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The potential utilization of non-timber vascular plants in the karst area of Ayah Village, Kebumen District, Central Java, Indonesia

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Abstract. *Indriyani S, Aurina DM, Ramadhan MF, Rachmalia F, Fauziyyah MD, Faturrahman AD, Nazar IA, Septiasari A, Naim DMD, Setyawan AD. 2023. The potential utilization of non-timber vascular plants in the karst area of Ayah Village, Kebumen District, Central Java, Indonesia. Intl J Trop Drylands 7: 55-65.* Karst vegetation has unique characteristics in its shape and species composition. As a result, karst plant communities have a high ability to adapt to environmental stress. In addition to ecological functions, vegetation that grows in karst areas also has the potential as natural medicine, food ingredients, and materials for folk traditions. This study aims to determine the diversity and potential utilization of non-timber vascular plants in the karst area of Ayah Village, Kebumen, Central Java, Indonesia. This study used a survey method, namely direct observation, by exploring the Ayah Forest area to observe the studied object, namely vascular plants. The results showed 44 plant families of 111 species in the Ayah Forest area. Vascular plants in the Ayah Forest area are mostly from Fabaceae and Poaceae families. Therefore, five habitus types grow there, including trees, herbs, shrubs, epiphytes, and vines. The vascular plants found during the research have different potencies. In this study, eight prospects could be utilized from vascular plants in Ayah Forest: ornamental plants, medicinal plants, food ingredients, beverage ingredients, flavorings, natural coloring, animal feed, and woven crafts. The potential use of vascular plants in the Ayah Forest is most widely used as medicine.

Keywords: Ayah Forest, biodiversity, karst, non-timber, vascular plants

INTRODUCTION

Karst has unique hydrological conditions and landscapes caused by rock dissolution and secondary porosity development (Nugroho and Paripurno 2019). Karst landscapes are formed from the erosion of rock by surface waters. Most karst area comprises carbonate rocks, mainly limestone and dolomite (Sulastoro 2013). The landscape of the karst area usually has steep slopes, many basins, prominent and irregular limestone, and caves. Karst also has a continuous underground river system. Karst ecosystems are fragile landscapes; if this ecosystem is disturbed, it will take a very long time to recover (Widyaningsih 2017). One of the crucial factors in restoring damaged karst ecosystems and preserving karst landscapes is maintaining biodiversity in karst areas because biodiversity is the key to regional ecological succession (Li et al. 2013).

In addition, the high plant diversity in karst areas influences the hydrological system and soil formation. The variety of plants in the karst area plays a role in water absorption, so the function of karst underground river springs can be appropriately maintained. For the karst area to function optimally as a water reservoir, vegetation can shade the karst and absorb much water (Sugita et al. 2015). Karst vegetation has unique characteristics in its shape and species composition. Vegetation forms in karst areas usually have sparse crowns attached to cliffs (Marwiyati 2012), consisting of plants that grow naturally and are cultivated. As a result, Karst plant communities can adapt to environmental stress (Nasrudin and Parikesit 2020). In addition to ecological functions, vegetation that grows in karst areas has another potential: natural medicine, food ingredients, toy making, and materials for folk traditions (Lumpert and Kreft 2017).

Indonesia has the potential for karst landscape areas of around 20% of its land area (Widyastuti et al. 2019). One of the karst areas in Indonesia is the South Gombong karst area in the Kebumen District, such as the Ayah Karst of Ayah Subdistrict. The Ayah karst area presents the main typological characteristics of coastal karst hills, with their geology consisting of relatively thin layers of limestone. The Ayah karst area consists of Miocene limestone, which underwent uplift and karstification at the end of the Pliocene. The karst of Ayah and surrounding areas is characterized by harmonious karst formations and closed basins (Haryono et al. 2017). The karst forest area in South Gombong has a moderate to dense vegetation density with a percentage of 90% and a rare to very rare vegetation density with a ratio of 10%. The vegetation of the South

Gombong karst forest area also consists of cultivated plants. This is because the South Gombong karst forest area is close to residential areas (Suhendar et al. 2018).

According to Minister of Forestry Number 35 of 2007, non-timber forest products are vegetable and animal products, with their derivative products and cultivation, except for wood originating from forests. Non-timber forest products are by-products of plants, such as sap, leaves, skin, and fruit (Batubara and Affandi 2017). Local communities can utilize most non-timber plants as ornamental and food ingredients (Hadi et al. 2016). Moreover, non-timber forest plants are necessary to support increased community welfare and income without reducing forest ecological functions (Mansur et al. 2018). At the same time, each vascular plant type holds a unique potential. However, few studies have examined the possibility of vascular plant groups in the Ayah karst area. Therefore, this study aims to determine the diversity and potential utilization of non-timber vascular plants in the karst area of Ayah Village, Ayah Sub-district, Kebumen, Indonesia.

MATERIALS AND METHODS

Study area

The research was carried out in November 2022. Observations were made in the karst forest area, Ayah Village, Ayah Sub-district, Kebumen District, Central Java, Indonesia (Figure 1). Ayah Sub-district is one of the sub-districts in Kebumen District, with sea areas apart from their mountainous. Ayah Sub-district is included in the South Gombong karst area, at coordinates of -7.726532, 109.399676 (Central Bureau of Statistics for Kebumen District 2020). Ayah Sub-district in the inland and mountainous areas has a livelihood as a farmer, while those in the low-coastal areas have a livelihood as fishermen. Ayah Sub-district consists of 18 villages, especially Ayah Village. Ayah Village is located at the western end of Kebumen District and is directly adjacent to Cilacap District. Ayah Sub-district is known to the public for its several tourist objects (Faozi and Santoso 2020), which are famous for their natural potential, such as Logending Beach, Pasir Beach, Jatijajar Cave, and Petruk Cave. In Ayah Forest, Pasir Beach around Ayah Village has various plant potential.

Procedures

Observation

Data were collected using survey and observation methods, namely direct observation by exploring the study area to observe the object to be studied, namely vascular plants (Li et al. 2022). First, each plant found in the Ayah Forest area is recorded, starting with the plant type, its special characteristics, and its habitus. These plants' characteristics are then documented through photos to facilitate identification.

Plant identification

Plants are identified based on the type, characteristics, and habitus of each plant species obtained from observations. The identification information mostly used internet base identifiers, such as plantamor.com, theplantlist.org, identify.plantnet.org, gbif.org, and powo.science.kew.org. If the name of the plant species is known, then its potential is sought based on Table 1 for a list of literature.

Data analysis

The data obtained were analyzed descriptively using a qualitative approach, then explained more concisely and clearly in tabular form by attaching pictures of observations. As a result, the information or data written down was more valid and strengthened this research results.

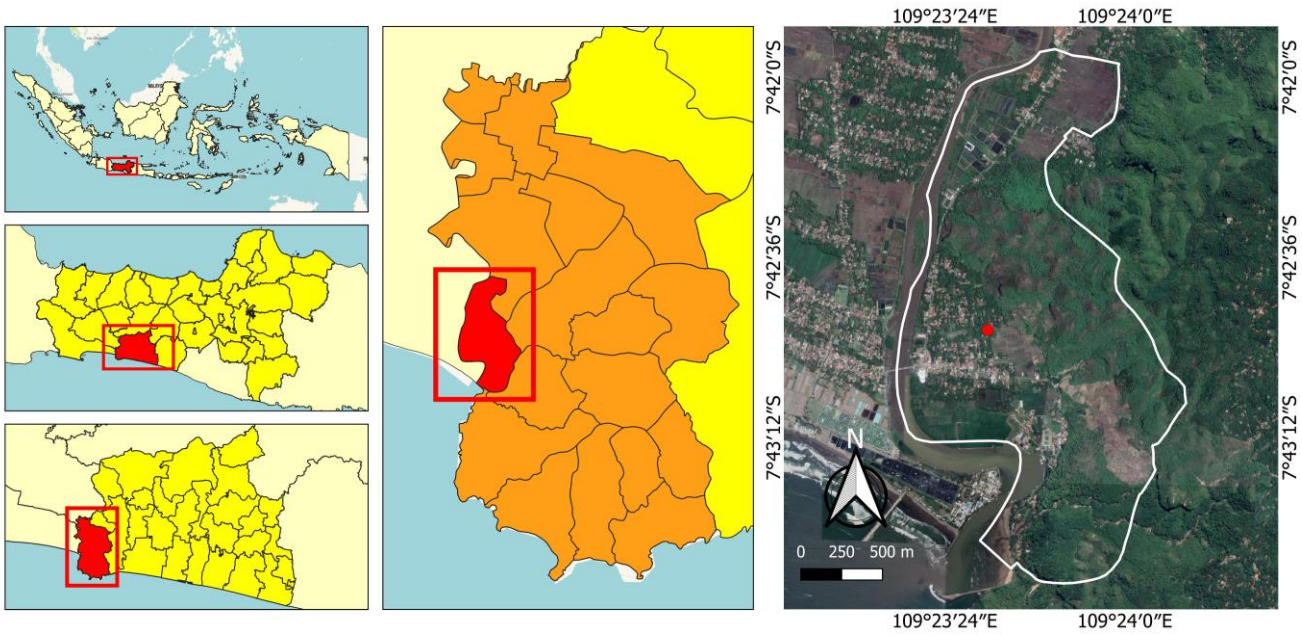

Figure 1. Location of Ayah Village Forest, Ayah Sub-district, Kebumen, Central Java, Indonesia

RESULTS AND DISCUSSION

Vascular plants in the karst area of Ayah Village

From research conducted in the karst area of Ayah Village, 111 species of vascular plants were found consisting of 44 families. The family most often found in Ayah Village Forest is the Fabaceae or the legume family (Figure 2). There are 12 species of plants of the family Fabaceae found in the Ayah karst area. Based on data found by Faida et al. (2018), four plant tribes are native karst, namely Euphorbiaceae, Moraceae, Fabaceae, and Palmae. The Fabaceae family is more prevalent because this group of plants is drought-tolerant and can live in tropical and subtropical climates (Dimmit 2014). Based on literature studies, the Fabaceae family was found to have many potential uses, such as medicinal plants, ornamental plants, animal feed, and foodstuffs (Table 1). Moreover, the Fabaceae family has potential as green plants, agricultural production plants, etc. (Adelita and Dharmono 2018). The Poaceae family is also found in the karst of Ayah Forest with ten species, widely known as a group of grasses, and the fourth largest family in the plant world (Sagar et al. 2018). Poaceae have an important role in resisting erosion at the cliff's foot. In addition, Poaceae are easy to grow and drought tolerant (Hirman et al. 2021).

Habitus is divided into five types: trees, herbs, shrubs, epiphytes, and vines. This study found herbs habitus were more dominant than others in Ayah Village Forest (Figure 3). The high percentage was herbs (49%), followed by shrubs (20%), trees (19%), epiphytes (9%), and the last is vines (3%).

Based on Figure 4, the highest potential utilization of non-timber vascular plants is medicinal plants 74 species, followed by ornamental plants 19 species; foodstuffs 17 species; animal feed 13 species; beverage ingredients four species; flavoring two species; natural coloring one species; and one species of woven craft.

Plant potential

The vegetation around Ayah Village Forest has possibilities that the surrounding environment can be utilized. The results showed nine potential plant uses: medicinal, ornamental plants, food ingredients, animal feed, natural dyes, flavorings, beverage ingredients, and woven crafts.

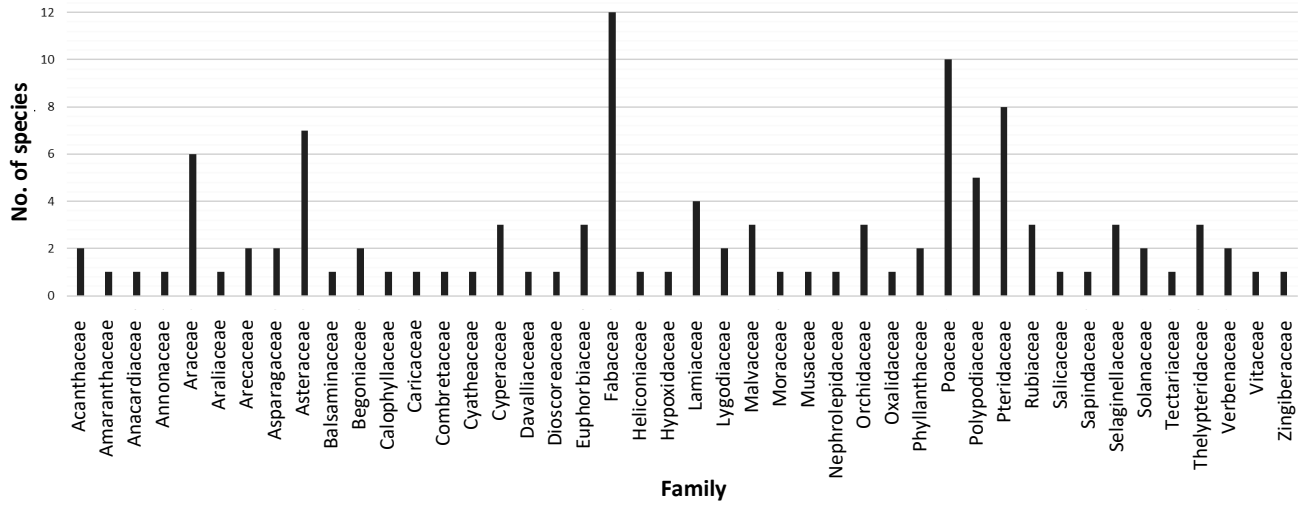

Figure 2. Bar chart of families found in Ayah Village Forest, Kebumen District, Central Java, Indonesia

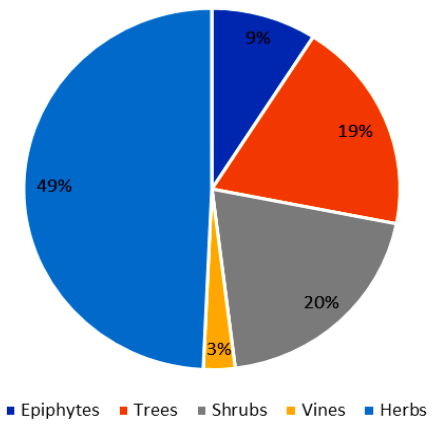

Figure 3. The habitus found in Ayah Village Forest, Kebumen District, Central Java, Indonesia

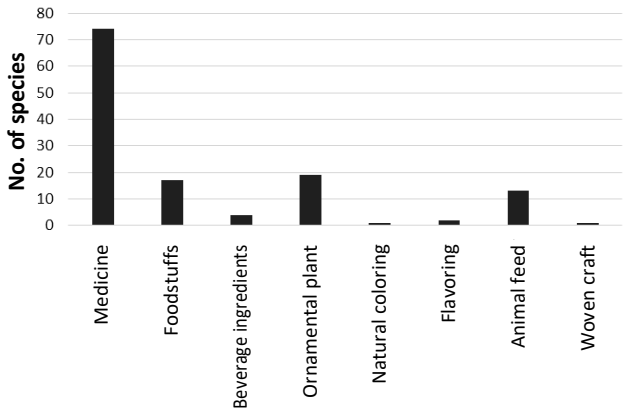

Figure 4. The potential non-timber utilization of vascular plants found in Ayah Village Forest, Kebumen District, Indonesia

Table 1. List of non-timber vascular plants recorded in Ayah Village, Ayah Sub-district, Kebumen District, Central Java, Indonesia

Family	Name	Local name	Habitus	Potency
Acanthaceae	*Asystasia gangetica* (L.) T. Anderson	Ara Sungsang	H	Medicine (45)
	Ruellia tuberosa L.	Pletekan	H	Medicine (1)
Amaranthaceae	*Alternanthera sessilis* (L.) DC.	Kremah	H	Medicine (74)
Anacardiaceae	*Mangifera indica* L.	Mangga	T	Foodstuffs, medicine (75), beverage ingredients
Annonaceae	*Annona muricata* L.	Sirsak	T	Foodstuffs, medicine (76), beverage ingredients
Araceae	*Alocasia inornata* Hallier f.	-	H	Ornamental plant
	Alocasia longiloba Miq.	-	H	Ornamental plant
	Amorphophallus sp.	-	H	-
	Colocasia esculenta (L.) Schott)	Talas (kecil)	H	Foodstuffs
	Philodendron grandipes K.Krause	-	H	Ornamental plant (54)
	Xanthosoma mexicanum Liebm.	-	H	Ornamental plant
Araliaceae	*Polyscias scutellaria* (Burm.f.) Fosberg	Mangkokan	S	Medicine (34)
Arecaceae	*Arenga pinnata* (Wurmb) Merr.	Aren	T	Foodstuffs
	Cocos nucifera L.	Kelapa	T	Foodstuffs, beverage ingredients
Asparagaceae	*Cordyline fruticosa* (L.) A.Chev.	Andong Merah	S	Medicine (38)
	Dracaena angustifolia (Medik.) Roxb	Suji	S	Medicine, natural coloring (41)
Asteraceae	*Ageratum conyzoides* L.	Babadotan	H	Medicine (46)
	Chromolaena odorata (L.) R.King & H.Rob.	Kirinyuh	S	Medicine (11)
	Cyanthillium cinereum (L.) H.Rob.	-	H	Medicine (16)
	Eleutheranthera ruderalis (Sw.) Sch.Bip.	Karenyuik	H	-
	Melampodium divaricatum (Rich.) DC.	Bunga Kertas	H	Medicine (39)
	Mikania cordifolia (L.f.) Willd.	-	V	Medicine (44)
	Porophyllum ruderale (Jacq.) Cass.	Ketumbar Bolivia	S	Flavoring (33)
Balsaminaceae	*Impatiens platypetala* Lindl.	Pacar Tere	H	Ornamental plant
Begoniaceae	*Begonia tenuifolia* Dryand.	Begonia	H	Ornamental plant
	Begonia urophylla Hook.	Begonia	H	Ornamental plant (37)
Calophyllaceae	*Calophyllum calaba* L.	-	T	Medicine (64)
Caricaceae	*Carica papaya* L.	Pepaya	H	Foodstuffs
Combretaceae	*Terminalia catappa* L.	Ketapang	T	Foodstuffs, medicine (42)
Cyatheaceae	*Sphaeropteris* sp.	-	T	-
Cyperaceae	*Cyperus iria* L.	-	H	Animal feed, medicine (48)
	Cyperus kyllingia Endl.	Rumput nnop	H	Animal feed
	Cyperus odoratus L.	Rumput Teki	H	Animal feed, medicine (20)
Davalliaceaea	*Davallia denticulata* (Burm.fil.) Mett. ex Kuhn	Paku Tertutup	E	Ornamental plant (22)
Dioscoreaceae	*Tacca palmata* Blume	Gadung Tikus	H	Medicine (53)
Euphorbiaceae	*Codiaeum variegatum* (L.) Rumph. ex A.Juss.	Puring	S	Medicine (12)
	Manihot carthaginensis (Jacq.) Mull.Arg.	Singkong	S	Foodstuffs, animal feed (84)
	Manihot esculenta Crantz	Singkong	S	Foodstuffs (77)
Fabaceae	*Acacia auriculiformis* A.Cunn. ex Benth.	Akasia	T	Medicine (61)
	Acacia mangium Willd.	-	T	Medicine (9)
	Albizia chinensis (Osbeck) Merr.	Sengon	T	Medicine (78)
	Cassia fistula L.	Tengguli	T	Medicine (43)
	Cassia siamea Lam.	Johar	T	Medicine (8)
	Clitoria ternatea L.	Telang	V	Medicine, ornamental plant (62)
	Desmodium gangeticum (L.)	Samak-Samak	S	Medicine (15)
	Flemingia strobilifera (L.) W. T. Aiton	Hahapaan	S	Medicine (19)
	Leucaena leucocephala (Lam.) de Wit	Lamtoro	T	Foodstuffs, animal feed, medicine (17)
	Mimosa pudica L.	Putri Malu	H	Medicine (2, 10)
	Sesbania grandiflora (L.) Poir.	Turi	T	Medicine, foodstuffs (27)
	Senna tora (L.) Roxb.	Senna Sabit	H	Medicine (52)
Heliconiaceae	*Heliconia psittacorum* L.f.	Sepit Udang	H	Ornamental plant (3)
Hypoxidaceae	*Molineria capitulata* (Lour.) Herb.	-	H	Medicine (57)
Lamiaceae	*Hyptis capitata* Jacq.	Rumput Knop	S	Medicine (24)
	Plectranthus scutellarioides L.	Miana	H	Ornamental plant, medicine (40)
	Tectona grandis L.f.	Jati	T	Medicine (60)
	Vitex altissima L.f.	-	T	Medicine (79)
Lygodiaceae	*Lygodium circinnatum* (Burm.fil.) Sw.	Ketak	E	Foodstuffs, medicine, woven crafts (4)
	Lygodium japonicum (Thunb.) Sw.	-	V	Medicine (6)
Malvaceae	*Hibiscus rosa-sinensis* L.	Bunga Sepatu	S	Ornamental plant
	Urena lobata L.	Pulutan	S	Medicine (21)
	Sida rhombifolia L.	Sidaguri	S	Medicine (47)

Moraceae	*Ficus septica* Burm.fil.	Awar-Awar	T	Medicine (10)
Musaceae	*Musa paradisiaca* L.	Pisang	H	Foodstuffs
Nephrolepidaceae	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam	-	H	-
Orchidaceae	*Acampe pachyglossa* Rchb.f.	Anggrek	E	Ornamental plant
	Dendrobium crumenatum Sw.	Anggrek Merpati	E	Ornamental plant, medicine (59)
	Rhynchostylis retusa (L.) Blume	Anggrek Ekor Rubah	E	Ornamental plant, medicine (58)
Oxalidaceae	*Oxalis barrelieri* L.	Belimbing Tanah	H	Medicine (23)
Phyllanthaceae	*Breynia vitis-idaea* (Burm.f.) C.E.C.Fisch.)	Buah Tinta	S	Medicine (51)
	Phyllanthus urinaria L.	Meniran	H	Medicine (2)
Poaceae	*Brachiaria mutica (Forskk.) T.Q.Nguyen*	Kolonjono	H	Animal feed
	Cymbopogon citratus (DC.) Stapf	Sereh	H	Flavoring, medicine (35)
	Gigantochloa apus (Schult.f.) Kurz	Bambu Apus	T	Medicine (63)
	Gigantochloa atter (Hassk.) Kurz	Bambu Legi	T	Foodstuffs (80)
	Melinis minutiflora P.Beauv.	Rumput Molasses	H	Animal feed (28)
	Oplismenus compositus (L.) P.Beauv.	-	H	Medicine, animal feed (81)
	Panicum repens L.	Lempuyang	H	Animal feed (18)
	Paspalum conjugatum P.J.Bergius	Papaitan	H	Animal feed, medicine (32)
	Sorghum bicolor L. Moench	Sorgum	H	Foodstuffs, animal feed (31)
	Themeda arguens (L.) Hack.	Rumput Merakan	H	Animal feed
Polypodiaceae	*Drynaria quercifolia* L.	Daun Kepala Tupai	E	Medicine (55)
	Drynaria sparsisora (Desc.) Moore	Simbar Layangan	E	-
	Microsorum scolopendria (Burm.fil.) Copel.	Pakis	H	Medicine (56)
	Phymatosorus scolopendria (Burm.fil.) Pic. Serm.	Pakis Kutil	E	Medicine (82)
	Pyrrosia nummularifolia (Sw.) Ching	Paku Duduitan	E	Medicine (83)
Pteridaceae	*Adiantum capillus-veneris* L.	Suplir	H	Medicine (65)
	Adiantum philippense L.	Kamuding	H	Medicine (68)
	Cheilanthes farinosa (Forssk.) Kaulf.	-	E	Medicine (69)
	Pityrogramma calomelanos (L.) Link	Paku Perak	H	Ornamental plant, medicine (67)
	Pteris biaurita L.	-	H	Medicine (36)
	Pteris ensiformis Burm.	Paku Pedang	H	Ornamental plant
	Pteris multifida Poir.	-	H	Medicine (66)
	Pteris vittata L.	Pakis Rem Cina	H	Medicine (26)
Rubiaceae	*Canthium horridum* Blume	Tembung Kanjut	S	Ornamental plant (73)
	Coffea canephora Pierre ex A.Froehner	Kopi Robusta	T	Beverage ingredients
	Spermacoce remota Lam	Gigiwangan	H	Medicine (7)
Salicaceae	*Flacourtia indica* (burm.fil.)Merr.	-	S	Medicine, ornamental plant (50)
Sapindaceae	*Schleichera oleosa* (Lour.) Oken	Kesambi	T	Animal feed, medicine (25)
Selaginellaceae	*Selaginella aristata* Spring	-	H	Medicine (49)
	Selaginella ornata (Hook & Grev.) Spring	-	H	Medicine (70)
	Selaginella plana (Desv. ex Poir.) Hieron.	Paku Rane	H	Medicine (70)
Solanaceae	*Capsicum frutescens* L.	Cabai	S	Foodstuffs
	Solanum melongena L.	Terong	S	Foodstuffs
Tectariaceae	*Tectaria angulata* (Willd.) Copel.	Paku bukit	H	Medicine (71)
Thelypteridaceae	*Christella subpubescens* (Blume) Holttum	Jajarat	H	Medicine (65)
	Cyclosorus interruptus (Willd.) H. Ito	-	H	Medicine (72)
	Cyclosorus sp.	-	H	-
Verbenaceae	*Stachytarpheta jamaicensis* (L.) Vahl	Pecut Kuda	S	Medicine (29)
	Stachytarpheta urticifolia Sims	-	S	Medicine (5)
Vitaceae	*Leea indica* (Burm.fil.) Merr.	Tanaman Girang	S	Medicine (14)
Zingiberaceae	*Amomum compactum* Roem. & Schult.	Kapulaga	H	Medicine (13)

Note: E: Epiphytes, T: Trees, S: Shrubs, V: Vines, and H: Herbs; 1. Xu et al. (2020), 2. Kartika (2017), 3. Silalahi (2019), 4. Rahayu et al. (2020), 5. Septiyadi et al. (2021), 6. Lee et al. (2006), 7. Meidalima (2013), 8. Rajegowda and Honnagirigowda (2022), 9. Pereira et al. (2022), 10. Huang et al. (2017), 11. Vaisakh and Pandey (2012), 12. Karyati and Adhi (2017), 13. Praditha et al. (2020), 14. Hossain et al. (2021),15. Vaghela et al. (2013), 16. Firison et al. (2018), 17. Zayed and Samling (2016), 18. Kumalasari et al. (2020), 19. Shital et al. (2021), 20. Dari et al. (2022), 21. Silalahi (2020), 22. Meliza et al. (2019), 23. Tagne et al. (2015), 24. To'bungan (2020), 25. Goswami and Singh (2017), 26. Paul et al. (2020), 27. Thissera at al. (2020), 28. Djufri (2016), 29. Liew and Yong (2016), 30. Dattaray (2022), 31. Khalid et al. (2022), 32. Garduque et al. (2019), 33. Winara and Suhaendah (2020), 34. Rosa et al. (2019), 35. Shah et al. (2011), 36. Dalli et al. (2007), 37. Surya and Astuti (2017), 38. Nurza (2019), 39. Rizki et al. (2019), 40. Hamidah et al. (2019), 41. Andila and Warseno (2019), 42. Santos et al. (2016), 43. Khairunnisa et al. (2019), 44. Mohammad et al. (2013), 45. Mugabo and raji (2013), 46. Harfiani et al. (2017), 47. Syafrullah (2015), 48. Malavika et al. (2021), 49. Silva et al. (1995), 50. Selim et al. (2021), 51. Nagar and Chauhan (2016), 52. Kang et al. (2020), 53. Trimanto and Hapsari (2016), 54. Rundel et al. (2020), 55. Gupta et al. (2021) , 56. Balada et al. (2022), 57. Umaru et al. (2020), 58. Rohani et al. (2018), 59. Tarmizi et al. (2020), 60. Nuralifah et al. (2021), 61. Aoetpah et al. (2019), 62. Marpaung (2020), 63. Sujarwo et al. (2010), 64. Laopian et al. (2019), 65. Pagea et al. (2022), 66. Yu et al. (2013), 67. Sutoyo et al. (2018), 68. Paul et al. (2017), 69. Yonathan et al. (2006), 70. Setyawan (2009), 71. Abdullah et al. (2021) , 72. Mitra et al. (2019), 73. Hidayat et al. (2010), 74. Walter et al. (2014), 75. Yap et al. (2021), 76. Yajid et al. (2018), 77. Abotbina et al. (2022), 78. Sharmin and Rashid (2022), 79. Bhavana et al. (2019), 80. Partasasmita et al. (2017), 81. Li and Xing (2016), 82. Mannan et al. (2008), 83. Wulandari et al. (2013), 84. Septiasari et al. (2021)

Medicinal

The research conducted in the forest area of Ayah Village shows that it has the potential for various medicinal plants. In identifying vascular plants, 74 species from 33 families were found in the forests of Ayah Village, which are useful in medicine. The ingredients contained in medicinal plants can accelerate the healing of disease (Lestari et al. 2021). Many people have used medicinal plants as herbal medicine. Therefore, the knowledge of these herbal medicine plants will be passed on to the next generation.

Many studies have been conducted to determine the content of plants. Usually, only certain parts of the plant can be used in medicine, even if all parts can be used in herbal medicine. According to Susanti et al. 2018, the plant parts mostly used for treatment are roots, stems, bark, flowers, fruit, and juice. Among the plant species found in Ayah Village Forest (Table 1), several plant parts can be used for treatment, starting from stems, leaves, sap, and roots. These plant species, as examples, *Urena lobata* (Figure 5A), *Ruellia tuberosa* (Figure 5B), *Polyscias scutellaria, Ageratum conyzoides, Chromolaena odorata, Melampodium divaricatum, Acacia auriculiformis, Albizia chinensis, Mimosa pudica*, *Plectranthus scutellarioides* and *Ficus septica* (Figure 5C). Medicinal plants have unique properties useful for curing diseases, such as wound medicine, inflammation medicine, fever reducer, and bladder stone.

Generally, the main factors that threaten the preservation of medicinal plants in the forest include habitat destruction, species scarcity, and excessive use of forest resources (Li et al. 2022). Nevertheless, some of these plants are active components in herbal medicine. For example, one of the medicinal plants that local people have used for a long time is *U. lobata*, which can be used as a fever reliever, rheumatism, wound and antiseptic, broken bones, and an anti-fertility agent (Silalahi 2020). In addition, *pulutan* leaf extract has antioxidant, antibacterial, and antifungal properties and can inhibit breast cancer cells (Fadillah et al. 2020).

The next plant that can be used as herbal medicine is *R. tuberosa (pletekan*). The presence of flavonoids, steroids, triterpenoids, and alkaloids in *pletekan* plants is well known. *Pletekan* leaves can be helpful to the bladder and coronary heart disease. Experimental studies have demonstrated these plants have ingredients as follows: antibacterial, anticancer, gastroprotective, antinociceptive, and anti-inflammatory properties of *R. tuberosa*. *Pletekan* also functions as a medicine in treating syphilis, bladder stones, bronchitis, cancer, heart disease, colds, fever, hypertension, and digestive problems (Nopiari et al. 2016). Next is *F. septica* or commonly known as *awar-awar*. People usually use *awar-awar* leaves as wound medicine. This plant also functions as a medicine for inflammation, and headaches, reducing fever, treating stomach aches, preventing diarrhea, as a medicine for fungal infections, and as a medicine in wound healing, namely steroids, flavonoids, and saponins (Tawi et al. 2019).

Ornamental plant

Therefore, 19 species of plants from 12 families have the potential as ornamental plants. Plant species that have the potential as ornamental plants are shrubs, epiphytes, and herbs. Ornamental plants have aesthetic value regarding leaves, flowers, and the whole plant (Majanah and Saputri 2019). The plants' types that have the potential to be ornamental plants found in the Ayah karst area include: *Alternanthera sessilis, Alocasia longiloba, Alocasia inornata, Philodendron grandipes, Xanthosoma mexicanum, Impatiens platypetala, Begonia urophylla, Begonia tenuifolia, Davallia denticulata, Heliconia psittacorum, Hibiscus rosa-sinensis, Acampe pachyglossa, Rhynchostylis retusa, Clitoria ternatea, Canthium horridum,* and *Pteris ensiformis.* The *D. denticulata* has beautiful leaves, so it is an ornamental plant that can be placed indoors and outdoors (Meliza et al. 2019). Apart from its potential as an ornamental plant, *H. psittacorum* has phytoremediation capabilities by reducing mercury metal contamination in the soil (Figure 5D) (Ulimma 2016). In addition to their potential as an ornamental plant, *H. rosa-sinensis* can analyze biomass and absorb carbon (Figure 5E) (Haruna 2020). The *R. retusa* is an orchid plant with exotic flowers and can be used as a commercial product (Nurfadilah 2013). The *A. longiloba* has arrow-shaped leaves with high aesthetic value, so it has the potential as an ornamental plant (Figure 5F) (Marega et al. 2016).

Foodstuffs

Ayah Forest area has abundant biodiversity. Among the species obtained in this study, several can be used as food by the local community. Regarding location, Ayah Forest is not far from settlements, so that local people can use the plants in the woods as food ingredients. Not only that, but the community can also plant fruit trees in the forest. Seventeen species in the Ayah Forest can be used as food. Among them are *Mangifera indica, Annona muricata, Colocasia esculenta, Arenga pinnata, Cocos nucifera, Carica papaya, Terminalia catappa, Manihot carthaginensis, Leucaena leucocephala, Sesbania grandiflora, Musa paradisiaca, Gigantochloa atter, Gigantochloa apus, Sorghum bicolor, Drynaria sparsisora, Capsicum frutescens,* and *Solanum melongena*. Usually, the species used as food ingredients are plants that produce fruit or vegetables to meet their daily needs. For example, bananas, soursop, tubers, chilies, and eggplants. Moreover, fruit has essential benefits for human health, especially for children growing up (Awuni and Isni 2022). Therefore, growing children would need balanced nutrition and nutrition by eating fruits and vegetables.

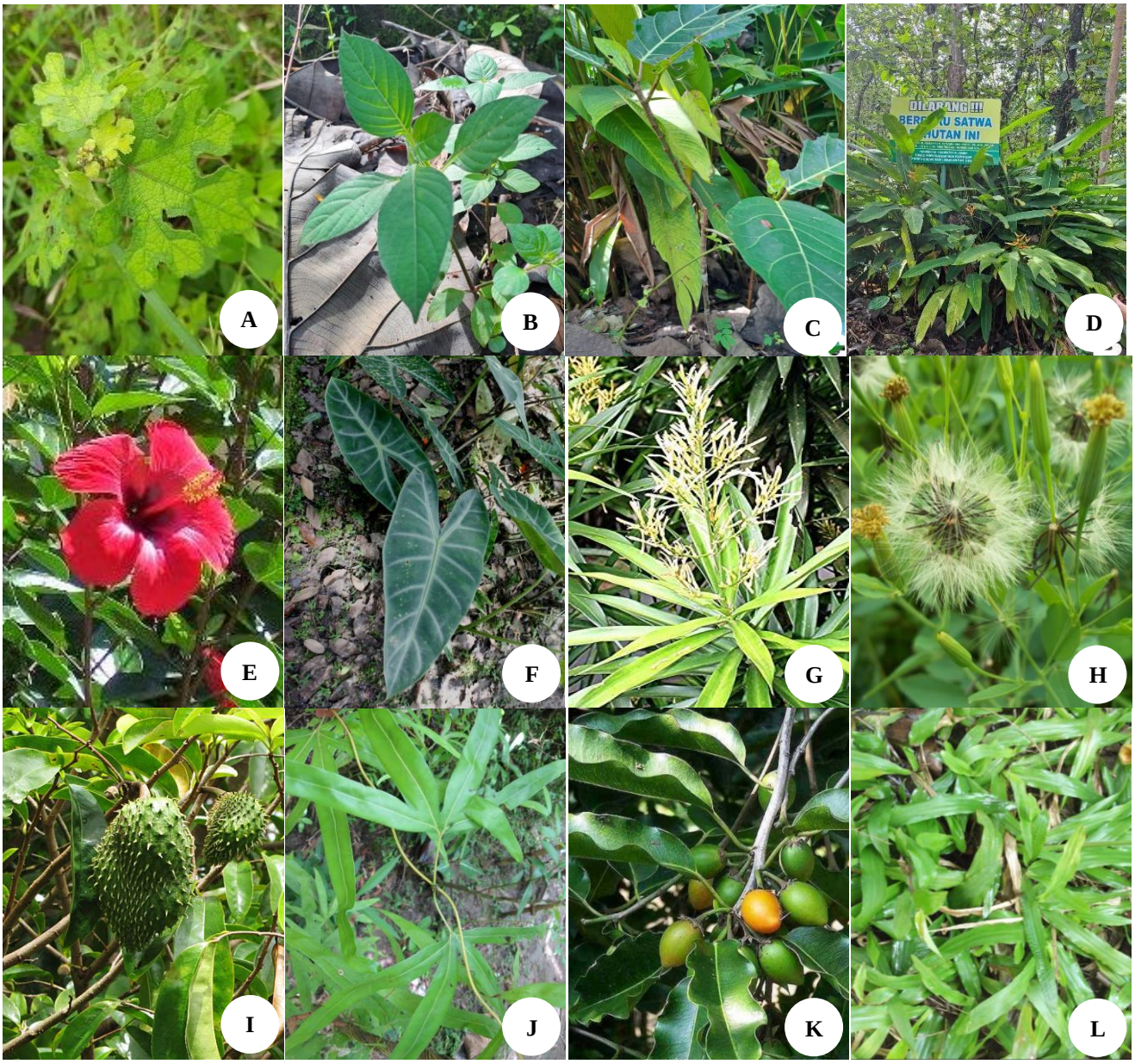

Figure 5. Some non-timber vascular plants found in Ayah Forest, Kebumen District, Central Java, Indonesia. A. *Urena lobata*, B. *Ruellia tuberosa*, C. *Ficus septica*, D. *Heliconia psittacorum*, E. *Hibiscus rosa-sinensis*, F. *Alternanthera sessilis*, G. *Dracaena angustifolia*, H. *Porophyllum ruderale*, I. *Annona muricata*, J. *Lygodium circinnatum*, K. *Schleichera oleosa*, L. *Brachiaria mutica*

Natural coloring

Based on the number of species obtained in the study, one species of plant found in the forests of Ayah Village could be used as a natural dye. The plant is *Dracaena angustifolia* (*suji*). A member of the *Dracaena* genus, *D. angustifolia*, also known as the suji leaf plant, is a widespread species and has long been used in Southeast Asia, including Indonesia. The *D. angustifolia* leaves are often used as a natural food coloring. That is because the chlorophyll pigment, which gives *suji* leaves their natural green color, is present. In the process, the *D. angustifolia* leaves are filtered after kneading with water. Next, *D. angustifolia* leaves are squeezed to release chlorophyll pigment (Andila and Warseno 2019). The juice from *D. angustifolia* leaves was then added to the cooking process to give color to the food. The high chlorophyll concentration in suji leaves simplifies chlorophyll extraction (Andistari et al. 2014).

Flavoring

There are two species from two families that have the potential to be used for food flavoring. The leaves of *Porophyllum ruderale* have an aromatic fragrance that can be used as a flavoring spice. The *P. ruderale* can be used as a condiment or spice in making traditional sauces known as "salsa" for mixed foods and soups in Mexico and South America (Putro 2021). Besides being known as kitchen lemongrass, *Cymbopogon citratus* is also known for its

distinctive smell, like fresh lemon and orange taste. This aroma is obtained from citral compounds in lemongrass essential oil (Wany et al. 2013). Lemongrass and citronella essential oils have antifungal and antibacterial properties (Han and Tory 2017). Therefore, Lemongrass leaves have a fragrant aroma traditionally used to scent food. Besides being a food flavoring, lemongrass can be used as an herbal drink, essential oil, and aromatherapy. Therefore, to make flavoring from lemongrass is done by drying the leaves first then the dried leaves are made into powder. Once powdered, this flavoring can be used for soups, salads, and curries (Shah et al. 2011).

Beverage ingredients

Three types of plants have the potential to be used as a drink, namely *M. indica, A. muricata*, and *Coffea canephora*. Mango (*M. indica)* can be made into drinks such as juice and syrup. Drinks made from mangoes are efficacious as antioxidants to increase endurance (Handayani et al. 2020). Coffee *(C. canephora)* is believed to be a drink that can be used to relieve sleepiness, increase alertness, and elevate mood. That is because coffee contains caffeine (Latunra et al. 2021). Several variations of processed drinks can be made from coffee beans, one of which is brown coffee (Faturrahman et al. 2021). Soursop fruit *(A. muricata)* and leaves can be used to make drinks such as juice. Soursop leaves can be used as a tea to treat cancer (Adri and Hersoelistyorini 2013). Soursop leaves can also be used as the base for making ice cream because soursop leaves contain annonaceous acetogenin compounds, which are good for health (Aulia and Purwidiani 2017).

Woven craft

Indonesia's nature provides quite a lot of diversity of plants that can be used as raw materials for the handicraft industry, including weaving. Producing woven products from plant materials requires knowledge and experience in recognizing plants with long and robust fibers (Yoese et al. 2019). In the research that was conducted by tracing the forests of Ayah Village, there is one type of plant that has the potential to be used as woven handicrafts, namely *Lygodium circinnatum*, which is a plant that belongs to the Lygodiaceae family. The *L. circinnatum* (rhizome) is used as raw materials for the woven craft industry. Woven handicraft products include baskets, bags, trays, fruit containers, and other souvenirs. Crafts from *L. circinnatum* grass products sell well locally (Susila et al. 2019).

Animal feed

Based on the number of species obtained in this study, seven families in the Ayah Forest can be used as animal feed, including *Brachiaria mutica, Melinis minutiflora, Panicum repens, S. bicolor, Cyperus kyllingia, Themeda arguens*, and *Schleichera oleosa.* Of the seven types of plant species that can be used as animal feed, there is one dominant family, namely the Poaceae family, which consists of the grass family. At first, people thought weeds were useless and even a nuisance, so they sometimes threw them away and burned them, but these grasses can be used as animal feed, which has many benefits and properties that are good for animals. For example, grass has good nutrition and can launch the metabolic system of animals (Penu 2021).

In conclusion, tropical karst ecosystems support the life of various non-timber vascular plants, with various potential benefits. Based on research that has been conducted, 111 species from 44 families have been found growing in Ayah Forest, Ayah Village, Ayah Sub-district, Kebumen, Central Java, Indonesia. The vascular plants found during the research had different potentials, so in this study, eight prospects were found that could be utilized from vascular plants in Ayah Forest, including: ornamental plants (16 species), medicinal plants (68 species), foodstuffs (13 species), beverage ingredients (3 species), flavoring (2 species), natural dyes (1 species), animal feed (6 species) and woven crafts (1 species).

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