Climber	*Ratti*	Purgative	Not Evaluated
Abutilon glaucum (Cav.) Sweet	Malvaceae	Shrub	*Kakai- Pandai*	Antipyretic	Not Evaluated
Achyranthes aspera L.	Amaranthaceae	Herb	*Chirchira*	Asthma, Baldness, Hair growth	Not Evaluated
Adhatoda vasica Nees	Acanthaceae	Tree	*Adusa*	Asthma, Antipyretic	Not Evaluated
Adiantum sp.	Polipodiaceae	Herb	*Hansra*	Emollient	Not Evaluated
Adina cordifolia (Roxb.) Brandis	Rubiaceae	Tree	*Haldu*	Febrifuge	Not Evaluated
Aegle marmelos (L.) Corrêa	Rutaceae	Tree	*Bel*	Diabetes, Diarrhoea	Near Threatened
Agave sisalana Perrine.	Agavaceae	Herb	*Kataki*	Antipyretic, Skin disease	Not Evaluated
Alangium salviifolium (L.f.) Wangerin.	Cornaceae	Tree	*Kankey*	Ulcer	Not Evaluated
Andrographis paniculata (Burm.f.) Wall. Ex Nees.	Liliaceae	Herb	*Kalmegh*	Malarial fever	Vulnerable
Antidesma acidum Retz.	Phyllanthaceae	Herb	*Khatta- amthi*	Antidote	Not Evaluated
Aristolochia indica L.	Aristolochiaceae	Shrub	*Easwarmool*	Antiseptic	Not Evaluated
Aristolochia littoralis Parodi	Aristolochiaceae	Climber	*Mushti*	Antipyretic	Not Evaluated
Asparagus racemosus Willd.	Asparagaceae	Climber	*Shatavar*	Aphrodisiac	Vulnerable
Asplenium sp.	Aspleniaceae	Climber	*Sankar-Jata*	Diuretic	Not Evaluated
Azanza lampas (Cav.) Alef.	Malvaceae	Shrub	*Van-Kapas*	Venereal disease	Not Evaluated
Bambusa bambos (L.) Voss	Poaceae	Herb	*Katang- Bans*	Cough	Not Evaluated
Bauhinia malabarica Roxb.	Caesalpiniaceae	Herb	*Amta*	Astringent	Not Evaluated
Bauhinia racemosa Lam.	Caesalpiniaceae	Tree	*Amthi*	Diarrhoea	Not Evaluated
Bauhinia ungustif L.	Caesalpiniaceae	Tree	*Kachnar*	Worms	Least Concern
Boerhavia diffusa L.	Nyctaginaceae	Tree	*Pathor-Chata*	Diuretic	Least Concern
Bombax ceiba L.	Malvaceae	Herb	*Semal*	Ulcer	Not Evaluated
Bonnaya tenuifolia (Colsm.) Spreng.	Linderniaceae	Herb	*Viskhapri*	Skin disease	Not Evaluated
Boswellia serrata Roxb.	Burseraceae	Tree	*Salai*	Rheumatism	Not Evaluated
Bridelia retusa (L.) A.Juss.	Phyllanthaceae	Tree	*Kasai*	Aphrodisiac	Not Evaluated
Buchanania lanzan Spreng.	Anacardiaceae	Tree	*Char*	Skin disease	Least Concern
Butea monosperma (Lam.) Kuntze.	Fabaceae	Tree	*Palas*	Diabetes, Tumor	Not Evaluated
Butea ungus Roxb. Ex Willd.	Fabaceae	Tree	*Palash-bel*	Astringent	Not Evaluated
Cajanus crassus (Prain ex King) Maesen	Fabaceae	Climber	*Vansemi*	Purgative	Not Evaluated
Careya herbacea Roxb.	Lecythidaceae	Climber	*Bhui – Kumhi*	Antipyretic	Not Evaluated
Cassia fistula L.	Liliaceae	Herb	*Amaltas*	Laxative	Least Concern
Catunaregam spinosa (Thunb.) Tirveng.	Rubiaceae	Tree	*Mainhar*	Ulcer	Not Evaluated
Celastrus paniculatus Willd.	Celastraceae	Tree	*Orangul, Malkangni*	Rheumatism	Not Evaluated
Centella asiatica (L.) Urb.	Apiaceae	Climber	*Bramhi*	Brain Tonic	Vulnerable
Chlorophytum tuberosum (Roxb.) Baker	Asparagaceae	Herb	*Safed- Musli*	Aphrodisiac	Vulnerable
Chloroxylon swietenia DC.	Rutaceae	Herb	*Bhirra*	Antiseptic	Not Evaluated
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Tree	*Kadu- Kachria, Indrayan*	Jaundice	Not Evaluated
Coccinia grandis (L.) Voigt	Cucurbitaceae	Climber	*Jangli-Kundru*	Jaundice	Not Evaluated
Colocasia indica (Lour.) Kunth	Araceae	Herb	*Jangli – Arbi*	Antidote	Not Evaluated
Convolvulus arvensis L.	Convolvulaceae	Herb	*Hirankhuri*	Cathartic	Not Evaluated
Cordia macleodii (Griff.) Hook.f. & Thomson	Boraginaceae	Climber	*Silvat*	Jaundice	Not Evaluated
Crotalaria ramosissima Roxb.	Fabaceae	Tree	*Van San*	Purgative	Not Evaluated
Crotalaria spectabilis Roth	Fabaceae	Herb	*Van San*	Skin disease	Not Evaluated
Crotalaria verrucosa L.	Fabaceae	Herb	*Hardul*	Throat trouble	Not Evaluated
Cucumis trigonus Roxb.	Cucurbitaceae	Herb	*Indrawan*	Worms	Not Evaluated
Curculigo orchioides Gaertn.	Amaryllidaceae	Climber	*Kalimusli*	Jaundice	Not Evaluated
Curcuma aromatica Salisb.	Zingiberaceae	Herb	*Van- Haldi*	Carminative	Not Evaluated
Curcuma caesia Roxb.	Zingiberaceae	Herb	*Kalihaldi*	Asthma	Not Evaluated
Curcuma neilgherrensis Wight	Zingiberaceae	Herb	*Tikhur*	Cooling	Not Evaluated
Cuscuta reflexa Roxb.	Convolvulaceae	Herb	*Amerbel*	Demulcent	Not Evaluated
Cyperus rotundus L.	Cyperaceae	Climber	*Gangaua*	Venereal disease	Not Evaluated
Datura metel L.	Solanaceae	Herb	*Dhatura Kala*	Rheumatism	Not Evaluated
Dendrocalamus strictus (Roxb.) Nees	Poaceae	Herb	*Bans*	Astringent	Not Evaluated
Dendrophthoe falcata (L.f.) Ettingsh.	Loranthaceae	Shrub	*Bandha*	Astringent	Not Evaluated
Desmodium triflorum (L.) DC.	Fabaceae	Herb	*Van-Maithi*	Astringent	Not Evaluated

Dillenia pentagyna Roxb.	Liliaceae	Herb	*Karmal*	Laxative	Vulnerable
Dioscorea bulbifera L.	Dioscoreaceae	Herb	*Jarda-Kand*	Tonic	Near Threatened
Dioscorea hispida Dennst.	Liliaceae	Climber	*Bechandi*	Nutrient	Not Evaluated
Dioscorea pentaphylla L.	Liliaceae	Climber	*Kadu-Kand*	Piles, Worms	Not Evaluated
Diospyros melanoxylon Roxb.	Ebenaceae	Tree	*Tendu*	Diarrhoea	Not Evaluated
Diplocyclos palmatus (L.) C.Jeffrey	Cucurbitaceae	Climber	*Doker-Bel, Shivlingi*	Eye disease, Febrifuge	Not Evaluated
Drimia indica (Roxb.) Jessop.	Asparagaceae	Herb	*Jangli-Pyaj*	Eye disease, Kidney Stone, Piles, Skin disease	Vulnerable
Eclipta ungustif (L.) L.	Asteraceae	Herb	*Ghamra, bhiringaraj*	Rheumatism	Not Evaluated
Ehretia aspera Willd.	Boraginaceae	Herb	*Datranga*	Febrifuge	Not Evaluated
Elephantopus scaber L.	Asteraceae	Herb	*Van-tambaku*	Astringent	Not Evaluated
Embelia robusta Roxb.	Primulaceae	Herb	*Bibidang*	Worms	Not Evaluated
Eranthemum purpurascens Wight ex Nees.	Acanthaceae	Shrub	*Ban-Tulsi*	Asthma, Leucorrhoea	Not Evaluated
Eulaliopsis binata (Retz.) C.E.Hubb.	Poaceae	Shrub	*Soom- Ghans*	Antidote	Not Evaluated
Euphorbia hirta L.	Euphorbiaceae	Herb	*Doodhi*	Diarrhoea	Least Concern
Evolvulus alsinoides (L.) L.	Convolvulaceae	Herb	*Shankh-puspi*	Brain Tonic	Not Evaluated
Ficus hispida L.f.	Liliaceae	Tree	*Bhuin gular, Daduri*	Laxative	Not Evaluated
Flemingia macrophylla (Willd.) Kuntze ex Merr.	Fabaceae	Shrub	*Bhaisatad Kala*	Ulcer	Not Evaluated
Flemingia semialata Roxb. Ex W.T.Aiton	Fabaceae	Tree	*Vanchana*	Astringent	Not Evaluated
Flemingia strobilifera (L.) W.T.Aiton	Fabaceae	Shrub	*Bhaisakand Safed*	Aphrodisiac	Not Evaluated
Gardenia latifolia Aiton	Rubiaceae	Tree	*Papde, Paniabellow*	Astringent	Not Evaluated
Globba marantina L.	Zingiberaceae	Herb	*Gangi*	Carminative	Not Evaluated
Gloriosa superb L.	Liliaceae	Herb	*Kalihari*	Abortifacient	Vulnerable
Grona heterocarpos (L.) H.Ohashi & K.Ohashi	Fabaceae	Herb	*Char Patti*	Diabetes	Not Evaluated
Guilandina bonduc L.	Caesalpiniaceae	Climber	*Gataran*	Febrifuge	Not Evaluated
Gymnema sylvestre (Retz.) R.Br. ex Sm.	Apocynaceae	Herb	*Gudmar*	Diabetes	Vulnerable
Helicteres isora L.	Sterculiaceae	Climber	*Marod – Phalli*	Diarrhoea	Not Evaluated
Hellenia speciosa (J.Koenig) S.R.Dutta	Zingiberaceae	Shrub	*Keokand*	Astringent	Not Evaluated
Hemidesmus indicus (L.) R.Br.	Apocynaceae	Shrub	*Anantmul*	Antipyretic	Not Evaluated
Hibiscus sabdariffa L.	Malvaceae	Herb	*Aamadi*	Diuretic	Not Evaluated
Holarrhena pubescens Wall. Ex G.Don	Apocynaceae	Tree	*Dhudhi, Katuj*	Diarrhoea	Not Evaluated
Indigofera oblongifolia Forssk.	Fabaceae	Tree	-	Antidote	Not Evaluated
Jatropha curcas L.	Euphorbiaceae	Shrub	*Ratanjot*	Skin disease	Not Evaluated
Lannea coromandelica (Houtt.) Merr.	Liliaceae	Herb	*Gunja*	Laxative	Not Evaluated
Lawsonia inermis L.	Lythraceae	Tree	*Mehndi*	Growth of hair	Not Evaluated
Litsea glutinosa (Lour.) C.B.Rob.	Lauraceae	Herb	*Maida*	Diarrhoea	Vulnerable
Madhuca longifolia (L.) J.F.Macbr.	Sapotaceae	Tree	*Mahua*	Skin disease	Not Evaluated
Mangifera indica L.	Anacardiaceae	Tree	*Aam*	Diabetes, Jaundice	Not Evaluated
Miliusa tomentosa (Roxb.) Finet & Gagnep.	Annonaceae	Tree	*Kari*	Cathartic	Not Evaluated
Mimosa pudica L.	Mimosaceae	Herb	*Lajwanti*	Diuretic	Not Evaluated
Mitragyna parvifolia (Roxb.) Korth.	Rubiaceae	Tree	*Mundi*	Skin disease	Not Evaluated
Mucuna pruriens (L.) DC.	Fabaceae	Shrub	*Kiwanch*	Aphrodisiac	Not Evaluated
Nelumbo nucifera Gaertn.	Liliaceae	Climber	*Kamal*	Piles	Not Evaluated
Nyctanthes arbor-tristis L.	Oleaceae	Herb	*Harshaingar*	Rheumatism	Not Evaluated
Olax scandens Roxb.	Olacaceae	Tree	*Hardull*	Aneamia	Not Evaluated
Oroxylum indicum (L.) Kurz	Bignoniaceae	Tree	*San-padhar, Jai Mangal*	Carminative	Not Evaluated
Oxalis corniculata L.	Oxialidacceae	Tree	*Amroolsag*	Plugo	Not Evaluated
Pavetta indica L.	Rubiaceae	Herb	*Narisa*	Rheumatism	Not Evaluated
Pennisetum alopecuroides (L.) Spreng.	Poaceae	Herb	*Gangerua*	Antidote	Not Evaluated
Pergularia daemia (Forssk.) Chiov.	Apocynaceae	Climber	*Dudhibel*	Rheumatism	Not Evaluated
Peristrophe bicalyculata (Retz.) Nees	Acanthaceae	Herb	-	Antidote	Not Evaluated
Peucedanum nagpurense (C.B.Clarke) Prain	Apiaceae	Herb	*Tejraj*	Demulcent	Not Evaluated
Phyllanthus emblica L.	Liliaceae	Tree	*Amla*	Laxative	Least Concern
Phyllanthus urinaria L.	Phyllanthaceae	Herb	*Lal Bhui- Amla*	Jaundice	Not Evaluated
Plumbago zeylanica L.	Plumbaginaceae	Herb	*Chitrak*	Abortifacient, Skin disease, Women Sterility	Not Evaluated

Pterocarpus marsupium Roxb.	Fabaceae	Tree	*Bija*	Diabetes	Near Threatened
Pueraria ungusti (Roxb. Ex Willd.) DC.	Fabaceae	Tree	*Ghorbal*	Demulcent, Emmenagogue	Not Evaluated
Randia uliginosa (Retz.) Poir.	Rubiaceae	Tree	*Kalapathar*	Cathartic	Not Evaluated
Ricinus communis L.	Euphorbiaceae	Tree	*Arandi*	Purgative	Not Evaluated
Schleichera oleosa (Lour.) Oken.	Sapindaceae	Tree	*Kusum*	Skin disease	Not Evaluated
Schrebera swietenioides Roxb.	Liliaceae	Tree	*Harakatul*	Leprosy	Not Evaluated
Semecarpus anacardium L.f.	Anacardiaceae	Tree	*Bhilma*	Cough, Rheumatism	Not Evaluated
Senna occidentalis (L.) Link.	Fabaceae	Tree	*Kasondhi*	Purgative	Not Evaluated
Senna tora (L.) Roxb.	Fabaceae	Herb	*Chakoda*	Purgative	Not Evaluated
Shorea robusta C.F.Gaertn.	Dipterocarpaceae	Herb	*Sal*	Astringent	Not Evaluated
Sida cordifolia L.	Malvaceae	Tree	*Khareta*	Diuretic, Rheumatism	Not Evaluated
Smilax zeylanica L.	Smilacaceae	Herb	*Ram–datun*	Rheumatism	Not Evaluated
Solanum melongena L.	Solanaceae	Herb	*Banbhata*	Throat trouble	Not Evaluated
Solanum melongena subsp. *Melongena*	Solanaceae	Herb	*Barhatta*	Purgative	Not Evaluated
Solanum virginianum L.	Liliaceae	Herb	*Bhat kataiya*	Piles, Purgative	Not Evaluated
Sonchus oleraceus L.	Asteraceae	Herb	*Dudhi*	Cough	Not Evaluated
Soymida febrifuga (Roxb.) A.Juss.	Meliaceae	Herb	*Rohan*	Diarrhoea	Not Evaluated
Sphaeranthus indicus L.	Asteraceae	Tree	*Gorakh-Mundi*	Antiseptic	Not Evaluated
Sterculia urens Roxb.	Liliaceae	Herb	*Kurllu*	Laxative	Not Evaluated
Sterculia villosa Roxb. Ex Sm.	Liliaceae	Tree	*Kinhi*	Laxative	Not Evaluated
Stereospermum chelonoides (L.f.) DC.	Bignoniaceae	Tree	*Ghata*	Diuretic	Not Evaluated
Swertia angustifolia Buch.-Ham. Ex D.Don	Gentianaceae	Tree	*Chirayata*	Antipyretic	Not Evaluated
Syzygium cumini (L.) Skeels	Myrtaceae	Herb	*Jamun*	Diabetes, Jaundice	Not Evaluated
Tamarindus indica L.	Fabaceae	Tree	*Emli*	Skin disease	Not Evaluated
Tamilnadia uliginosa (Retz.) Tirveng. & Sastre	Rubiaceae	Tree	*Safed-Katul*	Diarrhoea	Not Evaluated
Tectona grandis L.f.	Lamiaceae	Tree	*Sagoun*	Antiseptic	Not Evaluated
Tephrosia purpurea (L.) Pers.	Fabaceae	Herb	*Van-Kulthi*	Kidney Stone	Not Evaluated
Tephrosia villosa (L.) Pers.	Fabaceae	Herb	*Van – Kulthi*	Diabetes	Not Evaluated
Terminalia anogeissiana Gere & Boatwr.	Combretaceae	Tree	*Dhawa*	Venereal disease	Near Threatened
Terminalia arjuna (Roxb. Ex DC.) Wight & Arn.	Combretaceae	Tree	*Arjun*	Astringent	Not Evaluated
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	Tree	*Baheda*	Cough, Laxative	Not Evaluated
Terminalia chebula Retz.	Liliaceae	Tree	*Harra*	Laxative	Not Evaluated
Terminalia elliptica Willd.	Combretaceae	Tree	*Saja*	Rheumatism	Not Evaluated
Thalictrum foliolosum DC.	Liliaceae	Tree	*Mumri*	Piles	Vulnerable
Themeda quadrivalvis (L.) Kuntze.	Liliaceae	Herb	*Ghonad*	Laxative	Not Evaluated
Thymus linearis Benth.	Lamiaceae	Herb	*Van-Ajvine*	Vermifugo	Not Evaluated
Tribulus pentandrus Forssk.	Zygophyllaceae	Shrub	*Ondhi*	Diuretic	Not Evaluated
Trichosanthes bracteata (Lam.) Voigt	Cucurbitaceae	Herb	*Lal-Indrayan*	Jaundice	Not Evaluated
Tridax procumbens L.	Asteraceae	Herb	*Patharchatta*	Astringent	Not Evaluated
Uraria lagopodioides (L.) DC.	Fabaceae	Herb	*Gahua*	Astringent	Not Evaluated
Uraria picta (Jacq.) Desv. Ex DC.	Fabaceae	Tree	*Patvan*	Antidote	Vulnerable
Vachellia nilotica (L.) P.J.H.Hurter & Mabb.	Fabaceae	Tree	*Babool*	Diarrhoea, Vomiting, Loose Motion	Not Evaluated
Vallaris solanacea (Roth ex Roem. & Schult.) Kuntze.	Apocynaceae	Climber	*Duddebel*	Skin disease	Not Evaluated
Ventilago ungustifol Willd.	Rhamnaceae	Climber	*Papadebel, Keotibel*	Carminative	Not Evaluated
Vitex negundo L.	Lamiaceae	Climber	*Nirgundi*	Rheumatism	Not Evaluated
Wendlandia exserta DC.	Rubiaceae	Tree	*Tilwan*	Astringent	Not Evaluated
Woodfordia fruticosa (L.) Kurz	Lytheaaceae	Shrub	*Surtili*	Diarrhoea,Jaundice	Not Evaluated
Wrightia tinctoria (Roxb.) R.Br.	Apocynaceae	Tree	*Badi-Dodhi*	Astringent	Not Evaluated
Xanthium strumarium L.	Asteraceae	Herb	*Gokhru*	Rheumatism, Sedative	Not Evaluated
Zingiber capitatum Roxb.	Zingiberaceae	Herb	*Ganjal*	Carminative	Not Evaluated
Zingiber montanum (J.Koenig) Link ex A.Dietr.	Zingiberaceae	Herb	*Van-Adarak*	Carminative	Not Evaluated
Ziziphus nummularia (Burm.f.) Wight & Arn.	Rhamnaceae	Shrub	*Ghatol*	Diuretic	Not Evaluated

Table 3. UV and FL Value by categories for treating diseases

Aliments	UV	FL
Abortifacient	0.03	3.3
Anaemia	0.02	2.2
Antidote	0.19	18.9
Antipyretic	0.23	23.3
Antiseptic	0.14	14.4
Aphrodisiac	0.17	16.7
Asthma	0.14	14.4
Astringent	0.44	44.4
Brain Tonic	0.09	8.9
Carminative	0.18	17.8
Cathartic	0.07	6.7
Cooling	0.02	2.2
Cough	0.13	13.3
Demulcent	0.04	4.4
Diabetes	0.16	15.6
Diarrhoea	0.18	17.8
Diuretic	0.14	14.4
Emmenagogue	0.02	2.2
Emollient	0.02	2.2
Eye disease	0.04	4.4
Febrifuge	0.06	5.6
Growth of hair	0.08	7.8
Jaundice	0.14	14.4
Kindney Stones	0.03	3.3
Laxative	0.16	15.6
Leprosy	0.01	1.1
Leucorrhoea	0.01	1.1
Malarial faver	0.03	3.3
Nutrient	0.03	3.3
Piles	0.08	7.8
Plugo	0.01	1.1
Purgative	0.09	8.9
Rheumatism	0.16	15.6
Sedative	0.02	2.2
Skin disease	0.14	14.4
Throat trouble	0.02	2.2
Tonic	0.03	3.3
Tumor	0.02	2.2
Ulcer	0.04	4.4
Venereal disease	0.04	4.4
Vermifugo	0.01	1.1
Women Sterility	0.02	2.2
Worms	0.08	7.8

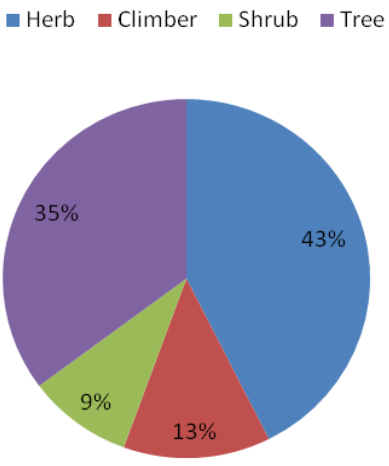

Figure 2. The analysis of habit- wise utilization

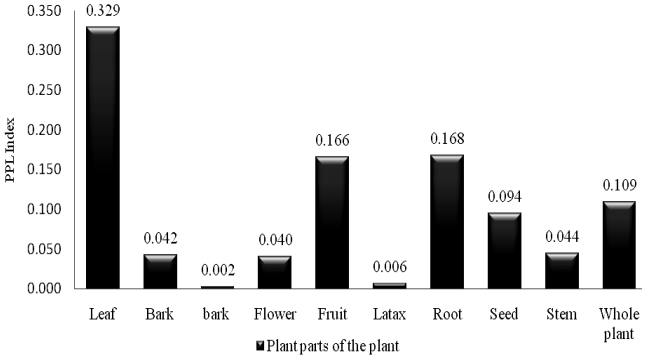

Figure 3. The utilization pattern of plants species

Due to the region's high diversity and plant species richness, many native species classified as weeds have found relevance in the traditional medicine system. Fresh leaves (0.329), roots (0.168), and fruit (0.166) have the highest PPV value as compared to other plant parts (see Figure 3). Herbs are the most commonly used plant, but for various reasons and modern medical facilities, the community's understanding of the forest varied, and younger generations were less knowledgeable. Out of 162 species listed here, 69 herbs are used as a medicine in folk treatment. It is also noted that herbs are important to most medicinal practices. Herb availability is also decreasing, posing a significant threat to these ecologically and culturally important plant groups. The harvesting practices of some economically important species, such as *Swertia angustifolia*, *Senna tora*, *Diospyros melanoxylon*, and *Phyllanthus emblica*, are important in terms of not only economically but ecologically as well in the long term. *Terminalia elliptica*, *Terminalia anogeissiana*, and *Dalbergia oojeinensis*, though having medicinal properties, the maximum quantity of these species were used as fuel wood, and less concern about the proper harvesting and regeneration of species in the region. High demand of *Andrographis paniculata*, *Chlorophytum tuberosum* are the most overexploited plant species in the area and is currently disappearing in most of the district's forest-dominated area. Other commonly traded medicinal plants in the area include *Buchanania lanzan*, *Terminalia bellirica*, *P. emblica*, *Plumbago zeylanica*, *Terminalia chebula*, *Smilax zeylanica*, *Uraria picta*, and *Vallaris solanacea* 20-30% households occasionally sell the components of medicinal plants as a means of generating revenue.

Traditional healthcare systems emphasize the importance of a plant-based diet such as *M. longifolia*, *Catunaregam spinosa*, *Bauhinia racemosa*, *Coccinia grandis*, *Dendrocalamus strictus*, *Dioscorea bulbifera*, *Dioscorea hispida*, *Drimia indica*, *P. emblica*, *Semecarpus anacardium*, *S. tora* and *S. cumini* for maintaining health and preventing illness. Certain medicinal plants are incorporated into daily meals or consumed as dietary supplements to promote overall well-being and strengthen the body's natural defenses. Many valued and economically minor forest products, non-timber forest products, and medicinal plants have become locally rare and endangered

or on the verge of extinction due to increased market demand over indigenous peoples' exploitation and unregulated harvesting of medicinal plants.

Forests, which include all plants, plant parts, and their products found in forest areas, have direct and indirect effects on the lives of local communities, tribes, forest dwellers, and many other underprivileged groups of people. These groups' sociological systems, customs, cultures, and lifestyles are likewise inextricably linked to the forest. Forest products were used for food, fodder, medicine, fuel, gum, agriculture, aromatic oils, defense equipment, musical instruments, rope, timber, and other social-religious objectives such as self-sustenance, daily requirements, and self-consumption. Nearly sixty percent of products are consumed by individuals, while surplus produce benefits local communities by increasing market sales and livelihoods. As is well established, local people are well aware of the flora and natural resources they rely on. Because of insufficient documentation, ethnoecological knowledge is quickly lost in traditional systems. Ethnomedicinal research can help uncover conservation difficulties, harvesting practices, and regeneration. The documentation process will assist local communities in preserving their ethnomedicinal legacy, fostering pride in local cultural knowledge and practices, and strengthening the links between communities and forests. Ethnobotanical and medicinal studies in Madhya Pradesh and Mandla include those by Chopra et al. (1956), Jain (1965), Brijlal and Dubey (1992), Oommachan and Saini (1993), Shukla and Oommachan (1994), Tiwari et al. (1996), Rai et al. (2001), Rai and Nath (2005), Khan et al. (2008), and Sahu (2010). However, there are studies available in some parts of Mandla done in the past (Sanghi 2013; Shrivastava 2013; Tiwari and Tiwari 2014; Sandya and Sandya 2015; Kanungo 2016; Javed 2017; Prasad 2022; Singh et al. 2022). Some studies done in Mandla on ethnomedicinal by Shrivastava (2013) reported 16 species from selected villages of the Bichhiya block, and Sandya and Sandya (2015) reported 30 species from the Mandla District. The present course of study will help to investigate existing ethnomedicinal knowledge of Baiga and Gond communities in the area and the status of diversity in the forest. Practical skills of the traditional knowledge holder and medicinal practitioners on botanical knowledge of plant species and their ecology are important. Therefore, involvement in local communities would be a great approach to conserve and restore plant species, which further help, support livelihood and rehabilitate the degraded lands.

In conclusion, local communities have valuable conservation knowledge that has helped preserve various forest types and species and, as a result, will help maintain the diversity of tree and floral species in the area. Many of the plants included in our study are also classified as endangered, common, planted, rare, or restricted in the area, and some are on the state's conservation list. Many human diseases and afflictions addressed by these described species can help us comprehend the value of this area in biodiversity conservation, and communities play critical roles in biodiversity conservation. However, there is a dilemma because these people also guide rural development initiatives, and the government focuses more on revenue-generating programs. In some cases, local communities are not aware of the sustainable harvesting practices of these plant species. Therefore, conservation focus must shift toward a community-centric approach where the community sustainably uses natural resources. Understanding and dealing with restoration and conservation efforts, human-wildlife interactions, land use change and urbanization, extraction of resources and exploitation, climate change, invasive species, and policies and regulations are critical for promoting sustainable development and maintaining ecological diversity, even in ecologically autonomous communities.

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Ethnobotany of traditional rituals of Javanese in the city of Surakarta, Central Java, Indonesia

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Abstract. *Mukarromah AN, Dzihni A, Azzam AK, Adiningsih AR, Utami AS, Nazar IA, Sunarto, Iskandar J, Saensouk S*, *Setyawan AD. 2024. Ethnobotany of traditional rituals of Javanese in the city of Surakarta, Central Java, Indonesia. Asian J Ethnobiol 7: 22-31.* Surakarta is one of the municipalities in Central Java Province, Indonesia, known as a multicultural city, so it might be potential for cultural performances in the form of historical buildings, local culinary delights, cultural products, cultural arts, and traditional rituals. This research aimed to determine the use and meaning of plants in traditional rituals carried out by the people of Surakarta. Data were collected using in-depth interviews and observation methods collected primary data in three villages: Baluwarti, Mojosongo, and Keprabon, Surakarta City, Central Java, Indonesia. The results show that there are 10 traditional rituals commonly carried out by people in three villages, namely *mitoni*, *medeking*, *procotan*, wedding, death, *grebeg maulud* or *sekaten*, *grebeg syawal*, *tedhak siten*, *tumpengan*, and *sadranan*, where, each traditional ritual uses plants according to their respective meanings. There are 27 plant species belonging to 20 families used in traditional rituals by the people of three villages. Most respondents purchase plants used in traditional rituals from the traditional markets due to increasingly limited open space for planting the plant species.

Keywords: Ethnobotany, meaning of plants, Surakarta, traditional rituals

INTRODUCTION

Indonesia is rich in various religions, tribes, cultures, and traditions (Fajrin et al. 2021). Traditional rituals are closely related to social activities in society which will be passed down to the next generation (Arianti and Marselina 2020; Satrianegara et al. 2021). Belief in tradition is an important part of cultural identity and is still practiced by community groups (Ogilvie et al. 2018; Nurfadilah et al. 2022).

Surakarta is a municipality in Central Java Province, Indonesia which was known as the economic and cultural center of Java in the past, it was the former capital of the Javanese kingdom (Mataram Sultanate). As an economic center, there are many immigrants to this area, although the Javanese remain dominant. Various native Indonesian tribes and ethnicities live in this city, as well as foreign ethnic groups, especially Chinese and Arabs (Purbasari and Suharno 2019; Praiswari and Arsandrie 2022).

The city has rich cultural diversity in the form of historical buildings, culinary delights, cultural products, cultural arts, and traditional rituals (Fadilah and Abidin 2021). Characteristics of traditional rituals of the city include *Grebeg* which is held three times a year in the Surakarta Palace; the traditional *Sekaten* ceremony is held to commemorate the birth of the Prophet Muhammad; and *panggih* is part of wedding customs (Rahayu and Suryono 2020; Purwani et al. 2022; Risyanti et al. 2022).

Ethnobotany is the study of interactions between humans and plants (Latifah and Ami 2022). Changes in human interactions with the environment, influenced by changes in populations, environmental conditions, and livelihoods, have increased the importance of human-plant relationships in biodiversity conservation (Ncube et al. 2022). Ethnobotanical study can be integrated into various areas of human life, significantly contributing to science and technology development and preserving local knowledge (Sutraningsih et al. 2019).

There is a close connection between local Indonesian communities or ethnic groups and plants in their ritual contexts (Sari and Setyawati 2019). It can be said that plants are an integral part of indigenous beliefs, traditions and culture and have important meaning, especially when used in religious ceremonies (Ristanto et al. 2020). Therefore, traditional Javanese culture seeks to prevent

excessive exploitation of natural resources by regulating their use and protection (Kathambi et al. 2020). There is a close relationship between local Indonesian communities or ethnic groups and plants in their ritual contexts (Sari and Setyawati 2019). As a result, traditional culture seeks to prevent the over-exploitation of natural resources by regulating their use and protection (Kathambi et al. 2020).

The types of plants used in traditional rituals vary in identity and number, and often have various symbolic meanings (Ramadhani et al. 2021). A few examples are *Amaranthus hybridus*, *Bryophyllum pinnatum*, *Cananga odorata*, *Carica papaya*, *Citrus aurantium*, *Cocos nucifera*, *Pandanus amaryllifolius* and *Rosa chinensis* (Sutrisno et al. 2020). One of the rituals in Indonesia that use plants is *ngemban belo selembar* or wooing a girl of the Karo Tribe, which uses plants, such as betel, areca nut, gambier and tobacco (Apriani 2023). The Dayak Bakati Tribe uses pumpkin, jasmine flowers, white turmeric to carry out the *balenggang* ritual (Rafdinal et al. 2023). The Ngusaba ceremony, by the Tenganan Pegringsingan community in Karangasem, Bali, uses *loja* (*Asystasia gangetica*), taro, and water spinach (Ratnani et al. 2021). The Peraq Api ritual of the Sasak Tribe on Lombok Island uses *Waru* leaves, turmeric, jasmine (Rahayu et al. 2020). *Moringa oleifera* is also used in the ritual of exorcising evil spirits or black magic by the Kedungbulus people of Gembong in Pati Regency (Dani et al. 2019).

In other countries, such as in Eastern and Southeastern Serbia, the ritual of the Lazarus Saturday holiday uses plant species, consisting of *Urtica dioica*, *Helleborus odorus*, and *Allium cepa* which are made into flower bouquets and placed next to the icon of the patron saint to protect the home from all bad things and improve the health and well-being of the household (Matejić et al. 2020). In addition, rituals at the 'Bihu' harvest festival in Assam, India, use the fruit of *Garcinia*, it is given to livestock as part of the ritual (Paul and Zaman 2022). This study aims to determine the use and meaning of plants in traditional rituals conducted by the people of Surakarta. We hope this research can provide information about the diversity of traditional rituals that they can be preserved as cultural treasures in Surakarta.

MATERIALS AND METHODS

Study area

The entire area of Surakarta City, Central Java Province, Indonesia is lowland with an altitude of 105 m asl. (Pemerintah Kota Surakarta 2022). The city of Surakarta is located between 110° 45' 15"-110°45' 35" E and 7°36'-7°56' S (DPMPTSP Kota Surakarta 2018). Three villages, Baluwarti Village, Keprabon Village, and Mojosongo Village, were selected to be the focus of the study area. The selection of study area was based on recommendations from several key persons regarding information on people who still carry out traditional rituals. This research was carried out in December 2023.

Baluwarti Village is located in Pasar Kliwon Sub-district, between 7° 57'-7° 58' S and 110° 82'-107° 83' E. The distance from the Pasar Kliwon Sub-district and Surakarta City Hall is 1.4 km and 1.7 km, respectively. Baluwarti Village is a special village because the entire land belongs to the Surakarta Sunanate (Kingdom) and is within the palace fort (PPID Kota Surakarta 2019). Keprabon Village is located between 7°56' S and 110°82' E. The village belongs to Banjarsari Sub-district. The distance to Banjarsari Sub-district and Surakarta City Hall is 4.5 km and 1.1 km, respectively. The village area belongs to the Mangkunegaran Palace on the northern and eastern sides. Meanwhile, Mojosongo Village is located between 7° 53'-7° 55' S and 110° 83'-107° 86' E. The village is located in Jebres Sub-district. The distance to Jebres Sub-district and Surakarta City Hall is 2.5 km and 3.5 km, respectively (Figure 1).

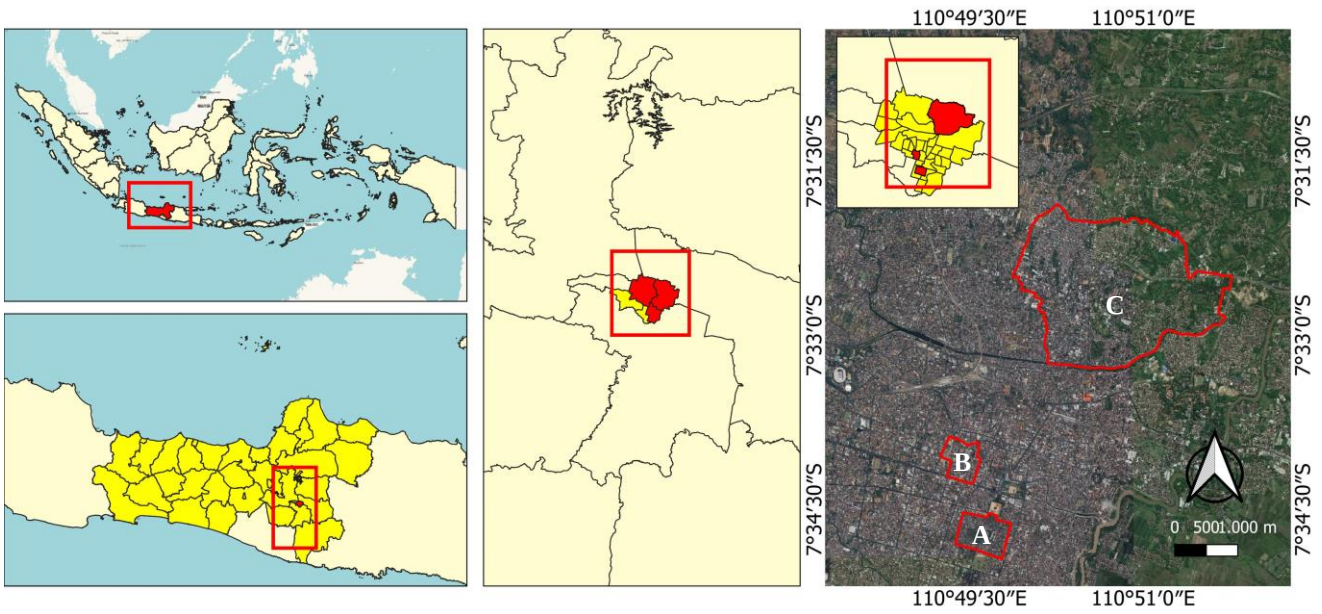

Figure 1. Map of the study area in A. Baluwarti, B. Banjarsari and C. Mojosongo Villages, Surakarta City, Central Java Province, Indonesia

Data collection

Primary data collection was used by observation and in-depth interviews. The observation approach was used to understand general environmental conditions on agriculture land, home gardens, and gardens. Observations were also carried out to observe plants that grow in people's yards and used in traditional rituals in three villages. In-depth interviews were conducted with competent informants who were selected purposively using the snowball technique by asking the main informants at the first time (Erawan et al. 2018). These included village staff, informal figures, male and female farmers, and traditional healers. In-depth interviews were conducted to obtain information about traditional rituals from traditional leaders and the community, including the names of various traditional rituals, plant used, plant's meaning, plant parts used, and how to obtain them. Botanical identification of commonly used plants was done by referring to local plants. This identification was carried out based on related literature and based on the authors' knowledge.

Data analysis

The qualitative data obtained from interviews was analyzed by cross-checking, summarizing, and writing descriptively, following Erawan et al. (2018).

RESULTS AND DISCUSSION

Diversity

Respondents from the three villages totaled 104 people (Table 1). The majority were women (72.2%), and men (27.8%). The majority of interviewees worked as self-employed (63.4%), Housewives were 31.7%, and Government employees (4.9%).

Based on Table 2 there are 27 plants usually used in traditional rituals in Surakarta, from 27 species and 18 families, namely Amaranthaceae (1 sp.), Bromeliaceae (1 sp.), Moraceae (1 sp.), Annonaceae (1 sp.), Solanaceae (4 sp.), Arecaceae (1 sp.), Fabaceae (3 sp.), Poaceae (3 sp.), Convolvulaceae (1 sp.), Oleaceae (1 sp.), Lamiaceae (1 sp.), Anacardiaceae (1 sp.), Moringaceae (1 sp.), Rutaceae (1 sp.), Musaceae (1 sp.), Pandanaceae (1 sp.), Piperaceae (1 sp.), and Rosaceae (2 sp.).

The implementation of traditional ritual cannot be separated from using plant parts. According to Mutaqin et al. (2018), the plant parts used in traditional events or rituals include roots, stems, leaves, fruits, flowers, seeds, fronds, and tubers. In this study, five plant parts were used in ritual practices, namely fruit, leaves, flowers, stalks, and seeds. The percentage of use for each type of plant part is fruit (33.4%), leaves (40%), flowers (20%), stems (3.3%), and seeds (3.3%). The part most used by the community is the leaf with a percentage of 40% (Table 3).

Traditional rituals

A total of 10 traditional rituals were commonly carried out by the people of Baluwarti, Keprabon, and Mojosongo villages.

Mitoni

The seventh-month celebration event in the first pregnancy is called *mitoni* or *tingkeban*. In the mitoni event, there is a procedure for *gantos penganggen*, or what is usually called changing clothes up to seven times, which is then known as *tingkeban*. The ceremony is held on odd dates without exceeding the full moon (3, 5, 7, 9, 11, 13, and 15); it is believed that the *mitoni* or *tingkeban* ceremony is held when a baby who is seven months old baby in the fetus has begun to live. Based on observations, *mitoni* is still being carried out in these three villages, and their implementation is generally the same.

According to Abdullah et al. (2021), the complete procedure for carrying out the *mitoni* starts with the *siraman*. The *siraman* is carried out at 11.00 a.m. because angels are believed to come down from heaven to bathe; those carrying out the *siraman* were seven or nine female elders. Meanwhile, the ladle used is made from coconut shells. Next is *gentos penganggen ngantos kaping pitu*, after finishing the watering, then change the cloth. The pregnant woman enters the house and stands where there are seven *sinjang* and *kemben*. The elders then put it on in turn. After putting it on, take it off, then put it on again; that repeated six times, and the elders' parents always said *durung patut* (improperly dressed). Finally, on the seventh cloth, the *pinisepuh* wear a *sinjang truntum kemben* with a *bangotulak* motif. At the same time, the elders said that *wis patut* (properly dressed). The plant used is young coconut (*C. nucifera*), commonly called *cengkir*, which ensures the mother's and baby's safety. Young coconuts have almost the same meaning in several regions; the mother and fetus are always blessed with good things (Fauzana et al. 2021); then, *bancaan*, a food serving containing long beans, kale, and spinach. Long beans mean that good traditions must be preserved for the next generation and not be broken, while fruit is a form of religious offering to the earth as a form of gratitude to God. Spinach means it symbolizes health and freshness. *Bancaan* means a form of gratitude, getting rid of bad luck, and sharing happiness because a child will be born.

Medeking

It is the same as *mitoni*, but *medeking* is held for the pregnancy of an odd-numbered child with the hope of becoming a religious child, a child with abundant sustenance, respecting parents, and being useful for their religion, society, homeland, and nation (Revlina 2023). *Medeking* is a pregnancy ritual for mothers who are pregnant with their third, fifth, seventh, and odd-number babies. The *medeking* ceremony is carried out based on the belief that the birth of children on their third, fifth, or seventh, is usually hard. In addition, among the three villages, *medeking* was only carried out in Keprabon Village.

The *medeking* ceremony is a spiritual effort to reject unwanted things and smooth the birthing process. Pregnant women have prepared the ingredients for *aking* rice; it could be made by ourselves, bought, or often given by close relatives. This is usually done for the third and fifth child at the end of the third or fifth month of pregnancy.

Once the ceremony equipment is available, male or female elders are invited to pray for the pregnant woman's safety and her family. After praying, the *aking* rice is distributed to relatives and neighbors. Next, the elders give water to the mother to drink. After that, they held the pregnant mother's stomach and said, *jabang* (Dear baby), even if you are going to see me in the wilderness, do not be fussy; just be an angel.

Medeking means safe *deking*; *deking* is *aking* rice with a side dish of *sura* (a kind of *sura* porridge), fried coconut (*cemplung*), tofu, tempeh, dried fish, bean sprouts, chicken eggs, and so on. This food is arranged on a plate and distributed to relatives and neighbors. The plant used is rice (*Oryza sativa*), which symbolizes prosperity and fertility for pregnant women and unborn babies. Side dishes include chicken and *bancaan*. The *bancaan* consists of long beans, kale, and spinach. Long beans have a good traditional meaning that must be preserved for the next generation and not be violated, while fruit is a form of religious offering to the earth as a form of gratitude to God. Spinach means it symbolizes health and freshness. *Bancaan* means gratitude, freedom from bad luck, and sharing happiness because a child will be born.

Table 1. Demographic characteristics of informants

Variable		Amount	Percentage (%)
Gender	Men	29	27.8
	Women	75	72.2
Work	Housewife/not working	33	31.7
	Government employees	5	4.9
	Self-employed	66	63.4
Total		104	100

Table 2. List of plants commonly used to perform traditional rituals by the people of Baluwarti, Keprabon, and Mojosongo villages, Surakarta City, Central Java Province, Indonesia

Scientific Name	Family	Local Name	Part of Plant Used	Rituals
Amaranthus spp.	Amaranthaceae	*Bayam*	Leaf	*Mitoni* ceremony (7 months)
Ananas comosus (L.) Merr.	Bromeliaceae	*Nanas*	Fruit	Wedding ceremony and *mitoni* (7 months)
Artocarpus camansi Blanco	Moraceae	*Kluwih*	Fruit	Wedding ceremony
Cananga odorata (Lmk)	Annonaceae	*Kenanga*	Flower	Death ceremonies, weddings, *sekaten*, *syawalan*, *tedhak siten*
Capsicum annuum L.	Solanaceae	*Cabai Merah*	Fruit	*Grebeg Maulud* ceremony
Capsicum var. annuum	Solanaceae	*Cabai Hijau*	Fruit	*Grebeg Maulud* ceremony
Cocos nucifera L.	Arecaceae	*Kelapa*	Fruit and Leaf	*Mitoni* (7 months) and marriage
Erythrina variegata L.	Fabaceae	*Dadap*	Leaf	Funerals
Ficus benjamina L.	Moraceae	*Beringin*	Leaf	Wedding ceremony
Imperata cylindrica (L.) Raeusch.	Poaceae	*Alang-Alang*	Leaf	Wedding ceremony
Ipomoea aquatica Forssk.	Convolvulaceae	*Kangkung*	Leaf	*Mitoni* (7 months) and *tumpengan*
Jasminum sambac (L) W.Art	Oleaceae	*Melati*	Flower	Death ceremonies, weddings, *syawalan*, *sekaten*, *tedhak siten*, and *sadranan*
Magnolia×alba (DC.) Figlar	Lamiaceae	*Kanthil*	Flower	Death ceremonies, weddings, *syawalan*, *sekaten*, *tedhak siten*, and *sadranan*
Mangifera sp.	Anarcadiaceae	*Mangga*	Fruit	*Mitoni* ceremony (7 months)
Moringa oleifera Lam.	Moringaceae	*Kelor*	Leaf	Funerals
Murraya paniculata (L.) Jack	Rutaceae	*Kemuning*	Flower	Funerals
Musa x paradisiaca L.	Musaceae	*Pisang*	Fruit and Leaf	Wedding ceremony, *mitoni* (7 months), and *procotan*
Nicotiana tabacum L.	*Solanaceae*	*Tembakau*	Leaf	*Grebeg sekaten* ceremony
Oryza sativa L	Poaceae	*Padi*	Seed	*Mitoni ceremony* (7 months), death, wedding, *deking*, *grebeg maulud*, *sepasaran manten*, and *sadranan*
Pachyrhizus erosus L.	Fabaceae	*Bengkoang*	Fruit	*Mitoni* ceremony (7 months)
Pandanus amaryllifolius Roxb.	Pandanaceae	*Pandan*	Leaf	Funerals
Piper betle Linn	Piperaceae	*Sirih*	Leaf	Wedding, death and *grebeg sekaten* ceremonies
Rosa x alba L.	Rosaceae	*Mawar Putih*	Flower	Death ceremonies, weddings, *syawalan*, *sekaten*, *tedhak siten*, and *sadranan*
Rosa sp.	Rosaceae	*Mawar Merah*	Flower	Death ceremonies, weddings, *syawalan*, *sekaten*, *tedhak siten*, and *sadranan*
Saccharum officinarum Linn	Poaceae	*Tebu*	Stem	Wedding ceremony, *tedhak siten*, *mitoni* (7 months)
Solanum melongena L.	Solanaceae	*Terong*	Fruit	*Grebeg Maulud* ceremony
Vigna unguiculata subsp. *sesquipedalis* (L.) Verdc.	Fabaceae	*Kacang Panjang*	Fruit	*Mitoni* ceremony (7 months), *tumpengan*, and *sekaten*

Table 3. Percentage of plant parts used in rituals

Part of Plant Used	Quantity	Percentage
Fruit	10	33.40%
Leaf	12	40%
Flower	6	20%
Stem	1	3.30%
Seed	1	3.30%
Total	30	100%

Procotan

Procotan is a ceremony carried out when the pregnancy is 9 months old. *Procot* means birth without obstacles. The religious offering that must be provided includes: *jenang procot*, *jongkong inthil*, *clorot*, and *jenang boning-baning*. These foods are usually served on banana leaves. The food served in the *procotan* ceremony has good meaning and prayers for the baby in the womb, such as *jenang procot* dan *clorot* which means that the baby can be born soon, while *jenang bonang baning* means that the baby is born in a clean state of mind and body. Javanese believe these foods can bring good things to the mother and baby as well as the birth process later.

The plant used is bananas (*Musa paradisiaca*) in this traditional *procotan* ceremony. Bananas symbolize prosperity, luck, and success in life. In this way, it is hoped that the born baby will always have good luck and success in life. The parts used are fruit and leaves as a base for the food served. Based on the results of interviews and observations at the three villages, *procotan* is still being implemented in Keprabon and Baluwarti Villages.

Wedding

Traditional wedding rituals are intended to express gratitude for the bride and groom's family. The community traditionally carries out wedding customs to hold a wedding, while wedding rituals are an activity that is usually carried out to prepare, carry out, and solidify a marriage. Each stage of a wedding ritual contains elements of purpose, place, time, tools, implementer, and implementation of the ritual. Wedding rituals continue to be carried out in three villages.

Plants used in bridal ceremonies, often called *mantenan* for the people of Surakarta, including coconut leaves and coconut fruit (*C. nucifera*), Banyan (*Ficus benjamina*), sugar cane (*Saccharum officinarum*), rice (*O. sativa*), and one bunch of plantains (*M. paradisiaca*). In a wedding series of customs, there is a ritual of the groom stepping on an egg. Then, water is poured from a jug by the bride onto the feet of the groom, who has stepped on the egg. Apart from that, there is another event called the *nyawer* ritual, where money and flowers are put into a silver bowl, and the bride throws the flowers and coins to the guests. Apart from that, grain mixed with coins is also commonly used for this ritual.

Various objects used in the wedding ceremony have symbolic meanings. In Surakarta, rice (*O. sativa*) means happiness and hope for the bride and groom to live a happy and prosperous life. Meanwhile, in Madiun East Java, rice means a husband's responsibility to his wife (Mustakim et al. 2022). Rice symbolizes happiness, so the prospective bride and groom are expected to be happy and prosperous. Various kinds of flowers, including red roses (*Rosa* spp.), white roses (*Rosa alba*), *kanthil* (*Magnolia* × *alba*), *kenanga* (*C. odorata*), and jasmine (*Jasminum sambac*) contain meanings and symbolic of fragrance and beautiful to look at. So, the new family is expected to have good behavior, such as being able to help other families in need, so that the new family has a 'good family name,' like the flower fragrance. At the same time, coins or small money symbolize good fortune or possessions. Hopefully, the new family will have a lot of money to live on. Money and rice have an important symbolic function; for example, the new couple in their life will gain wealth, success, and full of happiness. *Beringin* leaves symbolize is the bride and groom will live long and be able to provide shelter for their family. *Alang-Alang* leaves are a symbol that marriage can run smoothly, cleanly, modestly, and without any obstacles. Meanwhile, there is also *Lodeh Kluwih* (vegetable soup). The meaning of *Lodeh Kluwih* comes from the word *Kluwih* which means excess. Hope is that the bride and groom can be someone who has strengths or weaknesses.

The coconut leaves installed at the house entrance mean the bride and groom get a good fortune in whatever direction. In addition, the coconut leaves made from *mayang* twins or *gawar* are intended to unite the bride and groom and become soul mates in the afterlife. Usually placed at the house entrance, these leaves keep the bride and groom's souls cool, not easily angered and at peace. One bunch of plantains (*M. paradisiaca*) in a pair means that marriage is good so that husband and wife can be grateful to each other, accept each other, and understand each other. Banyan (*F. benjamina*) means that we must protect each other, while sugar cane means that husband and wife can have a sense of respect, affection, and love for each other. The meanings of several plants in wedding rituals in Surakarta and Madiun are different. In Surakarta, rice means happiness and hope for the bride and groom to live a happy and prosperous. Meanwhile, in Madiun, rice means a husband's responsibility to his wife (Mustakim et al. 2022). Besides that, coconut in Surakarta means that husband and wife can benefit others, family or neighbors, wherever they are. Meanwhile, in Madiun, coconut means uniting two individuals' hearts, feelings, actions, and thoughts in marriage (Mustakim et al. 2022).

Death

Death rituals are an important thing in various customs in Indonesian society. This signifies respect for the family of the deceased and prays that God will accept the deceased after death. Indonesia has various customs and cultures to honor people who have died. This means that Indonesia has various types of death ritual ceremonies, be it burial, washing away, or burning Death in any culture is always treated with ritualization. Like wedding rituals, death rituals continue to be carried out in three villages.

Javanese people view death not as a transition to a new status for the person who dies (Damayanti et al. 2019).

Dead people are held higher than living people. Death in Javanese society also gives rise to *ziarah* or grave viewing. The bond between the dead and the living is reconnected through the activity of grave visitations. This tradition also implicitly creates hope for the living that the dead, who are already in the other world, can channel blessings and *pangestu* to the living. In Javanese society, apart from believing that the spirit will be around the house until 40 days after death, they also believe that the spirit or ancestral spirits have the opportunity to see the grave (visit their grave) and *tilik omah* (visit their house). The ceremony is intended to obtain blessings or sustenance and safety on their job.

The *brobosan* culture is carried out when the body is about to be sent to the grave; that is, when the body is carried, the children and grandchildren of the person who has just died walk under the body seven times. According to the Javanese belief, by holding *brobosan*, people who are still alive will easily forget people who have recently died. *Brobosan* is a symbol of respect from relatives for someone in their family who has died. If the person who dies is very old, it is hoped that their children and grandchildren will inherit a long life. *Brobosan* is only carried out for married corpses, whereas if the deceased is not married, then it will not be held.

Slametan in death ceremonies is carried out to commemorate the day of death (*geblage*) of people who have died, including *surtanah* (when digging a grave), *telung dinane* (the third day after someone dies), *pitung dinane* (the seventh day after someone dies), *patangpuluh dinane* (the fortieth day after someone dies), *satus dinane* (the hundredth day after someone dies), *tahune* or *mendak pisan* (one year after someone dies), *rongtahune* or *mendak pindho* (two year after someone dies), *telung Tahune* or *nyewu* (three year after someone dies) (Setiawati 2019). In Keprabon Village, salvation for the dead also uses fried chili sauce and *ingkung ayam* (full-size chicken). Fried chili sauce means that living people must experience the formation of human character and identity. At the same time, *ingkung ayam* means that one's strength is shared with others so everyone can feel happy. Apart from that, *setaman* flowers are also used, including red roses (*Rosa* spp.), white roses (*R. alba*), *Kanthil* (*M.* × *alba*), *Kenanga* (*C. odorata*), and jasmine (*J. sambac*). The *kanthil* flower means that spiritual and physical success will be achieved by praying and living the noble values taught by their ancestors. Jasmine flowers convey a message of sincerity in doing everything, including pilgrimages to the graves of deceased family members. The rose conveys the message not to feel like you have everything in this world, meaning you have to accept the departure of your loved one back to God. Ylang-ylang flowers have a message to imitate all the good behavior of their ancestors. *Pandan* leaves are believed to be a symbol of respect and an embodiment of love from the living family to the person who has died. The meanings of several plants used in death rituals differ. For example, rice in death ceremonies in Surakarta and Batak Toba has different meanings; in Surakarta, rice has the meaning of giving smoothness and ease to the afterlife. Meanwhile, in the Toba Batak community, rice means God's blessing for the entire family (Marpaung and Idris 2022).

Grebeg maulud or sekaten

The tradition of *sekaten* is a Walisongo preaching that invites people to celebrate the birth month of the Prophet Muhammad SAW. The interviews and observations on the three villages show that *grebeg maulud* or *sekaten* are still being implemented in Keprabon and Baluwarti Villages. Surakarta Palace usually makes *gunungan* containing fruit, vegetables, *apem*, boiled chicken eggs, and half-cooked *rengginang*. This tradition also uses red roses (*Rosa* spp.), *Kanthil* (*M.* × *alba*), *Kenanga* (*C. odorata*), and jasmine (*J. sambac*). The vegetables that must be included in the *gunungan* are long beans (*Vigna unguiculata* subsp. *sesquipedalis*). At the same time, fruit is a form of religious offering to the earth as a form of gratitude to God. The *apem* on the *gunungan* is made rounded, which is related to the expression *kepleng ing rasa, handayoh kansampurnaning urip*, which means that while living, there are good things and bad things, so every human being must have a life determination and always be careful.

In the tradition of *grebeg maulud*, roses, jasmine, ylang-ylang, and *kantil* are also used, which means that people who witness it can remember it and keep it in their hearts. *Grebeg* is a traditional or customary ceremony of the Surakarta Palace (Keraton Surakarta) where, on the 12th of *maulud*, the king came out of the Palace to *Sitihinggil*, sat in the *manguntur tankil* ward, was greeted (faced) by the *srimpi* culture, the female courtiers and in addition to the courtiers in *ageng alit* at home and abroad in Surakarta, facing *sitihinggil* or at *sasono sumewo* performances (Pramusinto and Wahono 2020).

The *grebeg* ceremony is marked by the king taking out a large *tumpeng* called a *gunungan* and bringing it to the great mosque (Masjid Agung) to be given a prayer led by Kyai Penghulu Tafsir Anom in the midst of the community. The ceremony, with its typical large *tumpeng* offerings in the shape of a *gunungan*, shows the Javanese elements that have become the culture of the palace and its supporting community. The *grebeg* ceremony is marked by releasing the mountains from the palace and taking them to the great mosque in Surakarta. This event is quite interesting for people to visit and enjoy, have good luck or blessings, have recreational, and other things.

When the *gunungan* came out, people came in droves to fill the *kamandungan* gate to the palace north square and the great mosque or mosque ward courtyard. *Gunungan* in Surakarta consists of two types: male and female. The male *gunungan* is shaped like a *tumpeng*, and the frame is made of woven wire or bamboo covered with banana leaves. *Gunungan* is shaped like a *tumpeng robyong* which consists of the ingredients: sugar cane (*S. officinarum*), long beans (*V. unguiculata* subsp. *sesquipedalis*), green chilies (*Capsicum annum* var. *annuum*), red chilies (*C. annum*) and eggplant (*Solanum melongena*). Those ingredients are arranged on a *tumpeng* frame until it is full. The female mount is shaped like a *mutho* umbrella, made from *rengginang* (a cracker-like food made from sticky rice), the size of a plate, with stems arranged until the

frame is completely covered. In addition, the *gunungan* in the *grebeg maulud* ritual in Surakarta and Yogyakarta has a different meaning. In Surakarta, this *gunungan* has a good traditional meaning that must be preserved for the next generation and must not be broken, and is a form of earthly charity as gratitude to God. Meanwhile, in Yogyakarta, this *gunungan* means prosperity and fertility (Al-Fajriyati 2019).

In Surakarta, *grebeg* ceremony tradition is also known as *sekaten*. The local community carries out *sekaten* based on preserving ancestral traditions passed down from generation to generation, originating from the traditions of cultural values during the heyday of Demak kingdom under the rule of Raden Patah (son of Prabu Brawijaya from the Majapahit Kingdom and plays an important role in teaching Islam structurally and culturally, one of which is through art) together with the guardians. This ceremony is also intended to attract people to visit the traditional commemoration of the birthday of the Prophet Muhammad SAW. *Sekaten* is a culture held to commemorate the birth of the Prophet Muhammad SAW, a mixed culture between Islamic and Javanese, this *sekaten* ceremony was carried out in harmony. In this culture, there is syncretism, which can be observed in implementing the *sekaten* culture (Ridwan and Sumarno 2022). The *sekaten* ritual in Surakarta uses seven types of vegetables, which are made into *tumpeng* with *setaman* flowers, betel, and tobacco so that it has several meanings, namely high ideals, a means of sharing happiness, blessings, and establishing friendship, purity and honor, as well as courage. Meanwhile, the *sekaten* ritual in Yogyakarta uses *gunungan* containing jasmine flowers, *Kanthil* flowers, long beans, and red chilies, which have meaning as a picture of worldly life and spiritual life in which God, as the ruler of the universe, holds control over all activities in the universe (Nugraha 2020).

Grebeg syawal

Grebeg syawal is the same as the *grebek maulud*, which uses a *gunungan*, but in the *grebeg syawal*, the *gunungan* is just one, while the *grebek maulud* is made of a pair. Based on the results of interviews and observations at the three villages, *Grebeg Syawal* is still being implemented at these villages. *Gunungan* is shaped like a *tumpeng robyong*, which consists of sugar cane (*S. officinarum*), long beans (*V. unguiculata* subsp. *sesquipedalis*), green chilies (*C. annum* var. *annuum*), red chilies (*C. annum*) and eggplant (*S. melongena*).

Grebeg syawal is carried out by community members through *sungkeman* or apologizing to each other (Ridwan and Sumarno 2022). This activity began with a blackjack night with several activities, such as reciting and reading the Al-Qur'an, which was held during Ramadan. Apart from that, there is also *zakat* distribution to less fortunate local communities and compensation to orphans. The *Grebeg syawal* ritual in Surakarta also uses the *setaman* flower, which means blessing and hope for the fragrance of the ancestors. Meanwhile, the *Grebeg syawal* ritual in Demak District uses *tumpeng*, which means togetherness and harmony (Mahmudah 2020).

Tumpengan

Tumpengan is one of the traditional rituals as a manifestation of people's gratitude for the enormous, valuable and priceless blessings from God, namely by giving offerings to the earth so that people can live in peace and harmony. The results of interviews and observations at the three villages show that *tumpengan* is still being implemented. The plants used include water spinach (*Ipomoea aquatica*), long beans (*V. unguiculata* subsp. *sesquipedalis*), with the meaning of keeping fresh life (healthy), happy and blessed by good fortune. Apart from vegetables, the *tumpengan* also uses pointed rice, which means that the prayers offered are addressed to God, and boiled eggs are meaningful as the beginning of life.

Tumpengan can be performed for several events, such as *sepasaran* (35 days from the birth of the baby), funerals for the deceased, and *sadranan*. In Keprabon Village, salvation for the dead also uses fried chili sauce and *ingkung ayam* (full-size chicken). Fried chili sauce means that living people must experience the formation of human character and identity. At the same time, *ingkung ayam* means that one's strength is shared with others, so there will be happiness together.

Tedhak siten

Tedhak siten originates from the words *tedhak*, which means down, and *siten*, which means land, so *tedhak siten* or *tedak siti* is a tradition that introduces children to nature by setting their feet first on the ground. Usually, this tradition is carried out by the Surakarta palace families. The results of observations and interviews at the three villages show that *tedhak siten* is still carried out in Mojosongo Village, even though it is carried out by people who have a fairly high economic status. Therefore, currently there are few ordinary people who carry out *tedhak siten*. *Tedhak siten* uses several plants, such as jasmine (*J. sambac*) and red roses (*Rosa* spp.). *Melati* (jasmine) means uniting the heart, which means that in the future, the child can become a person who has compassion. The meaning of jasmine flowers in the *tedhak sinten* ritual between Surakarta and Aceh also has differences. In Aceh, jasmine flowers mean making children become humble people (Rahimah et al. 2019). The red rose, which means uniting the people, means that the children will always honor their parents.

Tedhak siten is a traditional event where a child aged around eight months (245 days) will be led by his or her mother to walk on the ground. Generally, the *tedhak siten* ceremony is held in the yard on the day of birth (Addini et al. 2023). The purpose of the *tedhak siten* event is as a form of gratitude because the child will start learning to walk. This ceremony also aims to introduce the child to the surroundings and mother nature. This also embodies a Javanese proverb that reads *Ibu Pertiwi Bopo Angkoso*, meaning the earth is the mother and the sky is the father.

The first procession is at the baby cage when the child is asked to hold or choose one of the items provided in the cage vicinity. According to their belief, the first object a child holds and takes symbolizes the child's future livelihood (fate). For example, if a child takes a writing

instrument, it is believed that the child will grow up intelligent and clever. The next process is that money and yellow rice from the rice (*O. sativa*) are put into a bowl, scattered, and fought over by the young children participating in the ceremony. After that, the child is taken out of the baby cage and then bathed in a tub filled with water containing *setaman* flowers, including red roses (*Rosa* spp.), white roses (*R. alba*), *kanthil* (*M.* × *alba*), *kenanga* (*C. odorata*), and jasmine (*J. sambac*). Finally, the child is dressed in new clothes and wears jewelry. The next ceremony is the *kenduri*, which ends the *tedhak siten* ceremony. This ceremony is conducted when a seven-month-old baby learns to sit and walk on the ground; this ceremony is intended for this child to become independent. The *tedhak siten* ceremony is always eagerly awaited by parents and relatives of Javanese families because, from this ceremony, they predict the interests and talents of their younger siblings who have just learned to walk. This series of traditions has its uniqueness and meaning for Javanese people.

Sadranan

The *sadranan* tradition is generally carried out twice a year, namely in *maulud* (Arabic calendar) or *muluddan* (Javanese calendar), which coincides with the birth of the Prophet Muhammad SAW, namely on the 12th of *maulud* and in *sya'ban* (*ruwahan*) before the fasting month. Usually, *nyadran* on *muluddan* is accompanied by *merthi desa*. *Merthi desa*, often called village clean, is essentially a symbol of the community's gratitude to the Almighty for the abundance of gifts He has given. Sadranan or Ruwahan is a tradition usually carried out by javanese people before arrival the month of Ramadhan by making a grave pilgrimage to family grave (grandmother, grandfather, mother, father, or other family members). The interviews and observations at the three villages show that *sadranan* is still being implemented at these villages.

People who do *nyadran* will pray for grandfathers, grandmothers, fathers, mothers, or relatives who have died. After praying, people holds a feast together (*kenduri*). Each family that takes part in the *kenduri* brings many of traditional food.

The plants used in *sadranan* are three-colored flowers or *setaman* flowers, namely *Mawar Merah* (*Rosa* spp.) and *Mawar Putih* (*R. alba*), jasmine (*J. sambac*), and *Kenanga* (*C. odorata*) which means the color of life, that human life begins from birth, matures and ends with death. *Setaman* flowers are synonymous with fragrance, beauty, and good purposes or prayers to honor and remember deceased ancestors or family. The *setaman* flower in the *sadranan* ritual has almost the same meaning in several regions, namely, to honor ancestors who have passed away (Suyitno 2022). Meanwhile, roses in death ceremonies have the meaning of making the soul of the deceased smell sweet and fragrant.

Discussion

Surakarta is one of economic and industrial centers that impacts people's lifestyles and traditional preservations. Javanese rituals require a more expensive cost and timely compared to modern, such as weddings. Marriage costs money, and requires much time and energy (Yuliana and Zafi 2020). Culturally, the Surakarta Palace and several traditional rituals still play an important role in the lives of the people of Surakarta Municipality. The Surakarta Palace is one of the cultural heritage sites of the kingdom, with monarchical rule in the past. Cultural heritage includes physical buildings, customs, and traditions passed down from generation to generation, which are still maintained today (Sunaryo and Masjhoer 2023). Apart from that, modernization also affects existing traditions that must be preserved. Tradition is a cultural asset that needs to be preserved so that its existence is not lost due to modernization. The impact of modernization means that society must try to preserve existing traditions (Saputri et al. 2021). From the three villages, the results of community interviews in each village showed that in Mojosongo Village, many people no longer carry out rituals because the area is urban. Baluwarti and Keprabon villages are also urban areas, but people still perform and preserve existing rituals. According to Eni et al. (2022), urban is an area that is used for urban settlements, social services, and economic activities, as well as centralization and government services.

In conclusion, there are 10 traditional rituals that the people of Baluwarti, Keprabon, and Mojosongo villages commonly carry out. These rituals include the seventh month of pregnancy (*mitoni*), *medeking*, *procotan*, wedding, death, *grebeg maulud* or *sekaten*, *grebeg syawal*, *tumpengan*, *tedhak siten*, and *sadranan*. Each traditional ritual uses plants according to their respective meanings. The percentage of use for each type of plant part is leaves (40%), fruits (33.4%), flowers (20%), stems (3.3%), and seeds (3.3%). Most of the respondents purchased plants used in traditional rituals because there was increasingly limited open space for planting these plants. The use of plants as a medium in traditional ceremonies is important, because each plant has its own symbolic meaning in traditional ceremonies. The use of various plant species has been passed down from generation to generation and preserved by the community, so their use cannot be changed carelessly because it is related to culture. For this reason, it is important to raise public awareness about collecting plants in traditional rituals, apart from that, it is also important to use plants wisely in traditional rituals. So we can anticipate potential impacts on the environment and biodiversity in the use of plants for traditional rituals, such as rare plants and damage to plant habitats.

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Plant diversity and its use in Javanese urban home garden: An ethnobotanical study in Central Java, Indonesia

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Abstract. *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: 32-42.* Urbanization makes the spread of botanical knowledge increasingly widespread. Ethnobotanical knowledge brought by village communities can be applied in urban areas. The implementation of Proklim (Climate Village Program) by the Indonesian Government strengthens the development of environmentally friendly cities that are able to adapt and overcome climate change and are sustainable by paying attention to the balance of social, economic, and environmental aspects. Currently, communities and home gardens have responded to various driving factors, such as the environmental movement and urban sustainability, and are more focused on providing healthy local food and community development. The objectives of this study were to find out the medicinal and food plants found in the home gardens and community gardens of ProKlim RW 16 Banjarsari Village, Banjarsari Sub-district, Surakarta City, Central Java, Indonesia and the influence felt by the community and knowing the existence of ProKlim RW 16 to support the 13th Sustainable Development Goals (SDGs), climate action. The method used is descriptive quantitative, which is conducted through observation, interviews, and questionnaires. Data from observations and interviews were calculated using the formula of Use Value, Relative Frequency of Citation, Informant Consensus Factor, and Fidelity Level. Meanwhile, questionnaire data is calculated using the Likert Scale calculations. The research results show 56 species that residents often use for medicinal and food plants. The most widely used medicinal plant is lemongrass (*Cymbopogon citratus* (DC.) Stapf), and the most widely used food plant is chili *(Capsicum frutescens* L.*).* Based on Likert Scale calculations, the adaptation indicator states that 90.25% of respondents agree that food plants grown by themselves are fresher and healthier. Meanwhile, on the mitigation indicator, 93.39% of respondents agreed that the more plants planted could reduce air pollution and lower the earth's temperature.

Keywords: Ethnobotany, plants, sustainable development, urban home garden, women farming groups

INTRODUCTION

Humans need nature to survive through water, land, and air components. Excessive use of the environment to meet human needs negatively impacts the environment and disrupts its ecosystem. Global warming is characterized by increasingly hot temperatures and erratic weather conditions. According to Leontinus (2022), climate change is an implication of global warming, which is caused by an increase in greenhouse gases, especially carbon dioxide (CO_2) and methane (CH_4). The increase in the earth's temperature not only has an impact on increasing the earth's temperature but also changes the climate system, which influences changes in various aspects of nature and human life, such as the quality and quantity of water, habitat, forests, health, agricultural land and ecosystems. The Indonesian Ministry of Environment and Forestry is adapting to climate change through the ProKlim (Climate Village Program) implemented throughout Indonesia. The program aims to increase community involvement and other stakeholders to strengthen adaptation capacity to the impacts of climate change and provide recognition for adaptation and mitigation efforts on climate change that have been carried out to improve welfare at the local level according to regional conditions.

Home gardens in Javanese villages often contain a wealth of flora that can be divided into ornamental gardens, vegetable gardens, fruit gardens, and border fences that demarcate the home garden or land ownership. Indonesian home gardens are ideal for growing a variety of flora as ingredients for spices, vegetables, medicinal, aromatic ingredients, or for other purposes. Moreover, various plants in gardens (*kebun*) or home gardens (*pekarangan*) are considered part of the farming culture in the environment around the house in urban communities (Hakim 2014). According to Shackleton et al. (2017), urban green spaces and home gardens encourage diversity and food security, enable adaptation to climate change, improve life quality and well-being, and increase connectivity between urban landscapes and remaining forest areas.

Ethnobotany is the science of the relationship between humans and plants. The terminology of ethnobotany was introduced by the North American plant expert John Harshberger in 1895 to describe the scientific discipline that pays special attention to matters related to plants used by primitive and aboriginal people. In the early days of ethnobotany, most surveys focused on collecting information on plant species, local names, and their benefits. There are several reasons why the study of urban ethnobotany should be prioritized, i.e.: (i) its potential for biodiversity and germplasm conservation; (ii) the high number of exotic and potentially invasive plant species; therefore, including of great economic and ecological importance; (iii) urban home gardens can provide food in

an environmentally friendly manner, preserving biodiversity and ecological and socio-economic sustainabilities; (iv) accelerating urbanization around the world will lead to gardens size reduction and potentially affect wealth; and (v) its contribute to the social networks maintenance.

Moreover, a home garden around the house with clear boundaries and ownership, has the potential to produce valuable crops. In addition to the garden aesthetic and production benefits, vegetable and medicinal plants support the health and wellness of family members. These gardens also have many additional benefits: follow a green lifestyle by planting gardens, starting from home, to cope with global warming trends (Igustita et al. 2023). RW 16 Banjarsari Village, Banjarsari Sub-district, Surakarta City, Central Java, Indonesia, is one of the Proklim program implementation areas. One of the programs is to support the previously existing Bon Surgo Women Farmers Group. This group is developing urban agriculture and managing a community garden (*kebon/kebun bersama*) called Asmatoga (medicinal plant garden) and other community gardens which were previously bare land, as well as supports the planting of useful plants in members' home gardens (house yards, *pekarangan*), especially food and medicinal plants. This research examined the plant diversity found in the community and home gardens of ProKlim RW 16 Banjarsari Village, knowing the existence to support the 13th Sustainable Development Goals (SDGs), i.e., climate action.

MATERIALS AND METHODS

Study area

This research was conducted from July to August 2023 at the Climate Village Program (ProKlim) in RW 16, Banjarsari Village, Banjarsari Sub-district, Surakarta City, Central Java, Indonesia (Figure 1). Banjarsari has an area of approximately 2.33 km^2. According to data from the Surakarta City Population and Civil Registration Service (2022), the 2022 population was 20,056 people.

Procedures

The research uses observation, as well as interview and questionnaire sheets for respondents who have met the criteria, i.e. home gardener, know plants, and are over 17 years old. The Slovin formula calculation, with a population of 174 people of ProKlim RW 16 Banjarsari Village (also member of Bon Surgo Women's Farmers Group) and a degree of accuracy of 5%, therefore, the sample size of 121 is sufficient. Meanwhile, interview with two key respondents, namely management from ProKlim RW 16 Banjarsari Village (i.e., Tri Sumardi) and Bon Surgo Women Farmers Group (i.e., Christian Hari), was used to provide a broad overview of socio-economic and environmental problems in the research location, to select initial respondents, and to support discussion.

The sampling technique used is non-probability sampling, namely purposive or non-random sampling, carried out with certain considerations and objectives. Respondents were appointed based on the direction of ProKlim RW 16 Banjarsari Village and Bon Surgo Women Farmers Group management and continued with a snowball sampling technique based on suggestions from previous respondents.

The data collection techniques used in this research were interviews, observation, and questionnaires. Data collected through field observations include the diversity of plant species, names, numbers, parts used, processing methods, and home garden development with the Bon Surgo Women Farmers Group. Plant diversity was carried out through direct house-to-house surveys to observe the presence of medicinal plants in home gardens (*pekarangan*). While, plants in community gardens (*kebun/kebon bersama*) of Asmatoga and others were recorded and documented for each species growing for further identification using POWO (Plants of the World Online, https://powo.science.kew.org/), as well as plants from home gardens.

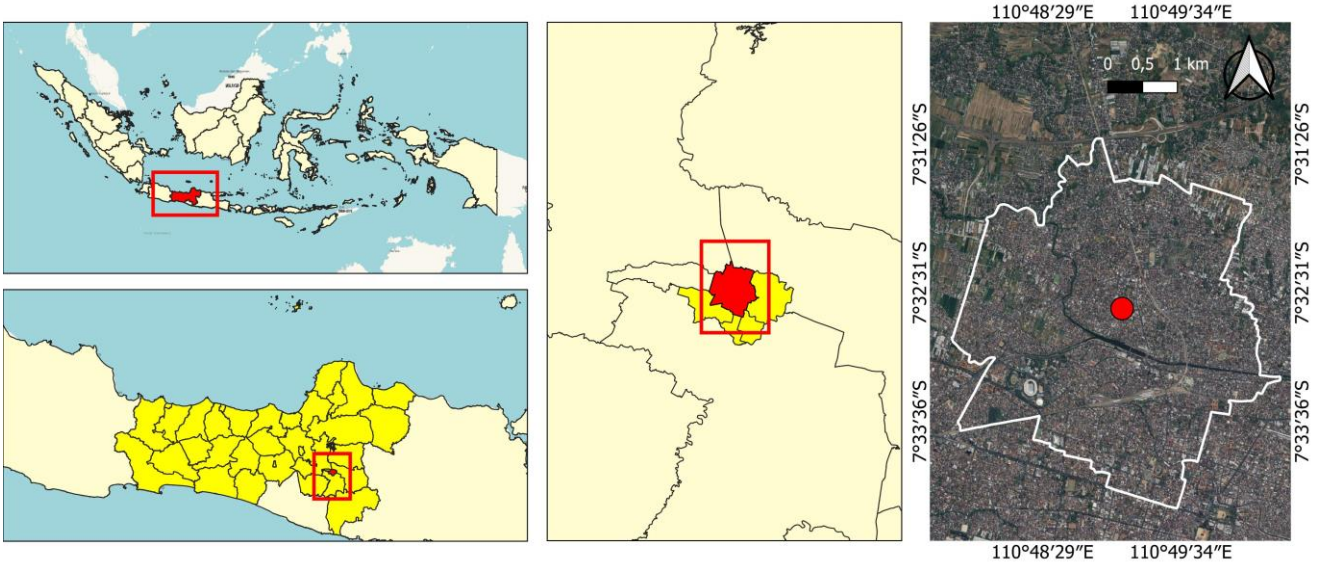

Figure 1. Map of research location in Banjarsari Village, Banjarsari Sub-district, Surakarta City, Central Java Province, Indonesia

Interviews were conducted to observe the management of the Bon Surgo Women Farmers Group and the perceived impact of the Climate Village Program (ProKlim). The questionnaire method was used to obtain respondents' opinions regarding the existence of ProKlim, which can support the Sustainable Development Goals, and to find out the plant diversity used, processing methods, parts used, and the plant's properties. The questionnaire, in the form of a statement, will be evaluated using a rating scale, i.e., Likert scale (Likert 1932). The data analysis technique uses quantitative descriptive methods.

Data analysis

The data analysis used in this research is an interactive analysis proposed by Miles and Huberman (1994) to assess the relative importance of locally known species using the Use Value (UV) formula.

$$UV = \frac{\Sigma U}{n}$$

Where:
UV : Use Value;
U : Number of citations per species;
n : Total number of informants.

Relative Frequency of Citations (RFC) is useful for indicating the local importance of each species. RFC was initiated by Tardío and Pardo-de-Santayana (2008). RFC has a value of 0 to 1.

$$RFC = \frac{Fc}{N}$$

Where:
RFC : Relative Frequency of Citation;
Fc : Number of informants who mentioned using the species;
N : Total number of informants.

Many medicinal plant variables influencing the environment include local and scientific species names, number of medicinal plants, most reported medicinal uses, most frequently treated diseases, processing methods, and perceived efficacy. The homogeneity of local knowledge use was determined using the Informant Consensus Factor formula by Trotter and Logan (2019). The ICF value varies from 0 to 1. The ICF value is calculated using the equation (Silalahi et al. 2018; Cornara et al. 2014):

$$ICF = \left(\frac{Nur - Nt}{Nur - 1}\right)$$

Where:
ICF : Informant Consensus Factor;
Nur : Several usability reports for each category;
Nt : Several plant species used for a particular category by all informants.

Fidelity or fidelity levels are used to calculate the percentage of medicinal plants used most frequently in each disease or particular use category. The Fidelity level value can be calculated using the following formula:

$$FL = \frac{Np}{N} \; x \; 100\%$$

Where:
FL : Fidelity Level;
Np : Informant who mentioned medicinal plants for certain disease categories;
N : Total number of informants.

Meanwhile, the questionnaire is analyzed using the Likert Scale formula. The Likert scale measures attitudes, opinions, and perceptions of a person or group of people about social phenomena using interval data (Likert 1932).

$$Likert\ Scale = T \; x \; Pn$$

Where:
T : Total number of respondents who voted;
Pn : Choice of Likert Score Numbers

RESULTS AND DISCUSSION

Diversity and benefits of plants

Linda and Nurlaila (2014) revealed that home garden areas are generally planted with various plants that benefit residents and the surrounding environment. The food and medicinal plant species in ProKlim RW 16 Banjarsari Village consist of various species that provide ecological benefits. According to Azra et al. (2014), other factors supporting this home garden's potential are the tropical climate conditions and the high biodiversity in Indonesia, which should be able to fulfill people's food needs throughout the year.

Besides, people deliberately plant to extract their benefits; the wider the home garden, the more plant species people plant (Tobondo et al. 2021). The UV, RFC, ICF, and FL calculations are important in ethnobotanical studies of each species of food and medicinal plant use in ProKlim RW 16, Banjarsari Village. Therefore, Table 1 shows the plants used by residents of RW 16 Banjarsari Village.

Based on Table 1, the results of observations of plant use by the community in the ProKlim RW 16 Banjarsari Village area showed that 56 species of plants were obtained. This research only focuses on the species of medicinal plants and food plants that are used. As a result, 31 medicinal plants and 27 food plants were found, where two species are used either as medicinal or food plants, namely *Carica papaya* L. and *Psidium guajava* L. The leaves are for medicine, while the fruits are for food.

Table 1. Diversity of plants used by residents of RW 16 Banjarsari Village, Surakarta, Central Java, Indonesia

Scientific name	Local name	Name	Type	Parts used	Processing method	Perceived benefits	Source for cultivation	Amount of plants
Allium cepa L.	*Bawang merah*	Onion	Food	Leaf	Boiled	Reduces the risk of cancer	Tubers	2
Aloe vera (L.) Burm.f.	*Lidah buaya*	Aloe vera	Medicine	Stem	Polished	Treating skin diseases	Bud	6
Alpinia galanga (L.) Willd.	*Laos*	Galangal	Medicine	Bulbs	Cooked	Food flavoring	Tubers	7
Alternanthera sissoo Velde	*Bayam brazil*	Brazilian spinach	Medicine	Leaf	Boiled	Improves immunity and bone health	Seeds	2
Amaranthus viridis L.	*Bayam*	Spinach	Food	Leaf	Boiled	Vitamin A adds iron, prevents anemia	Seeds	7
Annona muricata L.	*Sirsak*	Soursop	Food	Fruit	Blended	Increasing the body's endurance reduces the risk of hemorrhoids	Seeds	2
Annona squamosa L.	*Srikaya*	Sugar apple	Food	Fruit	Eaten raw	Vitamin	Seeds	2
Anredera cordifolia (Ten.) Steenis	*Binahong*	Heartleaf maderavine	Medicine	Leaf, seed	Eaten raw, boiled	Medicine for fatigue, herpes	Planted seeds, cuttings	2
Apium graveolens L.	*Seledri*	Celery	Medicine	Leaf	Boiled	Lowers high blood pressure	Seeds	8
Averrhoa bilimbi L.	*Belimbing sayur*	Star fruit	Medicine	Fruit	Boiled	Cough medicine	Seeds	3
Averrhoa carambola L.	*Belimbing*	Star fruit	Food	Fruit	Eaten raw	Lowers high blood pressure	Seeds, stem cuttings	2
Brassica chinensis L.	*Sawi sendok / pakcoy*	Pak choi	Food	Leaf	Cooked	Facilitates digestion	Seeds	9
Brassica oleracea L.	*Kubis*	Cabbage	Food	Fruit	Eaten raw	Protects the body from radiation	Seeds	2
Brassica oleracea var. *botrytis* L.	*Kembang kol*	Cauliflower	Food	Fruit	Boiled	Rich in antioxidants, it reduces the risk of heart attack	Seeds	4
Capsicum frutescens L.	*Cabai*	Chili	Food	Fruit	Boiled, fried	Cooking ingredients, preventing sprue, vitamin C	Seeds	44
Carica papaya L.	*Daun pepaya*	Papaya leaf	Medicine	Leaf	Cooked	Increase appetite	Seeds	8
Carica papaya L.	*Pepaya*	Papaya	Food	Fruit	Eaten raw	Facilitates digestion	Seeds	8
Centella asiatica (L.) Urb.	*Pegagan*	Asiatic pennywort	Medicine	Leaf	Boiled	Immune	Bud	2
Citrus aurantiifolia (Christm.) Swingle	*Jeruk nipis*	Lime	Medicine	Fruit	Squeezed	Relieves cough	Seeds	5
Citrus hystrix DC.	*Jeruk purut*	Kaffir lime	Medicine	Leaf, fruit	Squeezed	Oral health, food flavoring	Graft	6
Citrus limon (L.) Osbeck	*Lemon*	Lemons	Medicine	Fruit	Squeezed	Relieves cough	Graft	3
Citrus reticulata Blanco	*Jeruk*	Orange	Food	Fruit	Eaten raw	Vitamin C	Planted seeds, cuttings	5
Clitoria ternatea L.	*Bunga telang*	Butterfly pea	Medicine	Flower	Brewed	Bone strengthener	Seeds	4
Cucumis sativus L.	*Timun*	Cucumber	Food	Fruit	Eaten raw	Lowers high blood pressure	Seeds	2
Curcuma longa L.	*Kunyit*	Turmeric	Medicine	Bulbs	Boiled	Treats stomach acid, relieves stomach ulcers	Tubers	33
Curcuma zanthorrhiza Roxb.	*Temulawak*	Curcuma	Medicine	Bulbs	Boiled	Digestive medicine	Tubers	6
Cymbopogon citratus (DC.) Stapf	*Serai dapur*	Lemongrass	Medicine	Stem	Boiled	Repels mosquitoes, relieves fever, cough medicine, warms the body	Stem cuttings	40
Daucus carota L.	*Wortel*	Carrot	Food	Bulbs	Juice	Maintain eye health, control blood sugar levels	Tubers	5
Dimocarpus longan Lour.	*Kelengkeng*	Longan	Food	Fruit	Eaten raw	Prevents aging	Seeds	2
Fragaria ×ananassa (Weston) Rozier	*Strawberry*	Strawberries	Food	Fruit	Eaten raw	For heart health and preventing cancer, a source of vitamin C	Seeds, stolen	7

Ipomoea reptans Poir	*Kangkung*	Kangkong	Medicine	Leaf	Cooked	Prevent diabetes, increase iron, prevent anemia	Seeds	17
Kaempferia galanga L.	*Kencur*	Kencur	Medicine	Bulbs	Boiled	Treats bruises, relieves coughs and sore throats	Tubers	20
Limonium arboreum (Willd.) H.Arnaud	*Lavender*	Lavender	Medicine	Flower	Dried	Mosquito repellent	Stem/root cuttings	2
Luffa acutangula (L.) Roxb	*Gambas / oyong*	Loofah	Food	Fruit	Cooked	Reduces diabetes, cleans the blood, reduces weight, overcomes inflammation, and improves bowel movements	Seeds	5
Mangifera indica L.	*Mangga*	Mango	Food	Fruit	Eaten raw	Contains vitamin C	Seeds, stem cuttings	4
Manihot esculenta Crantz	*Singkong*	Cassava	Food	Bulbs	Boiled	Source of carbohydrates	Stem	8
Momordica charantia L.	*Pare*	Bitter melon	Food	Fruit	Cooked	Lowers high blood pressure	Seeds	4
Moringa oleifera Lam.	*Kelor*	Moringa	Medicine	Leaf	Boiled	Lowers high blood pressure and cholesterol, uric acid	Stem	4
Musa acuminata Colla	*Pisang / gedang*	Banana	Food	Fruit	Eaten raw	Strengthens leg bones	Stem	4
Pandanus amaryllifolius Roxb. ex Lindl.	*Pandan*	Pandan	Medicine	Leaf	Blended	Lowers high blood pressure, makes cooking smell good	Roots	20
Persea americana Mill.	*Alpukat*	Avocado	Food	Fruit	In juice	Maintains heart health, lowers cholesterol	Seeds	3
Phaleria macrocarpa (Scheff.) Boerl.	*Mahkota dewa*	God's crown	Medicine	Flower	Boiled	Lowers high blood pressure	Seeds	2
Phyllanthus buxifolius (Blume) Müll.Arg.	*Seligi*	Seligi	Medicine	Leaf	Pounded	Treating sprains	Stem cuttings	2
Piper ornatum N.E.Br.	*Sirih merah*	Celebes pepper	Medicine	Leaf	Boiled	Reproduction health	Leaf cuttings	2
Piper retrofractum Vahl	*Cabe puyang*	Balinese long pepper	Medicine	Fruit	Boiled	Body endurance	Stem cuttings	2
Pometia pinnata J.R.Forst. & G.Forst.	*Matoa*	Matoa	Food	Fruit	Eaten raw	Vitamins increase body endurance	Seeds, graft them	2
Psidium guajava L.	*Daun jambu*	Guava	Medicine	Leaf	Boiled	Cure diarrhea	Seeds	4
Psidium guajava L.	*Jambu biji*	Guava	Food	Fruit	In juice	Maintain body endurance	Seeds, stem cuttings	10
Sauropus androgynus (L.) Merr.	*Katuk*	Star gooseberry	Medicine	Leaf	Boiled	Facilitates breast milk	Stem cuttings	4
Senna siamea (Lam.) H.S.Irwin & Barneby	*Johar*	Siamese cassia	Medicine	Leaf	Boiled	Overcoming itching	Stem cuttings	2
Solanum lycopersicum L.	*Tomat*	Tomato	Food	Fruit	Eaten raw	Maintain eye health, vitamin C	Seeds	18
Solanum melongena L.	*Terong*	Eggplant	Food	Fruit	Boiled, fried	Prevents chronic diseases, source of vitamins	Seeds	18
Syzygium aqueum (Burm.f.) Alston	*Jambu air*	Water rose apple	Food	Fruit	Eaten raw	Contains vitamins	Seeds	5
Syzygium polyanthum (Wight) Walp.	*Daun salam*	Bay leaf	Medicine	Leaf	Boiled	Treating high blood pressure, kitchen spices, gout	Stem	19
Vigna sesquipedalis (L.) Fruwirth	*Kacang panjang*	Long beans	Food	Fruit	Boiled	Vitamin	Seeds	6
Vitis vinifera L.	*Anggur*	Grape	Food	Fruit	Eaten raw	Reduces the risk of heart attack	Seeds	3
Zingiber officinale Roscoe	*Jahe*	Ginger	Medicine	Bulbs	Boiled	Relieves sore throat	Tubers	20
Ziziphus mauritiana Lamk.	*Daun bidara*	Bidara leaves	Medicine	Leaf	Boiled, juice	Antioxidant	Stem	2

The medicinal plant species most often used by the community is the lemongrass (*Cymbopogon citratus* (DC.) Stapf). As many as 40 respondents mentioned lemongrass as a plant that has properties for repelling mosquitoes, reducing fever, cough medicine, and warming the body. The part of the lemongrass (*C. citratus*) that is used is the stem, and then the method of processing is boiling. The food crop that respondents most widely use is the chili plant as a food crop. A total of 44 respondents mentioned chili (*C. frutescens*). Chili is useful as a cooking ingredient, preventing sprue and vitamin C. The use of parts of the chili plant is in the fruit, and then the method of processing is by boiling or frying.

Use value determines plant species that have high utility in society. The greater the value obtained, the more the plant species is useful in society (Anggreini et al. 2021). The results of the highest use value calculation with a value of 1 are found in 4 food plant species, including Brazilian spinach (*Alternanthera sissoo* Velde), *Matoa* (*Pometia pinnata* J.R.Forst. & G.Forst), soursop (*Annona muricata* L.) and *gambas* (*Luffa acutangular* (L.) Roxb). Brazilian spinach is useful for improving immunity and bone health. Based on research by Elidar and Purwati (2022), *Matoa* trees have many potential benefits so that they can be developed. *Matoa* seeds can be used as local food, wood can be used for light construction materials, and bark and leaves can be used to treat fever and increase stamina. The bark is used to treat festering wounds because it contains antibacterials.

The soursop plant also increases the body's endurance and reduces the risk of hemorrhoids. Soursop leaves are also effective in preventing cancer. The *gambas* plant is a plant that has benefits for reducing diabetes, cleansing the blood, reducing weight, overcoming inflammation, and improving bowel movements. Ginger is the plant with the lowest use value (*Zingiber officinale* Roscoe). This plant has a use value of 0.05. People in RW 16 only said that the ginger plant has one benefit: relieving sore throats. The mention of the value of a species regarding the benefits felt by society influences the use value.

The Relative Frequency of Citation (RFC) of plants used by the community in the ProKlim RW 16 Banjarsari Village area is 0.02-0.36. Chili plants have the highest RFC value, 0.36. The chili plant (*C. frutescens*) is often used by 44 respondents as a cooking ingredient to prevent sprue. It contains vitamin C. Plants with high RFC values are the species most often used to cure diseases by the community because they are easy to find and cultivate in the environment.

Moreover, 24 plant species have the lowest RFC value of 0.02. These species include: starfruit (*Averrhoa bilimbi* L.), lemon (*Citrus limon* (L. Osbeck)), avocado (*Persea americana* Mill.), grape (*Vitis vinifera* L.laf), lavender (*Limonium arboreum* (Willd.) H.Arnaud), *pegagan* (*Centella asiatica* (L.) Urb.), *seligi* (*Phyllanthus buxifolius* (Blume) Müll.Arg.), *srikaya* (*Annona squamosa* L.), *cabe puyang* (*Piper retrofractum* Vahl), *bidara* leaves (*Ziziphus mauritiana* Lamk.), *binahong* (*Anredera cordifolia* (Ten.) Steenis), *mahkota dewa* (*Phaleria macrocarpa* (Scheff.) Boerl.), *johar* (*Senna siamea* (Lam.) H.S.Irwin & Barneby), star fruit *(Averrhoa carambola* L.), onion *(Allium cepa* L.), longan (*Dimocarpus longan* Lour), cabbage (*Brassica oleracea* L.), cucumber (*Cucumis sativus* L.), *sirih merah* (*Piper ornatum* N.E.Br.), Brazilian spinach (*A. sissoo*), *Matoa* (*P. pinnata*) and soursop (*A. muricata*). These plants have low RFC values because they are rarely used by most people in everyday life.

ICF values range from 0.43 to 1. In calculating ICF, need Nur and Nt. Nur is the number of usability reports for each category. Meanwhile, Nt is the number of plant species used for a particular category. A value of 1 was found in 10 species in fever, diarrhea, reproduction health, sprains, breast milk booster, bruises, increased appetite, prevention anemia, warm the body and fatigue. The plant that can treat sprains is the *seligi* (*P. buxifolius*); the seligi plant is used by pounding it. Furthermore, plants for breast milk boosters are found in the *katuk* (*Sauropus androgynus* (L.) Merr.) when boiled.

Guava leaves *(Psidium guajava* L.) boiled enriched can treat diarrhea. To boost breastmilk, you can use the *katuk* leaf (*S. androgynus*), whose leaves are boiled. Papaya leaves (*Carica papaya* L.) can increase appetite. Boiled turmeric (*Kaempferia galanga* L.) can treat bruises. Apart from warming the body, the lemongrass (*C. citratus* can also reduce fever. Maintaining reproductive health can use *sirih merah* (*P. ornatum*) and *kangkung* (*Ipomoea reptana* Poir) to prevent anemia. Boiled *binahong* (*A. cordifolia*) can treat fatigue. The lowest ICF value is 0.43, which is efficacious in increasing body endurance. Based on the Nt column, there are 5 species of immune-boosting plants, namely gotu kola (*C. asiatica*), Brazilian spinach (*A. sissoo*), *cabe puyang* (*P. retrofractum*), *bidara* (*Z. mauritiana*) and soursop (*A. muricata*).

Fidelity Level values range from a high of 19% to a low of 0.42%. A value of 19% was found in the cough category. The 6 species of plants that can treat coughs include starfruit (*A. carambola*), lemon (*C. limon*), lime (*Citrus aurantiifolia* (Christm.) Swingle), ginger (*Z. officinale*), kencur (*K. galanga*) and lemongrass (*C. citratus*). Meanwhile, the lowest value of 0.42% was found in the sprains, fatigue medicine, and reproductive health categories. *Seligi* (*P. buxifolius*) is the plant used to treat sprains. The plant used to treat fatigue is *binahong* (*A. cordifolia*). Then, to maintain reproductive health, respondents use the *sirih merah* (*P. ornatum*). Based on research by Silalahi et al. (2018), it can be said that a high RFC value does not always accompany a high ICF value because the community mentions no plant restrictions, so they cannot focus on certain plants.

Response to climate program

Twenty (20) statements were given to 121 respondents to discover their perceptions regarding ProKlim activities with SDGs goal 13, i.e., climate action, and the data were calculated using a Likert scale. The Likert scale values were calculated by calculating the score for each statement with a value of 4 (agree) and 5 (strongly agree) to find a positive value for the hypothesis, which states that ethnobotanical studies support the SDGs. Table 2 represents the questionnaire calculations using a Likert scale.

Table 2. Results of questionnaire calculations using a Likert Scale

Statement no.	Dimensions	Indicator	Results (%)
1a	Plants planted in the home garden can achieve sustainable consumption and production patterns	Adaptation	84.96
1b	The plant products grown in the Women Farmers Group have economic and ecological value	Mitigation	85.45
2	I like growing food plant	Adaptation	83.64
3	The presence of green open space can be useful in supporting sustainable cities and settlements	Mitigation	89.59
4	I support the presence of green open spaces as an environmental movement and city sustainability	Mitigation	90.58
5	I have felt the impacts of climate change, such as rising temperatures and weather changes	Mitigation	84.96
6	I believe that the more plants planted can reduce air pollution and lower the earth's temperature	Mitigation	93.39
7	I am aware of the importance of environmental management and maintenance in achieving sustainable development	Mitigation	85.12
8	Women Farmers Group activities can support adaptation and mitigation measures for climate change	Adaptation	84.3
9	I use organic fertilizer (compost) to reduce greenhouse gas emissions	Mitigation	80
10	Planting trees can reduce global warming	Mitigation	91.9
11	I plant food crops with varieties that are rain-resistant and drought-resistant	Adaptation	68.1
12	The number of trees can reduce temperature and light intensity and can increase oxygen, soil fertility, and water availability.	Mitigation	89.59
14	Limited land in urban areas is not an obstacle in creating climate change adaptation actions	Adaptation	77.36
15	The harvest of food crops grown by yourself is fresher and healthier	Adaptation	90.25
16	I feel the benefits of the Women Farmers Group	Adaptation	81.65
17	I am sure that the existence of the Women Farmers Group can increase food security	Adaptation	84.3
18	The presence of the Women Farmers Group helps create a beautiful and clean environment	Mitigation	88.1
19	The existence of the Women Farmers Group can strengthen the quality of life, welfare, and connectivity between residents.	Adaptation	83.64
20	The presence of Women Farmers Group can increase green open space in urban areas	Mitigation	82.81

Table 3. Calculation of Informant Consensus Factor and Fidelity Level

Disease Category	Nt	Nur	ICF	FL (%)
Cough	6	91	0.94	19
Herbs	4	52	0.94	10.86
Body endurance	5	8	0.43	1.67
Fever	1	40	1	8.35
Diabetes	2	19	0.94	3.97
Diarrhea	1	4	1	0.84
Reproduction health	1	2	1	0.42
Sprains	1	2	1	0.42
Cholesterol & uric acid	2	24	0.96	5.01
Indigestion	2	33	0.97	6.89
Breast milk booster	1	4	1	0.84
Bruises	1	20	1	4.18
Increase appetite	1	8	1	1.67
Prevent anemia	1	17	1	3.55
Warm the body	1	40	1	8.35
Reduces the risk of cancer	2	4	0.67	0.84
Fatigue	1	2	1	0.42
Bone strengthener	2	4	0.67	0.84
Mosquito repellent	2	42	0.98	8.77
Skin disease	3	10	0.78	2.09
High blood pressure	4	53	0.94	11.06

Table 3 revealed the calculation of 20 statements from the questionnaire were obtained. The highest score was obtained in statement number 7 at 93.39%, about the importance of environmental management and maintenance. The lowest value was obtained in statement number 12 at 68.01%, about the role of trees in reducing temperature and light intensity, as well as increasing oxygen, soil fertility, and water availability.

(1) As many as 84.96% of respondents agreed that plants planted in the home garden could achieve sustainable consumption and production patterns, which aligns with the Sustainable Development Goals. The results of interviews with Christian Hari, the Bon Surgo Women Farmers Group administrator and formerly manager, showed that the community garden (*kebon/kebun bersama*) used in RW 16 Banjarsari Village for Asmatoga medicinal garden and home garden (*pekarangan*) of the Bon Surgo Women Farmers Group achieved sustainable production and consumption patterns. All plants in the home garden and community garden use a sustainable planting system, and the community often needs the plants to be grown. The community also carries out 3R activities (reduce, reuse, recycle) channeled through the "Katon Semilak" Waste Bank to achieve sustainable consumption and production patterns.

(2) As many as 85.45% of respondents agreed that the plant products grown by the Bon Surgo Women Farmers Group had economic and ecological value. Plants grown in community gardens or residents' home gardens with various plant species can increase the ecological area's value. Through an interview with Tri Sumardi, the chairman of ProKlim RW 16 Banjarsari Village, the

Women Farmers Group aims to meet the residents' needs, but if the harvest is abundant, it will be sold to improve the residents' economy. Currently, respondents largely consume the harvested crops.

(3) As many as 83.64% of respondents agreed they preferred growing food plants in line with the aim of the ProKlim RW 16 Banjarsari Village adaptation activities, namely increasing food security. Even though people are used to consuming rice as a staple food, they also use other food plants as a substitute for rice, such as cassava, sweet potatoes, and taro. Apart from non-rice food crops, people also plant food crops in the form of vegetables and fruit in their home gardens.

(4) The presence of green open spaces is useful in supporting sustainable cities and settlements, as 89.59% of respondents agreed. Green open space plays a role in supporting sustainable cities and settlements, and the government has regulated the presence of green open space in cities by 30% of its area. Following research by Anisa (2023), Indonesia is implementing various strategies to realize sustainable cities and community goals by creating cities that are safe and comfortable for them, including: (i) Providing policies regarding air quality and waste management to reduce the negative impact on the urban environment. (ii) Providing policies regarding Public Spaces and Green Open Spaces which are considered to help create a safe, inclusive and easily accessible environment.

(5) The presence of green open spaces as an environmental and city sustainability movement is supported by 90.58% of respondents. Green open spaces in urban areas are an environmental movement that creates a beautiful environment for urban sustainability. One of the mitigation activities is increasing and maintaining vegetation cover in the ProKlim RW 16 Banjarsari Village area; this statement supports the environmental principle of biodiversity. The species planted are also diverse, so they can increase biodiversity and ecological value.

(6) As many as 84.96% of respondents are impacted by climate change, such as rising temperatures and weather changes; people felt the impact of global warming alone. According to research conducted by Nuraisah and Kusumo (2019), extreme climate events will cause (i) harvest and planting failures, which will lead to a decrease in productivity; (ii) damage to agricultural land resources; (iii) an increase in flood/drought intensity; (iv) increased humidity leading to increased nuisance organism intensities.

(7) The respondents agreed that planting more could reduce air pollution and lower the earth's temperature by 93.39%, and this statement has the greatest value compared to other statements. Residents of RW 16 planted various species along the road in residences as a mitigation effort, and bare land is also used as open space for farming. Plants are believed to reduce air pollution and lower the earth's temperature.

(8) Various parties' assistance is important in achieving sustainable development goals to increase public awareness of their environment. As many as 85.12% of respondents agreed with the importance of environmental management and maintenance in achieving sustainable development. Therefore, sustainable development is the effort to maintain environmental resilience to be able to answer environmental problems. This statement also supports environmental principle number two, namely the principle of preservation and continuity. Sustainable development policies are directly related and aim to safeguard human life, balance natural resources, and promote environmental sustainability (Khairina et al. 2020).

(9) Bon Surgo Women Farmers Group activities support adaptation and mitigation measures to climate change by 84.3%. Adaptation to climate change has the potential to reduce the impacts of climate change. The Women Farmers Group adaptation to climate change is increasing food security by planting plants in the home garden using pots or vertical gardens. This supports establishing the Climate Village Program, namely strengthening global efforts to cope with climate change through food security. The food crops planted diversity affects climate change because the existence of various plants aims to anticipate crop failure due to the impact of climate change. With the diversity of species planted, the food plants that grow in a particular location become increasingly varied so that other plants can still be harvested if one species fails in a particular season.

Several plants resistant to climate change include chilies, tomatoes, eggplant, spinach, sorghum, corn, taro, cassava, pumpkin, long beans, and cucumber. Chili plants are popular with the community and have high economic value. The community has adopted chili plants as an anticipatory measure when the price of chilies increases. Climate changes, due to changes in rainfall, temperature, and humidity, also affect the yield of cayenne pepper (Ridho and Suminarti 2020).

Mitigation efforts are carried out by increasing and maintaining vegetation cover along roads in the RW 16 Banjarsari Village area and reducing greenhouse gas emissions with organic fertilizer. Ethnobotanical studies at ProKlim RW 16 Banjarsari Village have supported mitigation actions against climate change through reforestation. Reforestation is an activity that restores, maintains, and improves the condition of land so that it can produce and function optimally. Reforestation is carried out by maximizing unused land by planting various food crops, and these activities increase economic and environmental profits (increased green open space).

(10) Reducing greenhouse gas emissions is carried out to support climate change mitigation measures. As many as 80% of respondents agreed that using organic fertilizer (compost) could reduce greenhouse gas emissions. In line with research, using organic products is a mitigation technology to bind carbon by slowing the conversion of carbon into CO_2 gas, which will be released into the atmosphere (Munandar et al. 2014; He et al. 2023). Organic fertilizer is fertilizer composed of living creature material, such as weathered remains of plants, animals, and humans (Arifien et al. 2023).

(11) The statement that planting trees can reduce global warming was agreed upon by 91.9% of respondents. This means that respondents are aware that planting plants provides life benefits. Plants are useful for producing oxygen, which is necessary for living organisms, and

making the environment cool and comfortable. More plants planted will reduce air pollution, which can cause global warming (Rini et al. 2018). Home gardens contribute to climate mitigation due to the presence of plants that sequester and store carbon for a long time (Wiryono et al., 2023).

(12) Based on calculations, statement number 12 has a value of 68.1%. The statement "I grow food crops with rain-resistant and drought-resistant varieties" has the lowest value compared to other statements. Even though this statement has the lowest score compared to other statements, according to Table 3, this statement is still in the strongly agree/good category, which can still support the positive value of ethnobotanical studies in supporting the SDGs. Erratic weather changes mean that what is planted can change and even threaten crop failure. Following research by Servina (2019), the impact of climate change on fruit and vegetables in tropical Indonesia includes a decrease in production, both quantity and quality, the emergence of new pests, an increase in pest and disease attacks, and crop failure due to extreme climate. Climate change triggers environmental changes that cause changes in plant responses.

(13) 89.59% of respondents agreed that the number of trees can reduce temperature and light intensity, increasing oxygen, soil fertility, and water availability. Excessive light intensity and temperature can limit plant productivity. Light intensity is when the sun shines in one day (Putra and Faiza 2021), and excessive sunlight increases temperature and reduces air humidity, damaging plants (Friadi and Junadhi 2019).

(14) Limited land in urban areas is not an obstacle in creating climate change adaptation actions at 77.36%. The adaptation activity to this matter is using home gardens and bare land for planting plants. Following research by Rekavianti (2019), other activities that can be carried out to utilize the home garden are cultivating various species of plants, raising fish, and other activities carried out around the house to continuously diversify food ingredients and improve family nutrition.

(15) Moreover, 90.25% of respondents agreed that food crops grown themselves are fresher and healthier. Food grown in the home garden and community garden uses organic fertilizers and pesticides. Providing organic materials can increase productivity and obtain optimal harvest results that are fresher and healthier. According to Pathak et al. (2023) and Kaur et al. (2024), there has been an increase in public awareness of the use of inorganic chemical fertilizers, synthetic pesticides, and growth hormones in agricultural production, which can have a negative impact on human health and the environment.

(16) Therefore, 81.65% of respondents agreed that they felt the benefits of the existence of the Women Farmers Group. They provide benefits related to the environment, including contributing to environmental sustainability, reducing air pollution, and creating beauty and coolness in residential environments (Rinurwati et al. 2021). Similar research was also carried out by Ardy (2022) through the Women Farmers Group to support women in becoming more productive and independent and improving their socio-economic abilities.

(17) The Women Farmers Group was formed to increase food security in ProKlim RW 16, Banjarsari Village. As many as 84.3% of respondents agreed that the existence of Bon Surgo Women Farmer Groups could increase food security. There needs to be more land in urban areas to grow rice, but the community adapted by planting non-rice foods that function as carbohydrates, such as sweet potatoes, taro, and cassava. Apart from that, the community also grows vegetables, fruit, and medicinal plants, which can be used to fulfill the family's nutrition and health. Based on the results of the author's interview with Christian Hari, the Bon Surgo Women Farmers Group administrator and formerly manager, the aim of establishing ProKlim in RW 16 Banjarsari Village is to raise community awareness to manage their environment and to harvest own crops that reduce vegetable costs of each household. Currently, the harvest is consumed by itself; in the future, it will be sold if the land owned is larger to meet the customer demands.

(18) The presence of the Women Farmers Group helps create a beautiful and clean environment, approved by 88.1% of respondents. Women Farmers Group in urban areas contributes to green open spaces to make the environment beautiful and clean. According to Rini et al. (2018), green open space is necessary to heal the damage to the urban environment, decreasing the oxygen supply. The imbalance of green open space with high air pollutants will cause many problems and disrupt life and human health comfort.

(19) The respondents agreed that the Women Farmers Group could strengthen the quality of life, welfare, and connectivity between respondents by 83.64%. The majority of respondents' jobs are housewives, so the existence of the Bon Surgo Women Farmers Group is very helpful in improving their life and welfare quality and connectivity between residents. Following Isma's research (2023), the Women Farmers Group is a forum for women farmers to process agricultural products that benefit their families and the surrounding community. Statement number 19 supports environmental principles in the form of local wisdom. This principle emphasizes that environmental protection and management efforts must consider the noble values in the community's life system. According to Irwan et al. (2018) and Suwartapradja et al. (2023), the social function of the home garden includes being a place for activities and social interaction. Activities that can be done in the home garden include gathering with neighbors on various activities and setting up a place for social activities. So, it can be concluded that women farming groups can strengthen the quality of life, welfare, and communication between residents.

(20) Respondents agreed that the presence of Women Farmers Group could increase green open space in urban areas with a score of 82.81%. Urban agriculture has developed in many cities, involving community involvement that varies between countries and cities (Tornaghi 2014). Providing green open space as an icon of ecosystem balance is useful for providing clean air and

absorbing carbon dioxide (CO_2) while reducing urban areas' greenhouse effect and warming (Saragi et al. 2022).

Based on the 20 statements discussed, we find that 17 statements scored above 80%, which means they strongly agree in supporting the SDGs. There are 2 statements with the lowest scores, namely statements 12 and 14, but the results are still above 60%, meaning they still agree to support the SDGs. All the statements submitted in the questionnaire conclude that the ethnobotanical study at ProKlim RW 16 Banjarsari Village can support the 13th Sustainable Development Goal, namely climate action. Following the goals, one of the targets is increasing education, awareness, and human and institutional capacity related to mitigation, adaptation, impact reduction, and early warning of climate change. The observations, interviews, and questionnaires have shown that the community in ProKlim RW 16 Banjarsari Village has awareness and knowledge of mitigation, adaptation, impact reduction, and early warning of climate change.

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Biological resources utilization in *grebeg maulud* ceremony in Surakarta City, Indonesia

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Abstract. *Ayuningtyas HR, Nabila I, 'Azizah HPN, Andewi LC, Saensouk S, Setyawan AD. 2024. Biological resources utilization in* grebeg maulud *ceremony in Surakarta City, Indonesia. Asian J Ethnobiol 7: 43-49.* Indonesia is a country of diverse nature, culture, and traditions in each region. Implementing traditional ceremonies is closely related to utilizing natural resources, both plants and animals, in the surrounding area. The *sekaten* or *grebeg maulud* is a ceremony which is often held every month of Rabi'ul Awal, involves *gunungan* elements in the form of crops contested by the community. This research was conducted in Surakarta City, Central Java, Indonesia, from November to December 2023, in Mojosongo Village, Keprabon Village, and Baluwarti Village. This study aims to determine the understanding of the community regarding the *grebeg maulud* ceremony, identify the biodiversity used in *grebeg maulud*, and determine the utilization of these resources in people's lives. The methods used in this research are survey methods, group discussions, ethnographic studies, key informant interviews, and the surrounding community interviews. The important thing that becomes the basis of this research is the utilization of crops by the surrounding community, which is calculated using the Index of Cultural Significance (ICS) value calculation. People in Mojosongo, Keprabon, and Baluwarti Villages utilize several species for *grebeg maulud* activities, including 2 species of fauna and 19 species (taxa) of flora. The parts of the fauna utilized are eggs and meat; the most utilized part of the flora is the fruit.

Keywords: *Grebeg maulud*, *gunungan*, natural resources, tradition, utilization

INTRODUCTION

Indonesia is a country that has a variety of natural diversity, cultures, and traditions with uniqueness in each region. Culture is a phenomenon closely related to the behavior and actions of the people who support or live it. It has become a reflection and symbol of the region in Indonesia (Farida and Shofi'unnafi 2020). Culture can be in the form of real objects and community behavior, including behavior patterns, language, art, religion, and others which are used to help humans live social lives. Traditional ceremonies are part of a cultural heritage that are routinely carried out for generations by the community (Setyawan et al. 2023).

Traditional ceremonies are a form of culture. Implementing traditional ceremonies is generally closely related to using and utilizing natural resources, both plants and animals, in the surrounding area. Because traditional ceremonies are part of human cultural products on a practical level, they must be inseparable from using natural resources such as flora and fauna in the surrounding environment (Mutaqin et al. 2018). A field of science that studies the knowledge of a community or tribal group regarding the utilization of biological natural resources and their ecosystems is referred to as ethnobiology (Purwanto 2021). Ethnobiological research is conducted to scientifically analyze biodiversity values by applying science and technology so that the local communities' wisdom in managing natural resources and the environment can be scientifically accounted for. Ethnobotany, as a branch of ethnobiology, studies the direct relationship between humans and plants regarding utilization and management in traditional societies or indigenous tribal communities (Fauziah et al. 2017). Ethnobotany potentially opens a community's traditional knowledge system toward the diversity of biological resources, culture, and environmental conservation (Tapundu and Anam 2015). Meanwhile, human knowledge about animal resources around them and science that studies the relationship between humans and animals in the local sociocultural context is an understanding of ethnozoology (Nikmatila et al. 2023).

One of the traditional ceremonies in Indonesia is *sekaten* or *grebeg maulud*, which is held every month of Rabi'ul Awal and is usually the third month in the lunar calendar. *Sekaten* is a term from the Javanese community to refer to the Islamic religious celebration ceremony commemorating the Prophet Muhammad's birthday, usually carried out in several cities in Indonesia, especially Yogyakarta and Surakarta. Not only a religious celebration,

grebeg maulud is also an Indonesian cultural heritage that has been a tradition of the Surakarta Palace for a long time. This ceremony can be a form of appreciation and preservation of cultural heritage and potentially become cultural tourism in this modern era (Pramusinto and Wahono 2020). It contains moral values that can serve as guidelines in realizing civilized human life by respecting and preserving the ancestors' culture. Although today, the *sekaten* ceremony is only considered as the public poorly understands a tradition with tourism value and its meaning, it displays a form of harmony between religion and culture (Rahayu et al. 2020).

In the *grebeg maulud* ceremony, *gunungan* will be contested by those who attend the events. There are various types of crops arranged in the *gunungan*. These crops are very commonly used by the community in everyday life (Amboro et al. 2020). The community utilizes existing crops in various ways, such as using them to improve the economy by selling them as processed food (Ridzal and Hasan 2019), for daily food needs, companion needs, and as traditional medicine (Jamshidi-Kia et al. 2017). The utilization of the crops produced can continue to increase as the population increases (Begna 2021).

There are several problems found regarding the *grebeg maulud* ceremony, including (i) public knowledge related to *grebeg maulud* is decreasing, and it is difficult to find information from scientific sources; (ii) An ethnobiological study of the natural resources used in *grebeg maulud* has never been conducted before. Therefore, this study aimed to collect information related to the *grebeg maulud* ceremony, identify the biodiversity used in *grebeg maulud*, and determine the utilization of these resources in people's lives. Thus, public knowledge related to *grebeg maulud* can increase, and awareness of cultural preservation is maintained. In addition, knowledge related to ethnobiology in *grebeg maulud* is important for the community because it is useful to know the potential and sustainable use of biological resources in *grebeg maulud*.

MATERIALS AND METHODS

Research area

This research was conducted in Surakarta City, Central Java, Indonesia from November to December 2023. The research locations are Mojosongo Village (*kelurahan*) with coordinate points (-7.54320, 110.84186), Keprabon Village with coordinate points (-7.56843, 110.82250), and Baluwarti Village with coordinate points (-7.58010, 110.82812) (Figure 1). According to the Information Management and Documentation Officer of Surakarta City (2023), Mojosongo Village has an area of 532.927 hectares, with a population of 49,253 residents. Keprabon Village has an area of 46.72 hectares, with 3,122 residents. Baluwarti Village has an area of 40.70 hectares, with 7,478 residents. Mojosongo Village is about 4.4 km from Surakarta Hadiningrat Sunanate Palace (the cultural center of Javanese people); Keprabon Village is near Pura Mangkunegaran and about 2 km from Surakarta Hadiningrat Sunanate Palace. Meanwhile, Baluwarti Village is one of the villages located within the Surakarta Hadiningrat Sunanate area.

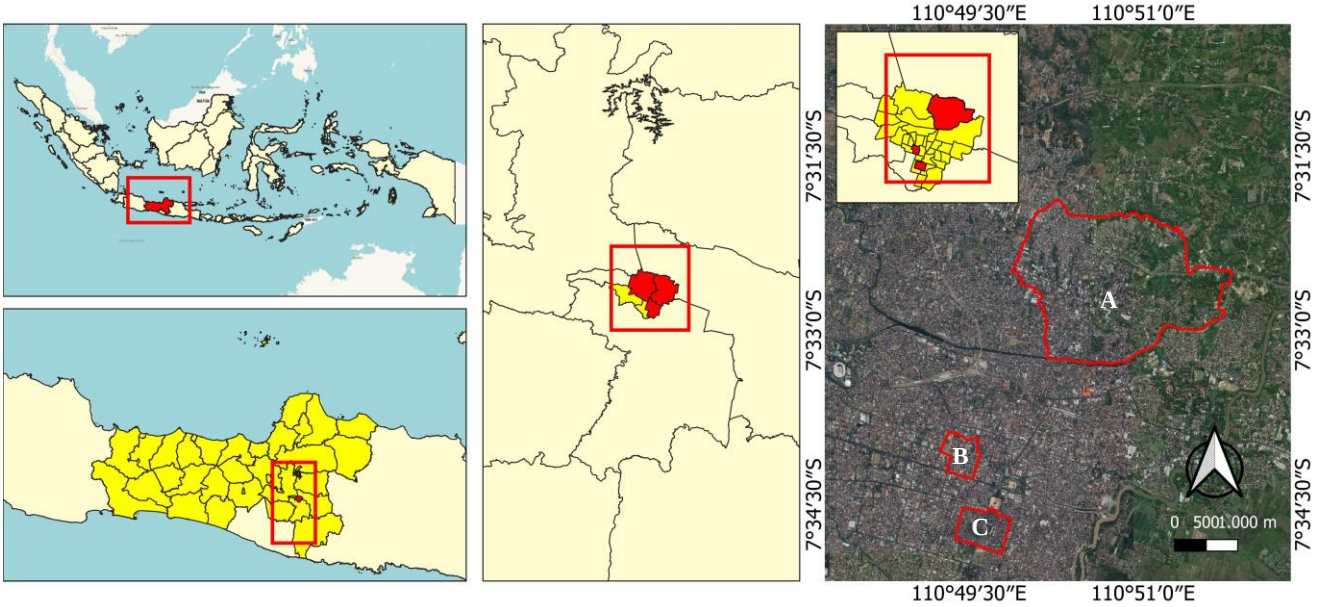

Figure 1. Research locations in Surakarta City, Indonesia: A. Mojosongo Village, B. Keprabon Village, and C. Baluwarti Village

Procedures

Selection of informants

The methods used in this research were survey methods, group discussions, ethnographic studies, key informant interviews, and the surrounding community. The informants totaled 65 people, consisting of 5 key informants and 60 general informants aged 19 to 70 years. Key informants can be used as the center of information about this research. Key informants are the main source of information related to these issues under study (Suriani and Jaliani 2023). Meanwhile, general informants were used as sources of information on the utilization of species. The sample was taken randomly with a diverse demographic background of informants and data on the utilization of crop products in *gunungan grebeg maulud* from each informant.

Data collection

Two types of data were collected: primary data and secondary data. Primary data were obtained through interviews with key informants and the surrounding community (Rinaldi and Ardianto 2022). Interviews with key informants were conducted to gather in-depth information about the history of the utilization, the series of events, the philosophy, and the meaning of *gunungan*. Interviews with the community were conducted to gather information about the utilization of crops and their knowledge about the *sekaten* or *grebeg maulud* traditional ceremonies. Secondary data included demographic data and education level. The literature used in this research comes from various sources, such as journals.

Data analysis

Moreover, the important information in this research is the utilization of crops leading to the utilization of the surrounding community for personal and economic use. Then, for the crops that have been obtained, the Index of Cultural Significance (ICS) value is calculated based on the data obtained from the people who have been interviewed. The ICS will show each species' importance to the community's needs. According to Ratnani et al. (2021), the formula that can be used is as follows:

$$ICS = \sum_{i=1}^{n} (q \times i \times e) ui$$

Because each species has different uses, it can be calculated with the following equation:

$$ICS = (q_1 \times i_1 \times e_1) + (q_2 \times i_2 \times e_2) + (q_3 \times i_3 \times e_3) \ldots. + (q_n + i_n + e_n)$$

Where:

q: Utilization of the species. 5: Staple food, 4: Complementary food (vegetables, fruits, snacks, snacks), 3: Food additives (spices), medicines, 2: Ritual, recreation, decoration, container/packaging, and 1: Only know and do not use.

i: Intensity of use. With information, 5: every day, 4: 2-3x a week, 3: once a week, 2: once a month, 1: only on special celebrations.

s: Importance of species. With information, 2: first choice, no second, 1: possible choice, and 0.5: last choice.

RESULTS AND DISCUSSION

Respondent demographic data

The respondents in this research were 65 informants from Mojosongo Village, Keprabon Village, and Baluwarti Village, Surakarta (Table 1). There were 29 male informants and 36 female informants. The highest age frequency was in the 46-55 age group, with 14 informants (21.54%). Respondents occupations are 17 entrepreneurs, 15 merchants, 6 laborers, 18 housewives, 6 civil servants, and 3 other professions. Respondents educational levels were (15.38%) elementary school, (23.08%) junior high school, (44.62%) senior high school, and (16.92%) university level.

Grebeg maulud* ceremony and symbolic meaning of *gunungan

The history of the *grebeg maulud* ceremony in Surakarta began before Islam entered the island of Java, around the 7th century (Agustin 2019). At that time, people already believed in God, and there was already a *grebeg* ceremony which became a ritual to express gratitude for the harvest. *grebeg maulud* was first held during the leadership of Sultan Agung in the Islamic Mataram Kingdom. *Grebeg* comes from the word *gemebreg*, which means noisy or boisterous; this meaning describes the atmosphere during the *grebeg* event when the community will be noisy or boisterous to grab the *gunungan* that will be distributed (Pratisara 2020). Meanwhile, *grebegan* means inviting the community. The purpose of the *grebeg maulud* ceremony is to respect, welcome, and celebrate the birth of the Prophet Muhammad as a role model.

Table 1. Respondent demographics

Parameter	Specification	Freq.	Percentage
Gender	Male	29	44.62
	Female	36	55.38
Age	15-25	8	12.31
	26-35	12	18.46
	36-45	10	15.38
	46-55	14	21.54
	56-65	11	16.92
	66+	10	15.38
Profession	Entrepreneur	17	26.15
	Merchant	15	23.08
	Laborer	6	9.23
	Housewife	18	27.69
	Civil Servant	6	9.23
	Others	3	4.62
Education	Elementary School	10	15.38
	Junior High School	15	23.08
	Senior High School	29	44.62
	University Level	11	16.92

Sekaten is one of the terms used by Javanese people to refer to the celebration of the birth of the Prophet Muhammad (Al-Fajriyati 2020). Before the *grebeg maulud* ceremony is held, there is a *sekaten* celebration marked by a night market as a means of recreation and shadow puppet shows (Farida and Shofi'unnafi 2020). In addition, there are also traditional dance performances, recitation of *sholawat* and prayers done together, as well as a procession around the city with chariots and *keris*, which involves sultans, soldiers, and officials, as well as people who want to participate in that moment. After the *sekaten* celebration, the highlight is the *grebeg maulud*, a *kirab* procession led by the Sultan of Surakarta Kasunanan (Dasanti 2020). In this procession, various decorations, royal equipment, traditional elements including gamelan and dances, and *gunungan* containing Surakarta's products are prayed for and paraded around the palace to be contested by the community. People believe that getting the *gunungan* will bring blessings to them. They seek this blessing for peace of life, increased welfare, and authority (Wardhani et al. 2021). During the procession, the Sultan of Surakarta Kasunanan usually provides basic food or other basic needs to the community assistance. That reflects the concepts of social justice and responsibility that are part of Islamic teachings and Javanese traditional beliefs. Until now, the *sekaten* and *grebeg maulud* traditions are still implemented and preserved in the Surakarta Hadiningrat Sunanate.

Every tradition in Indonesia has deep meanings and symbols. One that has similarities to the *grebeg maulud* is the *hang woja* traditional ceremony in Manggarai District. This ceremony is a form of gratitude and celebration of the change of seasons and years. This ceremony also has several processions. The difference is that *grebeg maulud* has been acculturated with Islamic religious culture, while *hang woja* still maintains local beliefs, this ceremony is a tribute to God (*Mori*), ancestors (*Empo*), nature, dan fellow humans (Ikin et al. 2023).

The research conducted in three villages shows people have almost the same understanding of the *sekaten* or *grebeg maulud* ceremony. People around the Surakarta Hadiningrat Sunanate Palace know more about the *grebeg maulud* ceremony than people who live far from the palace, starting from the history, meaning, and series of events. This is because people who live around the palace tend to follow the activities more often than those who live far from the palace.

Gunungan in the *grebeg maulud* ceremony symbolizes fertility and prosperity. The people of the three villages interpret the *gunungan* as a gratitude for the crops produced and a form of alms from the upper class to the community. *Gunungan* are made in pairs, which means that everything is created in pairs, good and bad, as well as men and women. Two pieces of *gunungan* will finally leave the palace from Sasono Sewoko to Sitinggil, Pagelaran, North Square, and end at the Great Mosque. In the Great Mosque, both the people will contest *gunungan*, and each will compete to get as many products as possible. This is because people who follow this tradition believe that the products in the *gunungan* hold a lot of sustenance and blessings (Farida and Shofi'unnafi 2020). *Gunungan* Surakarta consists of two types of *gunungan*: *jaler* (male symbolism) and *estri* (female symbolism). It is known that the *gunungan jaler* are shaped like a *tumpeng*; the frame is made of woven wire/bamboo, covered with banana leaves, shaped like *tumpeng robyong* consisting of ingredients: sugar cane, long beans, red chili, and eggplant. Everything is arranged on a *tumpeng* frame until all parts of the frame are covered. In comparison, the *gunungan estri* is shaped like a *motha* umbrella, made of *rengginang*, a cracker-like food made from glutinous rice as big as a plate, given a stalk and arranged until the framework is completely covered. Then, the top part is arranged with bananas and *jenang dodol* (Pramusinto and Wahono 2020).

The two *gunungan*s contain crop products and various spices; the compositions of raw materials, processed food, and skeletons to the base of the *gunungan*, and the crop products from their earth. The crop products comprise long beans, carrots, eggplants, cucumbers, red chilies, and *oyong*, kale. Of all these vegetable types, added other products include fruit, tubers, and some leaves and stems. Vegetables that must be present in the *gunungan* are long beans and carrots. Long beans are the most numerous, expressing *aja ninggal kacang lanjaran*, meaning do not leave the existing tradition. At the same time, carrots have a meaning as a symbol and an effort to develop an awareness of God. Sugar cane expressing *mantebing kalbu* means mutual respect and love for fellow humans. There are also additional fruits such as plantain and coconut. The plantain symbolizes that the king, as the highest leader, must be able to protect the people under him. At the same time, the coconut means that everyone shows their awareness and concern for God for expecting progress and development. There are also chicken or duck eggs that must be present and rice that comes from ricefield. Eggs can represent the beginning of human life, and rice represents human life needs.

In the *gunungan*, there are also various flowers, such as roses, which means *manunggaling warga*, the unity of the family. There is also bamboo as the frame of the *gunungan*, which means respect and love for the family and a form of unity from all societal elements. Moreover, as the base, banana leaves are usually used, as well as pandanus and betel leaves as decorations. In addition to raw crop products, there are various processed foods in the *gunungan*. The processed foods include *rengginang*, made from glutinous rice; *apem* cake, made from rice flour; jenang, made from rice flour and coconut milk; *dodol*, made from sticky rice flour and coconut milk; and cenil, made from black sticky rice flour. Just like other raw materials, processed foods also have various meanings, such as *rengginang*, which is assembled using ropes (*dironce*), which means that the whole community must continue to be united. In addition, *apem* cake also shows unanimity in seeking life perfection or what is commonly called *keplenging rasa handayoh kasampurnaning urip*.

Indonesia has many traditions, and some have a similar meaning to the *gunungan* event in the *grebeg maulud*. One of them is the *maras taun* tradition on Belitung Island. This tradition expresses gratitude for the abundance of farmers' crops on Belitung Island. The difference is that the *grebeg*

maulud gunungan consists of crops with raw materials and various processed foods. The *maras taun* tradition has a large and a small *lepat* cake. The big *lepat* cake will be cut and distributed by the local leader, meaning that every leader must serve his people; the small *lepat* cake will be contested by the community there as a form of joy and gratitude for the crops obtained during the past year (Juniarti 2022). This is also similar to the *grebeg maulud* tradition, the crop products obtained by the community are spread on their rice fields or agricultures in the hope that the future results will be more abundant.

Biological ingredients utilized for *grebeg maulud* ceremony

Several plant and animal category materials from various families and habitus are used in *gunungan*. Table 2 and Figure 2 show the habitus data, including 10% bipedal animals, while in plants there are 48% herb habitus, 33% shurb habitus, 5% tree habitus, and 5% creep habitus. The highest percentage of habitus used by the community is herb habitus, with a percentage of 48%. There are 2 families in the animal category (Figure 3), 50% of the Anatidae and 50% of the Phasianidae. Meanwhile, in the plant category there are 10 families (Figure 4), 16% of the Cucurabitaceae, 16% of the Fabaceae, 11% of the Graminae, 11% of the Musaceae, 11% of the Poaceae, 11% of the Rosaceae, 5% of the Pandanaceae, 5% of the Piperaceae, and 5% of the Umbeliferae. It is known that the percentage of family utilization in the animal category by the community in *gunungan* is the same. In comparison, the highest percentage of families utilized by the community in the plant category are Cucurbitaceae and Fabaceae with the same percentage of 16%. The lowest percentage of family utilization is Pandanaceae, Piperaceae, and Umbeliferae, with a percentage of 5% each.

Figure 5 shows the animal and plant parts used, there are egg with percentage of 5%, egg and meat is 5%, fruit 37%, seed 21%, leaf 16%, trunk 11%, flower 11%, and root 5%. The highest utilization of plant parts is in the fruit, with a percentage of 37%, and the lowest is the root, with a percentage of 5%. The biological materials from animals and plants used in the *gunungan* are obtained from the palace garden, and a small portion is purchased from the market.

Javanese society is very strong with the value of tradition and local wisdom, which is known from various forms of local wisdom ceremonies as an expressions of belief and appreciation for the almighty creator, such as local wisdom is *sadranan* (Herayanti et al. 2023). Each traditional ceremony has a different context, purpose, and symbolism, so the supporting elements differ. Compared to the *sadranan* ceremony in Surakarta City, *sekaten* and *grebeg maulud* have used more animals and plants because the ceremony uses elements like *gunungan*. It is known that the *gunungan* element contains various types of plants from the crop products of Surakarta City ranging from vegetables, fruits, and also some livestock (Pramusinto and Wahono 2020).

Table 2. Species used for *grebeg maulud* by the people of Mojosongo Village, Keprabon Village, and Baluwarti Village of Surakarta City, Indonesia

Family	Scientific name	Local name	Habitus	Part used	ICS value	Category
Fauna						
Anatidae	*Anas platyrhynchos* f. *domesticus* L.	*Bebek*	Bipedal	Egg	11	Low
Phasianidae	*Gallus gallus* subsp. *domesticus* L.	*Ayam*	Bipedal	Egg, Meat	29	Medium
Flora						
Cucurbitaceae	*Cucumis sativus* L.	*Timun*	Herb	Fruit	16	Low
Cucurbitaceae	*Luffa acutangula* L.	*Oyong*	Herb	Fruit	12	Low
Cucurbitaceae	*Glycine max* L.	*Kedelai*	Herb	Seed	36	Medium
Fabaceae	*Cocos nucifera* L.	*Kelapa*	Tree	Fruit	18	Low
Fabaceae	*Saccharum officinarum* L.	*Tebu*	Shurb	Trunk	25	Medium
Fabaceae	*Vigna unguiculata* L.	*Kacang panjang*	Herb	Fruit	20	Medium
Graminae	*Oryza sativa* var. *glutinosa* (Lour.) Körn.	*Ketan putih*	Herb	Seed	6	Low
Graminae	*Oryza sativa* var. *glutinosa* (Lour.) Körn.	*Ketan hitam*	Herb	Seed	5	Low
Musaceae	*Musa paradisiaca* L.	*Pisang raja*	Herb	Fruit	18	Low
Musaceae	*Musa paradisiaca* L.	*Pisang*	Herb	Leaf	8	Low
Pandanaceae	*Pandanus amaryllifolius* Roxb.	*Daun pandan*	Shurb	Leaf	15	Low
Piperaceae	*Piper betle* L.	*Daun Sirih*	Creep	Leaf	5	Low
Poaceae	*Oryza sativa* L.	*Padi*	Herb	Seed	72	High
Poaceae	*Gigantochloa apus* (Schultz) Kurz	*Bambu*	Shrub	Trunk	4	Very low
Rosaceae	*Rosa gallica* L.	*Mawar merah*	Shrub	Flower	5	Low
Rosaceae	*Rosa alba* L.	*Mawar putih*	Shrub	Flower	5	Low
Solanaceae	*Capsicum annuum* L.	*Cabai merah*	Shrub	Fruit	60	High
Solanaceae	*Solanum melongena* L.	*Terong*	Shrub	Fruit	18	Low
Umbelliferae	*Daucus carota* L.	*Wortel*	Herb	Root	25	Medium

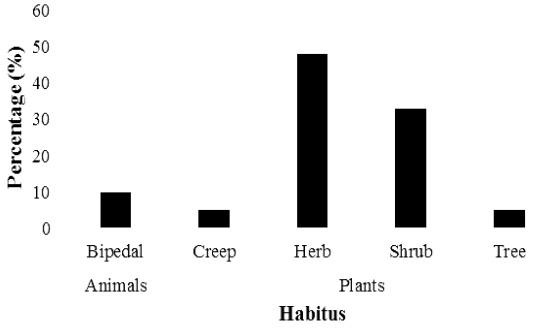

Figure 2. Percentage chart of animals and plants habitus used in *grebeg maulud*

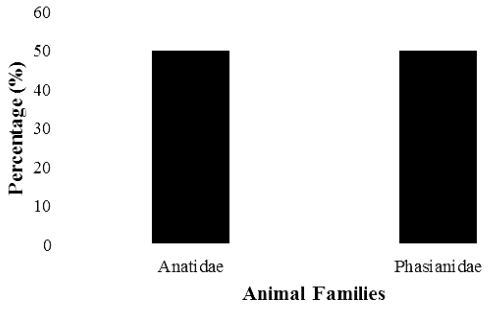

Figure 3. Percentage chart of animal families used in *grebeg maulud*

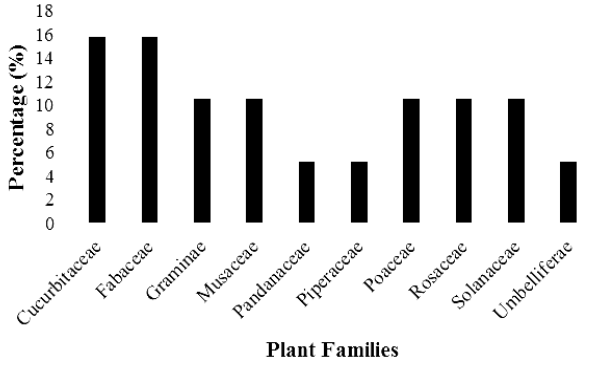

Figure 4. Percentage chart of plant families used in *grebeg maulud*

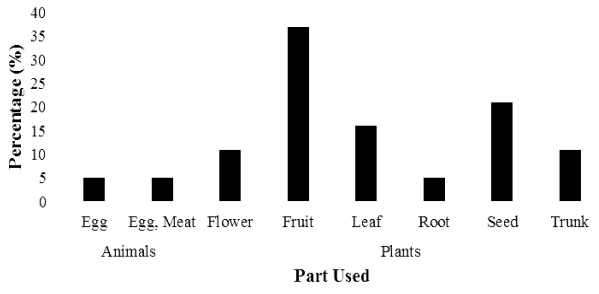

Figure 5. Percentage chart of animals and plants part used in the *grebeg maulud* tradition

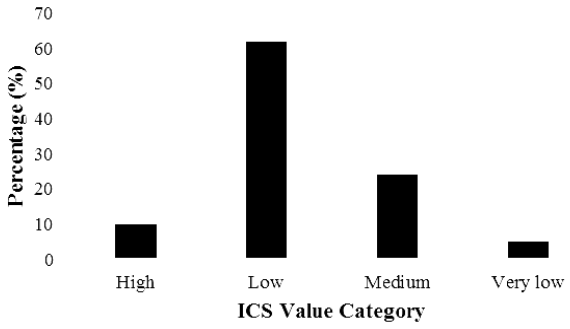

Figure 6. Percentage chart of ICS value categories

Index of Cultural Significance (ICS)

The percentage of ICS has 62% ICS low categories, 24% medium, 10% high, and 5% very low categories (Figure 6). The highest ICS value category in plant material is in the low category, with a percentage of 62%, and the lowest is in the very low category, with a percentage of 5%. A high ICS value number represents a species with a high consumer or use value, while a low ICS value number represents a species with a low consumer and use value (Has et al. 2020). Bamboo (*Gigantochloa apus*) has the lowest ICS value of 4, while rice (*Oryza sativa*) and red chili (*Capsicum annuum*) have the highest ICS value of 72 and 60 (Table 2). The highest value can be obtained because rice is a staple food that can be utilized as the main ingredient, complementary food ingredients such as crackers, and also be used as an ingredient in making *beras kencur* herbal medicine. In addition, red chili peppers are also used as a complementary food, a vegetable, and an additional ingredient or spice. Meanwhile, bamboo has the lowest ICS value because the community rarely utilizes it; it is only used as crafts and building materials less desirable to the community.

The number generated from the calculation of the ICS can show the level of importance of each plant species utilized by the community (Has et al. 2020). ICS can also be used to measure the value of plants for the community in providing important input in programs that have goals for biodiversity conservation; in other words, this calculation can be used to consider the management of the calculated resources (Helida et al. 2015). After the calculation, the resulting value will determine what types of natural resources are prioritized for conservation. When the ICS value is high, conservation efforts need to be prioritized. Therefore, conservation enforcement can be done by observing the carrying capacity supporting conservation success. Conservation can minimize genetic erosion or species extinction due to high utilization (Ismail et al. 2023). The community can cultivate natural resources independently, such as planting banana trees, roses, and chili peppers; they can also replant natural resources that have been utilized. Increasing the soil fertility where these plants are conserved is crucial (Sutraningsih et al. 2019). In general, conservation will make natural resources sustainable.

In conclusion, the *grebeg maulud* ceremony is still preserved and maintained by the people in Surakarta until now. A peak activity in the series of *grebeg maulud* events, namely *gunungan*, contains crop products with various species. People in Mojosongo, Keprabon, and Baluwarti Villages utilize several species for *grebeg maulud* activities, including 2 species of fauna and 19 species (taxa) of flora. The parts of the fauna are eggs and meat; the most utilized part of the flora is the fruit. The species with the highest ICS value is rice (*O. sativa*), with an ICS value of 72 and is included in the high category. The species with the lowest ICS value is bamboo (*G. apus*) with an ICS value of 4 and is included in the very low category. From the ICS value, it can be observed that rice is the most important species in the utilization of *grebeg maulud* activities.

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Assessing social capital in community forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia

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Abstract. *Herdananta BY, Ibriza NM, Wardha'adlina WA, Sulton MN, Sugiyarto, Budiharta S, Setyawan AD. 2024. Assessing social capital in community forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia. Asian J Ethnobiol 7: 50-60.* Community-based Forest Management (CFM) offers more effective protection of forest resources with a decentralized approach to ownership and management, as well as the establishment of autonomous local institutions that provide adequate incentives for the parties involved. The community manages natural resources through mutual use agreements, which lead to the concept of social capital as a solution to overcome collective problems. The study aims to evaluate the state of social capital in community forest management in Kalibawang Sub-district, Wonosobo, Central Java, Indonesia and identify the determinants that influence it as recommendations for improvement to policymakers. Data collection was conducted in March 2024 with research methods included interviews, surveys with questionnaires based on The Social Capital Assessment Tool (SCAT) and the Social Capital Integrated Questionnaire (SC-IQ) and Focus Group Discussion (FGD) discussions with local communities. The results showed that social capital in the studied area was significantly influenced by various variables, such as the role of forest farmer groups, access to information, community knowledge, non-formal education, and forestry extension activities. Consequently, the average level of social capital is obtained at 36.91 with a moderate category. Additionally, the analysis of concern community reveals a high classification, with an average score of 8.39. Increased social capital can be reflected in a higher density and diversity of social ties, as well as greater access to resources and stronger trust among group members. The recommendations of this study emphasize the importance of government in encouraging community participation in CFM management, reducing mistrust and conflict with government agencies, and strengthening social capital essential for sustainable forest management.

Keywords: Agroforestry, CFM, social capital, sustainability, the role of forest farmer groups

INTRODUCTION

Sustainable development is based on three main pillars, namely economic, social, and ecological aspects. These three aspects are interrelated and have an important role in promoting sustainable development, as conveyed at the World Summit in 2015. In the context of forest management, the economic, social, and ecological dimensions have an inseparable causal relationship to achieve sustainability (Sukwika and Fransisca 2021). Community-based Forest Management (CFM) is a promising idea which can lead to the protection and sustainable utilization of forests through decentralization of ownership and management (Ranjan 2018). CFM creates local institutions that are autonomous and have adequate respect for those involved. This approach is particularly emerging in developing countries that may not have adequate infrastructure and monitoring capabilities to protect forests.

Caballero (2015) state that studies on CFM institutions must be based on various aspects such as institutional changes, political frameworks, legal regulations, property rights, governance mechanisms, user participation, and policy making. This includes forest management systems on local community land, as well as state forests in the form of collaborative management (Asmin et al. 2019). In many regions, forest communities have organized themselves to protect, sustainably manage and, in some cases, restore local forests by creating groups or associations (Dharmika et al. 2022). The focus of social forest management initiatives have evolved from merely resolving ecological constraints related to trees and forests to more broadly by incorporating socio-economic constraints, local institutional constraints, and most recently, government policy constraints (Ahammad et al. 2023). From the perspectives of socio-economic, institutional and governance, the management of forest resources by communities arises when there is a mutual use agreement among its members. This agreement can occur because of regular and continuous interaction between community members in the use of these resources. To understand the structure, relationship and interaction in community-based forest management, the concept of social

capital developed in social sciences can be used to support decision-making (Sabet and Khaksar 2024).

The concept of social capital began to develop from the understanding that a society needs collective actions and cooperations to overcome its problems (Engbers et al. 2017). This idea was introduced by Lyda Judson in the early 20th century, although the term of "social capital" only became known in academia in the late 1980s. Pierre Bourdieu explains that economic, cultural, and social capital is convertible (Pylypenko et al. 2023). Economic capital can take the form of money; cultural capital, such as education, can also be economic capital; and social capital can generate material benefits (Pret et al. 2016). Structural social capital includes various forms of social organization, such as networks, roles, rules, and procedures, while cognitive social capital refers to norms, values, attitudes, and beliefs that are jointly held (Claridge 2018). The existence of shared values and norms, shared rules and responsibilities, and relationships built on trust and mutual benefit all play an important role in strengthening cooperation and supporting collective action, both in social interaction and decision-making (Prayitno et al. 2024).

The development of social capital in community-based forest management in Kalibawang Sub-district, Wonosobo, Central Jawa, Indonesia hinges on the intricate interplay of shared values, norms, and trust among its inhabitants (Prayitno et al. 2024). According to data from the Disdukcapil Wonosobo (2023), the population of Kalibawang Sub-district in 2022 reached 29,082 people, with the majority of their livelihoods are sourced by farming on forest land. In this regard, forest sustainability and the need for livelihoods are critical to maintaining a balance between environmental conservation and local communities' economic needs. In Kalibawang Sub-district, the implementation of sustainable community-based forest management is imperative for maintaining forest sustainability and improving the welfare of the Kalibawang community (Wiyono et al. 2020). Forest management in Kalibawang is based on community forestry principles, which might require a different approach compared to, for example industrial forestry or national park (Syaprillah and Sapriani 2014). In Kalibawang, forest management is focused on rural communities that are typically involved in subsistence agriculture, and the sustainable forest management practices are new to them. The establishment and management of community forests entails the formation of community forestry associations, which coordinate, monitor, and advise community forest committees on how to successfully implement their activities (Palmolina 2015). The purpose of this study is to assess social capital in community-based forest management in Kalibawang Sub-district, Wonosobo, and determine the factors affecting it. These determinants can be used as recommendations to improve forest management in the studied area wheret local policymakers can adopt.

MATERIALS AND METHODS

Study area

This research was conducted in four villages in Kalibawang Sub-district, Wonosobo District, Central Java Province, Indonesia (Figure 1). The four villages are Mergolangu (7°30’48.661”S, 109°53’11.789”E), Depok (7°29’54.805”S, 109°54’21.341”E), Dempel (7°30’36.655”S, 109°55’19.556”E), and Karangsambung (7°30’11.876”S, 109°55’35.976”E). The elevation in Kalibawang ranges from 549 to 984 meters above sea level, and the area is characterized by hilly terrain with many hills (Shiddieqy et al. 2023). The sub-district has an extent of 4.78 thousand hectares, accounting for 4.86% of the total area of Wonosobo District. The average land slope in Kalibawang Sub-district ranges from 10 to 40%. The average temperature is 22°C with average rainfall of 2.200 mm/years (BPS 2023).

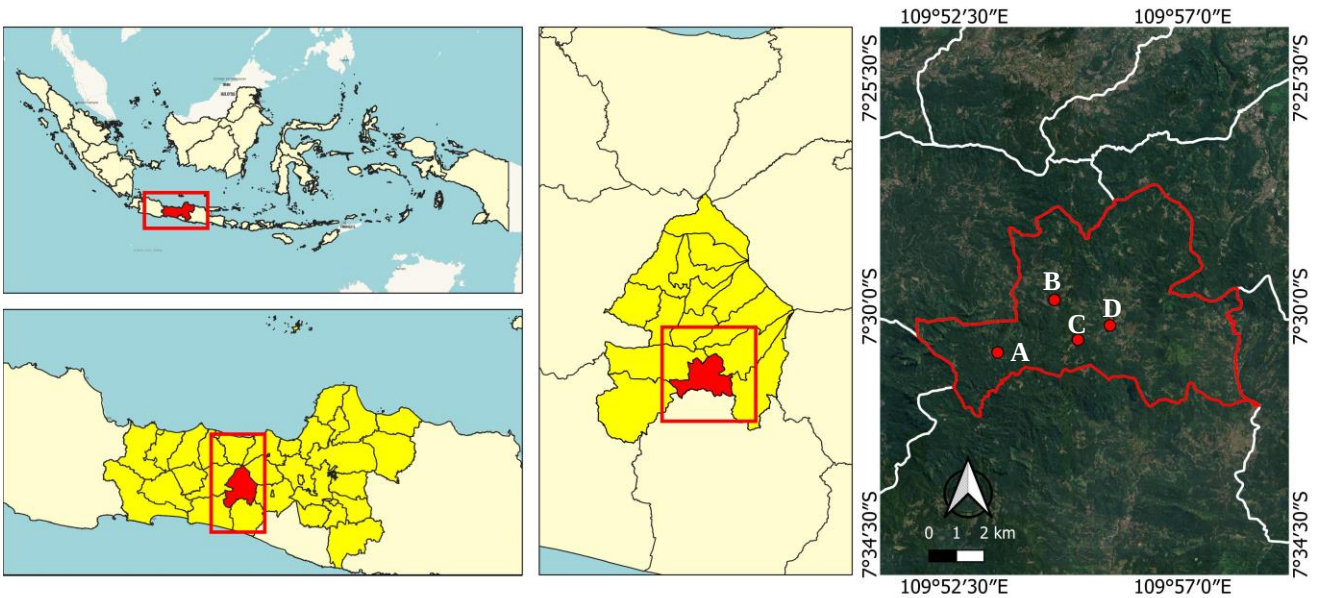

Figure 1. Study area of Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia. A. Mergolangu, B. Depok, C. Dempel, and D. Karangsambung

Data collection

Data collection was carried out in March 2024 through field observations/surveys and in-deepth interviews, as well as literature review, especially for plant diversity, soil and climate conditions. Primary data were collected through interviews and surveys using structured questionnaires. The questionnaire was prepared based on Grootaert et al. (2004). The Social Capital Assessment Tool (SCAT) and the Social Capital Integrated Questionnaire (SC-IQ) were used to assess social capital, which is a concept that refers to the networks, norms, and trust that exist between individuals and within communities. Kalibawang Sub-district consisted of 9829 households and the questionnaire was targeted to the head of households who are the members of forest farmer group. The sample number is obtained using the Slovin formula and a simple random sampling technique with a 10% margin of error due to the population's homogeneous characteristics (Lawadi et al. 2023). The data was compiled by collecting samples from 100 community forest farmer households, which were obtained based on:

$n = N / (1 + Ne^2)$

Where:

n = Sample size

N = Population size

e = Acceptable margin of error

In addition to respondent surveys and interviews, the data in this study was also obtained through Focus Group Discussions (FGDs) involving the community, which aimed to understand community's perspective about managing forests and gain direct insight into their challenges, needs, and aspirations related to forest management. FGD is an effective method for gathering qualitative data in various research contexts, including health services, disaster management, and community development (Onwuegbuzie and Frels 2015). FGDs also provide opportunities for the participants to share knowledge and experience, which can increase the depth of analysis and understanding of the study. The FGD process was carried out using discussion guidelines that have been systematically prepared to ensure the completeness of the information obtained and direct the discussion on aspects relevant to the research objectives. Following that, the data obtained from the FGD was critically and holistically analyzed to gain a comprehensive understanding of community perspectives on forest management.

Analytical framework

The study was conducted using quantitative descriptive analysis with questionnaires to determine individual characteristics, knowledge about CFM, external factors, and elements of social capital (Duong et al. 2020). The scoring was then derived from the survey results and analyzed using the interval value formula as presented below:

$$\textit{Interval value} = \frac{\textit{Difference between the highest total score and the lowest total score}}{\textit{Class number}}$$

Individual characteristics, knowledge of CFM, and external factors were evaluated based on three categories: low, moderate, and high, with each score being 1 for low, 2 for moderate, and 3 for high (Lee et al. 2017).

Social capital, as a variable (Y), included trust (Y1), social networks (Y2), social norms (Y3), proactive actions (Y4), and concern (Y5) (Figure 2).

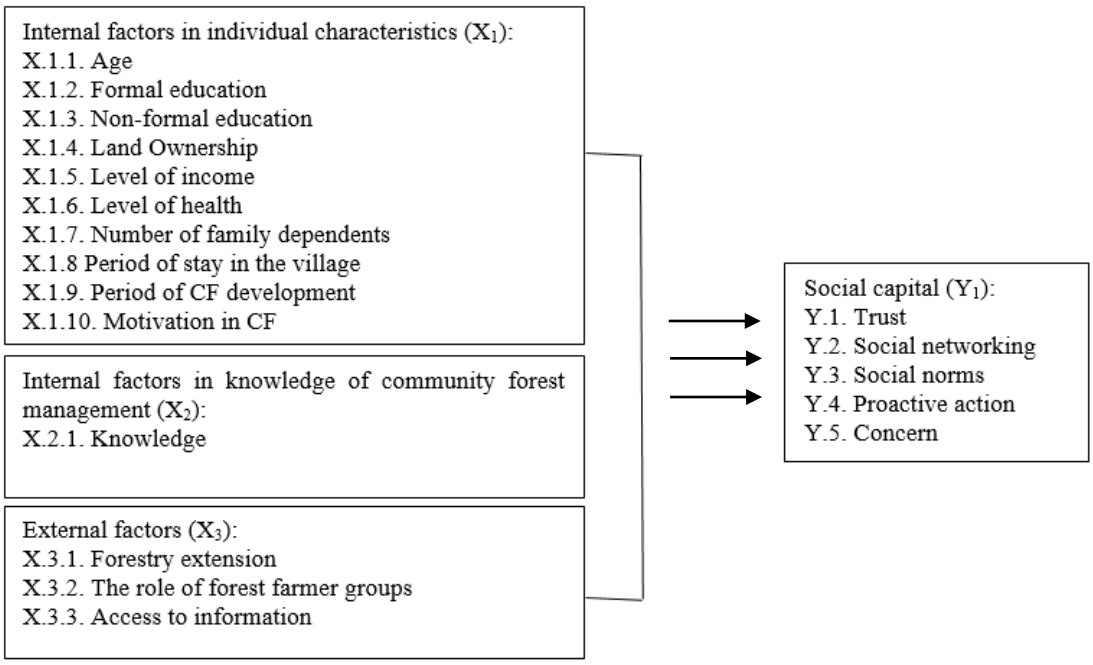

Figure 2. Analytical framework of the research with respective code of each factor

Trust levels were measured by the Forestry Service trust in community leaders, farmer groups, and extension services. Social networks were measured by the number of community groups followed, motivation to join the group, willingness to participate in the group, respondents' interaction with other members, and intensity of attendance at group meetings. Proactive action was measured by the experience and participation in resolving community conflicts, social norms were measured by the degree of difference in groups and the number of conflicts between community members, while concern was measured by the attitudes that show concern, solidarity, and empathy for community members and the surrounding environment. The influencing factors were made up of internal factors consisting of individual characteristics (X1) and knowledge of community forest management (X2) and external factors (X3). Internal factors in individual characteristics included age, formal education, non-formal education, land ownership, level of income, level of health, number of family dependents, period of stay, period of land ownership, period of community forest development, and motivation in community forest (Table 1).

Internal factors in knowledge of community forest management included understanding intercropping systems, their benefits, and CFM's technical capabilities. External factors included forestry extension activities, the role of respondents in community groups, and access to information. The variable of forestry extension activities was measured by the benefits felt by the respondents from the extension activities. The role of the farmer group included the knowledge and skills gained through the activities of the farmer group. Access to information refers to the level of respondents' access to information received about forestry.

Data analysis

We used SPSS Statistics 25 to analyze the data. We conducted multiple linear regressions to determine the influence of social capital on internal and external factors in CFM in Kalibawang Sub-district, Wonosobo District, Indonesia. Regression results can be used as a determining factor to increase social capital in the study area.

RESULTS AND DISCUSSION

Status of community forest management

The forest area studied in Kalibawang Sub-district, Wonosobo District is a community-based forest management with the land is owned by Perhutani (Indonesian Forest State Enterprise). The legal status of this forest is designated as production forest, managed collaboratively between Perhutani and the local community, in accordance with the prevailing laws and regulations in Indonesia. Studies conducted in four villages show that the majority of communities implement an agroforestry system locally known as a "tumpangsari". This term refers to a planting pattern that utilizes various types of plants simultaneously in one field. This system has proven to be an adaptation strategy for the majority of people who work as farmers either as landowners, land tenants, or agricultural workers. The main commodity production in this system is focused on food and vegetable crops, following ecological principles that allow sustainable land optimization (Lalican 2018).

The majority of plants in Kalibawang Sub-district are woody and tree species, such as *sengon* (*Albizia chinensis*), *pinus* (*Pinus merkusii*), *durian* (*Durio zibethinus*), avocado (*Persea americana*), mahogany (*Swietenia mahagoni*), and teak (*Tectona grandis*). The selection of these plants is due to a variety of factors, such as good soil conditions, that allow woody plants to grow with necessary nutrients (Wang et al. 2021; Negari et al. 2023). In addition, water availability is an important factor for woody plants since lack of water can reduce plant growth and productivity (Barry et al. 2016). Another factor that can affect woody plant growth in Kalibawang Sub-district is high soil moisture (Emmyzar 2020). Intercropping plants in Kalibawang are various types of annual plants that can be planted and harvested within one year (Figure 3), such as food crops and feed crops (Darma and Angka 2020).

Figure 3. Intercropping system of forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia

Common food crops grown in Kalibawang Sub-district are rice, cassava, and corn. Fruit plants are also widely cultivated, such as bananas, mangosteen (*Garcinia mangostana*), durian, avocados, and cocoa (*Theobroma cacao*). Some food plants, such as cassava, are intercropped with woody plants, such as pine. Pine can be a growing medium and fertilizer for cassava plants (Pranamulya et al. 2013). Although pine leaves have allelopathic potential, research also indicates that when processed properly, pine leaves can be used as compost. Through proper composting processes, allelopathic compounds can be broken down, thus the end product can enhance soil fertility and provide nutrients for plants (Anwar et al. 2019). In addition, cocoa is grown together with corn and various kinds of horticultural crops. We also noted that, in addition to growing food and medicinal crops, the community of Kalibawang implement silvopastoral to support goat livestock commodities by utilizing the lower area of woody plants as a place for grass development.

Demographic profiles

Intercropping systems have been shown to have a significant impact on local communities in terms of socio-economic status. The result indicates that more than half of the respondents chose intercropping farming because of higher profits (87%). However, the average annual income of some respondents (34%) is low (<700,000 IDR) because the majority of Kalibawang people have a land area below 0.8 ha (82%) (Table 1). In the context of community forest management, intercropping systems are seen as a way to promote sustainable forest management and improve community welfare (Kailola et al. 2023). The success of this system, however, depends on a variety of factors, including the level of social capital in the community. According to interviews with respondents in Kalibawang Sub-district, the level of community trust in four villages in the study area was moderate.

For the respondent, the economic condition of the agriculture sector is crucial. Community forests represent a farming business of high economic value and provide farmers with opportunities for additional income. Based on the result of the survey, farmer's average annual income from the community forest business is around 700.000-12.700.000 IDR (60%), with average land ownership of 0.8 ha (82%), and average number of dependents of 0-3 (73%). The demographic profile of the Kalibawang community underscores the significance of agriculture in their livelihoods. Furthermore, based on the survey, it is evident that the majority of working individuals in Kalibawang are productive farmers with age between 19 and 45 years old comprised 56% of the surveyed population (Table 1). This demographic composition not only highlights the community's reliance on agriculture but also suggests a potential receptiveness towards agroforestry practice in Kalibawang.

Table 1. Individual characteristics of respondents in Kalibawang, Wonosobo District, Indonesia

No.	Variable (Code)	Category	Score	Frequency	%
1	Age (X.1.1)	a. Less productive : > 60 years old	1. Low	0	0
		b. Quite productive : 45 - 60 years old	2. Moderate	44	44
		c. Productive : < 45 or 19 - 45 years old	3. High	56	56
2	Formal education (X.1.2)	a. Elementary	1. Low	40	40
		b. Middle school	2. Moderate	28	28
		c. High school/university	3. High	32	32
3	Non-Formal education (X.1.3)	a. Never	1. Low	93	93
		b. Some : 1-2 times	2. Moderate	3	3
		c. Often : > 3 times	3. High	4	4
4	Land ownership (X.1.4)	a. Narrow : 0. 8 ha	1. Low	82	82
		b. Quite wide : 0. 8 - 2. 9 ha	2. Moderate	15	15
		c. Wide : > 2. 9 ha	3. High	3	3
5	Level of income (X.1.5)	a. < 700,000 IDR	1. Low	34	34
		b. 700,000 – 12,700,000 IDR	2. Moderate	60	60
		c. > 12,000,000 IDR	3. High	6	6
6	Level of health (X.1.6)	a. Bad : > 20 days	1. Low	1	1
		b. Health enough : 10 - 20 days	2. Moderate	1	1
		c. Healthy : < 10 days	3. High	98	98
7	Number of family dependents (X.1.7)	a. 0 - 3	1. Low	73	73
		b. 4 - 8	2. Moderate	0	0
		c. >9	3. High	27	27
8	Period of stay in the village (X.1.8)	a. Short : < 29 years	1. Low	10	10
		b. Quite long : 29 - 53 years	2. Moderate	64	64
		c. Long : > 53 years	3. High	26	26
9	Period of CF development (X.1.9)	a. Short : < 21 years	1. Low	39	39
		b. Quite long : 21 - 40 years	2. Moderate	28	28
		c. Long : > 40 years	3. High	33	33
10	Motivation in CF (X.1.10)	a. Encouragement from the outside	1. Low	6	6
		b. Own desire because of higher profits	2. Moderate	87	87
		c. Own desire because of concern for forest	3. High	7	7

Table 2. Evaluation of individual characteristics in Kalibawang, Wonosobo District, Indonesia

Individual characteristics	Score	Average	Category
Age	230	2.3 ≈ 2	2 Moderate
Formal education	170	1.7 ≈ 2	2 Moderate
Non-formal education	101	1.01 ≈ 1	1 Low
Land ownership	111	1.11 ≈ 1	1 Low
Level of income	157	1.57 ≈ 2	2 Moderate
Level of health	267	2.67 ≈ 3	3 High
Number of family dependents	140	1.4 ≈ 1	1 Low
Period of stay in the village	195	1.95 ≈ 2	2 Moderate
Period of CF development	170	1.7 ≈ 2	2 Moderate
Motivation in CF	182	1.82 ≈ 2	2 Moderate
Total	1723	17.23	Moderate

Note: "≈" means rounding to the nearest number

Table 3. Community knowledge in community forest management in Kalibawang, Wonosobo District, Indonesia

Knowledge (code)	Total score interval	Category level	Freq.	%
Knowledge	8-13	Low	3	3
(X.2.1)	14-19	Moderate	25	25
	20-24	High	72	72
Total			100	100

Table 4. Evaluation of community forest management knowledge in Kalibawang, Wonosobo District, Indonesia

Knowledge of community forest management	Score	Average	Category
Knowledge	1,879	18.79	Moderate

Table 2 is the result of the evaluation of individual characteristics, in which there are ten categories in individual assessment. Age has score of 230 with an average of 2, indicating a moderate category. Formal education reaches the score of 170 with an average of 2, which is also included in the moderate category. Non-formal education achieves 101 with an average of 1 in the low category. Land tenure has score of 111 with an average of 1, making it a low category. With an average of 2, the income level reaches 157, including in the moderate category. The health level receives the highest score (267 with an average of 3) and fell into the high category. The number of family dependants has score 140 with an average of 1, falling into the low category. Length of stay obtains a score of 195, with an average of 2 in the moderate category. The duration of CF implementation receives a score of 170 with an average of 2, also included in the moderate category. Motivation in CF gets a score of 182 with an average of 2, including the moderate category. The overall total is 1,723, with an average of 17.23 in the moderately dominant category. The income inequality index is a statistical measure that describes how much income differs between individuals or groups in a population. In their study, Negi et al. (2018) found that the income of the local community fluctuates in the range between 0.31 and 0.54. The index's average is estimated at 0.39, with an uncertainty level of approximately 0.05 SD. This suggests that income is largely unevenly distributed among members of the community studied, with significant variation from the mean value. Based on research by Kailola et al. (2023), the income earned by respondents ranged from 739,591.83 IDR to 2,112,127.66 IDR per month. In terms of length of stay, respondents have settled in their villages over a period of 20 to 79 years, indicating that they have had a depth of experience in the environment. The results showed that the community has a strong understanding of the socio-cultural conditions and biophysical landscape in their area (Dako et al. 2019).

Table 3 explains the level of community knowledge on forest management, which is divided into three categories, namely low, moderate, and high. Based on the total number of respondents, 3% fall into the low category, with interval scores between 8 and 13, while 25% of respondents fall into the moderate category, with interval scores between 14 and 19, and 72% fall into the high category, with interval scores between 20 and 24. In their research, Lee et al. (2017) divided community knowledge into two categories, namely conceptual and procedural. The overall total shows that community knowledge is in the high category, with the acquisition of procedural knowledge scores in the moderate category and conceptual knowledge in the high category.

Table 4 shows the results of the evaluation measuring the community's level of knowledge about forest management, with a total score of 1,879 and an average score of 18.79, indicating that the community is at a moderate level of knowledge about forest management. This moderate level of knowledge in the community is influenced by several factors, namely the effectiveness of the extension program, access to information, and the level of community participation in environmental conservation activities. Interestingly, in a study conducted by Kailola et al. (2023), community knowledge was categorized as high. This success can be attributed to sustained efforts by tribal chiefs or traditional leaders in disseminating knowledge, as well as strict sanctions on those who violate existing forest management norms. Thus, the direct intervention of such local leaders plays an important role in improving community understanding and adherence to sustainable practices in forest management.

Table 5 explains the external factors that affect forest management which are classified into three categories, namely low, moderate, and high. The influencing external factors include forest expansion activities, the role of farmer groups, and access to information. Forest expansion activities in the low category (intervals of 2-3) consist of 39 respondents; while in the moderate category (intervals of 3-4) are 44 respondents; and in the high category (intervals of 5-6) are 17 respondents. Then, regarding the role of forest farmer groups, there are 2 respondents in the low category with an interval of 8-13; 30 respondents in the moderate category with an interval of 14-18; and 68 respondents are in the high category with an interval of 19-24. Regarding access to information, there are 30 respondents in the low category, with an interval of 2-3; 62 respondents are in the moderate category, with an interval of 3-4; and 8

respondents are in the high category, with an interval of 5-6. Lee et al. (2017) found that local communities were not actively involved in the development and participation in extension programs. In addition, they also recognized the importance of the role of forest farmer groups and the availability of access to information at a sufficient level.

Table 6 displays the results of the external factors evaluated based on three criteria. First, forestry extension activities obtain a score of 388 with an average of 3.88, which puts them in the medium category. The moderate score of forestry extension activities is influenced by several factors, such as the method and scope of extension, the quality of the material delivered, and the interaction between extension staff and the community. The role of forest farmer groups falls into the high category, with a score of 1,978 and an average of 19.78. Factors contributing to this high score include the group's ability to manage resources sustainably, the community's active participation in conservation projects, and solid partnerships with government and non-government organizations. Access to information results in score of 369 with an average of 3.69, also falling into the medium category. This is influenced by several factors, including government policies related to information transparency. Overall, the total score obtained is 2,735, with an average of 27.35, which is dominated by the moderate category. According to the research findings of Kailola et al. (2023), the social network element shows an overall score of 23.06, which falls into the high category. However, the study also highlighted some villages that scored low, ranging from 20.68 to 22.22. This is due to barriers to building institutional cooperation, which in turn hinders communication.

Table 7 is an evaluation of social capital in forest management, showing that the group element has a score of 1,112, with an average of 11.12 (low) and a range of high-lowest scores of 21-7. The trust element has a score of 589, with an average of 5.89 (moderate) and a high-low score range of 9-3. Proactive element has a score of 554, with an average of 5.54 (moderate) and a range of high-low scores of 9-3. The social norms element has a score of 597, with an average of 5.97 (moderate) and a range of high-low scores of 9-3. The concern element has a score of 839, with an average of 8.39 (high) and a high-low score range of 10-3. The overall total score is 3,691, with an average score of 36.91 (high) and a range of high-lowest scores of 58-19 for all elements evaluated. Kailola et al. (2023) found that the analysis of the level of trust in the community showed a moderate level with an average value of 32.57. The findings also reveal a high level of trust in various entities, such as family, neighbors, friends, groups, individuals from the same tribe, religious leaders, community leaders, and written rules. However, trust in the district government, provincial government, and written rules is low. Furthermore, the analysis of the community's concern reveals a high classification, with an average score of 8.39. This finding confirms that communities still attach importance to concern that prioritize values such as awareness, commitment, knowledge of unwritten rules, and compliance with regulations in the forestry context.

Table 5. External factors that affect forest management in Kalibawang, Wonosobo District, Indonesia

External factors (code)	Total score interval	Category level	Freq.	%
Forest extension activity (X.3.1)	2-3	Low	39	39
	3-4	Moderate	44	44
	5-6	High	17	17
Total			100	100
Role of forest farmer groups (X.3.2)	8-13	Low	2	2
	14-18	Moderate	30	30
	19-24	High	68	68
Total			100	100
Access to information (X.3.3)	2-3	Low	30	30
	3-4	Moderate	62	62
	5-6	High	8	8
Total			100	100

Table 6. Evaluation of external factors that affect forest management in Kalibawang, Wonosobo District, Indonesia

External factors	Score	Average	Category
Forest extension activity	388	3.88	Moderate
Role of forest farmer groups	1978	19.78	High
Access to information	369	3.69	Moderate
Total	2735	27.35	Moderate

Table 7. Evaluation of social capital in forest management in Kalibawang, Wonosobo District, Indonesia

Social capital elements (code)	Score	Average	Max.-min. score	Category
Group (Y.1)	1112	11.12	21-7	Low
Trust (Y.2)	589	5.89	9-3	Moderate
Proactive (Y.3)	554	5.54	9-3	Moderate
Social Norm (Y.4)	597	5.97	9-3	Moderate
Concern (Y.5)	839	8.39	10-3	High
Total	3691	36.91	58-19	Moderate

Key determinants of social capital

The results of our investigation show the impact of internal and external factors on the level of social capital in a community. This capital plays an important role in achieving the sustainable development goals of society, including sustainable CFM. Based on multiple linear regression analysis, we found that social capital in Model 1 is 66.1%, which was influenced by the variable role of forest farmer groups (Table 8). Other variables, such as formal education and the CFM development period, do not show significant value. Therefore, individuals who join farmer groups are likely to have a deeper understanding of CFM management than those who do not. In addition, Model 2 shows that 73% of social capital is significantly influenced by the role of farmers, forest groups, and access to information (Table 8).

Table 8. Estimation results for the impact of independent variables on social capital from three regression models

Variable	Model I	Model II	Model III	Model IV	Model V
Constant	8.292 (0.000)***	9.196 (0.000)***	4.9*** (0.000)	5.14*** (0.000)	4.954*** (0.000)
Age					0.585 (0.560)
Formal Education	0.406 (0.686)				
Non Formal Education				**-2.872*** (0.005)**	-2.871*** (0.005)
Land ownership			-1.443 (0.152)		
Level of income		1.145 (0.255)			
Level of health					-1.162 (0.248)
Number of family dependents					1.608 (0.111)
Period of stay				-1.13 (0.262)	
Period of CF development	1.174 (0.243)				
Motivation in CF development					-0.86 (0.392)
Community knowledge			2.636** (0.01)	**3.192*** (0.002)**	3.181*** (0.002**)**
Forestry extension activity					**-2.406** (0.018)**
The role of forest farmer group	**13.927*** (0.000)**	10.418*** (0.000)	10.439*** (0.000)	10.788*** (0.000)	10.786*** (0.000)
Access to information		5.085*** (0.000)	5.365*** (0.000)	6.135*** (0.000)	**6.718*** (0.000)**
Adj. R	0.661	0.73	0.745	0.763	0.774

Other variables, such as income level, do not show a significant value. This shows that the role of farmer groups in obtaining information is very large in the implementation of CFM, thus affecting several factors, such as their economies individually. The delivery of information about agriculture still uses oral media, so misunderstandings often occur in interpreting the information, and the sources of information cannot be reached by all members of farmer groups. This implies that information systems in the agricultural sector are very important for farmers (Sentono 2022).

In model III, social capital of 74.5% is obtained, with significant variables being the role of farmer forest groups, access to information, and people's knowledge of CFM (Table 8). This shows that farmer groups' involvement in training and associations resulted in the development of very broad knowledge in the community about CFM management. Furthermore, in Model IV, social capital is 76.3%, which was significantly influenced by variables such as the role of the farmer forest group, access to information, people's knowledge, and non-formal education. This proves that the existence of non-formal education for each individual can increase the significance of CFM management, which will be shared with other communities by utilizing farmer groups to increase their community knowledge. In Model V, variables that significantly affect social capital as much as 77.4% are the role of farmer forest groups, access to information, people's knowledge, non-formal education, and forestry extension activities. The change in the forest management paradigm in Indonesia has now provided more space for the community, in line with the government's goal of improving welfare while preserving forests through the Social Forestry Programme (Rachmawan et al. 2021). The role of the government in implementing community empowerment by conducting regular counseling is to increase public knowledge about CFM management and make it easier for them to obtain information.

Discussion

Our research investigates factors that have a significant impact on the formation of social capital, which is a valuable asset in natural resource management, particularly in the context of community forestry. Some of the key factors we identified include the vital role of forest farmer groups, access to information, community knowledge levels, non-formal education, and forestry extension activities. Social capital itself includes networks, trust norms, cooperation, and reciprocal exchanges among individuals and groups. Forest farmer groups not only serve as a place to exchange information but also as a center for learning, collaboration, production and processing facilities, and support service providers for their members. They can collaborate to improve soil conservation, introduce new technologies, and provide training on new practices, as shown by a study conducted by Ville et al. (2016). Research by Wuysang (2014) shows that social networks are considered very important by the majority of farmer groups in the formation of social capital. Access to information is also an important aspect, as it enables more informed decision-making and more effective participation in the group (Johnson 2007). Non-formal education can also be an effective alternative for improving individual skills, such as training, workshops, courses, and so on. Through such programs, communities can stimulate the growth of social capital by creating opportunities to interact and build relationships (Shahid et al. 2022). Such programs can help reinforce a sense of belonging and shared values, which in turn can strengthen social networks and increase trust among community members (Igaune et al. 2016). Developing social capital, therefore, necessitates attention to these factors as well as collaborative efforts from various community actors. Investments in farmer groups, access to information, non-formal education, and forestry extension activities can be effective strategies for strengthening social capital and promoting sustainable natural resource management. Synergies between these factors can bring significant benefits to community development and environmental conservation.

According to research conducted by Gorriz-Mifsud et al. (2017), social networks have a very significant role in facilitating collaboration. In today's digital era, social networks have become key to increasing the community's potential through empowerment activities that aim to increase knowledge and skills both individually and in groups. These knowledge and skills are considered to be very important in the context of community development. The study conducted by Auer et al. (2020) also emphasizes that knowledge and skills gained through social networks can strengthen social capital, which in turn supports further learning and development. This social capital is a valuable asset for advancing communities and expanding collaborative networks. Not only that, community knowledge about forestry also has a significant impact on environmental knowledge and pro-environmental behavior. Research by Wan and Du (2022) showed that social capital facilitates pro-environmental behavior. Research has shown that high levels of social participation and adherence to social norms increase the adoption of pro-environmental behaviors, both privately and publicly. Forestry extension activities are an effective way to provide communities with opportunities to socially interact, learn, and develop the skills and knowledge needed to strengthen social networks. Research by Savari and Khaleghi (2023) highlights that forestry extension activities have great potential to increase social capital by enriching environmental knowledge and encouraging pro-environmental behavior. In addition, in the context of environmental conservation, research by Dasanayaka and Matsuda (2022) emphasizes the importance of maintaining local wisdom related to forest management in the context of environmental conservation. This local wisdom is an important foundation in efforts to preserve natural resources and build harmonious relationships between humans and the environment. Overall, these studies demonstrate the important role of social networks in facilitating collaboration, enhancing knowledge and skills, and strengthening social capital for community development and environmental conservation. By effectively utilizing the potential of social networks, we can create a more knowledgeable, environmentally conscious, and empowered society.

We also compared the results of the influence of social capital on CFM management with other similar literature and found that the existence of farmer groups supported by local governments can provide more experience for each individual in CFM management. In addition, the ease of obtaining information about counseling and managing CFM greatly affects social capital. Community-based institutional mechanisms are needed to help farmers acquire information and business skills, market produce, and promote quality (Zerihun 2021). A study by Valenzuela et al. (2020) in the Philippines found that having more social capital means having more diverse and dense social ties, better access to resources, and stronger trust. This means that networks built by community group members through their work on government-led environmental projects allow for the creation of more networks, which in turn lead to more project participation and benefits, both directly and indirectly. This is also supported by research conducted by Apipoonyanon et al. (2020) in Thailand, which states that future forest management approaches should emphasize the participatory needs of local communities, such as training programs, knowledge transfer, and information dissemination, thereby reducing mistrust and conflict between local community members and government agencies. In terms of government institutions, they also get support due to their ease of entering CFM to cooperate with the community in its management (Dako et al. 2019). Moreover, extension strategies, including field schools, exchange visits, and farmer training, are effective ways of disseminating needed information (Mukhlis et al. 2022). Research conducted by Ahmad et al. (2021) in Pakistan added that, apart from that, special focus must be given to strategies for developing community-based management, which includes trees and food plants in certain areas that can also be combined with livestock to produce products and services that will then be sold on the market at a higher selling price.

In conclusion, the results of the social capital analysis in Kalibawang Sub-district are classified as moderate. Significant determinants of the influence of social capital include forest farmer groups, access to information, and non-formal education, all of which play a role in improving community knowledge and skills, which in turn can strengthen community forest management capacity. This study's policy recommendations include expanding support for forest farmer groups, increasing information access, increasing non-formal education programs, and increasing community forest extension activities in Kalibawang Sub-district, Wonosobo.

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Ethnobiological study of *tumpeng*, traditional food in Surakarta City, Central Java, Indonesia

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Abstract. *Septhia ND, Izdihar NS, Destiani NFL, Rindiani N, Izdihar RS, Setyawan AD. 2024. Ethnobiological study of tumpeng, traditional food in Surakarta City, Central Java, Indonesia. Asian J Ethnobiol 7: 61-67.* The Javanese ethnic group, which is the largest ethnic population in Indonesia, shows its cultural richness through a variety of traditional foods, one of which is *tumpeng*. This research aims to find out information about each ingredient in *tumpeng*, the meaning of *tumpeng* in various Javanese traditions or ceremonies, and the knowledge of the people in Surakarta City, Central Java, Indonesia regarding this tradition through ethnobotanical studies. The research method used was observation and interviews with the people of Surakarta City regarding the *Tumpengan* tradition. Of the 60 respondents from Baluwarti, Kauman, and Mojosongo Villages in Surakarta City, the majority, especially 42 people, showed a "somewhat understand" level of understanding of *tumpeng*. The locals mention at least 19 plants and 3 animals often used as ingredients in *tumpeng*, such as coconut, water spinach, spinach, yarlong beans, mung bean sprouts, carrots, cucumber, cabbage, as well as chicken meats and eggs, milkfish, and anchovies. *Tumpeng* and each food element on it has a deep symbolic meaning for the community which is related to the relationship between humans and God, humans and nature, and humans and humans. For example, side dish such as chicken symbolizes gratitude and peace given by God, and cone-shaped rice shows the hope that there must always be progress and improvement in every life.

Keywords: Culture, ethnobiology, traditional botanical knowledge, *tumpeng*

INTRODUCTION

Indonesia is an archipelagic country with the largest number of islands in the world, which has more than 300 ethnic groups and more than 5,300 types of typical food from each ethnicity or region. This is because each ethnic group inhabiting these islands generally has a variety of traditional foods (Yudhistira and Fatmawati 2020). This diversity becomes a culture's identity, symbolized through traditions, rituals, and special events found in its social group. As well as being the unique character and uniqueness of each ethnic group, both in terms of food preparation procedures, food serving, and the way of eating the food itself (Wijaya 2019).

The Javanese ethnic group is the largest ethnic population in Indonesia, with a percentage of 40.2% of the total population in Indonesia, or reaching 95.2 million people (Triwibisono and Aurachman 2021). Like other tribes, the Javanese also have various variations of traditional food as their characteristics and uniqueness. Where, one example of traditional food that can show the ethnobiological richness of the Javanese ethnic is *tumpeng*. The term *tumpeng* comes from the phrase "*Tumungkulo sing mempeng*," which means that to achieve salvation, every human should always be diligent in worship (Ganjari 2020). However, according to Sunyoto (2016), *tumpeng* comes from the words *Tu/To* (hidden God) and *mpeng*, which is an offering (*sajen*) given by *Kapitayan* (animism-dynamism) adherents to perform devotional worship to God (*Sanghyang Tunggal*). Based on KBBI (2023), *tumpeng* means rice served in a cone-like shape (for salvation, etc.); while *tumpengan* means a celebration by serving *tumpeng* (rice) as the main food.

Generally, *tumpeng* is made from white rice and is shaped like a cone (volcano mount shape), which depicts the stages of human life from beginning to end and is often used as an offering, namely a series of Javanese rituals in the form of advice that is symbolized physically (Pianto et al. 2022). Apart from that, *tumpeng* is also known as a Javanese cultural heritage, which has various important meanings or philosophies at every event and is not only related to the relationship between humans and God but also with fellow humans and nature (Ridzki and Achmadi 2023). One of the philosophies contained in *tumpeng* is found in the earth alms ceremony (*Sedekah bumi*), which is carried out in one of the northern coastal areas of the island of Java using the "*Tumpeng Sego Golong*" greeting as a form of respect for individuals who contributed to the founding of the village and consists of one large *tumpeng* and nine small *tumpeng* around it with the symbolic meaning of struggle originating from the Walisongo history (Rochmawati et al. 2021).

Tumpeng is also an important element in the *Selikuran* night tradition of the Surakarta Kasunanan Palace, which requires a thousand *tumpeng* as a symbol of the promise of reward from Allah SWT to His servants (Prophet

Muhammad SAW) who carry out worship on the night of *Lailatul Qadar* sincerely (Bakri and Muhadiyatiningsih, 2019). When viewed historically, the tradition of *Mitoni* (pregnancy ceremony) or serving *tumpeng* rice also illustrates the result of cultural acculturation from Hindu habits to the Islamic religion, which has undergone slight changes since the arrival of Islam (Nurazizah, 2022). In a historical context, it is also known that *tumpeng* is related to religious dimensions in the past, such as animism-dynamism (*Kapitayan*) and Hindu-Buddhist religion (Ngadat 2023). Based on this description, this research aims to find out information regarding the knowledge of the people around the research location regarding *tumpeng*, the ingredients used in *tumpeng* along with the philosophy or meaning contained therein, and the meaning of *tumpeng* in various Javanese traditions or traditional ceremonies in Surakarta City, Central Java Province, Indonesia.

MATERIALS AND METHODS

Study area

This research was carried out from November to December 2023 in three villages in Surakarta City, Central Java, Indonesia including Baluwarti Village (-7.5372, 110.8453), Kauman Village (-7.8057, 110.3619), and Mojosongo Village (-7.5374, 110.8455). Baluwarti Village has an area of around 40.70 ha. The land available is only for the use of yard land (home garden), including use for raising free-range chickens, ornamental plants/potted plants, and physical gardens. Kauman Village is an area of around 20.10 ha. Land use includes residential areas, businesses and other public buildings. These two villages are densely populated urban areas with flat topography and an altitude of 90-95 m above sea level. Meanwhile, Mojosongo Village has an area of 532.927 ha, at an altitude of 90-130 above sea level. The topography of Mojosongo Village is hilly and is the highest plain in Surakarta. Various land uses are found in this area, including settlements, businesses, agricultural lands, forest gardens, and home gardens.

Data collection

The respondents of this research are native residents of Baluwarti, Kauman, and Mojosongo Villages of Surakarta City. In collecting information regarding each respondent's name, age, education, and occupation, an interview process was carried out using several pre-designed questions. Before the data collection process, each respondent was informed about the purpose of the research being carried out to provide clarity and obtain approval. This consent is intended to obtain the respondent's permission and willingness to participate in the interview process and use the information they provide, which will later be published without revealing the respondent's identity.

In the data collection process, all respondents were cooperative, open, and willing to participate in this research's data collection or survey process. Not a single respondent refused to participate in the survey. There were no specific criteria for determining respondents, only that no respondents were found aged less than 15 years. This is quite strengthening the data that has been collected because the respondents interviewed can at least be said to quite easily understand the questions and be aware of the information that will be provided. Each informant was asked the same questions, using Indonesian and Javanese languages, with an interview duration of around 15 to 25 minutes.

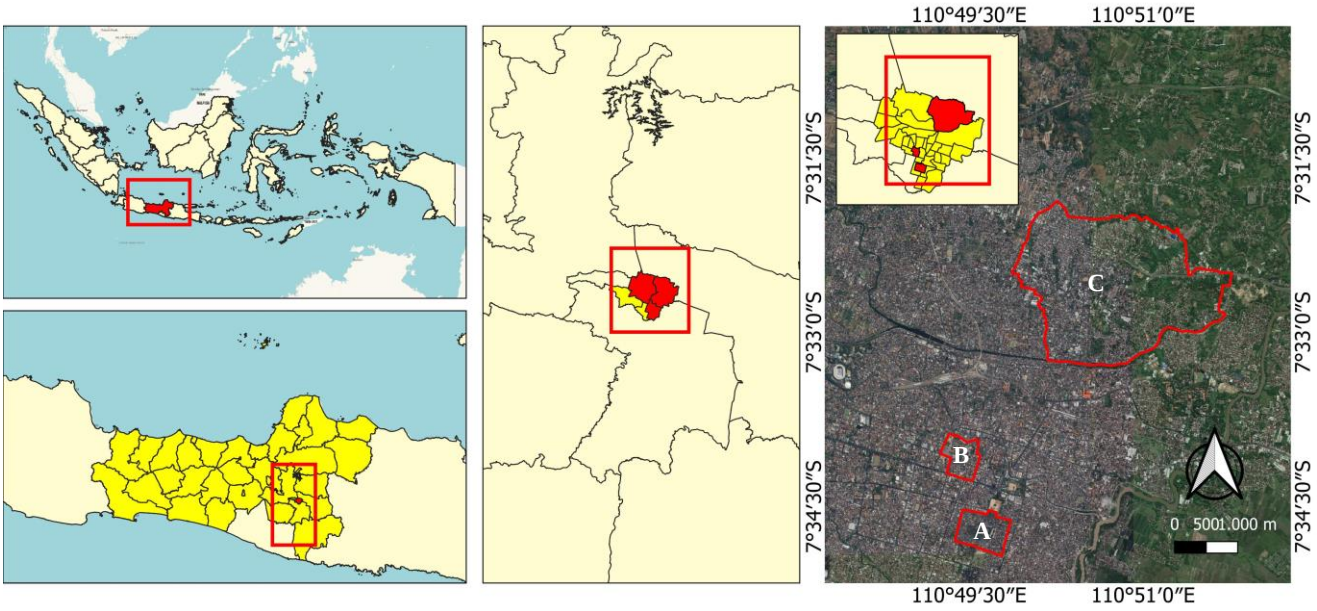

Figure 1. Map of research locations in Surakarta City, Central Java, Indonesia. A. Baluwarti, B. Kauman, and C. Mojosongo Villages

Information or data on *tumpeng* or the *Tumpengan* tradition was obtained through semi-structured questionnaires and personal interviews with 60 respondents from three different villages in Surakarta City. Data collection through interviews was carried out by asking respondents questions related to the existence of the *Tumpengan* tradition for the respondent and the surrounding environment, a description of the components or contents of *tumpeng*, the types of plants and animals used, important days that require the creation or existence of *tumpeng*, and the traditional values and meaning of preparing *tumpeng* and its contents in a celebration. The side dish components obtained can be used to identify the types of plants and animals used. Strengthening the data obtained regarding this tradition was carried out by taking two key respondents, who could be said to be experts and were directly related to the *Tumpengan* tradition.

Data analysis

The data that has been obtained is then processed by analyzing using a descriptive and qualitative approach. The data collected covers various aspects, such as the frequency of implementation of *Tumpengan*, the types of dishes served, and community participation. By combining these two approaches, the data analysis carried out will provide a more holistic understanding of the *Tumpengan* tradition. Descriptive results provide a strong quantitative view, while in-depth qualitative findings detail significant aspects that cannot be measured directly (Chatra et al. 2023). The historical sources used are quite diverse, starting from interviews with people who are perpetrators and witnesses of history, cultural figures, book sources, academic publications, theses, and dissertations, as well as other sources whose validity can be scientifically acceptable. The combination of these two approaches will produce a more comprehensive picture and reality of the situation, freedom of view, and methods with strong conclusions (Waruwu 2023) about the meaning and role of *Tumpengan* in the social dynamics of society, opening up opportunities to a deeper understanding of the cultural context and the values contained in this tradition.

RESULTS AND DISCUSSION

Respondent demographics

Moreover, 60 respondents from three villages including Baluwarti, Kauman, and Mojosongo villages in Surakarta City, participated in this research (Table 1). Overall, 25 male and 35 female respondents aged between 15 and 66 years and over participated in this research. Respondents came from various job categories: students, farmers, housewives, traders, entrepreneurs, laborers, teachers, civil servants, etc. The highest frequency of respondents was in the 46-55 year age group, namely 19 people (31.67%). Most of the respondents in this study had a minimum high school education level, namely 22 people (36.67%). Apart from that, this research also obtained information regarding the community's knowledge of traditional ceremonies related to *tumpeng*.

Table 1. Demographic data of respondents participating in the research

Parameter	Specification	Freq.	Percentage (%)
Gender	Male	25	41.67
	Female	35	58.33
Age	15-25	2	3.33
	26-35	8	13.33
	36-45	15	25.00
	46-55	19	31.67
	56-65	12	20.00
	>66	4	6.67
Profession	Student	2	3.33
	Housewife	27	45.00
	Merchant	7	11.67
	Laborer	6	10.00
	Civil Servant	5	8.33
	Other	13	21.67
Education	Elementary School	16	26.67
	Junior High School	18	30.00
	Senior High School	22	36.67
	University	4	6.67
Knowledge of traditional ceremonies	Very understand	0	0.00
	Somewhat understand	42	70.00
	Little/don't understand	18	30.00

There are 42 respondents out of the total number of respondents fall into the "somewhat understand" category, while the other 18 fall into the "little/don't understand" category. The respondents' understanding level of traditional ceremonies or traditions related to *tumpeng* is influenced by the respondent's knowledge and experience regarding this matter. The "somewhat understand" category consists of respondents who have consumed *tumpeng* and know about the types of traditional ceremonies that use *tumpeng* as one of the components, but have never cooked, seen, or do not know the philosophies contained therein. Meanwhile, the "little/don't understand" category consists of respondents who have only heard of or do not know about the type of traditional ceremony that uses *tumpeng* as one of its components.

The meaning and philosophy of *tumpeng* in community traditions

Tumpeng is a traditional food that is familiar to everyone, including the people of Surakarta City. Until now, *tumpeng* is still used as a symbol or ritual in celebrations, thus making it a cultural heritage that must always be preserved. *Tumpeng* has its place in the lives of Javanese people because *tumpeng* is not only given and used carelessly for daily needs but can also be made and used for important rituals (Krisnadi 2020). Generally, *tumpeng* has a philosophy closely related to deep values or meanings, such as tolerance, sincerity, wealth, purity, and human gratitude to Allah SWT for all the sustenance and blessings He has given. The philosophies contained in *tumpeng* are not only related to the shape or general

philosophy. However, if observed more deeply, these philosophies are also contained in every part of every element that makes up a *tumpeng*, such as the rice color on *tumpeng*, as well as the side dishes used around it (Ridzki and Achmadi 2023).

The word *tumpeng* comes from the term "*tumapaking penguripan-tumindak alat tumuju Pangeran*," which describes the view that humans should always follow God's path. The existence of traditional Javanese beliefs related to supernatural powers outside humans can influence each community's lives. Based on this belief, every Javanese community must always maintain the relationship between themselves and the Creator to ask for safety, protection, prosperity, and blessings from Allah SWT. Apart from that, the word *tumpeng* can also be interpreted as "*Yen metu kudu mempeng*," meaning if you want to leave, you must do it with serious enthusiasm. The meaning of leaves contained in this statement can be interpreted as an attempt to make a change. *Tumpeng* has a shape that tapers upwards or resembles a mountain. According to Javanese belief, the top tip of *tumpeng* symbolizes Mount Semeru, considered the gods' abode and the center of the world. However, according to Islamic views, the top tip of *tumpeng* is considered a symbol of Allah SWT (Chandra and Hadi 2021). The rice in *tumpeng* can be served using white or yellow rice. White *tumpeng* rice is a symbol used to interpret the Sun God found in Hinduism and is a symbol of sunlight, which means the source of life (Lindayani et al. 2020). Meanwhile, *tumpeng* rice with a yellow color is a form of symbolism carried out to honor or serve God Almighty. *Tumpeng* is also generally arranged or placed on banana leaves with a minimum number of side dishes of seven types arranged in a circle, using seven side dishes. This is based on the number seven which in Javanese is called "*pitu*," which comes from "*pitulung*," which means that fellow humans should help each other (Mahanani 2022).

Based on the results of observations and interviews conducted regarding the use and knowledge of the community regarding traditional ceremonies or traditions of *tumpeng* among respondents who live in the Surakarta area, it can be seen that the majority of respondents stated that *tumpeng*, in general, is often used in various celebrations and events, both general celebrations and special ones and related to customs that develop in society. Most respondents generally stated that *tumpeng* is often used at birthdays, competitions, and Independence Day celebrations. Meanwhile, celebrations related to the customs or traditions of Javanese society stated by respondents include celebrations of the birthday of the Prophet Muhammad SAW or referred to as *Maulid*, *Grebegan suro*, alms earth or *Bersih desa* (village cleaning), *Wetonan*, *Poso*, changing family names, as well as at events *Jumenengan* (commemoration of the king's ascension to the throne). Earth almsgiving, also known as *Bersih desa*, is a form of traditional ceremony carried out by the community as a form of handing over the natural product obtained back to nature, where in this ceremony, *tumpeng* is used to commemorate the return of Dewi Sri (rice goddess) (Masruroh et al. 2021), a belief that has existed since prehistoric times (*Jawa kuno*) before the arrival of Hindu-Buddhist influence (Nastiti 2020).

Besides, *tumpeng* is also one of the mandatory components that must be present in the *wetonan* ceremony, which is a traditional ceremony carried out by the Javanese people to commemorate a person's birthday based on their *weton* day and as a form of respect for every caregiver or guard in every human places (Sofiah et al. 2023). Based on the interview results, it was also stated that *tumpeng* is one of the components used in the *1 Suro* tradition carnival or a tradition carried out to welcome the *Hijriah* New Year (Javanese New Year). In this tradition, *tumpeng* used is large and is known as *Gunungan*, which consists of various food types, comprised of agricultural products, such as rice, fruit, and ointment, and has a philosophical meaning as a form of offering to God Almighty (Muthoharoh, 2022). There are a thousand small *tumpeng* in the *Selikuran* night tradition of the Kasunanan Palace in Surakarta. This small *tumpeng* is placed inside a *takir*, a place for rice made from banana leaves. Each *takir* contains savory rice as a small *tumpeng* accompanied by black soybeans, green chilies, *rambak*, and cucumber. A thousand *tumpeng* symbolizes the promise of Allah SWT will give a reward equivalent to a thousand months to His servants who sincerely worship on the night of *Lailatul Qodar*. However, *tumpeng* is not a typical feature of the *Selikuran* tradition because *tumpeng* is also used in *Grebeg* and other rituals. In addition, the uniqueness of the *Selikuran* tradition is that the number of *tumpeng* reaches exactly one thousand as a symbol of a thousand months (Bakri and Muhadiyatiningsih 2019).

Meaning and philosophy of plants used in *tumpeng*

Tumpeng rice consists of cone-shaped rice covered with a banana leaf and topped with red chilies shaped especially. The cone-shaped rice is then surrounded by vegetables called *urap*, or the people of Surakarta often call it *gudangan*. Regarding the contents of the *urap*, each region has its characteristics and styles. However, based on the results obtained from the interview and observations, the *urap* that is often found in the Surakarta area consists of various types of plants and vegetables, including coconut, water spinach, spinach, yarlong beans, mung bean sprouts, carrots, cucumber, and cabbage. Later, plants and vegetables are processed by boiling for a few minutes and only seasoned with salt without adding other spices. The spices and flavors are already found in grated coconut, previously seasoned with various herbs and spices. *Tumpeng* and its vegetables and side dishes are a unity that has a very deep meaning. Cone-shaped rice shows the hope that there must always be progress and improvement in every life, where you always try to achieve the goals and dreams you want by trying to face and overcome all existing trials (Putri et al. 2022). Some people also argue that the conical shape of *tumpeng* rice that rises upwards shows the majesty of God Almighty as the ruler of nature. White rice symbolizes purity, and based on banana leaves symbolize patience and peace (Kumaidi et al. 2023). *Tumpeng* is often served with banana leaves as a base, wrapping snacks, and other accessories. Where banana leaves themselves also have a meaning or philosophy that explains that humans are not naked (Maryani et al. 2021).

Table 2. List of plants and parts used in *tumpeng*

Local Name	Common Name	Scientific Name	Family	Parts Used	Philosophy/Use
Pisang	Banana	*Musa paradisiaca* L.	Musaceae	Leaves	Patience and peace
Kedelai (tempe kering)	Soya bean	*Glycine max* (L.) Merr.	Fabaceae	Seeds	Life cycle
Cabai	Chili	*Capsicum annum* L.	Solanaceae	Fruit	Courage
Wortel	Carrot	*Daucus carota* L.	Apiaceae	Tubers	Honesty, hardworking, and perseverance
Kangkung	Water spinach	*Ipomoea aquatica* Forssk.	Convolvulaceae	Leaves and stems	Protection
Kacang panjang	Yarlong beans	*Vigna unguiculata subsp. sesquipedalis* (L.) Verdc.	Fabaceae	Flesh (pods)	Health and long life
Kacang hijau (tauge)	Mung beans	*Vigna radiata* (L.) R.Wilczek	Fabaceae	Sprouts	Fertility
Kol	Cabbage	*Brassica oleracea subsp. capitata* L.	Brassicaceae	Leaves	Purity
Bayam	Spinach	*Amaranthus* L.	Amaranthaceae	Leaves and stems	Peace
Kelapa muda	Coconut	*Cocos mucifera* L.	Arecaceae	Flesh	Sincerity in living life
Padi	Rice	*Oryza sativa* L.	Graminae	Seeds (endosperm)	The majesty and holiness of God Almighty
Seledri	Celery	*Apium graveolens* L.	Apiaceae	Leaves	Triumph
Labu siam	Chayote	*Sechium edule* (Jacq.) Sw.	Cucurbitaceae	Seeds	Infirmity
Timun	Cucumber	*Cucumis sativus* L.	Cucurbitaceae	All parts	Fertility
Kentang	Potato	*Solanum tuberosum* L.	Solanaceae	Tubers	Life's difficult trials will always have a solution
Selada	Lettuce	*Lactuca sativa* L.	Asteraceae	Leaves	Fertility
Tomat	Tomato	*Solanum lycopersicum* L.	Solanaceae	Flesh of fruit	Honesty
Daun singkong	Cassava leaves	*Manihot esculenta* Crantz	Euphorbiaceae	Leaves	Humility
Kemangi	Basil	*Ocimum sanctum* L.	Lamiaceae	Leaves	Sanctity

Table 3. List of animals and parts used in *tumpeng*

Local name	English name	Scientific name	Family	Parts used	Philosophy/use
Ayam Kampung	Kampong Chicken	*Gallus gallus* f. *domesticus* Linnaeus, 1758	Phasianidae	Meat and eggs	Symbolizing gratitude and tranquility from God and eggs depict two sides of life.
Ikan Bandeng	Milkfish	*Chanos chanos* Forsskål, 1775	Chanidae	All parts	Abundance of fortune
Ikan Teri	Anchovy	*Stolephorus* Lacepède, 1803	Clupeidae	All parts	Harmony

Therefore, using various plants in *tumpeng* has meaning and philosophy for the people of Surakarta (Table 2). Like the yarlong beans in *tumpeng*, which have the philosophy that those who eat them will be blessed with health and long life; Water spinach (*kangkung*), which means "*jinakung*" or symbolizes protection; spinach, which is a symbol of peace; mung bean sprouts, which symbolize creativity and have the philosophy that everyone will always be in the process and growing; chilies on rice shoots symbolize exemplary life, a world that has many trials and obstacles, and the red color of the chilies symbolizes courage (Novarel 2022). Apart from that, mung bean sprouts are grown from germinating green bean seeds and have many nutrients good for human health. In *tumpeng*, mung bean sprouts have a philosophy or meaning of fertility (Nurmalasari and Ami 2021). Grated coconut fruit is also used in *tumpeng* as one of the complements, where generally the young coconuts contain philosophical or deep meaning if every human being at a young age should always feel sincere in dealing with various things and not have a sense of arrogance or jealousy; hence, they will be useful for others at their old age (Sulastri and Apriyani 2021). When all these ingredients are mixed, they will become ointment or *urapan*, which has its meaning and philosophy. Furthermore, the name *urap* or "*urip*" symbolizes living with various kinds of trials or, in other words, a life colored by various meanings and life struggles which are symbolized by various vegetables, which have their philosophies and meanings. Apart from that, in *tumpeng* rice, there is fried chili sauce (*sambal goreng*) consisting of potatoes, tempeh, and tofu, which means that in every living, there must be cooperation and harmony in society. Tempeh is a product made from processed soybeans, a complement or side dish in *tumpeng* cooked dry, called dried tempeh (*tempe goreng)*. Dried tempeh also contains a philosophical meaning that a life cycle must make every human being feel joy and sorrow (Sari et al. 2019).

Meaning and philosophy of animals used in *tumpeng*

Apart from using plants, *tumpeng* is also covered with side dishes. Table 3 shows that animal types are often used as side dishes, including free-range chicken (Kampong chicken), anchovies, and milkfish. Like plants, animals and the parts they use also have their deep meaning and philosophy. The first side dish in *tumpeng* is chicken *ingkung (*full-size chicken*)*, where the type of chicken usually used in this *tumpeng* is free-range chicken. The use of chicken as a side dish in *tumpeng* can be interpreted as a symbol of gratitude and peace given by God, as well as a prayer or hope for every human being to be able to sort out what is good and what is bad, like chickens who sort out what food is good or not. to eat (Muktaruddin et al. 2021). The next part used for this animal is the egg, a symbol of the origin of life which is always present in two different ways, such as male or female, and day or night (Syam 2023). Apart from that, the egg also has two parts with different colors, where yellow symbolizes strong determination, while white symbolizes purity (Kristanti et al. 2022). The side dishes used as accompaniments to *tumpeng* are anchovies and milkfish. According to Syam (2023), the use of milkfish or fish with many spines contains a philosophical meaning in the form of an abundance of good fortune, while anchovies can be interpreted as a value of harmony or togetherness.

In conclusion, it is known that there are 19 species of plants and 3 species of animals used in *tumpeng* with all parts contained in it, including the size, color, and type of materials used in general, have various philosophies or deep meanings related to the relationship between humans and God, humans and nature, and humans and humans. It encourages *tumpeng* to be one of the components often used and involved in various traditions or traditional ceremonies in Surakarta. In every tradition or traditional ceremony, *tumpeng* is philosophized as a form of the values of tolerance, sincerity, wealth, purity, and gratitude to God for the blessings He has given. Unfortunately, the knowledge of Surakarta people about the *Tumpengan* tradition is dominated by groups of people with the category "somewhat understand", these people only ever consume and know *tumpeng* as one of the components of a tradition and do not know the philosophy contained.

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Diversity, composition, and role of woody Non-Timber Forest Products in Tawangmangu, Central Java, Indonesia

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Abstract. *Haqqin F, Arkan F, Ibriza NM, Fadhilah RN, Safira RN, Dewangga A, Kusumaningrum L, Thenya T, Setyawan AD. 2024. Diversity, composition, and role of woody Non-Timber Forest Products in Tawangmangu, Central Java, Indonesia. Asian J Ethnobiol 7: 68-78.* Forests have an important role in supporting biodiversity and providing various ecosystem services vital for human welfare; besides that, forests are also an important resource for Non-Timber Forest Products (NTFP), which are forest products other than timber used by local communities. NTFP can be categorized into fodder, firewood, food wrapping, medicinal plants, ornamental plants, spices, and food. The aim of this research was to analyze biodiversity and the use of NTFP in the villages of Plumbon, Nglebak, and Sepanjang, located in Tawangmangu Sub-district, Karanganyar District, Central Java, Indonesia. Data collection included interviews and field surveys. In the course of the interviews, a total of 62 respondents were engaged. The results showed that 83 plant species belonging to 41 families had been identified for many NTFPs such as (i) medicinal plant, (ii) food, (iii) ornamental plant, (iv) fodder, (v) spices; (vi) firewood; and (vii) food wrapping. The research findings indicate that Plumbon Village (Station A) exhibited the highest NTFP woody plant biodiversity value, with the highest values for each index component, i.e., 2.8 (H'), 5.9 (Dmg), and 0.765 (E). Each village is characterized by distinct dominant plant species: *Melastoma malabatrichum* dominates Plumbon Village (Station A), *Manihot esculenta* dominates Nglebak Village (Station B), and *Calliandra houstoniana* dominates Sepanjang Village (Station C). Notably, the plant with the highest use value is *Tectona grandis*, which serves as a medicinal plant, firewood, and food wrapping material. This research provides a deeper understanding of the biodiversity and use of NTFPs in the region, which has important implications for natural resource management and the well-being of local communities.

Keywords: Forest, NTFP, plants, Tawangmangu, woody

INTRODUCTION

Forests play an important role in providing habitats and various ecosystem services essential for human well-being (Brockerhoff et al. 2017). Forests are not merely vegetation complexes but vital ecosystems with important ecological functions. One of them is as a guardian of the life support system (Ristić et al. 2019). In this capacity, forests regulate the hydrological cycle, reduce the risk of flooding, control soil erosion, mitigate climate change through carbon sequestration, and maintain low levels of seawater intrusion. In addition, forests are also responsible for oxygen production through photosynthesis, providing an essential contribution to all organisms (Aju et al. 2015). Besides that, forests protect against disease and provide natural medicinal ingredients that traditional communities have long used (Setiawan et al. 2021). The presence of forests also improves air quality by filtering pollutants and dust and providing shelter for various species that play a role in maintaining ecosystem balance (Atmajayani 2020).

Indonesian forests are one of the few countries in the world with a very high diversity of flora and fauna. As a country with the second largest area of tropical forest after Brazil, Indonesia is home to thousands of unique and ecologically and economically valuable plant and animal species (Husin 2022). Indonesian forests have the potential for diverse tropical trees; wood is one of the main commodities produced from trees as the main component of forests (Akbar et al. 2020). Apart from that, spices such as cloves, nutmeg, and pepper are also important trade commodities and have been an integral part of the history of international trade since ancient times (Abbas and Yunianto 2022). Apart from its economic value, the diversity of Indonesia's flora also has invaluable ecological value. Endemic plants that grow in Indonesian forests are important in maintaining ecosystem balance and providing ecosystem services that support human life (Nugroho et al. 2022). Indonesia's tropical forest ecosystems also have an important role in maintaining the water cycle, regulating regional climate, and providing other environmental services that support human survival (Artaxo et al. 2022).

The condition of forests in Indonesia shows several problems that must be faced. Forests in Indonesia are currently experiencing threats from deforestation, degradation, and forest conversion for oil palm plantations (Pridananti 2022). Various factors, including large-scale agriculture, the timber industry, and mining, cause deforestation in Indonesia. Deforestation in Indonesia occurs yearly and impacts changing natural conditions (Rohmaningtyas 2022). Uncontrolled forest-burning activities also cause deforestation and forest degradation in Indonesia, especially during the dry season (Segah et al. 2023). Human pressure on forests also causes deforestation and degradation. A decrease in the quantity and quality of forests causes a reduction in stored carbon, releases carbon emissions into the atmosphere, and reduces the ability of forests to absorb carbon (Kyere-Boateng et al. 2022). Apart from that, illegal practices such as illegal logging and poaching also contribute to forest destruction, which is increasingly worrying (Mujetahid et al. 2023). Forest sustainability is the result of various processes that occur in the life of forest ecology. Problems that arise, such as burning and deforestation, are some of the factors that can significantly impact the environment and human life (Ahada and Zuhri 2020).

Generally, Non-Timber Forest Products (NTFP) consist of by-products from a timber tree, such as fruit, sap, bark, leaves, resin, essential oils, and plants with unique properties, such as bamboo and rattan (Fitriyani et al. 2020). According to Sudarmalik et al. (2006), NTFP has an important role in ecological, economic, and regional development. NTFP plays a role in providing the main food source for human life and wild animals to create a balance in the food chain in an ecological aspect. Meanwhile, from an economic perspective, the NTFP plays a role in maintaining the stability of household income and national foreign exchange. The community's NTFP production, processing, and marketing processes generate income, which is used as capital for regional development. Considering the critical role of NTFP, this research aims to analyze biodiversity and the use of NTFP in the villages of Plumbon, Nglebak, and Sepanjang, which are located in Tawangmangu Sub-district, Karanganyar District, Central Java, Indonesia. Tawangmangu, located on the western slopes of Mount Lawu, has long been known as a highland tourist destination in Indonesia. Moreover, Mount Lawu has been promoted as one of the terrestrial national parks in Indonesia (Setyawan 2000, 2001).

MATERIALS AND METHODS

Study area

Tawangmangu Sub-district is one of the 17 sub-districts in Karanganyar District, Central Java Province, Indonesia. The distance from the district capital is 27 km east. Therefore, most people work as farmers and farm laborers. The primary commodities in Tawangmangu are rice, corn, cassava, and sweet potatoes (BPS 2023). The research was conducted in the Tawangmangu Sub-district, where three villages were chosen for the research, namely: Plumbon Village (Station A), Nglebak Village (Station B), and Sepanjang Village (Station C). The three villages are located around 800 m above sea level (Figure 1).

Forest conditions around Tawangmangu have somewhat sparse vegetation but relatively dense vegetation (Roziaty et al. 2023). Mount Lawu divides its area into two administrative provinces: the western slope and the eastern slope. The western slope is located in Central Java Province, covering Karanganyar, Sragen, and Wonogiri districts, while the eastern slope is located in East Java Province, covering Ngawi and Magetan districts (Purwanto and Titasari 2019). The western slope of Mount Lawu is located in the highlands with humid forest conditions (Witantri et al. 2015), and can store good water in its soil; apart from that, it is also supported by a neutral soil pH of around 7, which allows vegetation to grow well (Luthfiya et al. 2015).

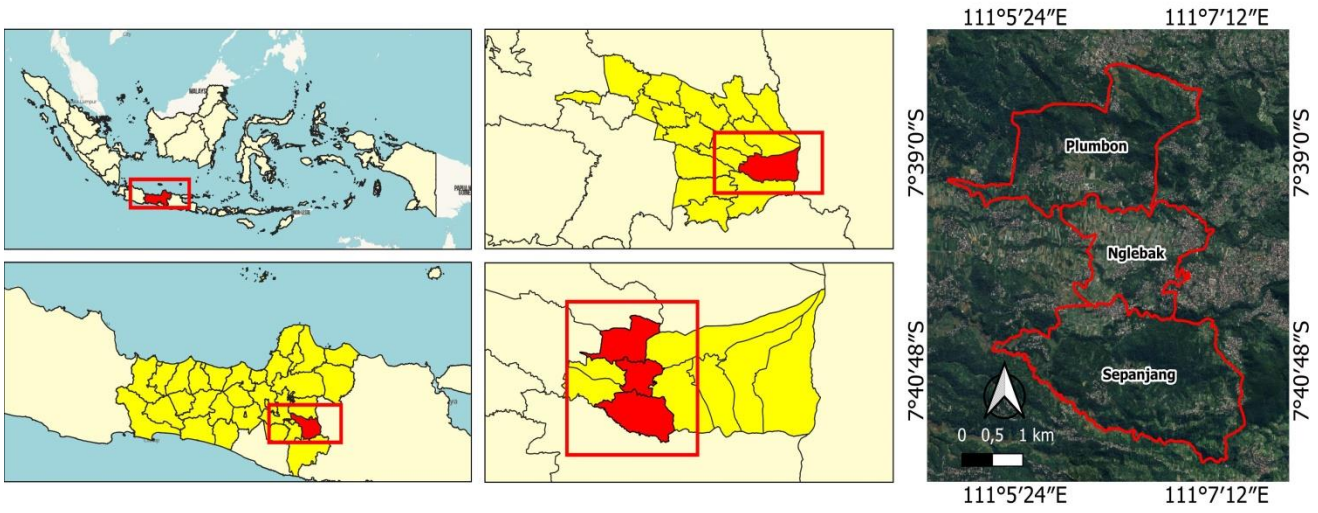

Figure 1. Map of the study area in Tawangmangu Sub-district, Karanganyar District, Central Java Province, Indonesia, including Plumbon Village (Station A); Nglebak Village (Station B); and Sepanjang Village (Station C)

Procedures

Research preparation

The tools and materials used to carry out the research were a list of questions, stationary, a tally sheet containing questions and tables to make data collection easier, and smartphones for documentation. Cameras and smartphone cameras are used for species documentation. Identification is carried out directly and indirectly for species whose identity is unknown, and documentation is carried out on the leaves, stems, flowers, and fruits. Taxonomic determination followed by the Global Biodiversity Information Facility (GBIF) (https://www.gbif.org), and the Plants of the World Online (POWO) (https://powo.science.kew.org/)

Data collection

The data collection methods used in this research were (i) semi-structured interviews and (ii) field surveys (Abebaw and Damme 2023). Respondents were selected by random sampling of local village communities, and the interview technique used was a questionnaire, which asked a list of questions related to the community's use of non-timber forest products in the villages of Plumbon, Nglebak, and Sepanjang. Field data were collected through cruising and purposive sampling for vegetation inventory (Efendi et al. 2024).

Data analysis

Data analysis was carried out descriptively and quantitatively. The data obtained from the interview results will determine the Use Value of the species found, while from the field survey results, the biodiversity index will be determined using predetermined formulas. These indices include the Shannon-Wiener diversity index (H'), evenness index (E), Margalef species richness index (Dmg), Sorensen similarity index (IS), and Simpson dominancy index (C). Taxonomic species identification was carried out using the Global Biodiversity Information Facility or GBIF website (https://gbif.org/), and the Plants of the World Online (https://powo.science.kew.org/).

Simpson dominancy index

The following information pertains to the Simpson Dominance Index, which determines the dominant species at each research station. The index is derived using the following formula (Simpson 1949):

$$C = (Ni/n)^2$$

Where:
C : Simpson dominance index
Ni : number of individuals of the i-th species
n : total number of individuals of all species.
Simpson assessment criteria:
C>1 : high dominance
C=0 : low dominance

Shannon-Wiener diversity index

Species diversity found in ecology can be determined from the Shanon-Wiener diversity index (Odum 1996) with the following formula:

$$H' = -\sum (ni/N) \ln (ni/N)$$

Where:
H' : Shannon-Wiener Index
ni : Number of individuals of the i-th species
N : Total number of individuals of all species
Diversity index classification
H' < 1 : low diversity
1<H'<3 : moderate diversity
H' > 3 : high diversity

Evenness index (E)

According to (Krebs 1989), the evenness index can be used to calculate the evenness of individual abundance for each species. The formula used to calculate the evenness index is as follows:

$$E = \frac{H'}{ln(S)}$$

Where:
E : Evenness Index
H' : Diversity Index
S : Number of species identified
Evenness Index assessment criteria:
E > 0.6 : High species evenness
0.4<E<0.6 : Moderate species evenness
E < 0.4 : Low species evenness

Margalef species richness index (Dmg)

The species richness index can determine species richness in an ecosystem compared to the number of individuals. The formula used to calculate the Margalef Species Richness Index (Margalef, 1958) is as follows:

$$Dmg = \frac{(s-1)}{ln\ N}$$

Where:
Dmg : Margalef Species Richness Index
S : Number of identified species
N : Total number of individuals of all species
Margalef species richness assessment criteria:
Dmg < 2.5 : Low level of species richness
2.5<Dmg<4 : Moderate level of species richness
Dmg>4 : High level of species richness

Sorensen similarity index (Similarity)

The similarity index shows the similarities between stations or research areas. It can be calculated using the formula (Sorensen, 1948).

$$S = \frac{2C}{A+B} \times 100\%$$

Where:
A : Number of vegetation types in community A
B : Number of vegetation types in community B
C : Number of same vegetation types in communities A and B
Assessment criteria:
IS>90% : very high similarity
61%<IS<90%: high similarity
31%<IS<60%: moderate similarity
IS<30%: low similarity

RESULTS AND DISCUSSION

Respondent characteristics

The number of respondents is 62, dominated by men often found in home gardens (Table 1). Gender also indirectly influences the quality of work in farming activities. According to respondents' job characteristics, the majority of jobs are self-employment. It is because job opportunities are very limited in Tawangmangu Sub-district, so residents are encouraged to start businesses like farmers. The results showed that respondents with self-employed jobs reached 67.7%. The dominant occupation for women is housewife, with a percentage of 22.6%. The results also show that the age composition of respondents falls into the vulnerable age category for -blue-collar jobs requiring strong physical conditions, where 50% of respondents are over 50 years old. Even so, most respondents are still of a productive age and have high work enthusiasm. Elementary school accounted for 40.3% of the respondents' last level of education, while 24.2% did not graduate. Low education does not necessarily rule out the possibility that they possess more knowledge and experience in the workplace, particularly in areas such as forest management or agriculture.

Plant diversity

Based on the results of field surveys and interviews at three villages in Tawangmangu Sub-district, 83 plant species from 41 plant families were identified (Table 2). Family is a higher taxonomic unit than genus and species, and the existence of many families indicates significant ecosystem diversity in the region.

According to the results, the Fabaceae family has the highest number of species (Figure 2). The analysis identified 12 species within the Fabaceae family, i.e.: *Acacia mangium, Albizia chinensis, Calliandra houstoniana, Crotalaria juncea, Dalbergia latifolia, Dalbergia obovata, Falcataria falcata, Leucaena leucocephala, Mimosa pudica, Samanea saman, Sesbania grandiflora,* and *Zapoteca tetragona.* It is supported by the ability of Fabaceae plants to grow well on marginal land with sloping topography, soil dominated by parent material (rocky), little nutrient and organic material content, and low moisture content (Ma'ruf et al. 2023). The Fabaceae family generally includes cosmopolitan plants, meaning they can grow in tropical and subtropical areas in various habitats ranging from savanna deserts to tropical rainforests (Hariri et al. 2021). Fabaceae plants can grow in wild areas from the lowlands to the mountains (Jannah 2023). This family can be easily recognized by their pod-shaped fruit, most of which are trees and lianas, equipped with beautiful and colorful flowers, so many are used to decorate gardens (Opianida et al. 2020). Apart from that, Fabaceae plants are known to be able to carry out symbiosis with certain bacteria in their roots or stems to fix nitrogen directly from the air without going through soil fluids (Amin 2018). Fabaceae is known to have high economic value; it is widely//' cultivated by people as food, medicinal plants, ornamental plants, fruit producers, wood producers, natural dyes, erosion control, and land reclamation (Semiun and Mamulak 2024).

Table 1. Demographic characteristics of respondents

Parameter	Specification	Freq	Percentage (%)
Gender	Male	28	45
	Female	34	55
Age	<20	1	2
	21-30	4	6
	31-40	9	14
	41-50	15	24
	51-60	114	23
	>61	19	31
Education	No education	15	25
	Elementary School	25	41
	Junior High School	2	20
	Senior High School	7	12
	University	1	2
Job	Laborer	3	5
	Self-employed	42	68
	Private	3	5
	Housewife	14	22

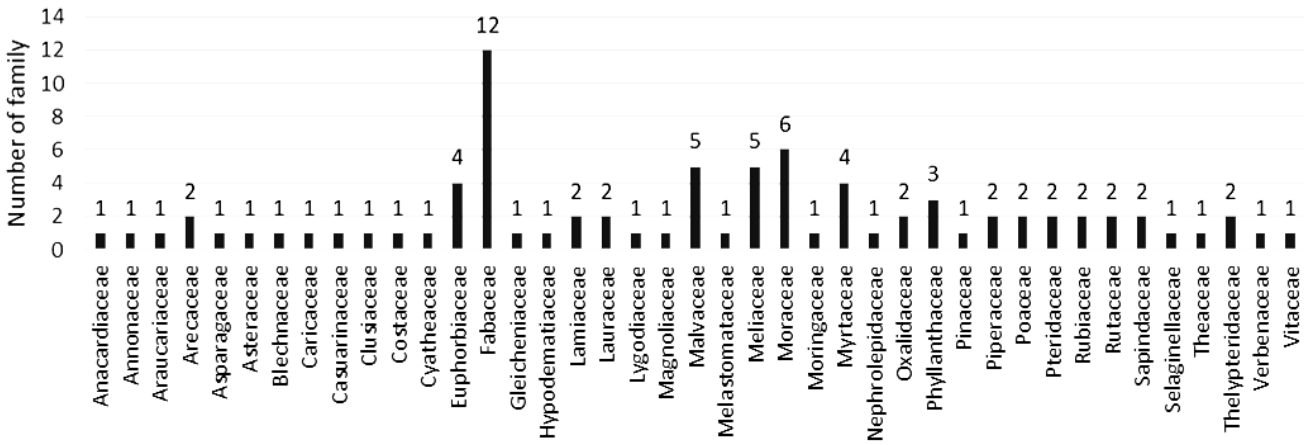

Figure 2. Number of woody plant species in each family

Table 2. Woody plants found in the study sites and their dominance index at each station

Family	Scientific name	Local name	Station		
			Plumbon	Nglebak	Sepanjang
Annonaceae	*Annona muricata* L.	*Sirsak*	-	-	0.003
Araucariaceae	*Agathis dammara* (Lamb.) Rich. & A.Rich.	*Damar*	-	-	0.017
Arecaceae	*Calamus melanochaetes* (Blume) Miq.	*Rotan penjalin*	0.007	-	-
Arecaceae	*Cocos nucifera* L.	*Kelapa*	0.027	-	-
Asparagaceae	*Cordyline fruticosa* (L.) A.Chev.	*Hanjuang*	0.032	0.005	-
Asteraceae	*Chromolaena odorata* (L.) R.M.King & H.Rob.	*Kirinyuh*	0.374	-	0.066
Blechnaceae	*Blechnum orientale* L.	*Paku lipan*	0.007	-	-
Caricaceae	*Carica papaya* L.	*Pepaya*	0.046	-	-
Costaceae	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	*Pacing*	0.002	-	-
Cyatheaceae	*Cyathea contaminans* (Wall. ex Hook.) Copel.	*Pakis pohon*	0.025	0.025	-
Euphorbiaceae	*Manihot esculenta* Crantz	*Singkong karet*	0.034	**0.425**	0.033
Euphorbiaceae	*Macaranga* sp.	*Makaranya*	0.005	-	0.010
Euphorbiaceae	*Euphorbia hirta* L.	*Patikan kebo*	-	0.025	0.060
Fabaceae	*Falcataria falcata* (L.) Greuter & R.Rankin	*Sengon laut*	0.077	0.005	0.066
Fabaceae	*Leucaena leucocephala* (Lam.) de Wit	*Petai cina*	0.055	0.232	0.080
Fabaceae	*Dalbergia obovata* E.Mey.	*Simpur*	0.002	-	-
Fabaceae	*Dalbergia latifolia* Roxb.	*Sonokeling*	0.005	-	0.007
Fabaceae	*Samanea saman* (Jacq.) Merr.	*Trembesi*	0.175	-	-
Fabaceae	*Mimosa pudica* L.	*Putri malu*	0.016	-	-
Fabaceae	*Zapoteca tetragona* (Willd.) H.M.Hern.	*Kaliandra putih*	-	0.089	-
Fabaceae	*Calliandra houstoniana* (Mill.) Standl.	*Kaliandra merah*	0.080	0.020	**0.633**
Fabaceae	*Sesbania grandiflora* (L.) Poir.	*Turi*	-	0.035	-
Fabaceae	*Crotalaria juncea* L.	*Orok-orok*	-	0.005	-
Fabaceae	*Albizia chinensis* (Osbeck) Merr.	*Sengon jawa*	-	-	0.010
Fabaceae	*Mimosa pudica* L.	*Putri malu*	-	-	0.003
Gleicheniaceae	*Dicranopteris linearis* (Burm.fil.) Underw.	*Resam*	0.068	0.005	0.073
Hypodematiaceae	*Leucostegia immersa* C.Presl	*Leukostasia*	-	-	0.003
Lamiaceae	*Tectona grandis* L.f.	*Jati*	0.014	0.123	0.017
Lamiaceae	*Gmelina arborea* Roxb. ex Sm.	*Jati putih*	-	-	0.007
Lauraceae	*Cinnamomum verum* J.Presl	*Kayu manis*	-	0.010	-
Lauraceae	*Persea americana* Mill.	*Alpukat*	-	0.094	0.007
Lygodiaceae	*Lygodium* Sw.	*Ligodium*	0.002	-	0.003
Malvaceae	*Durio zibethinus* Murray	*Durian*	0.023	0.094	0.033
Malvaceae	*Ceiba pentandra* (L.) Gaertn.	*Randu*	-	0.005	-
Malvaceae	*Sida rhombifolia* L.	*Sidaguri*	-	0.060	-
Malvaceae	*Hibiscus tiliaceus* L.	*Waru*	-	-	0.003
Melastomataceae	*Melastoma malabatrichum* L.	*Senggani*	**0.403**	-	0.371
Meliaceae	*Swietenia mahagoni* (L.) Jacq.	*Mahoni*	0.109	0.010	0.073
Meliaceae	*Toona sinensis* (A.Juss.) M.Roem.	*Surian*	0.018	0.044	-
Meliaceae	*Toona sureni* (Blume) Merr.	*Pupus hijau*	0.096	0.049	0.073
Meliaceae	*Azadirachta indica* A.Juss.	*Mimba*	-	0.010	-
Moraceae	*Artocarpus heterophyllus* Lam.	*Nangka*	0.011	0.030	0.013
Moraceae	*Ficus fistulosa* Reinw. ex Blume	*Beringin benying*	0.009	-	-
Moraceae	*Artocarpus odoratissimus* Blanco	*Terap*	-	0.005	-
Moraceae	*Artocarpus altilis* (Parkinson) Fosberg	*Sukun*	-	0.020	-
Moraceae	*Ficus septica* Burm.fil.	*Awar-awar*	-	0.010	-
Moringaceae	*Moringa oleifera* Lam.	*Kelor*	-	0.059	0.003
Myrtaceae	*Syzygium myrtifolium* Walp.	*Pucuk merah*	-	0.025	-
Myrtaceae	*Syzigium aromaticum* (L.) Merr. & L.M.Perry	*Cengkeh*	-	-	0.010
Nephrolepidaceae	*Nephrolephis* sp.	*Paku pedang*	0.021	-	-
Oxalidaceae	*Averrhoa bilimbi* L.	*Blimbing wuluh*	-	-	0.010
Phyllanthaceae	*Breynia androgyna* (L.) Chakrab. & N.P.Balakr.	*Katuk*	0.002	-	-
Phyllanthaceae	*Bridelia tomentosa* Blume	*Bridelia*	0.002	-	-
Phyllanthaceae	*Phyllanthus urinaria* L.	*Meniran*	-	-	0.106
Pinaceae	*Pinus merkusii* Jungh. & de Vriese	*Pinus*	0.007	0.005	0.003
Piperaceae	*Piper betle* L.	*Sirih*	0.005	-	-
Piperaceae	*Piper aduncum L.*	*Sirih hutan*	-	-	0.020
Poaceae	*Bambusa vulgaris* Schrad. ex J.C.Wendl.	*Bambu*	-	0.010	-
Poaceae	Gigantochloa apus (Schult.f.) Kurz	*Bambu hijau*	0.021	0.020	-
Pteridaceae	*Pityrogramma calomelanos* (L.) Link	*Paku perak*	0.011	-	-
Pteridaceae	*Adiantum peruvianum* Klotzsch	*Suplir*	0.071	0.104	0.113
Rubiaceae	*Coffea arabica* L.	*Kopi*	-	0.005	-
Rutaceae	*Citrus reticulata* Blanco	*Jeruk*	-	-	0.003

Rutaceae	*Citrus* × *limon* (L.) Osbeck	*Lemon*	-	-	0.003
Sapindaceae	*Nephelium lappaceum* L.	*Rambutan*	0.009	-	-
Selaginellaceae	*Selaginella* sp.	*Cakar ayam*	-	0.015	-
Theaceae	*Schima wallichii* (DC.) Korth.	*Puspa*	-	-	0.010
Thelypteridaceae	*Cyclosorus* sp.	*Paku*	0.007	-	0.023
Thelypteridaceae	*Christella subpubescens* (Blume) Holttum	*Paku*	-	0.005	-
Verbenaceae	*Lantana camara* L.	*Tembelekan*	0.089	0.020	0.033
Vitaceae	*Leea indica* (Burm.fil.) Merr.	*Girang*	0.034	-	-

Notes: A: Plumbon Village; B: Nglebak Village; C: Sepanjang Village. The numbers in bold show which species has the highest dominance value at the research station

The Moraceae family has the most species, with a total of 6 species: *Artocarpus heterophyllus*, *Artocarpus odoratissimus*, *Artocarpus altilis*, *Ficus fistulosa*, *Ficus septica*, and *Morus alba* (Figure 2 and Table 2). The research identified three genera within the Moraceae family: *Ficus*, *Artocarpus*, and *Morus.* Samsudin (2020) stated that these three genera are the main ones in the Moraceae family. *Artocarpus* is mainly found in the Malesian region, while half of the species in the largest genus, *Ficus*, are also spread across the Malesian area. *Morus* is the dominant genus in the warm northern climate and is widespread in the tropical mountains of Asia and America and the lowlands of Africa. These findings align with Rasnovi et al. (2024), who stated that plants from the Moraceae family are generally found in tropical regions, subtropical regions, and only in limited numbers in temperate regions.

Ecological indices

The ecological index is obtained from field survey data containing information related to the biodiversity index.

Simpson dominance index

These findings provide a reasonably comprehensive picture of the diversity of flora in the Tawangmangu Sub-district, especially woody plants. *Melastoma malabatrichum* is the most commonly found species, with the number of individuals reaching 0.403 (in Station A, Plumbon) and 0.371 (in Station C, Sepanjang) based on Simpson index dominancy. Meanwhile, the family group found most to be the Fabaceae family, with 12 species (Figure 2). Based on the field survey results, station A (Plumbon) was dominated by *M. malabatrichum* (0.403). Station B (Ngeblak) is dominated by *Manihot esculenta* (0.425). Station C (Sepanjang) is dominated by *C. houstoniana* (0.633) (Table 2).

The analysis reveals that each village has distinct dominant plant species. Plumbon Village has the highest dominance index of 0.40, which is found in the *senggani* plant (*M. malabatrichum*). In contrast, Nglebak Village has the highest dominance index of 0.42, which is found in cassava (*M. esculenta*), and Sepanjang Village has the highest dominance index of 0.63, which is found in the red calliandra (*C. houstoniana*).

These three plant species demonstrate a wide range of adaptability, thriving even in challenging environments. *M. malabatrichum* is prevalent in coastal areas (Laia et al. 2019) and in the highlands (Putri 2023). In contrast, *M. esculenta* and *C. houstoniana* plants exhibit the capacity to flourish in various soil types, including arid soil, requiring no special treatment (Handayani and Sundari 2016). Consequently, they are pioneer plants (Fatimah et al. 2023).

Field surveys at three villages showed that these four species were consistently present at each location. Apart from that, there are additional species, such as *Lygodium japonicum*, *Durio zibethinus*, *Swietenia mahagoni*, *Toona sinensis*, *Toona sureni*, *A. heterophyllus*, and *Lantana camara*, which are also found in the three villages. The presence of the same species in various habitats is an important highlight in the context of adaptation and ecological success. This phenomenon highlights the species' ability to adapt to environmental fluctuations, reflected in its significant tolerance to environmental conditions. These observations support the idea that these species have strong genetic and physiological abilities to adapt to changing environments, reflecting extraordinary evolutionary skills in maintaining survival.

Shannon-Wiener diversity index

The plant diversity index values in the three villages are different (Table 3). These measurements were performed using Shannon Wiener's diversity index formula. In Shannon Wiener's calculations, there are three classification indicators to assess the diversity found in the three villages. According to Shannon Wiener's Diversity Index (H`) classification, all villages have moderate plant diversity. Plumbon Village has an index (H`) 2.8, indicating moderate plant diversity. Nglebak Village has an index value of 2.7, indicating moderate plant diversity. Sepanjang Village's diversity index is 2.5, indicating moderate plant diversity. The three villages show moderate biodiversity because there is no high dominance of one species, and they do not have many species.

Table 3. Values of Diversity (H`), Richness (Dmg), and Evenness (E)

Village	H'	Dmg	E
Plumbon	2.8	5.9	0.765
Ngeblak	2.7	5.06	0.76
Sepanjang	2.5	5.31	0.70

Notes: A: Plumbon Village; B: Nglebak Village; C: Sepanjang Village

Evenness index

The evenness index is a measure of species distribution within a specific area. Research results indicate that all research stations exhibited a high evenness index, surpassing a total value of 0.6. This index is directly correlated with the H' value. A high evenness index suggests that no single species poses a threat to others, as they can coexist spatially.

Despite the presence of species with a high dominance index at each station, there is no discernible impact on the surrounding plant communities. It suggests that dominant species at each station, such as *M. malabatrichum*, *M. esculenta*, and *C. houstoniana*, do not exhibit invasive growth tendencies within that environment. Furthermore, the environmental conditions in the area continue to provide robust support and vitality for the plant community within the ecosystem.

Species richness index

Meanwhile, the Species Richness Index is related to the species richness of each species in each community. Naturally, the species richness index includes a classification index that indicates the current state of species richness. The species richness table shows that all villages are categorized as having good species richness because they have an index value above 4. The highest value is in Plumbon Village because the village has the highest number of species, with a value of 6.04.

The number of species factor is directly proportional to the value of the species richness index (Dmg). The species richness index (Dmg) is an index that shows the richness value of a species found in one area or village. It is related to the proportion of a species found among all individuals in the observation area or village. The higher the value of species richness (Dmg), the proportion of the species has a greater ratio to the number of individuals found. The total value also depends on the number of individuals found.

Similarity index

From the similarity index of the three villages, the Plumbon and Sepanjang villages have the highest similarity index among the three villages (Table 4). It is because many of the same species are found in both villages. In addition, the small value of the sum of variables of Plumbon and Ngeblak in the formula, which acts as dividing variables and is inversely proportional, also contributes to the low value of the similarity index. The Similarity Index is used to see how similar the community structure is between one village and another (Ibrahim et al. 2018).

Use value

Ethnobotanical data shows that 31 species of woody plants are categorized into 19 families, which are non-timber forest products (Table 5). Analysis of interview data shows that using non-timber forest products is a daily activity in local communities. The parts of plants that are often used are leaves, fruit, seeds, stems, and other parts. Local communities have various categories for utilizing non-timber forest products. The use value survey employs eight use categories, i.e., fodder, firewood, food wrapping, medicinal plants, ornamental plants, spices and food (Table 5). The research results show that its use as food (47.5%) is most commonly found in the community in Tawangmangu (Figure 3). This food source is harvested directly from the forest, or the community takes seeds from it and plants them in agroforestry systems such as home gardens (*pekarangan*) and forest gardens (*kebun/alas*).

A higher use value indicates that the species has more benefits. The plant species with the highest use value is teak (*Tectona grandis*), which has three uses, i.e. wound healing, food wrapping and firewood. The teak leaves are used as a wound-healing medicine by boiling them and covering the wound. Teak leaves are also used as food wrapping. Wrapping food in teak leaves will give off a distinctive aroma and increase appetite. Teak wood can also be used for firewood. On the other hand, using teak leaves for food wrapping can reduce dependence on plastic wrapping and become a sustainable alternative (Metananda et al. 2023).

Other species that have high use value are *T. grandis*, *Annona muricata*, *Cocos nucifera*, *A. chinensis*, *Syzigium aromaticum*, and *Psidium guajava*. *T. grandis* serves multiple purposes, including medicinal use (fruit), as a source of firewood (wood/twigs), and for food packaging (leaves). *A. muricata*, *C. nucifera*, and *P. guajava* are valued for their medicinal and culinary properties. *P. guajava* leaves are specifically boiled and used for medicinal purposes, commonly called herbal medicine by the community. *A. muricata* is used as a medicinal plant and food. *A. muricata* leaves are used to treat gout by selecting old leaves to boil until half the water remains and drinking the boiled water.

Table 4. Similarity index between villages

Village	Plumbon	Nglebak	Sepanjang
Plumbon		0.41	1
Ngeblak			0.58

Notes: A: Plumbon Village; B: Nglebak Village; C: Sepanjang Village

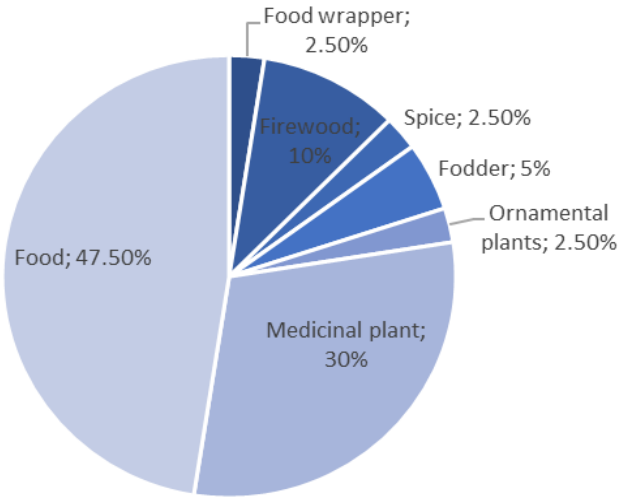

Figure 3. Percentage of plant use by the community

Table 5. Use value of species used by society

Family	Scientific name	Local name	Use	UV
Anacardiaceae	*Mangifera indica* L.	*Mangga*	2	0.02
	Mangifera odorata Griff.	*Kweni*	2	0.02
Annonaceae	*Annona muricata* L.	*Sirsak*	1, 2	0.03
Arecaceae	*Cocos nucifera* L.	*Kelapa*	1, 2	0.03
Casuarinaceae	*Casuarina equisetifolia* L.	*Cemara laut*	1	0.02
Clusiaceae	*Garcinia mangostana* L.	*Manggis*	2	0.02
Fabaceae	*Albizia chinensis* (Osbeck) Merr.	*Sengon*	6, 4	0.03
	Leucaena leucocephala (Lam.) de Wit	*Petai Cina*	2	0.02
	Acacia mangium Willd.	*Akasia*	1	0.02
	Sesbania grandiflora (L.) Poir.	*Turi*	2	0.02
	Zapoteca tetragona (Willd.) H.M.Hern.	*Kaliandra Putih*	4	0.02
Lamiaceae	*Tectona grandis* L.f.	*Jati*	1, 6, 7	0.05
Lauraceae	*Persea americana* Mill.	*Alpukat*	2	0.02
Magnoliaceae	*Magnolia ×alba* (DC.) Figlar	*Kantil*	3	0.02
Malvaceae	*Durio zibethinus* Murray	*Durian*	2	0.02
	Hibiscus tiliaceus L.	*Waru*	1	0.02
	Ceiba pentandra (L.) Gaertn.	*Randu*	6	0.02
	Swietenia mahagoni (L.) Jacq.	*Mahoni*	1	0.02
	Toona sinensis (A.Juss.) M.Roem.	*Surian*	1	0.02
	Artocarpus heterophyllus Lam.	*Nangka*	2	0.02
	Morus alba L.	*Mulberry*	2	0.02
Moringaceae	*Moringa oleifera* Lam.	*Kelor*	1	0.02
Myrtaceae	*Psidium guajava* L.	*Jambu Biji*	1, 2	0.03
	Syzygium aromaticum (L.) Merr. & L.M.Perry	*Cengkeh*	1, 5	0.03
	Syzygium aqueum (Burm.fil.) Alston	*Jambu Air*	2	0.02
Oxalidaceae	*Averrhoa carambola* L.	*Belimbing*	2	0.02
	Averrhoa bilimbi L.	*Belimbing wuluh*	2	0.02
Pinaceae	*Pinus merkusii* Jungh. & de Vriese	*Pinus*	6	0.02
Rubiaceae	*Coffea arabica* L.	*Kopi*	2	0.02
Rutaceae	*Citrus ×limon* (L.) Osbeck	*Lemon*	1, 2	0.03
Sapindaceae	*Nephelium lappaceum* L.	*Rambutan*	2	0.02
	Dimocarpus longan Lour.	*Kelengkeng*	2	0.02

Note: UV: Use Value, 1: Medicinal plants; 2: Food; 3: Ornamental plants; 4: Fodder; 5: Spices; 6: Firewood; 7: Food wrapper

Additionally, *A. muricata, C. nucifera,* and *P. guajava* are consumed directly as food without processing. Furthermore, *A. chinensis* is utilized as animal feed and as a source of firewood, whereas the *S. aromaticum* plant is highly regarded for its medicinal and culinary applications. Flowers can be made into *S. aromaticum* oil as a medicine for toothache. The *S. aromaticum* oil can be made by mixing olive oil and boiling it, then leaving it for 2-3 weeks, after which it is filtered, and the oil can be applied to external areas.

Medicinal plants

30% of plant types are categorized as medicinal plants. For treatment, the leaves of the P. guajava plant are processed by pounding them, then adding boiled water, then the mixture is filtered and drunk. Soursop leaves are also used as a gout medicine by boiling the leaves until half of the initial volume remains, after which the water is drunk. According to the community, the plants used for medicinal plants such as *T. grandis, A. muricata, P. guajava, S. aromaticum, Citrus × limon, C. nucifera, S. macrophylla,* and *Moringa oleifera*. These plants' leaves are also commonly used for medicinal purposes. The leaves most widely used in medicine are also described in Wonoharjo Village, Pangandaran, West Java (Nisyapuri et al. 2018). They believe that the use of leaves has high benefits, is easy to obtain, does not interfere with tree growth, can sprout again, and has soft fibers. Leaves are also a part of the plant that contains high carbohydrates, minerals, and vitamins (Abbas et al. 2017). People use plants by eating them directly, boiling them, sticking them on, and smearing them; they can also be used for bathing, soaking, and gargling (Nahdi and Kurniawan 2019).

Food

Based on interview results, utilization as food has the largest percentage, namely 47.50% (Figure 3). People in Tawangmangu use plants as food quite diversely because they can be processed/cooked or consumed directly/raw. The types of food consumed directly or raw are generally fruit such as *Mangifera indica, A. muricata, Mangifera odorata, C. nucifera, D. zibethinus, Dimocarpus longan, Nephelium lappaceum.* Meanwhile, the type of plant consumed through the processing process is *C. arabica,* which requires a drying and grinding process before being brewed with water and drunk; *Pinus merkusii* is prepared by roasting the seeds (strobilus) until golden and then mixing them into vegetables; Then there is the processing of *A. heterophyllus (nangka)* seeds to make flour by

cleaning the seeds from their skins, then drying them, then grinding them and filtering them.

Ornamental plant

It turns out that the use of plants as ornamental plants is quite rare among the Tawangmangu Community. Based on interview results, this type of NTFP use is only found in 2.5% of plant species. *Magnolia alba*, or what local people call *kantil*, is one of the ornamental plants for the Tawangmangu people. Apart from having a beautiful flower appearance, this type of plant is also famous for the delicious aroma of the flowers. Some beliefs say that this type of flower has a ritual function so that wherever you are, you will still have an attachment even though you are in a different world because this philosophy makes these flowers a source of pride for the people of Central Java (Kasirah et al. 2017). This type of flower is also used by the Karang Intan community in South Kalimantan as an ornamental plant (Ningsih et al. 2017).

Fodder

Albizia chinensis (*sengon Jawa*) and *Z. tetragona* (*kaliandra putih*) are two plants used as fodder. In research by Marhaeniyanto et al. (2019), it was explained that *sengon* leaves and white calliandra leaves have a crude protein content of >18%, which can increase productivity. This type of fodder is also used by the people of Malang, East Java (Marhaeniyanto et al. 2019) and Gowa, South Sulawesi (Suryanto and Prsetyawati 2014).

Spices

Plants used as spices or flavorings are only *S. aromaticum*. The use of this type of NTFP is found in the Tawangmangu community, namely 2.5%. Apart from being used as a kitchen spice, one way of processing *S. aromaticum* is through processing clove oil. The Tawangmangu people usually mix clove flowers with boiled olive oil and then let it sit for about 2-3 weeks, after which the oil is filtered and can be used. The benefits of non-timber forest products that can be used include *S. aromaticum* as a spice. Consuming spice plants will improve health. Considering the nutraceutical benefits of spice plants, there has been an increase in the commercialization of spices in various countries (Idowu et al. 2021).

Firewoods

Plants used as firewood include *T. grandis*, *A. chinensis*, *P. merkusii*, and *Ceiba pentandra*. For firewood and cooking, people use fallen or dry branches. One of them is teak, which has a softer texture with a higher water content, making the wood more flexible and flammable (Munib et al. 2021). The community of Wawonii Island in Southeast Sulawesi demonstrates discerning criteria when selecting firewood, seeking wood that ignites quickly even in damp conditions, emits minimal smoke, and sustains a prolonged burn. Typically, the preferred sources of firewood include standing timber within the forest, residual logs from canoe production, and trees within cultivated gardens and dry-fields (Sunarti and Ruqayah 2009).

Food wrapper

Use as a food wrapper is only found for teak plants. The part used is the leaves. The use of *T. grandis* as a food wrapper is also found in Gunungkidul, Yogyakarta, because it is considered an environmentally friendly alternative food wrapper (Arista et al. 2022). Apart from that, Southeast Asian people also use *T. grandis* leaves as food wrappers, especially for liquid foods such as cereal, soups, raita, and dhal, and used as food wrappers when steamed (Kalina et al. 2024).

In conclusion, this research produced important findings regarding the diversity and use of non-timber forest products (NTFP) in three villages in the Tawangmangu Sub-district. 79 plant species from 40 families were found in the three villages. Among Plumbon, Nglebak, and Sepanjang villages, a moderate H' index is observed, with the highest H' value recorded in Plumbon Village. This trend is also reflected in the Dmg and E values, which are highest in Plumbon Village. Then, woody plant species were also obtained and classified based on their utilization value. The use value varies for each species due to the amount of use. Based on the number of uses, it was found that the teak species had the highest use value. The Tawangmangu community effectively utilizes teak plants for purposes beyond furniture production. Teak, classified as NTFP, serves various functions, including medicinal use, food packaging, and as a source of firewood.

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