BIODIVERSITAS
Volume 25, Number 9, September 2024
Pages: 3041-3047

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d250925

The diversity of wild edible plants used by community living around Mount Merapi National Park, Central Java, Indonesia

KHOTROTUN NIDA FARIKHA[1], LATHIFA PUTRI WIEDHYA SYAHRANI[1], LUNETTA KHALIS ALFIYAH[1], LUTHFIA[1], MURNI NURWULANDARI[1], IRFAN ABU NAZAR[1], EDI JUNAEDI[2], AHMAD DWI SETYAWAN[1,3,♥]

[1]Department of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57126, Central Java, Indonesia. Tel./fax.: +62-271-669371, ♥email: volatileoils@gmail.com
[2]Department of Biology Education, Universitas Kuningan. Jl. Cut Nyak Dhien No. 36A, Cijoho, Kuningan 45513, West Java, Indonesia
[3]Biodiversity Research Group, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia

Manuscript received: 31 March 2024. Revision accepted: 14 September 2024.

Abstract. *Farikha KN, Syahrani LPW, Alfiyah LK, Luthfia, Nurwulandari M, Nazar IA, Junaedi E, Setyawan AD. 2024. The diversity of wild edible plants used by community living around Mount Merapi National Park, Central Java, Indonesia. Biodiversitas 25: 3041-3049.* Mount Merapi National Park is one of the conservation areas in Indonesia that serves as habitat for various species of wild plants with ecological value and social benefits for local communities. However, the impacts of social, economic, and environmental changes have led to a decline in community interest in utilizing the presence of wild plants there. This research aims to document the diversity of wild edible plants used by local community living around Mount Merapi National Park in Kemalang Sub-district, Klaten District, Central Java, Indonesia. Data collection involved physical observation and semi-structured questionnaires to 58 respondents. Data analysis was carried out by classifying plants based on their local names, families, scientific names, growth forms, parts utilized, uses, and conservation status. This study documented 45 species of wild edible plants belonging to 32 families with the dominance of the Zingiberaceae family. Wild edible plants are utilized as food sources, cooking ingredients, and traditional medicine with leaves being the most commonly utilized part. *Andrographis paniculata* is most frequently utilized by the community. Based on the IUCN Red List, there are 20 wild edible species categorized as Least Concern, 13 species Not Evaluated, 11 species Data Deficient, and 1 species Endangered.

Keywords: Herb, Mount Merapi, shrubs, tree, wild edible plant

INTRODUCTION

Forest is area covered mainly with tree vegetation. It provides habitat for wildlife, regulates water cycles, and helps maintain soil health, making them a vital component of the Earth's biosphere. More recently, forest is increasingly acknowledged as the planet's lungs by absorbing carbon dioxide and storing it in the form of biomass. Despite such ecological roles, forest provides numerous socio-economic benefits to the surrounding communities in various aspects of their lives. One of the main benefits of forest for local communities is as a food source which provides fruits, wild vegetables, mushrooms, and various other wild plants that can be consumed as daily nutritional needs. In several cases, the role of forest as a food source for local communities is crucial in areas where they mainly rely on natural resources to meet their food needs instead of buying it from market (Hakim et al. 2021). In maximizing the forest potentials for community welfare, the basic principle is that the forest resources and areas can be utilized by considering their nature, characteristics, and vulnerability (Rahayu and Triwanto 2021).

Mount Merapi National Park (*Taman Nasional Gunung Merapi/TNGM*) is one of the national parks in Indonesia. TNGM is located in Central Java Province and covers an area of 6,410 hectares, encompassing several regencies including Magelang, Sleman, and Boyolali (Rahmayanti 2022). This national park is known for its magnificent landscape and abundant biodiversity. However, apart from being a source of natural beauty, the presence of wild plants in TNGM also holds great potential for utilization by the local community. From traditional medicinal uses to food sources, the wild plants in this area provide various benefits that have not yet been fully explored.

Wild plants are plants that grow and develop naturally in their native habitat without human intervention. Wild plants play an important role in the natural ecosystem (Setiawan et al. 2020). Several studies have found that wild plants provide food and habitat for animals, produce oxygen, and have economic value, especially in the fields of medicine, food for communities, and others (Ayu et al. 2023). Wild plants also play a role in maintaining food security, especially for local communities that rely on natural resources to meet their food needs (Nurdin et al. 2022). Food wild plants are often utilized by communities for personal consumption or for sale (Sholichah and Alfidhdhoh 2020). Wild plants can provide important alternative food sources for local communities when primary food sources become scarce or disrupted, for example when harvests fail or during dry seasons (Kurniati et al. 2022). According to Wulandari et al. (2021), some wild plants can also survive throughout the year in certain environments, both during the dry season and the rainy season. This can help maintain food availability throughout

the year in areas experiencing extreme seasonal changes. The roles of wild plants in maintaining food security underscores the importance of preserving them and their natural habitat. By maintaining natural ecosystems and increasing community knowledge about wild plants, communities can rely on these natural resources to meet their long-term food needs.

Nonetheless, the community's dependence on wild plants is declining. This can be caused by several factors related to social, economic, and environmental changes. For example, the shift towards modernization and urbanization often leads to changes in the consumption patterns of local communities. Such changes often impact public health and can also have broad social, economic, and environmental consequences (Sugiyanto et al. 2022), inlcuding reducing local communities' access to wild plants. Therefore, it is important to make efforts to preserve and conserve wild plants, as well as to increase knowledge and appreciation of the value of wild plants, to ensure the sustainability of food sources for local communities. Therefore this research is conducted to document the diversity of wild plants in the TNGM area and to understand the knowledge of local community living in the nearby area (i.e. Kemalang Sub-district) on the utilization wild plants including forest wild fruits. This effort is of great importance to understand the extent to which communities care about preserving and protecting natural resources, thereby preventing damage or loss.

MATERIALS AND METHODS

Study area and period

The research was conducted in two villages i.e. Sidorejo (4°59'2.4"S, 91°13'48"E) and Tegalmulyo (4°8'18.24"S, 91°53'9.6"E) in Kemalang Sub-district, Klaten District, Central Java Province, Indonesia in March 2024 (Figure 1). This sub-district is located in the northernmost region of Klaten District, divided into 13 villages, and situated at an elevation between 300-1000 meters above sea level (Statistics Indonesia Kemalang Sub-district 2020). The majority of the area in Kemalang Sub-district is highland terrain, comprising mainly dryland agriculture (98.95% of the total area of 5,116 hectares), while the rest consists of technically irrigated rice fields covering 54.1 hectares. The majority of the population are farmers working on agricultural and plantation activities as well as livestock sector to support their economy.

Data collection procedure

Field surveys

The research was conducted by documenting wild plants in the Mount Merapi National Park area and around the homes of nearby residents. Documentation focused on wild edible plants or cultivated by the communities in Sidorejo and Tegalmulyo villages due to their specific benefits. Field visits were made to observe the actual conditions by documenting wild plants in the Mount Merapi National Park area.

Semi-structured questionnaire

Data collection was carried out using a semi-structured questionnaire. Information was gathered from 58 participants, comprising 55 individuals from various age groups and 3 key informants (i.e. Mount Merapi National Parks officers). The interview was complemented with physical observations to gather basic information about the utilization of wild plants in the area. This method is similar to the one used in a study Oduor et al. (2023), where a semi-structured survey questionnaire with the local community was designed to collect data on various aspects, including socio-demographic characteristics of households, Indigenous Wild edible plants (IWEPs) consumption, food security, perceptions regarding IWEP consumption, overall agricultural biodiversity, including market participation. The reason for selecting key informants was to obtain information with a high level of validity.

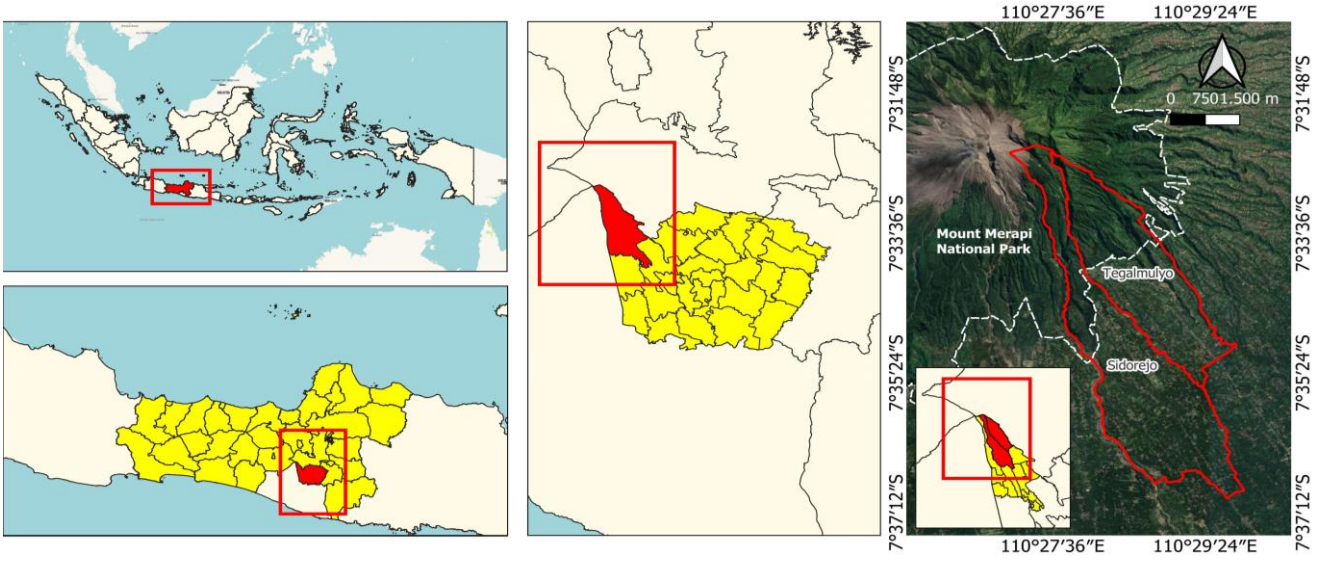

Figure 1. Map of study area in two villages of Kemalang Sub-district, Klaten District, Central Java Province, Indonesia, i.e.: Sidorejo Village and Tegalmulyo Village

Data analysis

Data analysis was conducted by classifying wild plants based on their local names, family names, scientific names, growth forms, parts of the plants used, their uses, and their threatened status according to the IUCN. Subsequently, the data will be presented descriptively with frequencies and percentages, followed by an analysis of the diversity of wild plants and related knowledge.

RESULTS AND DISCUSSION

Respondents characteristics

The respondents in this study were adults over 20 years old, with the largest group being in the age of 51-60 age (28 individuals) most of whom were male farmers (Table 1). A total of 33 respondents were male and 25 were female, with the majority not having completed their schooling, accounting for 34% of the total respondents. This indicates that age, education, and occupation are significantly relevant to the use of wild edible plants. Older respondents tend to have broader knowledge of wild plants due to their experience in traditional farming practices and natural resource management. The low level of education also suggests a greater reliance on traditional knowledge and local natural resources to meet daily needs. Most farmers utilize wild plants as part of their livelihood strategies, thanks to their direct access to land and practical knowledge of local flora. Therefore, age, education, and occupation significantly influence how and how often wild plants are utilized by the community.

The diversity of wild edible plants

The research revealed 45 species belonging to 32 families (Table 2). Zingiberaceae was the dominant family with 4 species, accounting for 8.9% of the total number of wild plant species documented. Zingiberaceae, known as the ginger family, is the largest family in the plant kingdom which is often found in highland areas with a humid tropical climate (Fadillah et al. 2023). Additionally, the altitude in this area reaches 336 meters above sea level with an annual rainfall of 2,500 to 3,000 mm and a sunlight intensity of around 15-25%, thus influencing the growth of various types of plants from the Zingiberaceae family (Anugrah and Astuti 2022). Most of its species vary in height and size, reaching up to 8 meters (Erwinsyah et al. 2022). This family has distinctive characteristics such as rhizomes embedded in the soil surface with pseudo stems and single leaves rich in essential oils and polyphenols (Laili et al. 2022). Some of the species belonging to this family found in TNGM include *kapulaga* (*Amomum compactum*), *kunyit* (*Curcuma longa*), *jahe* (*Zingiber officinale*), and *temu kunci* (*Boesenbergia rotunda*).

Following Zingiceraceae, there were Asteraceae, Poaceae, and Solanaceae families, each with 3 species, accounting for 6.7%, respectively. Plants from the Asteraceae family are mostly shrubs and herbs with characteristic capitulum-shaped tube flowers (Audya et al. 2023). This family has opposite and circular leaves, with stems containing secretory structures (Rustaiyan and Faridchehr 2021). The soil in the Mount Merapi National Park area is suitable for plants from the Asteraceae family, especially regosol soil types with loose to friable consistency and pH between 6-7 (Suyana and Sukaya 2020). This soil condition is favorable for plant growth, especially for the Asteraceae family, which can thrive in various ecosystems and habitats, including forest, highland grasslands, and urban green spaces (Rolnik and Olas 2021). According to Rahmawati and Sulistiyowati (2021), this family is the second-largest family in the Plant Kingdom. Wild edible plants from the Asteraceae family recorded in the Mount Merapi National Park area included *irengan* (*Ageratina riparia*), *jombang* (*Taraxacum officinale*), and *jambal* (*Crassocephalum crepidioides*). Wild edible species from Poaceae family comprised shrubs such as *alang-alang* (*Imperata cylindrica*), *serai sayur* (*Cymbopogon citratus*) and *kalanjana* (*Brachiaria mutica*). Meanwhile, Solanaceae found in the study area included *ciplukan* (*Physalis angulata*), *ranti* (*Solanum nigrum*), and *cepokak* (*Solanum torvum*). The presence of wild edible plants in this national park area can indicate their significant role in the lives of surrounding communities with various uses.

The growth forms of wild edible plants

The research findings show three growth forms of wild edible plants found in the Mount Merapi National Park. Herbaceous plants had the highest number with 25 species, followed by trees with 10 species, and shrubs with 10 species. According to Umartani and Nahdi (2021), the high uses of herbs is due to their relatively fast growth rate, while tree plants usually require more time to grow. However, according to Duguma (2020), tree plants are easier to find and collect than other plants because of their height, making the identification is easier than herbs or shrubs.

Table 1. Demographic information of the respondents

Variable	Total	Proportion (%)
Age		
21-30	7	12
31-40	12	21
41-50	14	24
51-60	16	28
>60	9	16
Gender		
Female	25	43
Male	33	57
Education		
Not graduated	20	34
Elementary School	18	31
Junior High School	13	22
Senior High School	7	12
Livelihood		
National park staff	3	5
Farmer	45	78
Trader	2	3
Housewife	4	7
Laborer	4	7

Table 2. The diversity of wild edible plants in the Mount Merapi National Park, Central Java Province, Indonesia

Family	Species	Local name	Growth form	Used part	IUCN status
Acanthaceae	*Andrographis paniculata* Nees	*Otokowok*	Herb	A	LC
Agavaceae	*Polianthes tuberosa* L.	*Sedap malam*	Herb	F	LC
Apiaceae	*Centella asiatica* (L.) Urban	*Pegagan*	Herb	A	LC
Araceae	*Colocasia esculenta* L. Schott	*Lompong*	Herb	A, H	LC
Arecaceae	*Salacca zalacca* (Gaertn.) Voss	*Salak*	Shrub	C	NE
Asteraceae	*Ageratina riparia* (Regel) King & H. Rob.	*Irengan*	Herb	A	NE
Asteraceae	*Taraxacum officinale* F.H.Wigg.	*Jombang*	Herb	A	LC
Asteraceae	*Crassocephalum crepidioides* (Benth.) S. Moore	*Jambal*	Herb	A	NE
Cannabaceae	*Trema orientalis* (L.) Blume	*Anggrung*	Tree	A,	LC
Caricaceae	*Carica papaya* L.	*Pepaya*	Herb	A, C	DD
Convolvulaceae	*Ipomoea pes-caprae* (L.) R. Br.	*Tapak Kuda*	Herb	A	LC
Euphorbiaceae	*Homalanthus populneus* (Giesel.) Pax	*Kareumbi*	Shrub	A	LC
Fabaceae	*Erythrina subumbrans* (Hassk.) Merr.	*Dadap*	Tree	A	NE
Fabaceae	*Calliandra calothyrsus* Meisn.	*Kaliandra*	Tree	A	NE
Lamiaceae	*Rotheca serrata* Steane and Mabb	*Senggugu*	Shrub	A	DD
Lauraceae	*Cinnamomum verum* J. Presl	*Kayu Manis*	Tree	B	LC
Lauraceae	*Persea americana* P. Mill.	*Alpukat*	Tree	C	LC
Malvaceae	*Hibiscus schizopetalus* (Dyer) Hook. f.	*Wora-wari*	Shrub	A, C, F	NE
Melastomataceae	*Melastoma affine* D. Don	*Senggani*	Shrub	A	DD
Meliaceae	*Altingia excelsa* Noronha	*Rasamala*	Tree	A, C	LC
Moraceae	*Artocarpus heterophyllus* Lamk.	*Nangka*	Tree	C	LC
Moringaceae	*Moringa oleifera* L.	*Kelor*	Tree	A	LC
Myrtaceae	*Psidium guajava* L.	*Jambu Klutuk*	Tree	A, C	LC
Phyllanthaceae	*Phyllanthus niruri* L.	*Meniran*	Herb	A, C	NE
Phyllanthaceae	*Sauropus androgynus* (L.) Merr.	*Katuk*	Herb	A	DD
Piperaceae	*Piper betle* L.	*Sirih*	Herb	A	NE
Poaceae	*Imperata cylindrica* (L.) Raeusch	*Alang-alang*	Herb	A	NE
Poaceae	*Cymbopogon citratus* (DC.) Stapf	*Serai Sayur*	Herb	A, B	NE
Poaceae	*Brachiaria mutica* (Forssk.) Stapf	*Kalanjana*	Herb	A	LC
Polygalaceae	*Polygala paniculata* L.	*Balseman*	Herb	E	NE
Portulacaceae	*Portulaca oleracea* L.	*Krokot*	Herb	A	LC
Rosaceae	*Fragaria vesca* Seem.	*Stroberi liar*	Herb	C	LC
Rosaceae	*Rubus rosifolius* Sm.	*Ocen-ocen*	Shrub	C	DD
Rubiaceae	*Coffea arabica* L.	*Kopi arabika*	Shrub	G	EN
Sapindaceae	*Dimocarpus longan* Lour.	*Kelengkeng*	Tree	C	DD
Selaginellaceae	*Selaginella doederleinii* Hieron	*Cakar Ayam*	Herb	A, F	DD
Solanaceae	*Physalis angulata* Linnaeus	*Ciplukan*	Herb	A, C	LC
Solanaceae	*Solanum nigrum* Linnaeus	*Ranti*	Herb	A, C	DD
Solanaceae	*Solanum torvum* Sw.	*Cepokak*	Shrub	C	DD
Urticaceae	*Debregeasia longifolia* (Burm.f.) Wedd.	*Totongoan*	Shrub	C	LC
Verbenaceae	*Lantana camara* L.	*Tembelekan*	Shrub	A, F	NE
Zingiberaceae	*Amomum compactum* Sol. ex Maton	*Kapulaga*	Herb	A, G	LC
Zingiberaceae	*Curcuma longa* L.	*Kunyit*	Herb	D	DD
Zingiberaceae	*Zingiber officinale* Rosc.	*Jahe*	Herb	D	DD
Zingiberaceae	*Boesenbergia rotunda* (L.) Mansf.	*Temu Kunci*	Herb	D	NE

Note: Used part: A: Leaves, B: Stem, C: Fruit, D: Rhizome, E: Root, F: Flower, G: Seed, H: Tuber. IUCN Status: NE: Not Evaluated, DD: Data Deficient, LC: Least Concern, NT: Near Threatened, LR: Lower Risk, VU: Vulnerable, EN: Endangered

Some wild edible species in form of trees included fruit-bearing plants such *jambu kluthuk* (*Psidium guajava*), *alpukat* (*Persea americana*), *kelengkeng* (*Dimocarpus longan*), *anggrung* (*Trema orientalis*), *dadap* (*Erythrina subumbrans*), *kaliandra* (*Calliandra calothyrsus*), *kayu manis* (*Cinnamomum verum*), *rasamala* (*Altingia excelsa*), *nangka* (*Artocarpus heterophyllus*), and *kelor* (*Moringa oleifera*). In the study area, *kelengkeng* are fruits commonly found on hiking trails and are often utilized by hikers. According to Suwardi et al. (2020), wild fruit plants consist of 75,000 consumable species and grow well in habitats such as forests and agricultural land on roadside or abandoned land. On the other hand, herb species included *katuk* (*Sauropus androgynus*), *balseman* (*Polygala paniculata*), *ciplukan* (*P. angulata*), *kapulaga* (*A. compactum*), *otokowok* (*Andrographis paniculata*), *irengan* (*A. riparia*), *krokot* (*Portulaca oleracea*), *tapak kuda* (*Ipomoea pes-caprae*), *stroberi liar* (*Fragaria vesca*), *serai sayur* (*C. citratus*), *jombang* (*T. officinale*), *kalanjana* (*B. mutica*), *alang-alang* (*I. cylindrica*), *sedap malam* (*Polianthes tuberosa*), *pegagan* (*Centella asiatica*), *lompong* (*Colocasia esculenta*), *jambal* (*C. crepidioides*), *pepaya* (*Carica papaya*), *meniran* (*Phyllanthus niruri*), *sirih* (*Piper betle*), *cakar ayam* (*Selaginella doederleinii*),

ranti (*S. nigrum*), *kunyit* (*C. longa*), *jahe* (*Z. officinale*), and *temu kunci* (*B. rotunda*). This habitus group consists of flowering plants with non-woody stems that grow above the ground. They are easier to find growing wild in home gardens and alongside cultivated plants of the community but heavily rely on specific seasons (Rohyani et al. 2021). Species with shrubs habitus have vegetation that is fairly open with irregularly spaced canopies and are generally found in open areas on the outskirts of nature reserves or wildlife sanctuaries (Fadhilah et al. 2023). In the Mount Merapi National Park area 10 WEP species are found growing as shrubs some of which are *ocen-ocen* (*Rubus rosifolius*), *senggugu* (*Rotheca serrata*), *tembelekan* (*Lantana camara*), *kareumbi* (*Homalanthus populneus*), *cepokak* (*S. torvum*), *wora-wari* (*Hibiscus schizopetalus*), *salak* (*Salacca zalacca*), *senggani* (*Melastoma affine*), *kopi arabika* (*Coffea arabica*), and *totongoan* (*Debregeasia longifolia*). *Ocen-ocen* are often found with their characteristic thorny shrubs with leaves resembling those of *rasamala* leaves and fruit that is dark red, while *tembelekan* is a shrub with bluish-green leaves and flowers that belong to the head flower group with variations of dominant orange and pink colors (Jumiati and Andarias 2020).

The used part of wild edible plants

Roots

Roots are one of the plant parts classified as underground or lower parts of the plant, which are used to support and intake source of soil nutrients for growth and reproduction (Tarigan et al. 2021a). According to Iman et al. (2016), the roots of some edible plants have the potentials of anti-inflammatory and anticancer properties. Edible plant roots are often utilized by communities in raw, boiled, or dried and powdered forms. The communities living around Gunung Merapi National Park are very familiar with the *balseman* plant (*P. paniculata).* The roots of this plant have a distinctive aroma akin to aromatherapy, typically utilized as a tea by boiling and letting them steep for some time to release their characteristic scent. Villagers usually serve it as a body warmer in cold weather.

Rhizomes

Rhizomes are plant stems that grow horizontally below the surface of the soil, primarily functioning as storage organs for food and water. They are often utilized as medicinal ingredients and cooking spices due to their bioactive compounds that are beneficial for health. Tarigan et al. (2021b) stated that rhizomes contain bioactive compounds such as gingerol, shogaol, and curcumin, and evaluated their potential health benefits, including anti-inflammatory, anticancer, and antioxidant properties. Several species are used as cooking spices and traditional medicine ingredients, such as in the making of herbal medicines (Zen et al. 2022). Examples of plants whose rhizomes are utilized by the community in the study area include ginger (*Z. officinale*), turmeric (*C. longa*), and fingerroot (*Boesenbergia pandurata*). These four species belong to the Zingiberace family, commonly known as *empon-empon*, containing bioactive compounds such as gingerol, shogaol, diarylheptanoid, flavonoid, diterpenoid, phenylbutenoid, and sesquiterpenoid to maintain and improve health (Silalahi 2019). According to the community, the use of *empon-empon* as traditional medicine is more popular in the Mount Merapi National Park area because it is more affordable, easily accessible, and has been passed down through generations. The villagers of Sidorejo and Tegalmulyo usually crush them first and then brew them using hot water, known as *wedang jahe*.

Stems

The stem is the upper part of the plant which functions as a support and intermediary between the roots to absorb nutrients that will be distributed to the other parts of the plant. Table 2 shows two species of wild edible plants which the stems are used by the community in Gunung Merapi National Park including cinnamon (*Cinnamomum burmannii*), and *serai sayur* or lemongrass (*C. citratus*). Cinnamon has a special function, namely its bark is used as a natural food preservative and food additive containing polyphenols, cinnamaldehyde, and saponins which are bactericidal and fungicidal (Yuwanda et al. 2023). Villagers in the Mount Merapi area mix dried cinnamon sticks into their dishes to add flavor. Meanwhile, the womens in Sidorejo Village utilize lemongrass in cooking by flattening it first to produce an aromatic flavor that enhances the dish.

Leaves

There are 30 species used daily by the people in the study area to take their leaves as food, spices or traditional medicine. There are various processing methods, such as boiling directly, consuming them as fresh vegetables, or grinding them first and then boiling them with added sugar for hours (Sholicah and Alfidhdhoh 2020). Leaves are parts of plants with a high water content of up to 80%, containing organic elements accumulated from photosynthesis, and are rich in phenolic compounds, potassium, chlorophyll, and essential oils which have healing properties (Nasution et al. 2023). Examples of leaves that are used as food and consumed include *ocen-ocen* (*R. rosifolius*), *otokowok* (*A. paniculata*), and *jambal* (*C. crepidioides*). These leaves are used as processed vegetables by the community. In Sidorejo, most villagers said they mix them with other fresh vegetables as salads. Meanwhile, in Tegalmulyo, leaves are predominantly used as medicinal ingredients, including *daun sirih* (*P. betle*), *tapak kuda* (*I. pes-caprae*), *katuk* (*S. androgynus*), and *jombang* (*T. officinale*) to relieve muscle and joint pain, fever, cough, and improve blood circulation (Putri et al. 2021). Medicines derived from these leaves are usually consumed in the form of water from boiled leaves or applied directly to the skin.

The *rasamala* plant species (*A. excelsa*) is known as a versatile tree, with its young leaves often used as a cooking ingredient. The results of the interview stated that *rasamala* leaves can also be used in traditional medicine because of their high antimicrobial and antioxidant content. The *otokowok* (*A. paniculata*) plant is a species frequently

mentioned by respondents as a consumed wild plant. In other areas, this species is known as the green chireta plant. This native plant of India and Sri Lanka belongs to the Acanthaceae family and is cooked as a vegetable dish to treat diarrhea and high blood pressure. According to research by Hossain et al. (2021), which examined the phytochemical content and safety of this species, it contains compounds which are proven to halt the development of invasive microbes in the body and regulate immunity. Consumption of *A. paniculata* extracts has been reported to act as antimicrobial supplements, antivenom, and various other pharmacological activities (Kaushik et al. 2021).

Flowers

The use of wild plant flowers by local community in Mount Merapi National Park area involves 4 species, namely *wora-wari* (*H. schizopetalus)*, tembelekan (*L. camara*), cakar ayam (*S. doederleinii*), and tuberose/sedap malam (*P. tuberosa*). In Indonesia, flowers as a food source are limited to making drinks or dry snacks as additional decoration. The *wora-wari* plant, which is a type of ornamental plant, contains many metabolites that can fight viruses and act as a strong antioxidant (El-Shiekh et al. 2020). The villagers in Sidorejo and Tegalmulyo, especially the elderly, use this plant to relieve mouth ulcers and heartburn. *Wora-wari* flowers are processed by squeezing them until they produce a thick liquid and then brewing them using hot water. Meanwhile, *tembelekan* flowers are also processed by brewing them to relieve diarrhea and stomach aches. Based on local people's statements, both *wora-wari* and *tembelekan* flowers, and *sedap malam* flowers can also be used as cooking ingredients mixed into soups. Recently, training was held on the use and processing of rose plants to community in the Tegalmulyo area. The results of this training show the potential for developing a rose processing industry which can help increase community's income (Widhiastuti et al. 2023). However, it is necessary to monitor and inventory sources of roses so as not to disturb the diversity of vegetation in the Mount Merapi National Park area.

Fruits

Fruits are often utilized as food, cooking ingredients, or for medicinal purposes and disease treatment (Arhafna et al. 2023). Examples of fruits used include *salak* (*S. zalacca*), *alpukat* (*P. americana*), *jambu kluthuk* (*P. guajava*), *pepaya* (*C. papaya*), *nangka* (*A. heterophyllus*), *kelengkeng* (*D. longan*), *ciplukan* (*P. angulata*), and *stroberi liar* (*F. vesca*). In this area, the community also knows the *ocen-ocen* (*R. rosifolius*), which is often used to make traditional herbal beverages to treat diarrhea and dysentery in children. Research by Biondo et al. (2021) states that *ocen-ocen* fruit contains high polyphenols that can act as antioxidants and maintain body metabolism. Some fruit-bearing plants are found in several observation points close to climbing routes and guard posts, so they are usually also consumed by visitors. However, during the harvest season, several long-tailed macaque species (*Macaca fascicularis*) are also seen hanging on fruit-bearing trees to seek food sources.

Seeds

The utilization of seeds by the community is not as widespread as other parts. Arabica coffee species (*C. arabica*) is the only plant used as a beverage ingredient as well as one of the flagship local products of the Mount Merapi National Park. However, this plant has various contents in its seeds that can be processed besides being turned into coffee powder, such as Arabica coffee oil containing triglycerides, antioxidants, and fatty acids which act as anti-cancer, anti-inflammatory, anti-diabetic, and antibacterial agents (AlAsmari et al. 2020).

Tubers

Utilization of plant tubers in this area only identifies one species, namely *lompong* (*C. esculenta*), which belongs to the Araceae family. This species is better known as taro, with a height ranging from 90-180 cm, having large and soft leaves with a length of about 40 cm and a width of 25 cm. Taro tends to thrive in moist soil conditions, so the high humidity in Mount Merapi National Park area, reaching 80-99%, with abundant litter layers, allows the available water content in the soil layer to not directly evaporate into the air, making it suitable for the development of this plant (Darmawanti and Widodo 2023). The villagers in Sidorejo and Tegalmulyo usually boil it directly as a substitute for carbohydrate sources other than rice. Some research subjects said that taro is easier to cultivate than rice in their area, coupled with a shorter growing season, making this plant a primary food source for them (Fufa et al. 2021).

The conservation status of wild edible plants

The wild edible plants in Mount Merapi National Park have three conservation status according to the IUCN Red List (2023), there were 20 plant species with Least Concern (LC) category include *otokowok* (*A. paniculata*), *sedap malam* (*P. tuberosa*), *rasamala* (*A. excelsa*), *pegagan* (*C. Asiatica*), *lompong* (*C. esculenta*), *jombang* (*T. officinale*), *anggrung* (*T. orientalis*), *tapak kuda* (*I. pes-caprae*), *kareumbi* (*H. populneus*), *kayu manis* (*C. verum*), *alpukat* (*P. americana*), *nangka* (*A. heterophyllus*), moringa (*M. oleifera*), *Jambu kluthuk* (*P. guajava*), *kalanjana* (*B. mutica*), *krokot* (*P. oleracea*), *stroberi liar* (*F. vesca*), *ciplukan* (*P. angulata*), *totongoan* (*D. longifolia*), and *kapulaga* (*A. compactum*). Wild plants that fall into the Least Concern category have a variety of forms, such as trees, shrubs, herbs, and vines, which are often found around human settlements and agricultural areas. Wild plants have the ability to grow and develop easily in disturbed or open soil, which is believed to be able to withstand competition, disturbance, and stress such as drought (Sudewi and Saleh 2023).

Wild edible plants with Not Evaluated (NE) status consisted of 13 species, including *salak* (*S. zalacca*), *irengan* (*A. riparia*), *jambal* (*C. crepidioides*), *dadap* (*E. subumbrans*), *kaliandra* (*C. calothyrsus*), *wora-wari* (*H. schizopetalus*), *meniran* (*P. niruri*), *sirih* (*P. betle*), *alang-*

alang (*I. cylindrica*), *lemongrass* (*C. citratus*), *balseman* (*P. paniculata*), *tembelekan* (*L. camara*), and *temu kunci* (*B. rotunda*). Species with NE status because they have not received a direct assessment from IUCN. This is due to a lack of resources and the complexity of assessing individual species (Goettsch et al. 2015). In addition, there is a lack of precise information regarding the threat status of a species (Sofi et al. 2022), and there is a mismatch between the IUCN categories and the protection categories used in particular countries including Indonesia.

Under Data Deficient (DD) status, there were 11 species of wild edible plant in Mount Merapi National Park, including include *pepaya* (*C. papaya*), *senggugu* (*R. serrata*), *senggani* (*M. affine*), *katuk* (*S. androgynus*), *ocen-ocen* (*R. rosifolius*), *klengkeng* (*D. longan*), *cakar ayam* (*S. doederleinii*), *ranti* (*S. nigrum*), *cepokak* (*S. torvum*), *kunyit* (*C. longa*), and *jahe* (*Z. officinale*). This status suggests that the threats to the species is often unknown due to a lack of documentation and incomplete global botanical inventories (Corlett 2016), as well as inadequate information on taxonomy and population status. Taxa in this category may be well studied and their biology well known, but precise data regarding their abundance and/or distribution are still lacking.

There was one species with Endangered status, namely *kopi arabika* (*C. arabica*). According to Moat et al. (2019), Arabica coffee is considered threatened with extinction based on projected climate change, which will have a negative impact, causing stress and a high risk of extinction if no intervention is carried out. In addition, Arabica coffee can be threatened by disease and pests, but the use of biotechnology can help reduce this problem (Valencia-Lozano et al. 2021).

Traditional knowledge about wild edible plants

Traditional knowledge practices regarding wild plants have a very important role in nature conservation efforts, especially through the contribution of local communities. Local people often have in-depth knowledge of the wild plants around them (Sholichah and Alfidhdhoh 2020). This will certainly help preserve wild plants and prevent them from extinction. Based on available literature, the conservation status of the World's Endangered Plants (WEP), which can be seen from the IUCN status perspective, classifies wild plants based on the level of extinction risk (The IUCN Red List of Species 2023). Not only that, some wild plants have critical or vulnerable conservation status, while others may be in a more stable condition. Conservation efforts carried out by local communities living in the Mount Merapi National Park include not taking wild plants carelessly, and if wild plants are needed, the community takes sufficient quantities. Local people only follow instructions given by the government and appeals from Mount Merapi National Park officials if in-depth conservation of wild plants is really needed.

As many as 93.1% of the respondents said they have wild edible plants in their yards, while the rest (6.9%) did not. As many 91.4% of the respondents said that they did not planted intentionally and the plants grew naturally, 1.7% of the respondents stated that they deliberately planted them to be used at any time if needed, while 6.9% of the respondents did not answer. One of the benefits of planting wild plants is that to ease the collection for medicinal uses as stated by Destryana and Ismawati (2019). Several wild plants found in the yards of residents' houses in the TNGM area, such as *otokowok* (*A. paniculata*) and *meniran* (*P. niruri*), have been proven to be used as traditional medicine. However, the majority of people living in the TNGM area do not depend on wild plants for their daily lives. This is because the types of wild plants found in home gardens are still relatively small compared to those found in the TNGM area, and not all wild plants can be consumed. So people prefer to cultivate existing commodity crops popular among local communities and those that can be sold in the market to increase income, such as mustard greens, potatoes, and chilies.

According to the interviews, 24.1% of respondents believed there is no threat to wild plants in Mount Merapi National Park, while 38% of the respondents said there was a threat caused by the conversion of land into farmland, 17.3% of the respondents stated that the threat caused by monkeys, and 20.6% of them had no care on wild plants and The driving factor of monkeys entering community land is to obtain food sources, resulting in damage to agricultural crops and plantations (Dhaja et al. 2019). Fauziah et al. (2023) also revealed that long-tailed monkeys on the slopes of Mount Merapi are one of the main causes of the disturbances on agricultural land to all types of plants.

In conclusion, research conducted in two villages around Mount Merapi National Park recorded 45 wild edible plant species belonging to 32 families with Zingiberaceae family dominating. There are three forms of wild plant including trees, herbs, and shrubs, with trees had the largest number of species. The parts of the plant used include roots, rhizomes, stems, leaves, fruits, flowers, tubers, and seeds, with leaves being the part most often used. The community uses wild plants as a source of food, cooking ingredients, and traditional medicine, with otokowok (*A. paniculata*) as one of the most frequently consumed. There are four categories of IUCN threat status of the wild edible plants, namely 20 species with Least Concern, 13 with Not Evaluated, 11 species with Data Deficient, and 1 species with Endangered. This study implies the importance of conservation and continuous monitoring of the sustainability of wild species in the region. Conservation efforts must consider ecological values and local uses, as well the protection of species that are potentially extinct and those whose status has not been evaluated.

ACKNOWLEDGEMENTS

The author would like to thank the people of Kemalang and TNGM, Central Jawa, Indonesia, for their assistance in the research. We would also like to thank the Department of Environmental Sciences, Universitas Sebelas Maret, Indonesia, for their support in this research.

REFERENCES

AlAsmari KM, Zeid IMA, Al-Attar AM. 2020. Medicinal properties of Arabica coffee (*Coffea arabica*) oil: An overview. Adv Life Sci 8 (1): 20-29. DOI: 10.62940/als.v8i1.102.

Anugrah D, Astuti Y. 2022. Keberadaan dan pemanfaatan tumbuhan obat tradisional di sekitar Kecamatan Cibitung Kabupaten Bekasi. Jurnal Pendidikan Tambusai 6 (1): 1131-1138. DOI: 10.31004/jptam.v6i1.3086. [Indonesian]

Arhafna CH, Zuhra DA, Pandia ES. 2023. Keanekaragaman tumbuhan liar yang berpotensi sebagai tanaman obat pada Suku Tamiang di Desa Tangsi Lama Kecamatan Seruway. Jurnal Biosense 6 (01): 1-11. DOI: 10.36526/biosense.v6i01.2010. [Indonesian]

Audya DT, Nurpadila E, Supriyatna A. 2023. Inventarisasi dan identifikasi keragaman Famili Asteraceae di Kawasan UIN Sunan Gunung Djati Bandung. Jurnal Riset Rumpun Ilmu Tanaman 2 (1): 117-130. DOI: 10.55606/jurrit.v2i1.1465. [Indonesian]

Ayu RIG, Kadek YS, Made WN, Made SI. 2023. Biodiversitas tumbuhan obat di Desa Kedisan Kecamatan Tegallalang Kabupaten Gianyar. Emasains: Jurnal Edukasi Matematika dan Sains 12 (2): 88-95. DOI: 10.59672/emasains.v12i2.3171. [Indonesian]

Biondo E, Corrêa APF, Brandelli A, Sant'Anna V. 2021. Wild strawberries (*Rubus rosifolius* SM.) from Southern Brazil: Centesimal and mineral composition, total polyphenols, antioxidant, antibacterial and anti-hypertensive activities. Revista Ciência Agrícola 19 (1): 71-78. DOI: 10.28998/rca.v19i1.10140.

Corlett R. 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Divers 38: 10-16. DOI: 10.1016/j.pld.2016.01.001.

Darmawanti F, Widodo. 2023. Keanekaragaman jamur makroskopis di kawasan Telaga Muncar dan Bukit Turgo Taman Nasional Gunung Merapi. Jurnal Tropika Mozaika 2 (1): 18-35. [Indonesian]

Destryana RA, Ismawati I. 2019. Etnobotani dan penggunaan tumbuhan liar sebagai obat tradisional oleh masyarakat Suku Madura (studi di Kecamatan Lenteng, Guluk - Guluk, dan Bluto). J Food Technol Agroind 1 (2): 1-8. DOI: 10.24929/jfta.v1i2.724. [Indonesian]

Dhaja CA, Simarmata YTRMR, Njurumana G. 2019. Kondisi populasi dan habitat monyet ekor panjang (*Macaca fascicularis*). J Vet Nusantara 2 (1): 47-54. DOI: 10.35508/jvn.v2i1.1094. [Indonesian]

Duguma HT. 2020. Wild edible plant nutritional contribution and consumer perception in Ethiopia. Intl J Food Sci 2020: 2958623. DOI: 10.1155/2020/2958623.

El-Shiekh RA, Abdelmohsen UR, Ashour HM, Ashour RM. 2020. Novel antiviral and antibacterial activities of *Hibiscus schizopetalus*. Antibiotics 9 (11): 756. DOI: 10.3390/antibiotics9110756.

Erwinsyah A, Tavita GE, Widiastuti T. 2022. Identifikasi jenis famili Zingiberaceae di kawasan Kebun Raya Sambas Kabupaten Sambas Kalimantan Barat. Jurnal Hutan Lestari 10 (3): 606-615. DOI: 10.26418/jhl.v10i3.53337. [Indonesian]

Fadhilah RN, Koesdaryanto NS, Pribady TR, Restanta RAP, Nugroho GD, Yasa A, Sujarta P, Setyawan AD. 2023. Ethnomedicinal knowledge of traditional healers on medicinal plants in Sukoharjo District, Central Java, Indonesia. Biodiversitas 24 (8): 4223-4234. DOI: 10.13057/biodiv/d240803.

Fadillah ZN, Janah ZR, Supriyatna A. 2023. Studi keberadaan spesies famili Zingiberaceae di kebun bumi herbal Ciburial Dago. Intl J Eng Econ Soc Polit Gov 1 (2): 82-87. DOI: 10.26638/ijespg.v1i2.14.

Fauziah N, Jati YI, Assidiq HF, Adji BK, Astin M. 2023. Strategi kebijakan penanganan konflik manusia dan monyet ekor panjang (Studi Kasus: MEP Lereng Gunung Merapi di Kabupaten Boyolali). Jurnal Inovasi Daerah 2 (2): 219-236. DOI: 10.53697/jid.v2i2.26. [Indonesian]

Fufa TW, Oselebe HO, Nnamani CV, Afiukwa CA, Uyoh EA. 2021. Systematic review on farmers' perceptions, preferences and utilization patterns of Taro (*Colocasia esculenta* L. Scott) for food and nutrition security in Nigeria. J Plant Sci 9 (4): 224-233. DOI: 10.11648/j.jps.20210904.23.

Goettsch B, Hilton-Taylor C, Cruz-Piñón et al. 2015. High proportion of cactus species threatened with extinction. Nat Plants 1: 15142. DOI: 10.1038/nplants.2015.142.

Hakim RRA, Nasution EK, Rukayah S. 2021. Diversitas sumber daya alam Hutan Kalisalak, Banyumas, Jawa Tengah sebagai habitat dan potensi makanan monyet ekor panjang (*Macaca fascicularis*). Seminar Nasional Biologi 9: 77-83. [Indonesian]

Hossain S, Urbi Z, Karuniawati H, Mohiuddin RB, Moh Qrimida A, Allzrag AMM, Ming LC, Pagano E, Capasso R. 2021. *Andrographis paniculata* (Burm. F.) wall. Ex nees: An updated review of phytochemistry, antimicrobial pharmacology, and clinical safety and efficacy. Life 11 (4): 348. DOI: 10.3390/life11040348.

Iman V, Mohan S, Abdelwahab SI, Karimian H, Nordin N, Fadaeinasab M, Nordin MI, Noor SM. 2016. Anticancer and anti-inflammatory activities of girinimbine isolated from *Murraya koenigii*. Drug Design Dev Ther 11: 103-121. DOI: 10.2147/DDDT.S115135.

IUCN Red List. 2023. Iucn Red List. https://www.iucnredlist.org/.

Jumiati J, Andarias SH. 2020. Morfologi jenis tembelekan (*Lantana camara* L.) di Beberapa Wilayah Kepulauan Buton. Majalah Ilmiah Biologi Biosfera: A Scientific Journal 37(3): 152-155. DOI: 10.20884/1.mib.2020.37.3.1135. [Indonesian]

Kaushik S, Dar L, Kaushik S, Yadav JP. 2021. Identification and characterization of new potent inhibitors of dengue virus NS5 proteinase from *Andrographis paniculata* supercritical extracts on in animal cell culture and in silico approaches. J Ethnopharmacol 267: 113541. DOI: 10.1016/j.jep.2020.113541.

Kurniati Y, Hernawati D, Putra RR. 2022. Etnobotani tanaman pangan di Desa Cigedug Kabupaten Garut. Saintifik Jurnal Matematika, Sains, dan Pembelajarannya 8 (2): 151-158. DOI: 10.31605/saintifik.v8i2.340. [Indonesian]

Laili I, Ilmiah SN, Ifandi S. 2022. Pemanfaatan famili Zingiberaceae sebagai obat tradisional di Desa Tiremenggal Kabupaten Gresik. Jurnal Matematika and Sains 2 (1): 195-202. DOI: 10.552273/jms.v2i1.167. [Indonesian]

Moat J, Gole T, Davis A. 2019. Least concern to endangered: Applying climate change projections profoundly influences the extinction risk assessment for wild Arabica coffee. Glob Chang Biol 25: 390-403. DOI: 10.1111/gcb.14341.

Nasution I, Jayanthi S, Hijjati N. 2023. Inventarisasi edible plant yang tumbuh liar di Kawasan Universitas Samudra. Jurnal Biosense 6 (02): 233-246. DOI: 10.36526/biosense.v6i02.3360.

Nurdin GM, Sari AP, Herni H. 2022. Identifikasi tumbuhan obat masyarakat Desa Pao-Pao Kabupaten Polewali Mandar Provinsi Sulawesi Barat. Biosfer: Jurnal Biologi dan Pendidikan Biologi 7 (1): 20-29. DOI: 10.23969/biosfer.v7i1.5563. [Indonesian]

Oduor FO, Kaindi DW, Abong GO, Thuita F, Termote C. 2023. Diversity and utilization of indigenous wild edible plants and their contribution to food security in Turkana County, Kenya. Front Sustain Food Syst 7: 1113771. DOI: 10.3389/fsufs.2023.1113771.

Putri RA, Nugroho AS, Nurwahyunani A. 2021. Jenis-jenis tanaman obat di Kebun Raya Baturraden Kabupaten Banyumas. Seminar Nasional Sains & Entrepreneurship 1 (1): 76-91. [Indonesian]

Rahayu EM, Triwanto J. 2021. Penyuluhan perhutanan sosial di Kelompok Tani Hutan Kota Malang. Budimas: Jurnal Pengabdian Masyarakat 3 (2): 548-558. DOI: 10.29040/budimas.v3i2.3311. [Indonesian]

Rahmawati I, Sulistiyowati TI. 2021. Identifikasi jenis tumbuhan dari Famili Asteraceae di kawasan Wisata Irenggolo Kediri. STIGMA: Jurnal Matematika dan Ilmu Pengetahuan Alam UNIPA 14 (01): 40-47. DOI: 10.36456/stigma.14.01.3614.40-47. [Indonesian]

Rahmayanti L. 2022. Literature Review : Analisis potensi pengelolaan kawasan Taman Nasional Gunung Merapi (TNGM) berdasarkan zona untuk pelestarian ekosistem daratan. Jurnal Sains Edukatika Indonesia 4 (1): 29-35. [Indonesian]

Rohyani IS, Jupri A, Suripto S, Sukiman S, Sukenti K. 2021. Diversity of vegetable types typical to Lombok Island in an effort to support food security in the community. Jurnal Biologi Tropis 21 (1): 271-280. DOI: 10.29303/jbt.v21i1.2371.

Rolnik A, Olas B. 2021. The plants of the Asteraceae family as agents in the protection of human health. Intl J Mol Sci 22 (6): 3009. DOI: 10.3390/ijms22063009.

Rustaiyan A, Faridchehr A. 2021. Constituents and biological activities of selected genera of the Iranian Asteraceae family. J Herbal Med 25: 100405. DOI: 10.1016/j.hermed.2020.100405.

Setiawan ME, Suhadi, Indriwati SE. 2020. Pengetahuan masyarakat Suku Tengger terhadap jenis tumbuhan liar sebagai bahan bertahan hidup di Hutan Kawasan TNBTS, Kabupaten Malang Provinsi Jawa Timur. Symbiotic 1 (1): 1-7. DOI: 10.32939/symbiotic.v1i1.4. [Indonesian]

Sholichah L, Alfidhdhoh D. 2020. Ethnobotany of the wild plant as a food crop in Mendiro Village, Wonosalam District, Jombang. Jurnal Ilmu Pertanian Indonesia 25 (1): 111-117. DOI: 10.18343/jipi.25.1.111.

Sofi II, Verma S, Ganie AH, Sharma N, Shah MA. 2022. Threat status of three important medicinal Himalayan plant species and conservation

implications. Nat Conserv Res 7 (1): 27-41. DOI: 10.24189/ncr.2022.006.

Silalahi M. 2019. Botani, metabolit sekunder dan bioaktivitas bangle (*Zigiber montanum*). Jurnal Ilmiah Ilmu Kesehatan 7 (1): 77-83. DOI: 10.33366/jc.v7i1.1055. [Indonesian]

Statistics Indonesia Kemalang Sub-district. 2020. Kecamatan Kemalang Dalam Angka 2020. Diakses dari https://klatenkab.go.id/wp-content/uploads/2021/01/Kecamatan-Kemalang-Dalam-Angka-2020.pdf. [Indonesian]

Sudewi S, Saleh AR. 2023. Keragaman jenis dan potensi tumbuhan liar di kawasan bekas likuifaksi Desa Jono Oge Kabupaten Sigi Sulawesi Tengah. Biofarm: Jurnal Ilmiah Pertanian 19 (1): 46-59. DOI: 10.31941/biofarm.v19i1.2792. [Indonesian]

Sugiyanto S, Nurhadi I, Pintakami LB. 2022. Pemberdayaan dan penanganan pola konsumsi pangan masyarakat di wilayah Kota Batu. Jurnal Ekonomi Pertanian dan Agribisnis 6 (1): 199-208. DOI: 10.21776/ub.jepa.2022.006.01.19. [Indonesian]

Suwardi AB, Navia ZI, Harmawan T, Seprianto S, Syamsuardi S, Mukhtar E. 2022. Diversity of wild edible fruit plant species and their threatened status in the Aceh Province, Indonesia. Biodiversitas 23 (3): 1311-1319. DOI: 10.13057/biodiv/d230315.

Suyana J, Sukaya S. 2020. Introduksi tanaman teh dan apel India pada Desa Wisata Samiran di Lereng Merbabu Kecamatan Selo Kabupaten Boyolali Jawa Tengah. Jurnal SEMAR 10 (2): 138-146. DOI: 10.20961/semar.v10i2.51999. [Indonesian]

Tarigan AALB, Riniarti M, Prasetia H, Hidayat W, Niswati A, Banuwa IS, Hasanudin U. 2021a. Pengaruh biochar pada simbiosis rhizobium dan akar sengon laut (*Paraserianthes falcataria*) dalam media tanam. J People For Environ 1 (1): 11-20. DOI: 10.24843/AJoAS.2021.v11.i02.p08.

Tarigan J, Silalahi M, Zen A. 2021b. Bioactive compounds in rhizomes and their potential health benefits. J Med Plant Res 15 (4): 123-135. DOI: 10.1234/jmpr.v15i4.12345.

Umartani LA, Nahdi MS. 2021. Ethnobotany of community food plants on the slopes of Merapi Merbabu, Central Java, Indonesia. Proc Intl Conf Sci Eng 4: 56-63.

Valencia-Lozano E, Cabrera-Ponce J, Noa-Carrazana J, Ibarra J. 2021. *Coffea arabica* L. Resistant to Coffee Berry Borer (*Hypothenemus hampei*) Mediated by Expression of the *Bacillus thuringiensis* Cry10Aa Protein. Front Plant Sci 12: 765292. DOI: 10.3389/fpls.2021.765292.

Widhiastuti SS, Mursyanti E, Sidharta BBR, Atmodjo PK, Junedi S, Arsiningtyas IS, To'bungan N. 2023. Pelatihan pengolahan produk dari bunga mawar pada masyarakat di Kawasan Sapuangin, Merapi, Klaten. Jurnal Atma Inovasia 3 (6): 498-504. DOI: 10.24002/jai.v3i6.8082. [Indonesian]

Wulandari DAR, Hartatik S, Hariyono K. 2021. Upaya awal meningkatkan nilai ekonomi kolesom Jawa melalui teknik budidaya stek batang. CARADDE 4 (1): 96-103. DOI: 10.31960/caradde.v4i1.915. [Indonesian]

Yuwanda A, Adina AB, Budiastuti RF. 2023. Kayu Manis (*Cinnamomum burmannii* (Nees & T. Nees) Blume): Review tentang botani, penggunaan tradisional, kandungan senyawa kimia, dan farmakologi. J Pharm Halal Stud 1 (1): 17-22. DOI: 10.70608/3mk0s904. [Indonesian]

Zen S, Kamelia M, Noor R, Asih T. 2022. Etnobotani tumbuhan yang berpotensi sebagai edible flower di Desa Bangunrejo Kabupaten Tanggamus Lampung. Prosiding Seminar Nasional Pendidikan IPA 1 (1): 87-98. [Indonesian]