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Ethnobotany of wild edible plants used by local communities in three districts along the upper Bengawan Solo River, Central Java, Indonesia

ADITYA TRIYANTO[1], FITRIA PURNAMASARI[2], FENINTA SETYANING PARAMITA[2], FAUZAN RAFI WICAKSONO[2], FARIE AIMAR RAMADHAN[2], SUGENG BUDIHARTA[3], SURAPON SAENSOUK[4], AHMAD DWI SETYAWAN[2,5,♥]

[1]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia
[2]Department of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia. Tel./fax.: +62-271-663375, ♥email: volatileoils@gmail.com
[3]Purwodadi Botanic Gardens, Research Center for Ecology and Ethnobiology, National Research and Innovation Agency. Jl. Surabaya-Malang Km. 65, Pasuruan 67163, East Java, Indonesia
[4]Plant and Invertebrate Taxonomy and Its Applications Unit Group, Biodiversity Program, Walai Rukhavej Botanical Research Institute, Mahasarakham University. Kantarawichai District, Maha Sarakham 44150, Thailand
[5]Biodiversity Research Group, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia

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Abstract. *Triyanto A, Purnamasari F, Paramita FS, Wicaksono FR, Ramadhan FA, Budiharta S, Saensouk S, Setyawan AD. 2024. Ethnobotany of wild edible plants used by local communities in three districts along the upper Bengawan Solo River, Central Java, Indonesia. Biodiversitas 25: 1596-1605.* Wild Edible Plants (WEPs) grow naturally in the environment without human assistance and have parts that humans or animals can consume. The declining interest of local communities in consumable wild plant species, especially among the younger generation, resulted in the loss of public knowledge on the utilization of wild natural resources and the extinction of various types of wild species in nature. This study aims to determine wild edible plants used by local communities in three districts along the Bengawan Solo River, Central Java, Indonesia. This research used qualitative and quantitative data obtained by conducting open, semi-structured, and structured interviews with 90 respondents aged 20-80 years old. Quantitative data was analyzed to produce Use Values (UV) and Informant Consensus Factor (ICF). The study found that the community consumes approximately 49 species from 32 families of WEPs and the most consumed species were *Leucaena leucocephala*, *Carica papaya*, *Dendrocalamus asper*, *Muntingia calabura*, *Peperomia pellucida*, *Gnetum gnemon*, *Moringa oleifera*, and *Portulaca oleracea*. Consumable wild plants along the Bengawan Solo River have an ICF value ranging from 0.645 to 1. The WEPs were used for carbohydrates, vegetables, fruits, seeds, and medicine. The study highlights the diverse uses of plant parts, emphasizing the community's holistic approach to incorporating wild plants into their diet and medicine. The research emphasizes the need to preserve and comprehend the multifaceted roles of WEPs, which are crucial for sustaining cultural traditions and community well-being.

Keywords: *Leucaena leucocephala*, nutraceuticals, use values, wild edible plants

INTRODUCTION

Humans have an instinct to survive by relying on nature, including plant resources. Wild Edible Plants (WEPs) are plants that grow naturally and can be consumed by humans or animals. Some WEPs contain more nutrients, such as vitamins, minerals, and carbohydrates, than cultivated plants, suggesting they can serve as an alternative nutritional source, especially during food shortages (Pinela et al. 2017; Mishra et al. 2021). However, not all wild plants are safe to eat because they also can be harmful. Therefore, the utilization of wild plants as food sources should be done with awareness and adequate botanical and ecological knowledge.

Wild edible plants have been used in various conditions, including as emergency food during disasters or unfortunate events such as during the European famine (Ceccanti et al. 2018). In the modern era, there is a growing interest in wild edible plants with the increasing paradigm of going back to nature, reinforced by the knowledge that categorizes them as new functional foods. Moreover, rural communities in developing countries depend on wild edible plants as additional nutrient-rich food sources during food shortages (Berihun and Molla 2017). These wild plants provide vitamins and micronutrients and are important in maintaining food and nutrition security. Getachew et al. (2013) demonstrated that rural communities consume hundreds of wild plant species sporadically, underlining the vast potential that can be utilized to improve food security and nutrition at the local levels.

Over time, the consumption of WEPs has evolved into a cultural tradition (Haokip and Panmei 2022). Nonetheless, wild edible plant consumption has significantly decreased in the modern era due to globalization, land conversion of natural vegetation into other land uses (e.g., settlement and industry), and socio-economic transition and changes in culture and lifestyle. These factors contribute to modernization, leading to the reduction in natural land, which serves as WEPs habitats and the decrease in public knowledge regarding their uses (Al Yamini et al. 2023).

Nowadays, people have shifted from consuming wild edible plants obtained from nature to buying raw materials in the market, resulting in the erosion of the culture and knowledge of the villagers regarding WEPs (Pereira et al. 2020).

In Indonesia, various kinds of wild plants can be consumed, and some species have useful nutritional and medicinal properties. While numerous wild edible plants can be found in natural ecosystems, such as primary forests, some wild plants might also grow naturally on vacant or uncultivated land. Local communities utilize wild plants that can be consumed with various functions such as traditional drinks, food, medicine, animal feed, etc. (Sutrisno et al. 2020; Elfrida et al. 2021; Navia et al. 2021; Sutrisno et al. 2021; Suwardi et al. 2021; Ramaidani and Navia 2022; Syamsuardi et al. 2022).

Central Java Province, renowned for its diverse flora and fauna, harbors many wild plants that can be consumed, or utilized for medicinal purposes (Rana et al. 2019; Farizal et al. 2020). These plants, which can be found near many residents, serve as food sources or ingredients for traditional medicines. Several communities living along the Bengawan Solo River are known for their ethnobotanical knowledge of the uses of wild plants for food and medicinal uses. The community uses water from the river as the primary source for home use, electricity generation, recreation, irrigation, and industry (Pristianto et al. 2018). Bengawan Solo River also serves as the main source of livelihood for locals, particularly in Central and East Java, because it passes through heavily crowded commercial, industrial, and residential areas.

Despite the ideal habitat for wild edible plants to grow, the areas along Bengawan Solo River have experienced significant land use changes. This condition threatens the existence of wild vegetation in this area. In addition, the declining interest of local communities in consumable wild plant species, especially among the younger generation, resulted in the loss of public knowledge on the utilization of wild natural resources and the extinction of various wild species in nature. Therefore, this study aims to determine wild edible plants used by local communities in three districts along the Bengawan Solo River, Central Java, Indonesia. The results of this study might be useful for informing local communities about the importance of preserving biodiversity and indigenous knowledge related to wild edible plants. This study can help bridge the knowledge gap between generations and raise awareness about the valuable resources that these wild plants provide.

MATERIALS AND METHODS

Study period and area

This research was conducted in October 2023. The research area included three villages in three districts along the Bengawan Solo River, Central Java, Indonesia, namely Sidodadi Village (7°28'57.6" S, 110°54'07.9" E) in Sragen District, Ngringo Village (7°34'19.6" S, 110°51'36.7" E) in Karanganyar District and Palur Village (7°33'24.8" S, 110°52'23.8" E) in Sukoharjo District (Figure 1). The three villages have the same topographic conditions.

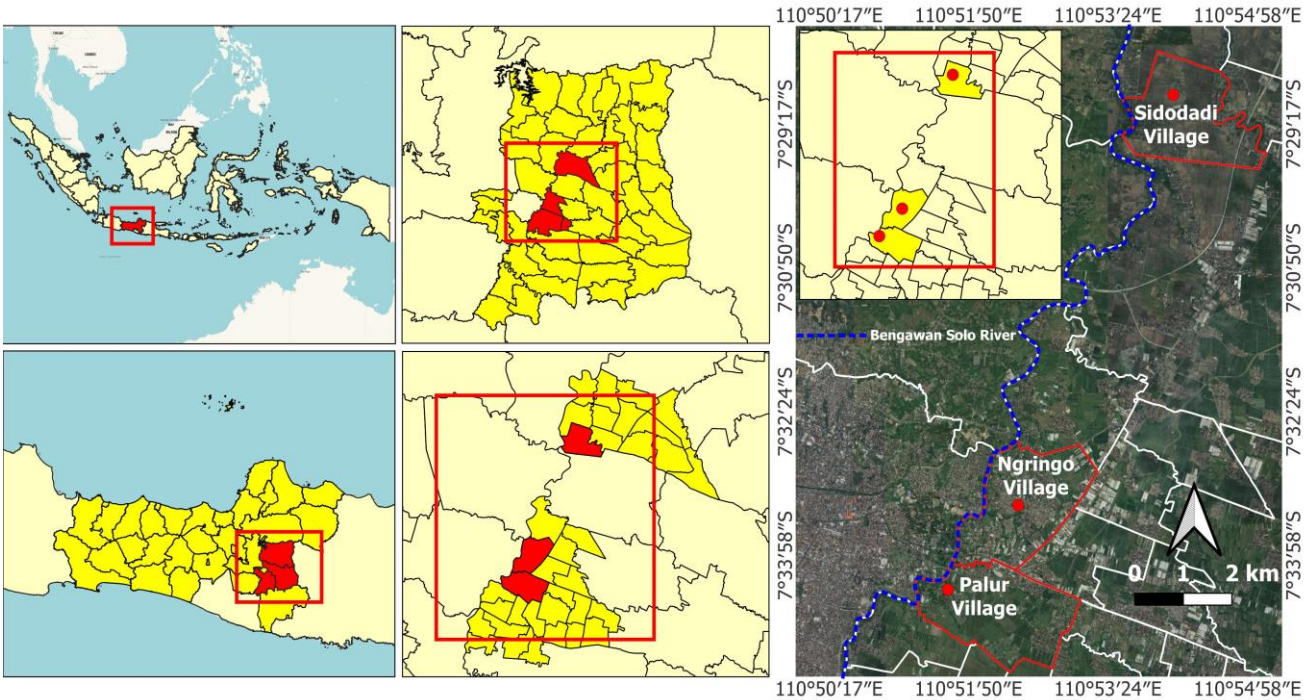

Figure 1. Map of study location and sampling locations: Palur Village, Sukoharjo District; Ngringo Village, Karanganyar District; and Sidodadi Village, Sragen District, Central Java Province, Indonesia

Data collection

This study used qualitative and quantitative data. Data was collected by conducting open, semi-structured, and structured interviews directly by visiting key and ordinary informants' homes. Key informants were selected using a purposive sampling method based on the research objectives and information from village officials/local residents who recommended informants who had extensive knowledge about wild edible plants. On the other hand, regular respondents were selected using a combination method of snowball sampling and purposive random sampling. Snowball sampling is a technique that initially has a small number, then gets bigger (Suriani et al. 2023). In comparison, purposive random sampling is a technique of determining and obtaining samples with certain considerations determined by researchers (Sugiyono 2015). The respondents selected were those who use wild plants for food. The respondents knew the wild plants for food, how to use and process them, and their medicinal uses. The number of respondents was 90 people (30 respondents in each village) with ages ranging between 20-80 years.

In addition to interviews, another method was field observation of wild edible plants in their natural habitat accompanied by local informants. After obtaining data on the diversity of medicinal plant species in local nomenclature, we continued with the identification of scientific names using online platforms, specifically Powo (https://powo.science.kew.org/) and GBIF (Global Biodiversity Information Facility - https://www.gbif.org/). Data collected included the diversity of wild edible plant species, processing methods, habitats, and utilization frequency.

Data analysis

Data results obtained from the interviews were in the form of letters or numbers. The data were then processed in Microsoft Excel to produce graphs, figures, and tables. A graphic is used to represent the percentage of total data value. Meanwhile, frequency tables, percentage tables, and quantitative tables are used to present data in a systematic and easy-to-read manner. Those presentations make evaluating data and identifying patterns or differences between categories possible.

Furthermore, quantitative data was analyzed using the Use Values (UV) and Informant Consensus Factor (ICF) using the formula as follows :

Use Values (UV)

According to Phillips et al. (1994), Use Value is calculated as follows:

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

Where: U is the number of uses mentioned by informants for a plant species, and N is the total number of informants interviewed for a plant species. Plant has a high UV value (close to 1) if it is used and reported by many respondents, and plant has a low UV value (close to 0) if it is used by fewer users (Zahoor et al. 2017; Chaachouay et al. 2019; Sarquis et al. 2019; Al Yamini et al. 2023).

Informant Consensus Factor (ICF)

The Informant Consensus Factor (ICF) was used to determine the homogeneity of local knowledge. The ICF value was calculated using the equation:

$$ICF = \frac{[Nur - Nt]}{Nur - 1}$$

Where: Nur is the total number of plants mentioned by respondents to treat a particular disease, and Nt is the total plant species mentioned to treat a particular disease. ICF values vary from 0-1 (Cornara et al. 2014).

RESULTS AND DISCUSSION

Demographic structure of respondents

Respondent demographic data (Table 1) shows that most respondents were women (65.6%). There is a greater frequency of female respondents than male respondents due to the role differences between males and females (Iswandono et al. 2015). Women manage natural resources, including wild edible plants, and are usually responsible for cooking wild edible plants for the family's food needs. In terms of age, the majority of respondents were from productive ages of 15-64 years (Setiawan and Qiptiyah 2014). This age group usually has more experience with the natural environment, making it easier for them to answer the questions easily. In terms of education, most of the respondents in this study had senior high school education (37.78%). This shows that formal education also plays a role in increasing people's knowledge about wild food plants.

Diversity of wild edible plant species

In the studied areas in Sidodadi, Ngringo, and Palur villages, the respondents used approximately 56 species of Wild Edible Plants (WEPs) from 32 families (Table 2). The number of WEPs species varied among the surveyed villages. The family with the largest number of species was Solanaceae, with five species, followed by Asteraceae, Euphorbiaceae, Fabaceae, Moraceae, Phyllanthaceae, and Convolvulaceae, with three species.

Table 1. The demographic structure of respondents

Parameter	Specification	Freq.	Percentage (%)
Gender	Male	31	34.4
	Female	59	65.6
Age	20-30	7	7.77
	31-40	14	15.56
	41-50	23	25.56
	51-60	23	25.56
	61-70	11	12.22
	71-80	12	13.33
Education	Elementary school	12	13.33
	Junior High School	18	20
	Senior Highschool	34	37.78
	University	17	18.89
	Other	9	10

Table 2. Wild edible plant species used by local communities in three villages along the upper Bengawan Solo River, Central Java, Indonesia

Family/scientific name	Local name	Growth form	Part of use	Habitat
Acanthaceae				
Andrographis paniculata (Burm.fil.) Nees	*Sambiloto*	Shrub	Leaf	Yard
Alismataceae				
Limnocharis flava (L.) Buchenau	*Genjer*	Herb	Leaf	Ricefield
Amaranthaceae				
Amaranthus spinosus L.	*Bayam duri*	Herb	Leaf	Yard
Amaranthus viridis L.	*Bayam*	Herb	Leaf	Yard
Annonaceae				
Annona squamosa L.	*Srikaya*	Tree	Fruit	Yard
Apocynaceae				
Catharanthus roseus (L.) G.Don	*Tapak dara*	Shrub	Leaf	Yard
Araceae				
Amorphophallus paeoniifolius (Dennst.) Nicolson	*Suweg*	Herb	Leaf, root tuber	Garden
Colocasia esculenta (L.) Schott	*Keladi*	Herb	Stem, root tuber	Yard
Asparagaceae				
Dracaena angustifolia (Medik.) Roxb.	*Suji*	Shrub	Leaf	Yard
Asteraceae				
Cosmos caudatus Kunth	*Kenikir*	Herb	Leaf	Yard
Pluchea indica (L.) Less.	*Beluntas*	Shrub	Leaf	Garden
Smallanthus sonchifolius (Poepp. & Endl.) H.Rob.	*Daun Insulin*	Herb	Leaf	Yard
Athyriaceae				
Diplazium esculentum (Retz.) Sw.	*Pakis*	Herb	Leaf	Yard
Basellaceae				
Anredera cordifolia (Ten.) Steenis	*Binahong*	Herb	Leaf	Yard
Basella alba L.	*Lembayung*	Herb	Leaf	Garden
Brassicaceae				
Nasturtium officinale R.Br.	*Selada air*	Herb	Leaf	Ricefield
Caricaceae				
Carica papaya L.	*Pepaya*	Herb	Leaf, flower, fruit	Garden
Combretaceae				
Terminalia catappa L.	*Ketapang*	Tree	Seed	Yard
Convolvulaceae				
Ipomoea aquatica Forssk.	*Kangkung Air*	Herb	Leaf	Ricefield
Dioscoreaceae				
Dioscorea esculenta (Lour.) Burkill	*Gembili*	Shrub	Root tuber	Garden
Euphorbiaceae				
Cnidoscolus aconitifolius (Mill.) I.M.Johnst.	*Pepaya jepang*	Herb	Leaf	Yard
Euphorbia hirta L.	*Patikan kebo*	Herb	Leaf	Yard
Fabaceae				
Clitoria ternatea L.	*Telang*	Herb	Flower	Yard
Leucaena leucocephala (Lam.) de Wit	*Petai cina*	Shrub	Seed	Yard
Tamarindus indica L.	*Asam jawa*	Tree	Fruit	Yard
Gnetaceae				
Gnetum gnemon L.	*Melinjo*	Tree	Leaf, fruit, seed	Yard
Lamiaceae				
Ocimum basilicum L.	*Kemangi*	Herb	Leaf	Garden
Moraceae				
Artocarpus altilis (Parkinson) Fosberg	*Sukun*	Tree	Fruit	Garden
Artocarpus heterophyllus Lam.	*Nangka*	Tree	Fruit	Garden
Morus alba L.	*Murbei*	Shrub	Fruit	Yard
Moringaceae				
Moringa oleifera Lam.	*Kelor*	Shrub	Leaf	Yard
Muntingiaceae				
Muntingia calabura L.	*Kersen*	Tree	Fruit	Yard
Myrtaceae				
Psidium guajava L.	*Jambu biji*	Shrub	Fruit	Yard
Syzygium aqueum (Burm.fil.) Alston	*Jambu air*	Tree	Fruit	Yard
Oxalidaceae				
Averrhoa bilimbi L.	*Belimbing wuluh*	Shrub	Fruit	Garden

Phyllanthaceae				
Phyllanthus acidus (L.) Skeels	*Cermai*	Tree	Fruit	Yard
Phyllanthus urinaria L.	*Meniran*	Shrub	Leaf	Yard
Breynia androgyna (L.) Chakrab. & N.P.Balakr.	*Katuk*	Shrub	Leaf	Garden
Piperaceae				
Peperomia pellucida (L.) Kunth	*Tumpang air*	Herb	Leaf	Ricefield
Piper ornatum N.E.Br.	*Sirih merah*	Herb	Leaf	Yard
Poaceae				
Cymbopogon citratus (DC.) Stapf	*Serai*	Herb	Stem	Yard
Dendrocalamus asper (Schult.f.) Backer	*Bambu*	Bamboo	Shoots	Garden
Portulacaceae				
Portulaca oleracea L.	*Krokot*	Herb	Leaf	Garden
Rubiaceae				
Morinda citrifolia L.	*Mengkudu*	Herb	Fruit	Yard
Rutaceae				
Murraya koenigii (L.) Spreng.	*Salam koja*	Shrub	Leaf	Yard
Solanaceae				
Capsicum annuum L.	*Cabe*	Herb	Fruit	Garden
Physalis angulata L.	*Ciplukan*	Herb	Fruit	Yard
Solanum torvum Sw.	*Terong pipit*	Herb	Fruit	Yard
Talinaceae				
Talinum paniculatum (Jacq.) Gaertn.	*Ginseng jawa*	Herb	Leaf	Yard

Note: Yard: *pekarangan/homegarden*, Ricefield: *sawah*, Garden: *kebon/kebun*

The number of species recorded in this study (49 species) is lower than the 86 wild plant species reported in South Aceh and Southwest Aceh (Adnan et al. 2023) but higher than the 30 species in Jharkhand, India (Das 2018), 30 species in Nias, North Sumatra (Ziraluo and Duha 2020), and 36 species in Benguet, Philippines (Chua-Barcelo 2014). These species number differences are influenced by several factors, such as environmental factors (topography, soil fertility, and air conditions) and cultural factors, such as the habits of the community. This also results in certain plants that only grow in specific areas.

Growth form, part used, and habitat

The habitus of wild edible plants utilized by the community along the Bengawan Solo River were trees, herbs, shrubs, vines, aquatic plants, bushes, bamboo, and fern. Herbs had the largest proportion of uses, with 53.06%, followed by shrubs at 26.53%, trees at 18.37%, and bamboo at 2.04% (Figure 2.A). The high utilization of species forms herb habitus because of their diverse species and abundance, and herbs can be used for food, medicine, seasoning, decoration, and others. Utilizing plant parts in the form of leaves also has other advantages because their growth and post-harvest recovery are faster than other plant parts, thereby ensuring their availability.

According to Lestari et al. (2021), many herbs are found in yards because they require minimal treatments, and the plants can grow even without care. For example, in Ngringo Village, people look after their yards to find herbs. The interviews revealed that residents have a mandatory program to plant medicinal plants in every yard/home garden (*pekarangan*), while wild edible plants also grow. In addition, shrubs and trees grow more slowly and require more specific environmental conditions. Therefore, shrubs and trees are often found in Sidodadi Village, which has a plantation area compared to the other two villages.

The surveys and interviews at the research site show that WEP species grow in several habitat types, namely yards/homegarden (*pekarangan*), gardens (*kebon/kebun*), and rice fields (*sawah*) (Figure 2.B). Each habitat has different characteristics and conditions that affect their well-being and survival. WEP species are most commonly found in yard habitats. The yard is the most dominant habitat because the research location is a residential area along the Bengawan Solo River, so many WEP species are found in this habitat. Anthropological activities affect the conditions along the river currently built as settlements, plantations, rice fields, and other activities. WEP species are also found in gardens and rice fields, which could be more optimal habitats. Contaminated areas influence the growth of WEPs. Gardens and rice fields are intensively cultivated by humans, which affects the habitat conditions of WEP species (Trisnaini et al. 2018). In these areas, WEP species should compete with cultivated plants. In addition, human activities in these areas also cause pollution, decreasing the populations of WEPs.

Communities along the Bengawan Solo River utilize seven parts of the plant, namely leaves of 28 species, fruits of 16 species, seeds of 3 species, root tubers of 3 species, flowers of 2 species, shoots of 1 species, and stems of 1 species. The leaves are the most utilized part of the plant, and several species use more than one part of the plant (Figure 2.C). The community commonly uses leaves to cook and as a side dish. In addition, some leaves can also be used as medicine, such as *Talinum paniculatum*, *Smallanthus sonchifolius*, and *Andrographis paniculata*.

Other parts, such as fruit, are the generative parts most commonly used in wild edible plants. Fruit contains sugar, starch, water, vitamins, and minerals, which are beneficial for humans and can be eaten fresh, cooked, or dried (Rejman et al. 2021). Seeds such as *Gnetum gnemon*, *Leucaena leucocephala*, and *Terminalia catappa* are the generative part, rich in nutrition, especially protein. Root tubers are vegetative parts that are commonly rich in carbohydrates. Some flowers, shoots, and stems can be eaten fresh, cooked, or dried.

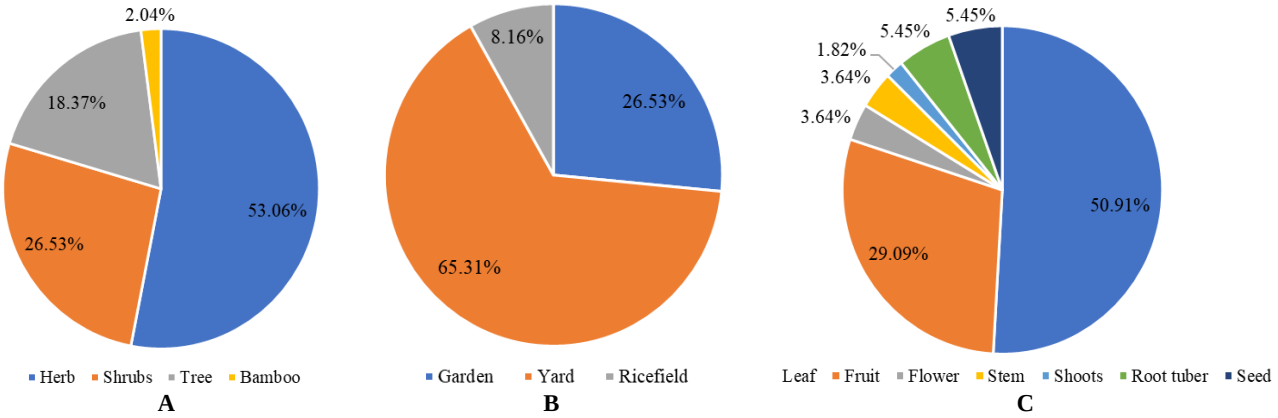

Figure 2. A. The percentage of plant growth forms; B. The percentage of plant habitat; C. The percentage of plant parts used in the research area

Wild edible plants as food source

Wild edible plants are used as food sources (fruit, vegetable, seed and carbohydrate) and medicines for local communities in three districts along the Bengawan Solo River, Central Java, Indonesia (Table 3). In general, wild edible plants can be consumed using two methods: directly or cooked first. The direct consumption method is generally used for plants where the part used is the fruit because the fruit does typically not require processing and can be a source of water and nutrients if eaten directly (Juliana et al. 2013). The method that requires direct cooking is processing, which aims to obtain the properties contained in the cooked part and eliminate the bitter taste that usually occurs in plants when eaten directly (Juita et al. 2015). The cooking method is a form of food preservation that is used to prevent the growth of bacteria, fungi (for example, yeast), and other microbes (Setyawan et al. 2013).

Source of carbohydrates

The primary sources of carbohydrates for residents along the Bengawan Solo River are rice and corn; however, they also utilize 2 other species as carbohydrate sources, there are *C. esculenta* and *D. esculenta*. Most carbohydrate sources come from tubers such as *C. esculenta* and are usually processed before consumption, such as by boiling. Some tubers (e.g., *Dioscorea* spp.) must be processed in a particular way by soaking and drying to remove the poisonous or non-edible contents since these plant tubers contain hydrogen cyanide compounds that have toxic properties if consumed (Estiasih et al. 2022).

The tuber of *C. esculenta* is very popular because it is easy to process into delicious food, such as starch, flour, fufu, poi, achu, sapal, and even beer. There are several methods to prepare *C. esculenta* tuber for eating, including as boiling, baking, roasting, frying, or adding them to other dishes. Apart from that, *C. esculenta* has many benefits, including controlling blood sugar levels because *C. esculenta* has the highest dietary fiber than other tropical crops (Adane et al. 2013). Meanwhile, Indonesians people have long been aware of and have used the *Dioscorea* tuber as a source of carbohydrates throughout the dry season, particularly in Maluku, Lesser Sunda, Sulawesi, and Java (Sulistyono and Marpaung 2004). *Dioscorea* is a valuable food source, particularly in rural areas. *Dioscorea* plays an important role in food security since it is easily propagated by their tubers (Wilson 1989) and thrives in marginal locations where main crops cannot be cultivated (Legaspi and Malab 2013). The greatest benefit of this crop is that it may be grown with little regard for cultivation techniques, even by the sides of roads, in homes, forests, and domestic gardens (Islam et al. 2011).

Source of vegetables

Residents along the Bengawan Solo River people utilize 27 species of plants as vegetables, such as *P. indica*, *L. leucocephala*, *M. oleifera*, *P. pellucida*, etc. People selectively harvest green plants. *Portulaca*, a vegetable commonly found in rice fields and moorlands, is prevalent during the rainy season, particularly after rice harvesting. Moreover, this plant proliferates extensively in newly prepared rice fields designated for tobacco cultivation at the onset of the dry season, where it assumes the role of a predominant weed. The plant is collected for vegetable soup, stir-fries, or boiling, commonly consumed with *sambal* as a side dish. *Portulaca* plants have the highest omega-3 fatty acid content compared to other commonly cultivated vegetables like spinach, mustard greens, and lettuce. The increasing number of enthusiasts, the ease of cultivation, and the many parts of the plant that can be consumed encourage people to plant this plant (Konsam et al. 2016).

Source of fruits

A total of 13 plant species are used as sources of fruits, such as *A. squamosa*, *A. heterophyllus*, *C. papaya*, *M. alba*, *M. calabura*, *P. guajava*, and others. In addition, people tend to favor sweet or tangy fruits, leading to fresh fruits being consumed or incorporated into salads. Fruits can be added to cakes (Šaponjac et al. 2016) or used as beverages (Reißner et al. 2019).

On the other hand, *A. heterophyllus* has a texture between soft and dense; this fruit's taste varies between sweet and not sweet. But uniquely, this fruit can be processed into vegetables and some desserts like others. Vegetable preparations usually use fruit that still needs to be ripe. This fruit contains phytonutrients called lignans, isoflavones, and saponins, which are anti-cancer and anti-aging. Fiber is very important to help facilitate digestion; therefore, consuming this fruit can also help facilitate digestion and cleanse the intestines (Ranasinghe et al. 2019).

Table 3. Wild edible plants as food sources by local communities in three districts along the Bengawan Solo River, Central Java, Indonesia

Species	Kind of source	Method of use/preparation	UV
Amaranthus spinosus	Vegetable	Cooked	0.22
Amaranthus viridis	Vegetable	Cooked	0.07
Amorphophallus paeoniifolius	Vegetable	Cooked	0.01
Andrographis paniculata	Medicinal	Cooked	0.02
Annona squamosa	Fruit	Eaten fresh	0.08
Anredera cordifolia	Vegetable	Cooked	0.06
Artocarpus altilis	Fruit	Eaten fresh	0.11
Artocarpus heterophyllus	Fruit	Cooked or eaten fresh	0.16
Averrhoa bilimbi	Fruit, vegetable	Cooked or eaten fresh	0.1
Basella alba	Vegetable	Cooked	0.17
Capsicum annuum	Vegetable	Cooked	0.01
Carica papaya	Fruit, vegetable	Eaten fresh or processed into dessert	0.5
Catharanthus roseus	Medicinal	Cooked	0.02
Clitoria ternatea	Medicinal	Cooked	0.02
Cnidoscolus aconitifolius	Vegetable	Cooked	0.12
Colocasia esculenta	Carbohidrate	Cooked	0.24
Cosmos caudatus	Vegetable	Cooked	0.03
Cymbopogon citratus	Vegetable	Cooked	0.01
Dendrocalamus asper	Vegetable	Cooked	0.49
Dioscorea esculenta	Carbohidrate	Cooked	0.01
Diplazium esculentum	Vegetable	Cooked	0.06
Dracaena angustifolia	Medicinal	Cooked	0.01
Euphorbia hirta	Medicinal	Cooked	0.02
Gnetum gnemon	Vegetable	Cooked	0.42
Ipomoea aquatica	Vegetable	Cooked	0.14
Leucaena leucocephala	Seed, vegetable	Cooked	0.73
Limnocharis flava	Vegetable	Cooked	0.06
Morinda citrifolia	Fruit	Eaten fresh or made juice	0.02
Moringa oleifera	Vegetable	Cooked	0.34
Morus alba	Fruit	Eaten fresh	0.08
Muntingia calabura	Fruit	Eaten fresh	0.46
Murraya koenigii	Vegetable	Cooked	0.02
Nasturtium officinale	Vegetable	Cooked	0.04
Ocimum basilicum	Vegetable	Cooked or eaten fresh	0.1
Peperomia pellucida	Vegetable	Cooked	0.44
Phyllanthus acidus	Fruit	Eaten fresh	0.03
Phyllanthus urinaria	Medicinal	Cooked	0.08
Physalis angulata	Fruit, medicinal	Eaten fresh	0.22
Piper ornatum	Medicinal	Cooked	0.01
Pluchea indica	Vegetable	Cooked	0.01
Portulaca oleracea	Vegetable	Cooked or eaten fresh	0.3
Psidium guajava	Fruit	Eaten fresh	0.1
Sauropus androgynus	Vegetable	Cooked	0.17
Smallanthus sonchifolius	Medicinal	Cooked	0.02
Solanum torvum	Vegetable	Cooked	0.18
Syzygium aqueum	Fruit	Eaten fresh	0.03
Talinum paniculatum	Medicinal	Cooked	0.26
Tamarindus indica	Fruit, vegetable	Cooked or eaten fresh	0.08
Terminalia catappa	Medicinal	Cooked	0.01

Source of seeds

Three plant species serve as seed sources, including *G. gnemon*, *L. leucocephala*, and *T. catappa*. The seed of *L. leucocephala*, a local name known as *melanding*, undergoes a boiling process to soften the membranes before consumption or can be cooked in other ways for complement. Consuming this plant might increase immunity and reduce weight. The main ingredient in *melanding* is saponin, which has been proven to be used as a compound that can stimulate collagen formation, which is a structural protein that plays a role in the wound healing process; it also can act as a cleanser so it is effective for healing open wounds. Hence, the bark of the *melanding* tree also has good ingredients in terms of analgesics or pain relievers. Although it is rarely used in Indonesia, in various countries, the bark of the *melanding* tree is cut and crushed, then drink to relieve muscle pain or for cramps during menstruation (Jetana 2017). Aside from *melanding*, the seeds of *G. gnemon*, or *melinjo*, are also highly sought after by the community. Stir-fried *melinjo* seeds are particularly popular among local communities because the flavor is very thick. Many studies have explored the potential of *melinjo*, which is rich in nutrients and minerals that benefit the body's health, including protein, fiber, zinc, iron, and magnesium (Winstead and Jacobson 2022).

Use Values (UV)

Based on the results, the UV values of wild edible plants in the studied area ranged between 0.01 and 0.73. In this study, the highest UV value is *L. leucocephala* (*petai cina*) with a UV value of 0.73, followed by *C. papaya* (*pepaya*) with a UV value of 0.5, *Dendrocalamus asper* or bamboo (UV = 0.49), *M. calabura* or *kersen* (UV = 0.46), *P. pellucida* or *tumpang air* (UV = 0.44), *G. gnemon* or *melinjo* (UV = 0.42), *M. oleifera* or *kelor* (UV = 0.34), and *Portulaca oleracea* or *krokot* with a UV value = 0.3. The *L. leucocephala* has more than one category of utilization in the food group, namely as a source of seeds and vegetables. This plant has a high UV value since it is also equally used by the local community. The number of use reports and category of utilization in the food group can also interpret UV values. Furthermore, the majority of species listed in more than one food group utilization category show how versatile wild edible plants may be (Nurcahyo et al. 2024).

Wild edible plant as medicinal plants

Besides providing nutritional requirements, many wild edible plants are used to treat various health ailments or as nutraceuticals (Table 4). As with food sources, wild edible medicines can also be consumed directly or cooked first. The direct consumption method is used to prevent a reduction in nutritional/metabolite content and its benefits in treating disease (Razzak et al. 2023). Another method is that it needs to be cooked first (generally boiled), which is an easy and effective process to obtain boiled juice, and useful for curing certain diseases (Jafar and Djollong 2018).

Euphorbia hirta reduces inflammation and increases body fitness and immunity. *Physalis angulata* is used for heart disorders. *Clerodendrum glandulosum* is well-known to treat hypertension. *Smallanthus sonchifolius*, or insulin leaves, are used to assist the body in controlling blood sugar levels and manage glucose as an energy source. Therefore, it is used to treat diabetes mellitus.

Talinum paniculatum is used for digestive problems, facilitating breast milk, and treating headaches. *Clitoria ternatea* can be made into tea from its flowers, useful as antioxidants and antimicrobials. *A. paniculata* is useful for colds, preventing diabetes, preventing stroke, and so on. *Piper ornatum* can treat diabetes mellitus, hepatitis, kidney stones, etc. *Euphorbia hirta* can be utilized by boiling the leaves and drinking the boiled water, which is useful as an asthma symptom reliever and immune booster. *Catharanthus roseus* is used as a medicine for diabetes mellitus, anti-cancer, anti-tumor, and hypertension. *Dracaena angustifolia* is useful for respiratory problems, dysentery, maintaining cholesterol levels, etc. The *T. catappa* seeds can be consumed to reduce the risk of heart attack, reduce cholesterol levels, and prevent hypertension. *Phyllanthus urinaria* leaves can be consumed to treat kidney stones, improve liver function, relieve gout, and so on. Although wild plants can disturb the surrounding area, many wild plants have many benefits, including medicine.

Local people in the upper Bengawan Solo River utilize wild plants as traditional medicine. In several cases, one species can cure several diseases. Generally, people use two or three parts of the plant to produce medicinal ingredients. Consumable wild plants along the Bengawan Solo River have an ICF value ranging from 0.645 to 1. The plant used as a drink only consists of one species, namely *C. ternatea*, with an ICF value of 0.983. Plants that have the same ICF value are *S. sonchifolius*, *A. paniculata*, *E. hirta*, and *C. roseus*, which have an ICF value of 0.983. The plant most known by respondents is *T. paniculatum*, with an ICF value of 0.645, and 23 respondents know this plant species with the part used is the leaf. *P. angulata* has an ICF value of 0.693, with 20 respondents mentioning this species and categorizing it as a fruit. There are plant species with the highest ICF value, namely *P. ornatum*, *D. angustifolia*, and *T. catappa*, with an ICF value of 1.

Table 4. The use of WEPs as medicinal plants by local communities in three districts along the Bengawan Solo River, Central Java, Indonesia

Species	Part used	Preparation	Application method	Medicinal use	ICF
Andrographis paniculata	Leaf	Boiled	Consumed and applied	Overcoming flu, maintaining heart health, preventing diabetes, maintaining digestive health	0.983
Catharanthus roseus	Leaf	Boiled	Consumed	Overcome cholesterol, diarrhea, and even cancer	0.983
Clitoria ternatea	Flower	Boiled	Consumed	Antioxidant and antimicrobial	0.983
Dracaena angustifolia	Leaf	Boiled	Consumed	Treating respiratory problems, overcoming dysentery, maintaining cholesterol levels, and reducing preeclampsia risk.	1
Euphorbia hirta	Leaf	Boiled	Consumed	Anti-inflammatory, relieves asthma symptoms, and increases the body's immunity.	0.983
Phyllanthus urinaria	Leaf	Boiled	Consumed	Treats kidney stones, improves liver function, relieves gout, lowers blood pressure	0.903
Physalis angulata	Fruit	Eaten fresh	Consumed	Treat high blood pressure	0.693
Piper ornatum	Leaf	Boiled	Consumed and applied	Diabetes mellitus, hepatitis, kidney stones, lower cholesterol, prevent stroke, gout, cancer, hypertension, liver inflammation, prostate inflammation, ulcers, fatigue, joint pain	1
Smallanthus sonchifolius	Leaf	Boiled	Consumed	Diabetes mellitus	0.983
Talinum paniculatum	Leaf	Boiled	Consumed	Digestion, facilitate breast milk, treat headaches	0.645
Terminalia catappa	Seed	Boiled	Consumed	Reduces the risk of heart attack, lowers cholesterol levels, prevents hypertension	1

In conclusion, the study underscores the abundant diversity of Wild Edible Plants (WEPs) species in three districts along the upper Bengawan Solo River, Central Java. The consumption of 49 species from 32 families reflects the community's profound connection to the natural environment. Environmental factors and cultural practices influence regional variations in consumed species. The prevalent use of herb habitus along the Bengawan Solo River highlights its versatility for various purposes. The study details the diverse uses of plant parts, emphasizing the community's holistic approach to incorporating wild plants into their diet and medicinal. Therefore, using WEPs for carbohydrates, vegetables, fruits, seeds, and medicine showcases their nutritional and therapeutic significance. High Informant Consensus Factor (ICF) values signify shared traditional knowledge about the medicinal uses of wild plants. The research emphasizes the need to preserve and comprehend the multifaceted roles of wild edible plants, which are crucial for sustainable cultural traditions and community well-being.

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