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Diversity of wild edible fruits in the agroforestry area of Cigalontang Village, Tasikmalaya, Indonesia

NENDEN NUR SAYYIDAH KULSUM, RATNA SUSANDARINI♥

Faculty of Biology, Universitas Gadjah Mada. Jl. Teknika Selatan, Sekip Utara, Sleman 55281, Yogyakarta, Indonesia. Tel./fax.: +62-274-580839, ♥email: ratna-susandarini@ugm.ac.id

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Abstract. *Kulsum NNS, Susandarini R. 2023. Diversity of wild edible fruits in the agroforestry area of Cigalontang Village, Tasikmalaya, Indonesia. Biodiversitas 24: 4161-4167.* Wild edible fruits are non-timber forest products that support the nutritional adequacy of communities around the forest. Scientific inventory and documentation of wild fruit plant diversity are important to reveal local resources' potential in supporting local communities food security. A study on wild edible fruits in the agroforestry area in Cigalontang Village aimed to document the diversity of fruit plant species and traditional knowledge of the community on food plants available from the forest. This study used semi-structured interviews with 63 respondents and guided fieldwork to identify natural habitats and collect specimens of wild edible fruits. The results showed that people of Cigalontang Village commonly consumed 49 wild edible fruit species belonging to 27 families. Zingiberaceae and Moraceae were two families with the highest number of wild edible fruit species mentioned by the respondents. All the fruits were consumed raw as fresh fruits, and some were known as ingredients for traditional medicine to treat minor health complaints. The community discussed the use of wild edible fruits with a review of the nutritional content based on relevant references. Results showed that the community used wild edible fruits for daily nutritional needs, not for sale. Both older and younger generations shared knowledge about the diversity of wild edible fruit plants and were closely related to local traditions kept within the frame of local wisdom. This knowledge, supported by local wisdom held by the community, is important to maintain the sustainability of fruit plant diversity and its conservation.

Keywords: Ethnobotany, food security, forest, species diversity, traditional knowledge

INTRODUCTION

Food is a basic human need that can be fulfilled from plants or animal sources. Foods from plant sources include wild edible plants (WEP), which are important in providing daily nutritional needs, especially for people who live near forests. Wild edible plants are plant species that humans can consume, commonly obtained from their natural habitat, and have not undergone a domestication process or been cultivated (Pradhan et al. 2020). Given that the knowledge and use of WEP are often found among forest dwellers, the term forest plant foods is sometimes applied to WEP. A study by Ickowitz et al. (2016) on communities living close to forests in 25 provinces in Indonesia showed an association between patterns of consumption of food plants as sources of micronutrients and types of forest use such as for agroforestry of horticultural plants. In a broader aspect, Majumdar and Datta (2009) mentioned that WEP as a non-forest timber product provides benefits for communities around forests, and the use of WEP has a positive impact on preserving the diversity of food plant species, which also protects the forest ecosystem for sustainable use.

Studies on food plants originating from forests and their benefits for local communities are important in fulfilling nutrition for the health and food security of communities around forests. This issue has been mentioned by Ickowitz et al. (2016), that forest products in the form of food contribute to providing quality nutrition for people living around the forest. Pradhan et al. (2020), in their review of the potentials of wild edible plants, noted that WEP not only functions in meeting the community's nutritional needs but also has an important role in the socio-ecological field in certain landscapes. In their research in Timor Leste, Erskine et al. (2015) reported that WEP plays an important role in maintaining food security, especially during the hard time of harvest failure, and this kind of food was mainly obtained from tuber-producing plants. Moreover, Harisha et al. (2021) reported that wild food plants not only play a role in meeting daily food needs but also play an important role in maintaining food security and even as one of the pillars of the economy of forest dwellers communities.

Among the WEP originating from forest areas, fruit is a group of food categories that is widely used, and this led to the recognition of the term wild edible fruits (WEF). Concerns about fruit plants from forests are demonstrated by studies on WEF reported from Indonesia in recent years. Harianja et al. (2021) reported that the Batak Toba community collected and used 29 species of WEF from the forest adjacent to their settlement. They consumed fruits in different ways, from being eaten raw, as a food flavoring, processed fruit, and even used some fruits as traditional medicine. Suwardi et al. (2022) documented 129 species of WEF from six districts in Aceh Province, Indonesia, and also noted the conservation status of these species. Meanwhile, Syamsuardi et al. (2022), in their study of WEF in Kampar District, Riau, Indonesia, reported that 67 species of wild edible fruits were used by people living in Bukit Rimbang Bukit Baling Riau. These previous studies have an

important issue in common: a concern about the preservation of community knowledge on WEF and the suggestion that the knowledge should be passed on to the younger generation to maintain WEF sustainability in nature.

This study aims to document the diversity of fruit plants found in agroforestry areas and to explore the knowledge of the people of Cigalontang Village, Tasikmalaya, Indonesia, in using fruit plants from the forest. This ethnobotanical study is the first of its kind in the area. The results of this study are important in revealing the potential of WEF in supporting the nutritional adequacy of the local community in Cigalontang Village, as well as providing information on the diversity of fruit species in order to raise public concern to preserve their existence in nature by protecting the plant's natural habitat.

MATERIALS AND METHODS

Study area

The study was conducted in Cigalontang Village, Cigalontang Sub-district, Tasikmalaya District, West Java Province, Indonesia. This village is located at 7°18'45"S 107°59'42"E-7°18'22"S 107°59'48"E (Figure 1), with an altitude of more than 800 m asl. This village covers an area of 537.6 hectares with a population of 3,904 people. Most of the people of Cigalontang Village are farmers. The people of Cigalontang Village have local wisdom or traditions that are very well preserved, and one of the traditions related to this study is that they do not go to the forest to gather food plants on Mondays and Thursdays.

The village, located in the hills area with fertile soil and abundant water, makes the people generally grow vegetables in their yard and have a fish pond. Rice fields are also found around the settlement. The vegetable garden and fish pond are used to fulfill daily food needs. In addition, the community generally takes food from agroforestry areas where coffee is planted and managed independently by the community. Forest areas where coffee agroforestry is located are secondary forests of mixed vegetation with a relatively open canopy. Several ditches are found in this forest.

Data collection

The study was performed in two stages: interviews with community representatives and field surveys of agroforestry areas to collect plant species based on the data obtained from interviews. The interviews and field surveys were carried out from June to October 2022. The interview topic was wild edible fruits consumed by the people of Cigalontang Village, obtained from the coffee agroforestry area. Interviews were conducted using a semi-structured method with a questionnaire comprising closed and open questions. The respondents who participated in the interview were 63 chosen using a combination of snowball and purposive sampling methods.

Guided fieldwork was carried out in a secondary forest frequently visited by the locals who planted coffee in agroforestry areas and people who deliberately went to the forest to collect wild food plants. The fieldwork was conducted to collect plant materials mentioned by the respondents in the interviews. The collected samples were then preserved in herbarium collections as voucher specimens for identification. Preparation of preserved specimens referred to dos Santos et al. (2014). Species identification was done based on observation of morphological characteristics and accomplished using taxonomic literature (Backer and van den Brink 1963; Heyne 1987; Berg and Corner 2005; Steenis et al. 2006; Lim 2012), and plant specimen databases including Biodiversity Heritage Library (https://www.biodiversitylibrary.org/), Global Biodiversity Information Facility (https://www.gbif.org/), World Flora Online (http://www.worldfloraonline.org/). Verification of valid species names was carried out in reference to Plants of the World Online (https://powo.science.kew.org/). Species identification and data analysis were accomplished from November 2022 to January 2023. The data on species diversity was then analyzed descriptively.

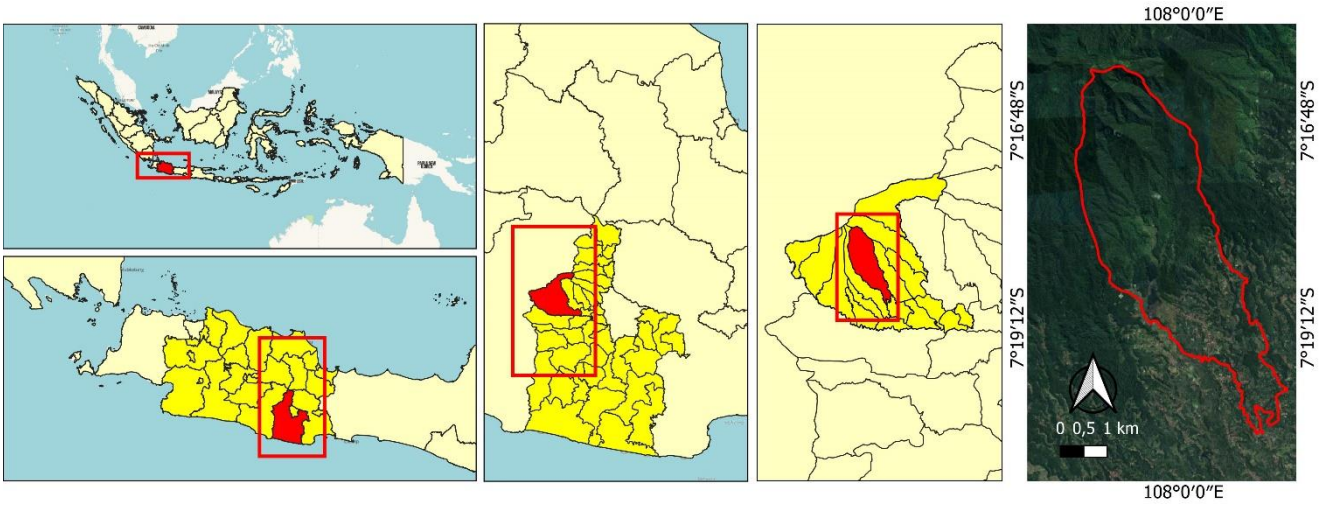

Figure 1. Location of Cigalontang Village, Tasikmalaya, West Java, Indonesia

Data analysis

This study was carried out using a combination of interviews with local people followed by direct observation and collection of plant materials in their habitat. The data were analyzed qualitatively, accompanied by a literature review regarding the nutritional content of selected fruit species as scientific support for claiming their health benefits.

RESULTS AND DISCUSSION

The interviews and fieldwork results showed that 49 species of WEF belong to 27 families (Table 1). Zingiberaceae, Moraceae, Arecaceae, Melastomataceae, and Rosaceae were the top five families contributing to providing WEF for the people of Cigalontang Village. Six species of Zingiberaceae reported here were all in fruiting season during the period of study (Figure 2).

Table 1. List of wild edible fruits in the agroforestry area of Cigalontang Village

Family	Species	Vernacular name	Plant habit
Actinidiaceae	*Saurauia pendula* Blume	*Kileho*	Tree
Anacardiaceae	*Mangifera laurina* Blume	*Pari*	Tree
Annonaceae	*Annona muricata* L.	*Nangka walanda*	Tree
Arecaceae	*Arenga pinnata* (Wurmb) Merr.	*Kawung*	Tree
Arecaceae	*Metroxylon sagu* Rottb.	*Kirai*	Tree
Arecaceae	*Salacca zalacca* (Gaertn.) Voss	*Salak*	Tree
Begoniaceae	*Begonia longifolia* Blume	*Bungbrun*	Herb
Clusiaceae	*Garcinia dulcis* (Roxb.) Kurz	*Munu*	Tree
Cucurbitaceae	*Zehneria odorata* (Hook.f. & Thomson ex Benth.) M.D.Dwivedi, A.K.Pandey & H.Schaef.	*Bobontengan*	Herb
Cucurbitaceae	*Zehneria japonica* (Thunb.) H.Y.Liu,	*Naga Sukma*	Liana
Cyperaceae	*Scirpodendron ghaeri* (Gaertn.) Merr.	*Harashas*	Herb
Ebenaceae	*Diospyros blancoi* A.DC.	*Dawolo*	Tree
Euphorbiaceae	*Antidesma bunius* (L.) Spreng.	*Huni*	Tree
Euphorbiaceae	*Glochidion borneense* (Müll.Arg.) Boerl.	*Mareme*	Shrub
Hypoxidaceae	*Curculigo capitulata* (Lour.) Kuntze	*Congkok*	Herb
Melastomataceae	*Melastoma malabathricum* L.	*Harendong blekeh*	Shrub
Melastomataceae	*Miconia crenata* (Vahl) Michelang.	*Harendong bulu*	Shrub
Melastomataceae	*Medinilla eximia* (Jack) Blume	*Harendang*	Tree
Mimosaceae	*Calliandra houstoniana* var. *calothyrsus* (Meisn.) Barneby	*Kaliandra beureum*	Shrub
Mimosaceae	*Zapoteca tetragona* (Willd.) H.M.Hern.	*Kaliandra bodas*	Shrub
Moraceae	*Ficus glumosa* Delile	*Amis mata*	Shrub
Moraceae	*Ficus variegata* Blume	*Kondang*	Tree
Moraceae	*Ficus racemosa* L.	*Loa*	Tree
Moraceae	*Artocarpus heterophyllus* Lam.	*Nangka leuweung*	Tree
Moraceae	*Artocarpus glaucus* Blume	*Tiwu landu*	Tree
Musaceae	*Musa acuminata* Colla	*Cau kole*	Herb
Myrsinaceae	*Maesa ramentacea* (Roxb.) A.DC.	*Kipiit*	Tree
Myrtaceae	*Syzygium aqueum* (Burm.f.) Alston	*Jambu aer*	Tree
Myrtaceae	*Psidium guajava* L.	*Jambu batu*	Tree
Oleaceae	*Olea europaea* L.	*Zaitun*	Tree
Oxalidaceae	*Oxalis barrelieri* L.	*Calincing*	Herb
Passifloraceae	*Passiflora foetida* L.	*Cermot*	Herb
Passifloraceae	*Passiflora quadrangularis* L.	*Markusa*	Liana
Rosaceae	*Rubus rosifolius* Sm.	*Arben gunung*	Shrub
Rosaceae	*Rubus fraxinifolius* Poir.	*Beberetean*	Shrub
Rosaceae	*Rubus moluccanus* L.	*Hareueus*	Shrub
Smilacaceae	*Smilax leucophylla* Blume	*Canar*	Tree
Solanaceae	*Physalis angulata* L.	*Cecendet*	Herb
Solanaceae	*Solanum americanum* Mill.	*Leunca kemir*	Shrub
Tiliaceae	*Muntingia calabura* L.	*Kersen*	Tree
Schisandraceae	*Kadsura scandence* (Blume) Blume	*Bunyur buut*	Tree
Urticaceae	*Dendrocnide stimulans* (L.f.) Chew	*Pulus*	Tree
Urticaceae	*Procris pedunculata* (J.R.Forst. & G.Forst.) Wedd.	*Uuyahan*	Shrub
Zingiberaceae	*Meistera aculeata* (Roxb.) Škorničk. & M.F.Newman	*Barahulu*	Herb
Zingiberaceae	*Amomum maximum* Roxb.	*Hangasa*	Herb
Zingiberaceae	*Etlingera elatior* (Jack) R.M.Sm.	*Honje*	Herb
Zingiberaceae	*Etlingera solaris* (Blume) R.M.Sm.	*Tepus*	Herb
Zingiberaceae	*Hornstedtia paludosa* (Blume) K.Schum.	*Pining*	Herb
Zingiberaceae	*Alpinia malaccensis* (Burm.f.) Roscoe	*Laja gowah*	Herb

Figure 2. Wild edible fruits from the Zingiberaceae family (insert: peeled or sliced fruits showing edible part). A. *Meistera aculeata*; B. *Amomum maximum*; C. *Etlingera elatior*; D. *Etlingera solaris*; E. *Alpinia malaccensis*; F. *Hornstedtia paludosa*

Zingiberaceae is a plant family commonly harvested for its rhizomes for food seasoning, but in this study, local people also used Zingiberaceae fruits as food. Although this situation was rarely reported, the study by Pitopang et al. (2019) on the traditional use of Zingiberaceae by the indigenous people of Lore Lindu National Park also noted that the fruits of *Etlingera acanthodes*, a member of Zingiberaceae, were consumed as food. Consuming the fruits of Zingiberaceae plants is based on the knowledge that these foods have medicinal properties, as reported by several studies (Ernilasari et al. 2021; Ying et al. 2021; Xu et al. 2022). Phytochemical analysis by Juwitaningsih et al. (2016) revealed the content of two pyrones compounds with antibacterial activities from the fruit extract of *A. malaccensis*, a giant Zingiberaceae herb bearing massive fruits found in this study. The fruit of *E. elatior* or torch ginger, which is very well known for its unique aromatic flower commonly used as cooking ingredients, was reported as having the highest flavonoid and phenolic content compared to flowers and leaves, and thus having beneficial antioxidant properties (Safrina et al. 2022).

Moraceae, the second family contributing the highest number of WEF in this study, was represented by five species. While *A. heterophyllus* and *A. glaucus* were widely known for their delicious fruits, three species of *Ficus*, namely *F. glumosa*, *F. variegata*, and *F. racemosa* were less known for their edible fruits. *Ficus recemosa* fruits contain nutrients that are good for health, including carotenoid, lycopene, ascorbic acid, vitamin A, and considerable amounts of minerals (Bhogaonkar et al. 2014). The Moraceae family, a group of plants with some species used as WEF in Aceh Province, was mentioned by Suwardi et al. (2022). Similarly, Syamsuardi et al. (2022), who explored WEF in eight villages in the Bukit Rimbang Bukit Baling Riau area, reported that Moraceae was the family that contributed the most to providing WEF with a total of 10 species. Another study showing that species belonging to the Moraceae family were widely used as food was reported by Abera et al. (2022) in Ethiopia.

The Melastomataceae family, which contributes three WEF species to the local community of Cigalontang Village, has long been recognized for its delicious edible fruits among the three species reported in this study. *Medinilla eximia*, formerly known as *M. speciosa* is the most widely known, and many studies have revealed the nutritional content and properties of the fruit. A study by Sa'adah et al. (2019) showed that *M. speciosa* fruit extract has a high anthocyanin content, making it an antioxidant and immunostimulant potential. Meanwhile, a study by Sari et al. (2018) on the potential of *M. malabathricum* fruits showed that the ripe fruits of this species contain various compounds with antioxidant properties. *Miconia crenata*, the third species documented as WEF from the Melastomataceae family, is famous among forest dwellers for its purple-black, sweet fruits. A phytochemical-based ethnomedicinal review of the genus *Miconia* by da Silva et al. (2022) described several health benefits of species in this genus, which showed analgesic, anti-inflammatory, antioxidant, antiparasitic, and antibacterial properties. Meanwhile, Rosaceae is a family with three species of *Rubus*

widely known by the people of Cigalontang Village as a source of WEF. *Rubus* ripe fruits with beautiful red color, which taste sweet and fresh, are often picked to be eaten directly by people during their activity in the forest. The nutritional content of five *Rubus* species was reported by Surya et al. (2018), which showed that *Rubus* fruits contain high fructose, high vitamin C, and a variety of micronutrients that are good for maintaining general health. Representatives of WEF from Cigalontang comprising species from various families are displayed in Figure 3.

A number of studies have demonstrated the role of WEF in providing nutritious foods for local communities. Paul et al. (2020), in their study of an ethnic community in Bangladesh, documented 49 WEF species and noted that these fruits played an important role as a source of nutrition for the local community. A recent study by Abera et al. (2022) showed that fruit was the most preferred category among the various categories of wild edible plants because it tastes good and can be eaten directly. The WEF obtained by the people of Cigalontang Village from the agroforestry forest area are all eaten raw.

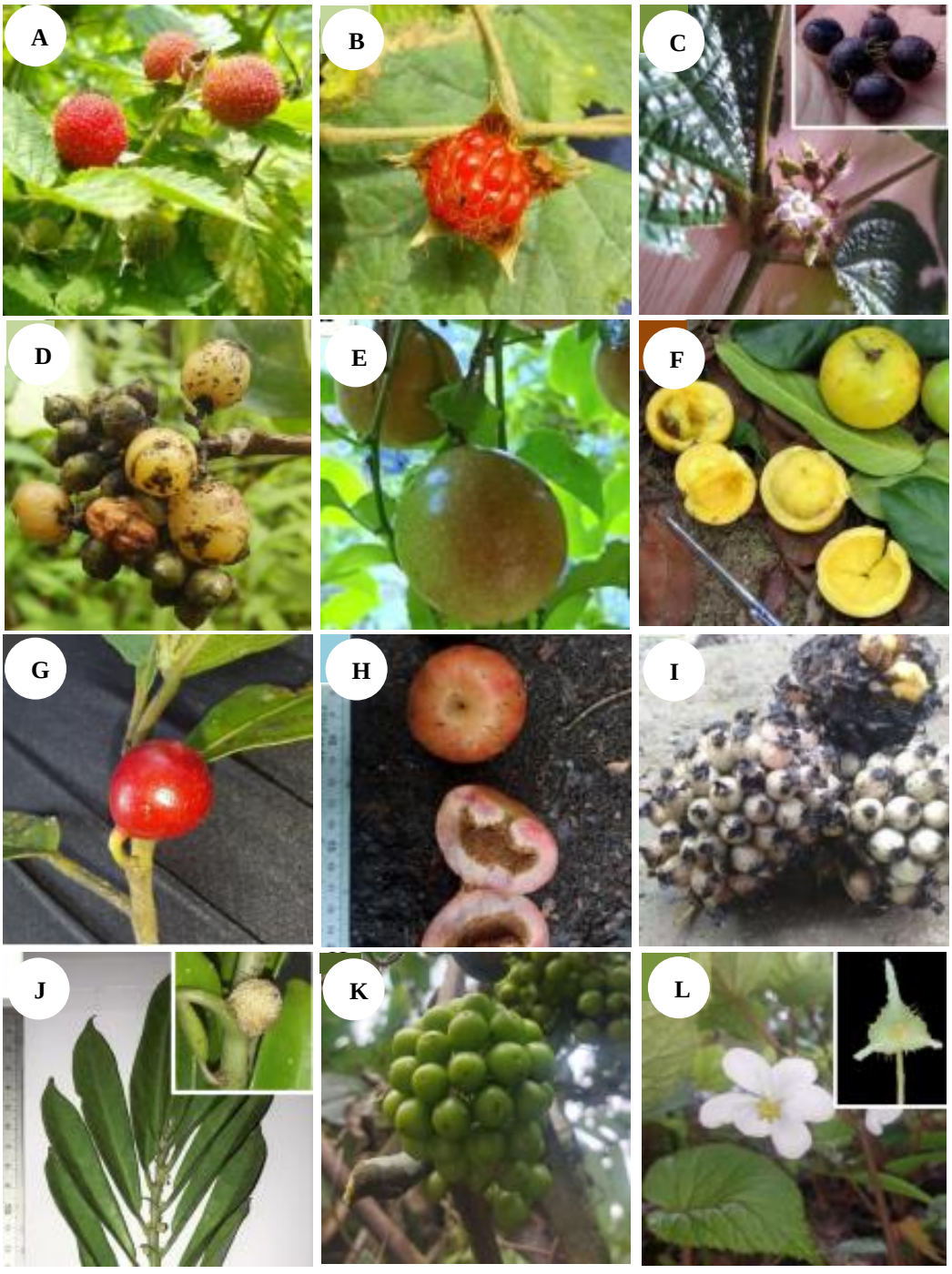

Figure 3. Wild edible fruits found in the agroforestry area of Cigalontang Village (insert: close-up fruit). A. *Rubus rosifolius*; B. R*ubus moluccanus*; C. *Miconia crenata*; D. *Maesa ramentacea*; E. *Passiflora quadrangularis;* F. *Garcinia dulcis*; G. *Ficus glumosa*; H. *Ficus variegata*; I. *Curculigo capitulata*; J. *Procris pedunculata*; K. *Smilax leucophylla*; L. *Begonia longifolia*

Consuming fresh fruit has the advantage that its nutritional content is still intact, compared to processed or cooked fruits. Processing fruits by cooking causes a decrease in their nutritional content, especially reducing the polyphenol content by five percent (Ellong et al. 2015). Results of a study by Shan et al. (2019) showed that WEF was generally eaten raw, and it was reported that consumption of WEF might overcome some problems related to the health of the digestive organs.

In addition to providing nutrition for local communities, the use of WEF by people who live around the forest can encourage their conservation in order to maintain the existence of these plants for communities around the forest. Sardeshpande and Shackleton (2019) noted that the community most widely used WEF among various types of non-forest timber products. In this case, WEF is not only playing a role in providing nutritious food, but also some of its species are useful as medicinal ingredients and commodities that support the economy of the forest dwellers. The same concern was expressed by Paul et al. (2020) that documenting the diversity of wild edible fruits and traditional knowledge within the community living close to forests is very important to maintaining sustainable use of wild edible fruits, as well as to building awareness of the community around the forest to protect the habitat of wild fruit plants.

The local community also knows a number of WEF species as ingredients for traditional medicine, such as *Z. japonica, M. malabathricum, M.eximia, M. crenata, P. angulata, A. dealbatum, H. paludosa*, and *E. elatior*. The benefits people commonly obtain from using fruit for traditional medicine come from its nutritional content, especially phenolic compounds, vitamins, and minerals (Neudeck et al. 2012). The use of wild fruits as traditional medicine has also been reported in ethnobotanical studies from various regions, including by Geng et al. (2016) and Sachula et al. (2020). The use of fruit from the forest to treat common health problems was found in the Toba Batak community, as Harianja et al. (2021) reported. The use of WEF as a medicinal ingredient was scientifically justified by the content of several compounds with antioxidant activity, as reported by Shan et al. (2019), which examined the phenolic, flavonoid, and flavonol content of 20 WEF species. *Zehneria japonica*, known by the local community as a sacred plant and believed to be efficacious for treating various internal diseases, has also been known as a plant with antitumor properties by people in the Philippines as mentioned by Roldan et al. (2018) who reported leaves extract of this species contains alkaloids, anthrones, flavonoids, and sterols which have cytotoxic and angio suppressive biological activity. *Melastoma malabathricum* fruits are known to contain flavonoids, terpenoids, phenolics, and tannins, which are efficacious as antioxidants against the effects of free radicals and are therefore declared to have potential as herbal tea ingredients that are safe for consumption (Sari et al. 2018). *Medinilla eximia* fruits, which are purplish, are known to be rich in anthocyanins, and a study by Sa'adah et al. (2020) showed that fruit extracts of this species have potent antioxidant activity. Meanwhile, plants from the genus *Miconia* have various health benefits, as da Silva et al. (2022) summarized by acting as antioxidants, antibacterial, anti-inflammatory, and antiparasitic, which come from various secondary metabolites compounds, especially the phenolic groups.

Results of this study showed that the people of Cigalontang Village take fruit from the forest for daily consumption and are not used as a commodity to be sold in the market. This result is similar to the report of Majumdar and Datta (2009) in India which states that WEF plants are non-forest timber products that do not have a formal market. The same situation is reported by Harianja et al. (2021) in that the Batak Toba community uses fruit species from the forest for their own consumption and not for sale. The same situation was also described by Harisha et al. (2021) that the people who live in the Malai Madeshawara Hills wildlife sanctuary area use food plants obtained from the forest for their daily needs and not for sale, or in other words, the community obtains non-monetary benefits from food plants naturally available in the forest.

The interviews with village residents of various age groups, educational strata, and livelihoods showed that the older and younger generations shared knowledge about WEF. Respondents were generally able to name 20 to 30 WEF species. Respondents have this knowledge from personal experience, observations of family daily life, and knowledge from older people. Knowledge about WEF that is well maintained across generations shows a good transfer of knowledge within the Cigalontang Village community, created partly by the environment close to forests where a wealth of food crops are available to support daily nutrition. Amente (2017) found the same condition, which noted that the maintenance of traditional knowledge about wild edible plants is partly due to the reliance and the practice of passing on knowledge from older to younger generations. The important role of traditional knowledge about wild edible plants in raising public awareness to preserve their existence is emphasized by Liao et al. (2018). The role of forests in providing food for the people who live around them has been mentioned by Ickowitz et al. (2016) based on data modeling in 25 provinces in Indonesia regarding food consumption patterns and types of forest vegetation cover, which found that there is a strong association between forest types and the area with tree-dominated land cover such as agroforestry, with the frequency of consumption of micronutrient-rich foodstuffs.

The results of this study indicate that the agroforestry area in Cigalontang Village, which consists of a secondary forest located near settlements, has a high diversity of wild edible fruits to support the local community's quality diet by providing nutritious food sources. The wealth of wild edible fruits in the study also holds the potential for the development of further research, especially on medicinal plants. The knowledge of the people of Cigalontang Village across generations regarding wild edible fruits is still well preserved and worthy of maintaining. Based on the results of this study and previous reports on the same topic, one general conclusion is that the significance of the WEF inventory is to provide information on its diversity in nature before its presence declines due to deforestation and land conversion. This information is essential for the younger

generation to become aware and care about the diversity of WEF around where they live so that imported fruits do not erode the existence of WEF.

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