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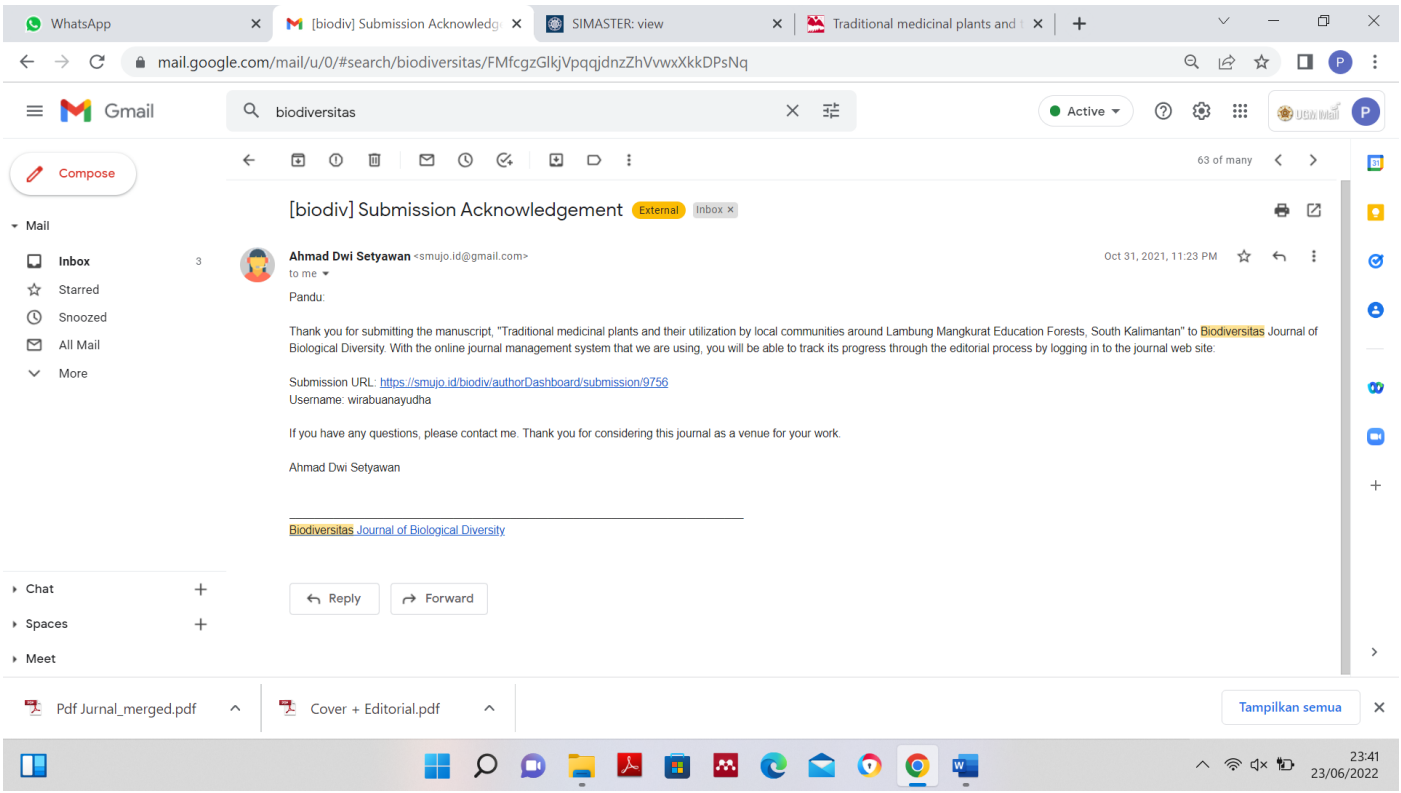

COVERING LETTER

Dear **Editor-in-Chief,**

I herewith enclosed a research article,

Title:

Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

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This study found there were 56 medicinal plant species that naturally distributed in Lambung Mangkurat Education Forest. The majority of medicinal plants have habitus as tree wherein their leaves were commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of Lambung Mangkurat Education Forest has a potential to support the important role of forest ecosystems for people health.

Statements:

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Place and date:

Yogyakarta, 31th October 2021

Sincerely yours,

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Pandu Yudha Adi Putra Wirabuana

Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

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Abstract. Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal plants. However, the data of medicinal plants in LMEF is still not good recorded even though it has been widely used by local communities. This study aimed to document the list of medicinal plant species that naturally grown in LMEF and to analyze the community perceptions of those medicinal plant utilization. Data were collected by exploratory surveys through field observation and also interview with people living in villages around LMEF. The inventory of medicinal plants were conducted by line transect method with a size of 1,000 m long and 20 m wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty respondents who lived around LMEF. Results showed that there were 56 medicinal plant species that naturally distributed in LMEF. The majority of medicinal plants have habitus as trees wherein their leaves were commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF has a potential to support the important role of forest ecosystems for people health.

Key words: forest ecosystems, local communities, people health, plant diversity, traditional medicine

Running title: Traditional medicinal plant and their utilization

INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area located in South Kalimantan. This area is managed by Universitas Lambung Mangkurat based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with high diversity of flora dan fauna. Besides managing as education and training forest, this site is also directed as one of the conservation area. Therefore, the activity of natural resources utilization inside of LMEF is relatively limited in order to protect this area from various disturbance and threats.

There are various potential resources that have been identified from LMEF. Some of the potential resources have even been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, there are other potentials that have not been revealed. Among those potential resources, the existence of medicinal plants become one of the most important information that should be investigated.

Medicinal plants are important resources because they are required by many people for healing diseases. Compared to chemical drugs, the medicinal plants are more safely for consumption due to the low risk of side effect. The distribution of medicinal plants in a special purpose forest area has been also reported by several previous studies from different location. For examples, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area located in Rantau found forty-one species of medicinal plants from various plant habitus (Suryanto and Syaifuddin 2017). Meanwhile, another similar study in Samboja found approximately thirty-seven of medicinal plants that naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still not available even though this information is required to preserve biodiversity in this area.

This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia, but also can be used as materials for socializing the

sustainability of these biological resources to the community around LMEF and also as research material to enrich pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

MATERIALS AND METHODS

Study area

The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiangin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data about community perception for medicinal plants utilization were collected from the local people who only live in the East Mandiangin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.

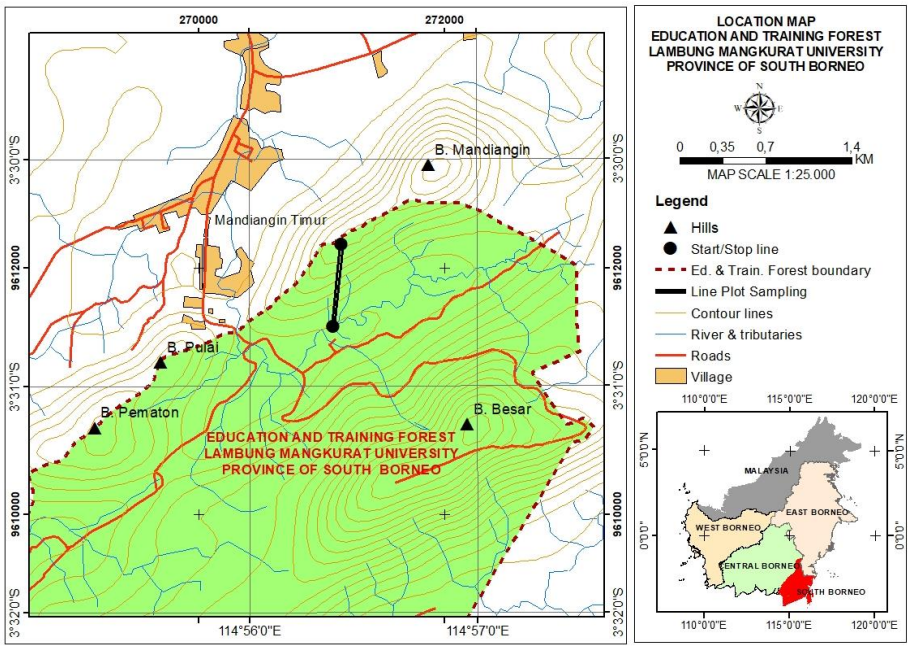

Figure 1. Map of study site in Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in an area of about 20,000 m^2. This rectangular area is formed from a straight cruising path of one kilometer long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at a height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

To identify the plant components that functioned as medicine and their utilization, interviews were conducted with fifty respondent who considered to be healers and the public directly using medicinal plants. All of these respondents are residents of East MandianginVillage, whose total population is 496 households. From this interview the specific information can be obtained including plant species and how to use them so that they are called medicinal plants as well as people's perceptions of these plants.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into specific table, consisting of family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, as well as the name of the disease or disorder that is cured and the method of processing that part of the plant. Public perception consists of three categories: positive, negative, and no opinion. All three are expressed in percentage which is the ratio of the total number of answers to the questionnaire submitted to the public.

RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). This number is higher than the number of medicinal plant species reported from several KHDTKs in Indonesia as mentioned above. However, based on the following two situations, that number is actually quite small.

First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only 0.12% of the total area of LMFE which reaches 1,627 hectares.

Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (Alphitonia excelsa) (Rusida et al. 2019), kimalaka (Phyllanthus emblica) (Matnasir et al. 2020), pulantan (Alstonia scholaris) (Wibisono et al. 2020), and tikusan (Clausena excavata) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as antimicrobial, antidiarrheal, antidysentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020). Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al. 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng).
Cannabaceae			
Trema tomentosa; balik angin	Tree	Stem	Anti mosquito bites. The bark is directly applied to the body.

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut and the water that comes out of the cut stem is drunk.
Euphorbiaceae			
Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a little kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots with a length of about 5 cm are boiled and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boostering/maintaining stamina or male virility. Leaves or young leaves are boiled and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example when in the forest. The bark is burned and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent.
Syzigium polyanthum; salam	Tree	Leaves	Hypertension medication. Five leaves are boiled and the water is drunk.

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut and the dripping liquid is drunk.
Oxalidaceae			
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and then rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled and the boiled water is used for gargling.
Passifloraceae			
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about 10 clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled and the boiled water is drunk. Roots can still be reused for at least 3 times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled and the boiled

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
			water is then drunk.
Vitaceae			
Tetrastigma sp.*;* ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut and the water that drips from the stems is then drunk.
Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.
Zingerberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

Habitus of medicinal plants that are most often used were trees (50%). The next habitus, from the most frequent to the least used were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are plant habitus which are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

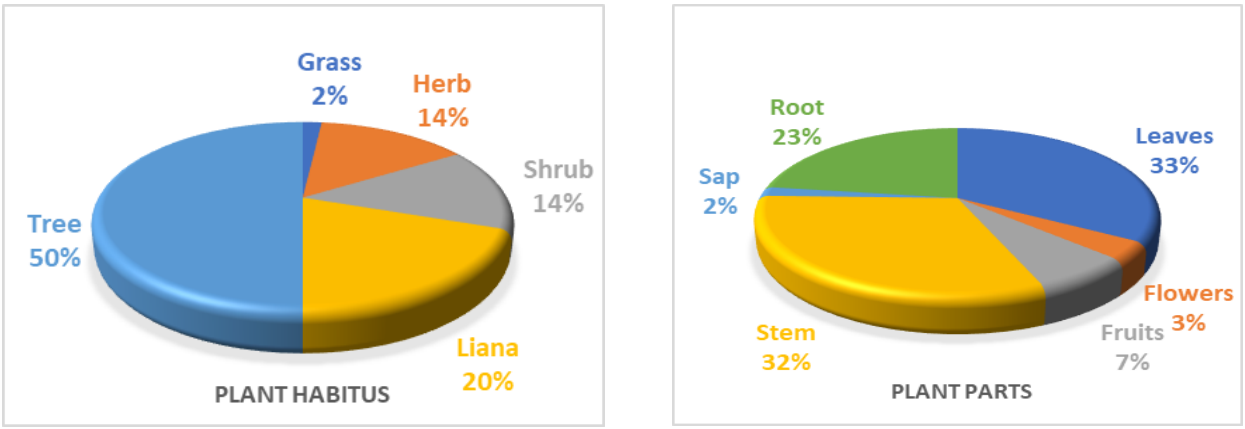

Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community, although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and the community in Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared, washed, splashed (or used as a washing agent), rubbed, inhaled, or left in the air to repel nuisance animals. However, the plants previously must be prepared by adding or not adding additional ingredients, crushing, or burning. To crush it, the

medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled. This process depends on the hardness of the plant parts.

There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1) solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *kuali* (a clay cauldron/pot/kettle) and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes that drying is an initial process before parts of medicinal plants are boiled and the aim is so that no sap is absorbed in the body when drunk.

Boiling is the process most often done in the preparation of drugs. The frequency reaches more than 43% (Figure 3). Boiling parts of medicinal plants is believed by the Kanayatn Dayak Ethnic, West Kalimantan so that the active ingredients dissolve quickly in water and heal faster after drinking the boiled water (Sari et al. 2021).

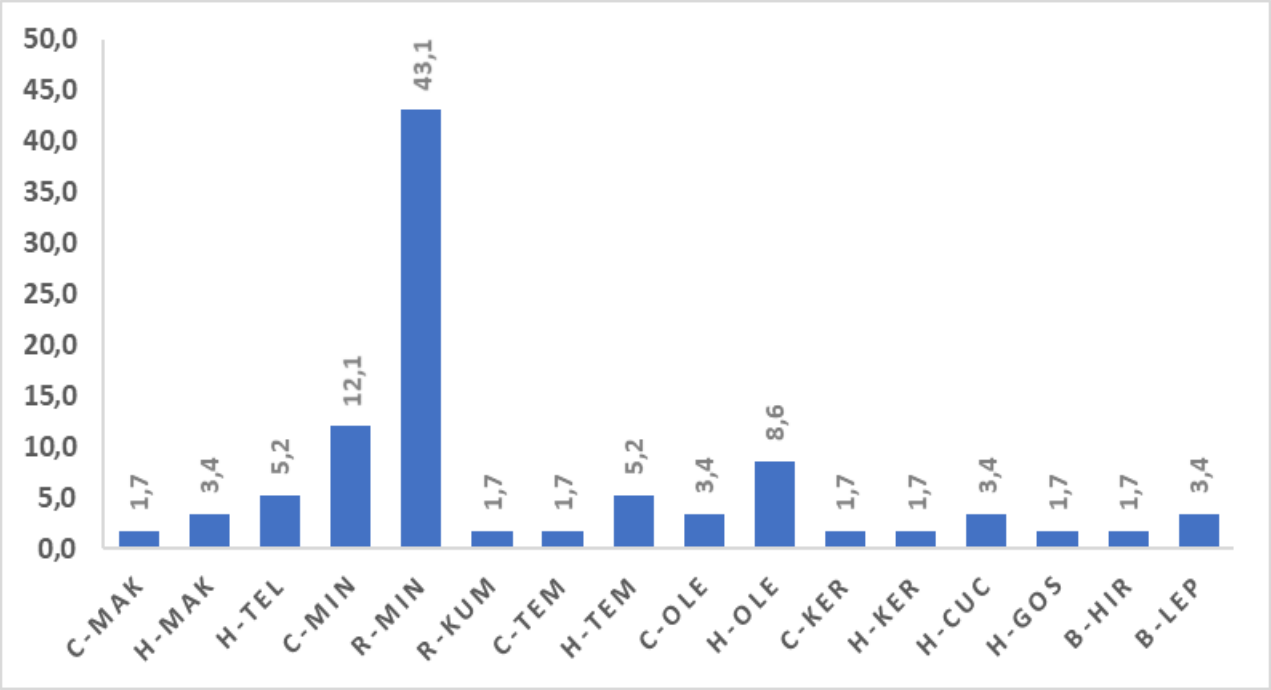

Figure 3. Frequency of drug preparation from plants and how to use them

Keterangan:
C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients
H-MAK = medicinal plant parts are crushed before being eaten
H-TEL = medicinal plant parts are crushed before being swallowed
C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients
R-MIN = parts of medicinal plants are boiled before the boiled water is drunk
R-KUM = parts of medicinal plants are boiled before gargling the boiled water air
C-TEM = parts of medicinal plants affixed with or without a mixture of other materials
H-TEM = parts of medicinal plants are crushed before being pasted
C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients
H-OLE = medicinal plant parts are crushed before being applied
C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients
H-KER = medicinal plant parts are crushed before washing
H-CUC = medicinal plant parts are crushed before being used to wash things
H-GOS = medicinal plant parts crushed before rubbing
B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled
B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

People Perception to Medicinal Plants

The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All respondents have used mobile phones as a means of communication because the internet network has been operated to this village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine that uses medicinal plants (Table 2).

Tabel 2. People perception of treatment using medicinal plants

No	People perception	Ratio (%)	Reasons
1	Positive	74,0	Traditional medicine is natural, has no side effects, is cheap, and easy to get; is an alternative choice of chemical drugs; does not require a doctor's prescription.
2	Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor, it is feared that it has side effects, is not practical, and is inefficient.
3	No opinion	6,0	People don't know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third, medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that the user has never suffered before appears.

The positive perception is in line with the condition that in the midst of modern medicine efforts with improved health services, traditional treatment or healing with medicinal plants is still applied by almost 80% of the world's population (Mbuni et al. 2020), starting from people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); even on the European continent, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, it is not impossible that the positive trend of returning to nature continues to increase, especially until now the Covid-19 pandemic continues to spread throughout the world and the treatment of diseases caused by the virus has not been found. Plants that have the potential to prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases, with the plant part that is widely used for treatment is the leaves and the processing method is mostly by boiling.

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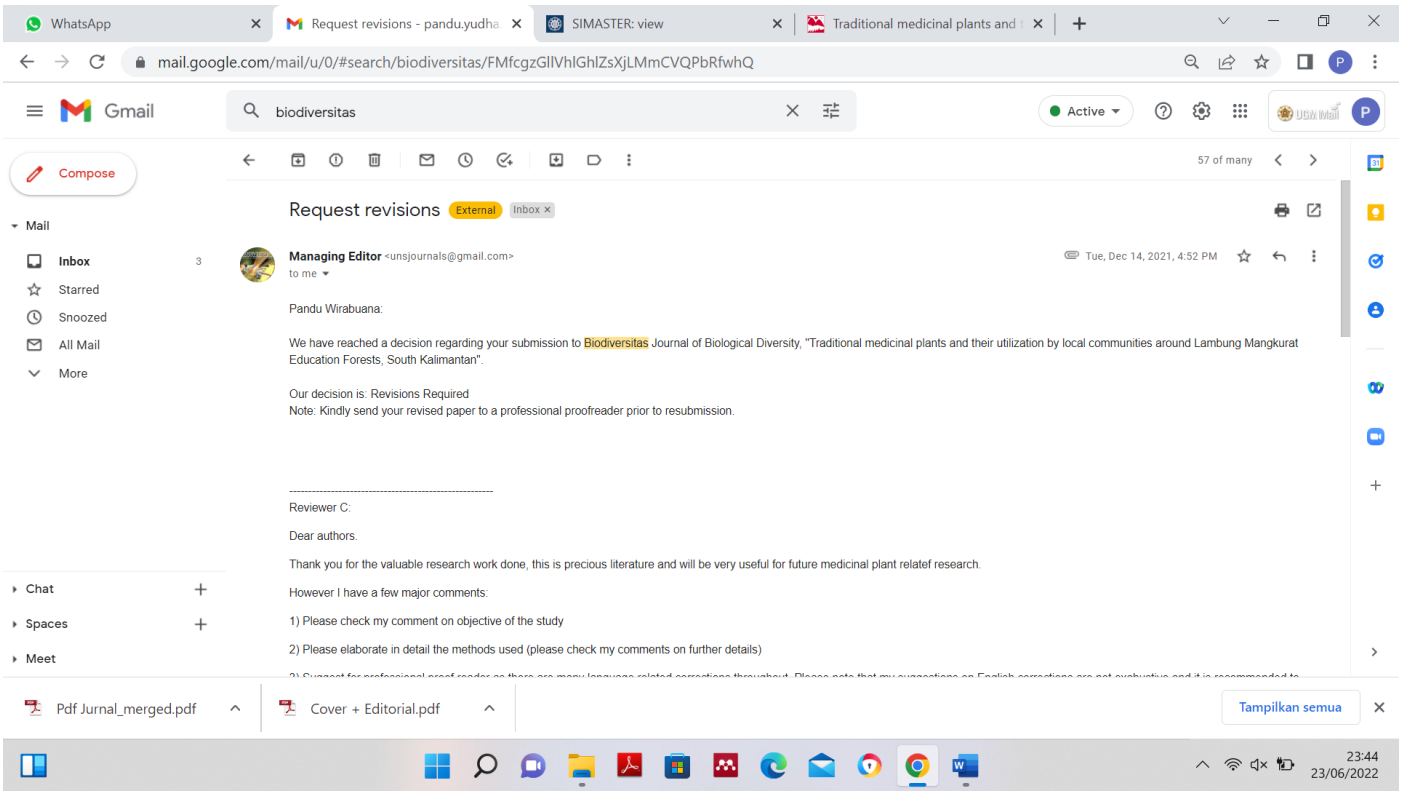

Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

Abstract. Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal plants. However, the data of medicinal plants in LMEF is still not good recorded even though it has been widely used by local communities. This study aimed to document the list of medicinal plant species that naturally grown in LMEF and to analyze the community perceptions of those medicinal plant utilization. Data were collected by exploratory surveys through field observation and also interview with people living in villages around LMEF. The inventory of medicinal plants were conducted by line transect method with a size of 1,000 m long and 20 m wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty respondents who lived around LMEF. Results showed that there were 56 medicinal plant species that naturally distributed in LMEF. The majority of medicinal plants have habitus as trees wherein their leaves were commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF has a potential to support the important role of forest ecosystems for people health.

Key words: forest ecosystems, local communities, people health, plant diversity, traditional medicine

INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area located in South Kalimantan. This area is managed by Universitas Lambung Mangkurat based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with high diversity of flora dan fauna. Besides managing as education and training forest, this site is also directed as one of the conservation area. Therefore, the activity of natural resources utilization inside of LMEF is relatively limited in order to protect this area from various disturbance and threats.

There are various potential resources that have been identified from LMEF. Some of the potential resources have even been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, there are other potentials that have not been revealed. Among those potential resources, the existence of medicinal plants become one of the most important information that should be investigated.

Medicinal plants are important resources because they are required by many people for healing diseases. Compared to chemical drugs, the medicinal plants are more safely for consumption due to the low risk of side effect. The distribution of medicinal plants in a special purpose forest area has been also reported by several previous studies from different location. For examples, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area located in Rantau found forty-one species of medicinal plants from various plant habitus (Suryanto and Syaifuddin 2017). Meanwhile, another similar study in Samboja found approximately thirty-seven of medicinal plants that naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still not available even though this information is required to preserve biodiversity in this area.

This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia, but also can be used as materials for socializing the sustainability of these biological resources to the community around LMEF and also as research material to enrich pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

MATERIALS AND METHODS

Study area

The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiangin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data about community perception for medicinal plants utilization were collected from the local people who only live in the East Mandiangin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.

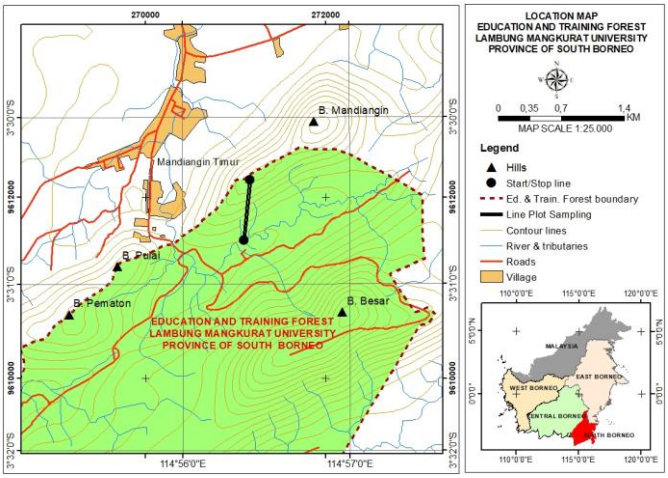

Figure 1. Map of study site in Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in an area of about 20,000 m^2. This rectangular area is formed from a straight cruising path of one kilometer long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at a height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

To identify the plant components that functioned as medicine and their utilization, interviews were conducted with fifty respondent who considered to be healers and the public directly using medicinal plants. All of these respondents are residents of East MandianginVillage, whose total population is 496 households. From this interview the specific information can be obtained including plant species and how to use them so that they are called medicinal plants as well as people's perceptions of these plants.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into specific table, consisting of family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, as well as the name of the disease or disorder that is cured and the method of processing that part of the plant. Public perception consists of three categories: positive, negative, and no opinion. All three are expressed in percentage which is the ratio of the total number of answers to the questionnaire submitted to the public.

RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). This number is higher than the number of medicinal plant species reported from several KHDTKs in Indonesia as mentioned above. However, based on the following two situations, that number is actually quite small.

First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only 0.12% of the total area of LMFE which reaches 1,627 hectares.

Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (Alphitonia excelsa) (Rusida et al. 2019), kimalaka (Phyllanthus emblica) (Matnasir et al. 2020), pulantan (Alstonia scholaris) (Wibisono et al. 2020), and tikusan (Clausena excavata) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as antimicrobial, antidiarrheal, antidysentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020). Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al. 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng).
Cannabaceae			
Trema tomentosa; balik angin	Tree	Stem	Anti mosquito bites. The bark is directly applied to the body.
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut and the water that comes out of the cut stem is drunk.
Euphorbiaceae			

Commented [MK1]: "Medicine, drug, etc." The use of such terms should be avoided. Because in order to be a drug, they have to pass the necessary stages by the health boards and so on. The definition of "treatment" would be more appropriate here.

Commented [MK2]: Same as the above description.

Commented [MK3]: Same as the above description.

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a little kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots with a length of about 5 cm are boiled and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boostering/maintaining stamina or male virility. Leaves or young leaves are boiled and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example when in the forest. The bark is burned and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent.
Syzigium polyanthum; salam	Tree	Leaves	Hypertension medication. Five leaves are boiled and the water is drunk.
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut and the dripping liquid is drunk.
Oxalidaceae			
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and then rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled and the boiled water is used for gargling.
Passifloraceae			

Commented [MK4]: "Medicine, drug, etc." The use of such terms should be avoided. Because in order to be a drug, they have to pass the necessary stages by the health boards and so on. The definition of "treatment" would be more appropriate here.

Commented [MK5]: Not for medical use. At best, this is an ethnobotanical use.

Commented [MK6]: Plants used as insect repellents cannot be considered medicinal plants.

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about 10 clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled and the boiled water is drunk. Roots can still be reused for at least 3 times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled and the boiled water is then drunk.
Vitaceae			
Tetrastigma sp.*;* ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut and the water that drips from the stems is then drunk.
Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.
Zingerberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

Habitus of medicinal plants that are most often used were trees (50%). The next habitus, from the most frequent to the least used were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are plant habitus which are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

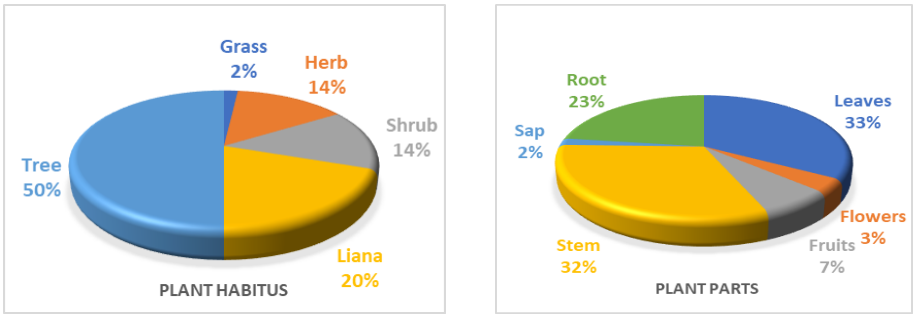

Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community, although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and the community in Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared, washed, splashed (or used as a washing agent), rubbed, inhaled, or left in the air to repel nuisance animals. However, the plants previously must be prepared by adding or not adding additional ingredients, crushing, or burning. To crush it, the medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled. This process depends on the hardness of the plant parts.

There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1) solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *kuali* (a clay cauldron/pot/kettle) and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes that drying is an initial process before parts of medicinal plants are boiled and the aim is so that no sap is absorbed in the body when drunk.

Boiling is the process most often done in the preparation of drugs. The frequency reaches more than 43% (Figure 3). Boiling parts of medicinal plants is believed by the Kanayatn Dayak Ethnic, West Kalimantan so that the active ingredients dissolve quickly in water and heal faster after drinking the boiled water (Sari et al. 2021).

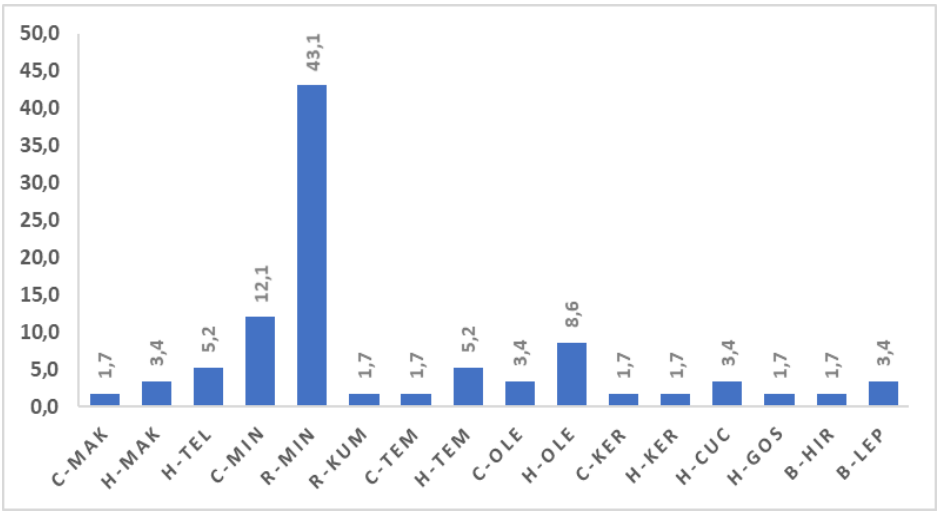

Figure 3. Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE = medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

People Perception to Medicinal Plants

The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All respondents have used mobile phones as a means of communication because the internet network has been operated to this village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine that uses medicinal plants (Table 2).

Tabel 2. People perception of treatment using medicinal plants

People perception	Ratio (%)	Reasons
Positive	74,0	Traditional medicine is natural, has no side effects, is cheap, and easy to get; is an alternative choice of chemical drugs; does not require a doctor's prescription.
Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor, it is feared that it has side effects, is not practical, and is inefficient.
No opinion	6,0	People don't know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the

experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third, medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that the user has never suffered before appears.

The positive perception is in line with the condition that in the midst of modern medicine efforts with improved health services, traditional treatment or healing with medicinal plants is still applied by almost 80% of the world's population (Mbuni et al. 2020), starting from people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); even on the European continent, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, it is not impossible that the positive trend of returning to nature continues to increase, especially until now the Covid-19 pandemic continues to spread throughout the world and the treatment of diseases caused by the virus has not been found. Plants that have the potential to prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases, with the plant part that is widely used for treatment is the leaves and the processing method is mostly by boiling.

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Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

Abstract. Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal plants. However, the data of medicinal plants in LMEF is still not good recorded even though it has been widely used by local communities. This study aimed to document the list of medicinal plant species that naturally grown in LMEF and to analyze the community perceptions of those medicinal plant utilization. Data were collected by exploratory surveys through field observation and also interview with people living in villages around LMEF. The inventory of medicinal plants were conducted by line transect method with a size of 1,000 m long and 20 m wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty respondents who lived around LMEF. Results showed that there were 56 medicinal plant species that naturally distributed in LMEF. The majority of medicinal plants have habitus as trees wherein their leaves were commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF has a potential to support the important role of forest ecosystems for people health.

Key words: forest ecosystems, local communities, people health, plant diversity, traditional medicine

INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area located in South Kalimantan. This area is managed by Universitas Lambung Mangkurat based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with high diversity of flora dan fauna. Besides managing as education and training forest, this site is also directed as one of the conservation area. Therefore, the activity of natural resources utilization inside of LMEF is relatively limited in order to protect this area from various disturbance and threats.

There are various potential resources that have been identified from LMEF. Some of the potential resources have even been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, there are other potentials that have not been revealed. Among those potential resources, the existence of medicinal plants become one of the most important information that should be investigated.

Medicinal plants are important resources because they are required by many people for healing diseases. Compared to chemical drugs, the medicinal plants are more safely for consumption due to the low risk of side effect. The distribution of medicinal plants in a special purpose forest area has been also reported by several previous studies from different location. For examples, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area located in Rantau found forty-one species of medicinal plants from various plant habitus (Suryanto and Syaifuddin 2017). Meanwhile, another similar study in Samboja found approximately thirty-seven of medicinal plants that naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still not available even though this information is required to preserve biodiversity in this area.

This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia, but also can be used as materials for socializing the sustainability of these biological resources to the community around LMEF and also as research material to enrich pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

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MATERIALS AND METHODS

Study area

The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiangin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data about community perception for medicinal plants utilization were collected from the local people who only live in the East Mandiangin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.

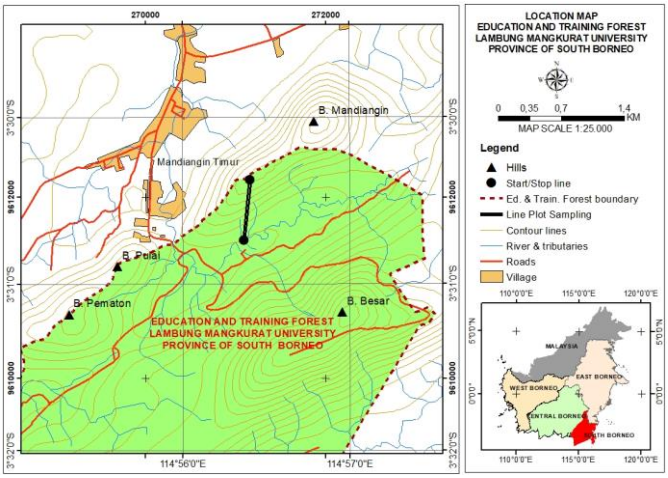

Figure 1. Map of study site in Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in an area of about 20,000 m^2. This rectangular area is formed from a straight cruising path of one kilometer long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at a height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

To identify the plant components that functioned as medicine and their utilization, interviews were conducted with fifty respondent who considered to be healers and the public directly using medicinal plants. All of these respondents are residents of East MandianginVillage, whose total population is 496 households. From this interview the specific information can be obtained including plant species and how to use them so that they are called medicinal plants as well as people's perceptions of these plants.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into specific table, consisting of family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, as well as the name of the disease or disorder that is cured and the method of processing that part of the plant. Public perception consists of three categories: positive, negative, and no opinion. All three are expressed in percentage which is the ratio of the total number of answers to the questionnaire submitted to the public.

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RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). This number is higher than the number of medicinal plant species reported from several KHDTKs in Indonesia as mentioned above. However, based on the following two situations, that number is actually quite small.

First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only 0.12% of the total area of LMFE which reaches 1,627 hectares.

Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (Alphitonia excelsa) (Rusida et al. 2019), kimalaka (Phyllanthus emblica) (Matnasir et al. 2020), pulantan (Alstonia scholaris) (Wibisono et al. 2020), and tikusan (Clausena excavata) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as antimicrobial, antidiarrheal, antidysentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020). Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al. 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng).
Cannabaceae			
Trema tomentosa; balik angin	Tree	Stem	Anti mosquito bites. The bark is directly applied to the body.
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut and the water that comes out of the cut stem is drunk.
Euphorbiaceae			

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Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a little kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots with a length of about 5 cm are boiled and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boostering/maintaining stamina or male virility. Leaves or young leaves are boiled and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example when in the forest. The bark is burned and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent.
Syzigium polyanthum; salam	Tree	Leaves	Hypertension medication. Five leaves are boiled and the water is drunk.
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut and the dripping liquid is drunk.
Oxalidaceae			
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and then rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled and the boiled water is used for gargling.
Passifloraceae			

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Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about 10 clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled and the boiled water is drunk. Roots can still be reused for at least 3 times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled and the boiled water is then drunk.
Vitaceae			
Tetrastigma sp.; ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut and the water that drips from the stems is then drunk.
Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.
Zingerberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

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Habitus of medicinal plants that are most often used were trees (50%). The next habitus, from the most frequent to the least used were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are plant habitus which are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

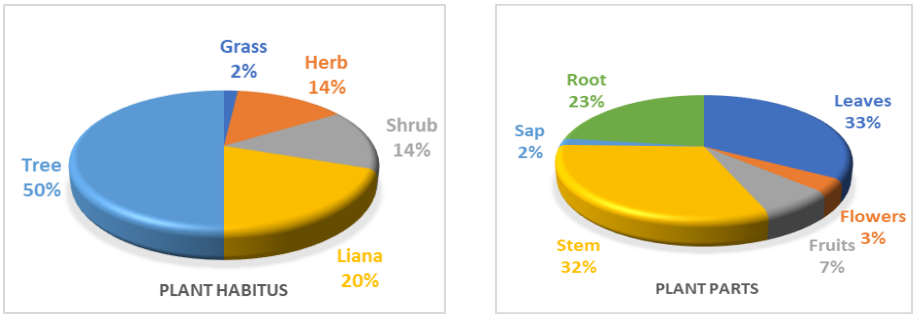

Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community, although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and the community in Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared, washed, splashed (or used as a washing agent), rubbed, inhaled, or left in the air to repel nuisance animals. However, the plants previously must be prepared by adding or not adding additional ingredients, crushing, or burning. To crush it, the medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled. This process depends on the hardness of the plant parts.

There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1) solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *kuali* (a clay cauldron/pot/kettle) and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes that drying is an initial process before parts of medicinal plants are boiled and the aim is so that no sap is absorbed in the body when drunk.

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Boiling is the process most often done in the preparation of drugs. The frequency reaches more than 43% (Figure 3). Boiling parts of medicinal plants is believed by the Kanayatn Dayak Ethnic, West Kalimantan so that the active ingredients dissolve quickly in water and heal faster after drinking the boiled water (Sari et al. 2021).

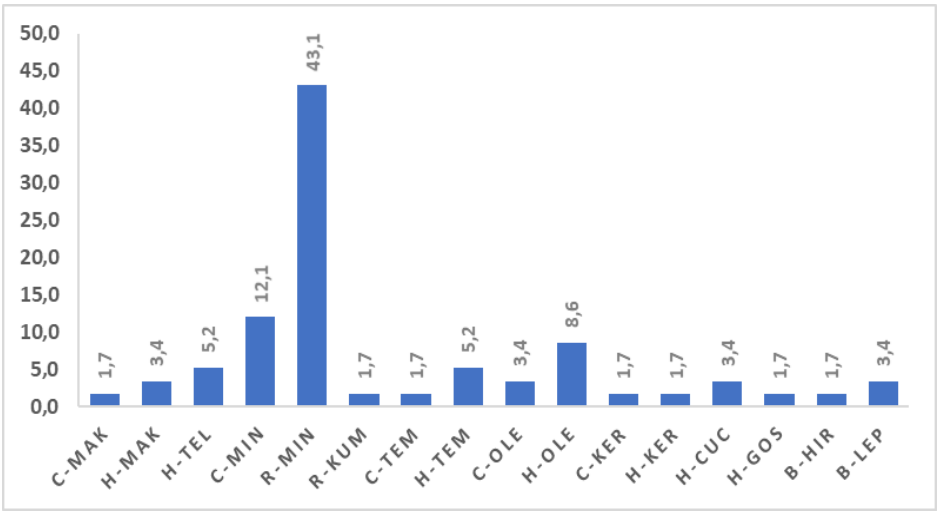

Figure 3. Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE = medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

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People Perception to Medicinal Plants

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The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All respondents have used mobile phones as a means of communication because the internet network has been operated to this village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine that uses medicinal plants (Table 2).

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Tabel 2. People perception of treatment using medicinal plants

People perception	Ratio (%)	Reasons
Positive	74,0	Traditional medicine is natural, has no side effects, is cheap, and easy to get; is an alternative choice of chemical drugs; does not require a doctor's prescription.
Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor, it is feared that it has side effects, is not practical, and is inefficient.
No opinion	6,0	People don't know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the

experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third, medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that the user has never suffered before appears.

The positive perception is in line with the condition that in the midst of modern medicine efforts with improved health services, traditional treatment or healing with medicinal plants is still applied by almost 80% of the world's population (Mbuni et al. 2020), starting from people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); even on the European continent, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, it is not impossible that the positive trend of returning to nature continues to increase, especially until now the Covid-19 pandemic continues to spread throughout the world and the treatment of diseases caused by the virus has not been found. Plants that have the potential to prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases, with the plant part that is widely used for treatment is the leaves and the processing method is mostly by boiling.

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ACKNOWLEDGEMENTS

We express our gratitude to the Chairperson of LMFE who gave us permission to enter this forest area. We also express our great appreciation to Mahyani and team who helped collect data in the field..

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Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

Abstract. Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal plants. However, the data of medicinal plants in LMEF is still not good recorded even though it has been widely used by local communities. This study aimed to document the list of medicinal plant species that naturally grown in LMEF and to analyze the community perceptions of those medicinal plant utilization. Data were collected by exploratory surveys through field observation and also interview with people living in villages around LMEF. The inventory of medicinal plants were conducted by line transect method with a size of 1,000 m long and 20 m wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty respondents who lived around LMEF. Results showed that there were 56 medicinal plant species that naturally distributed in LMEF. The majority of medicinal plants have habitus as trees wherein their leaves were commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF has a potential to support the important role of forest ecosystems for people health.

Key words: forest ecosystems, local communities, people health, plant diversity, traditional medicine

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INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area located in South Kalimantan. This area is managed by Universitas Lambung Mangkurat based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with high diversity of flora dan fauna. Besides managing as education and training forest, this site is also directed as one of the conservation area. Therefore, the activity of natural resources utilization inside of LMEF is relatively limited in order to protect this area from various disturbance and threats.

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There are various potential resources that have been identified from LMEF. Some of the potential resources have even been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, there are other potentials that have not been revealed. Among those potential resources, the existence of medicinal plants become one of the most important information that should be investigated.

Medicinal plants are important resources because they are required by many people for healing diseases. Compared to chemical drugs, the medicinal plants are more safely for consumption due to the low risk of side effect. The distribution of medicinal plants in a special purpose forest area has been also reported by several previous studies from different location. For examples, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area located in Rantau found forty-one species of medicinal plants from various plant habitus (Suryanto and Syaifuddin 2017). Meanwhile, another similar study in Samboja found approximately thirty-seven of medicinal plants that naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still not available even though this information is required to preserve biodiversity in this area.

This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia, but also can be used as materials for socializing the sustainability of these biological resources to the community around LMEF and also as research material to enrich pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

MATERIALS AND METHODS

Study area

The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiangin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data about community perception for medicinal plants utilization were collected from the local people who only live in the East Mandiangin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.

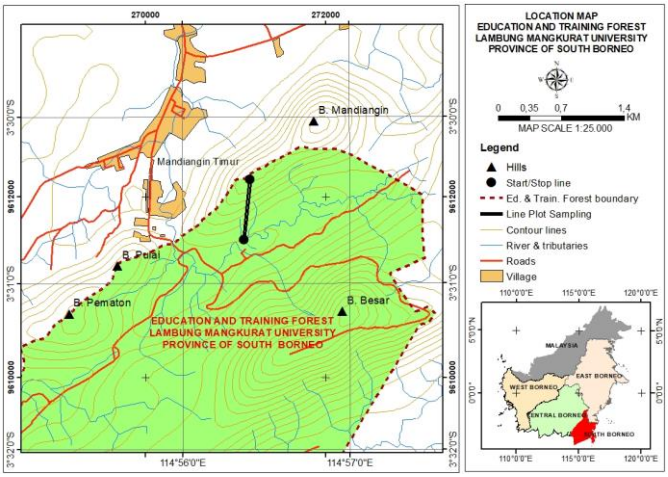

Figure 1. Map of study site in Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in an area of about 20,000 m^2. This rectangular area is formed from a straight cruising path of one kilometer long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at a height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

To identify the plant components that functioned as medicine and their utilization, interviews were conducted with fifty respondent who considered to be healers and the public directly using medicinal plants. All of these respondents are residents of East MandianginVillage, whose total population is 496 households. From this interview, the specific information can be obtained including plant species and how to use them so that they are called medicinal plants as well as people's perceptions of these plants.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into a specific table, consisting of the family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, as well as the name of the disease or disorder that is cured and the method of processing that part of the plant. Public perception consists of three categories: positive, negative, and no opinion. All three are expressed in percentage which is the ratio of the total number of answers to the questionnaire submitted to the public.

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RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). This number is higher than the number of medicinal plant species reported from several KHDTKs in Indonesia as mentioned above. However, based on the following two situations, that number is actually quite small.

First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only 0.12% of the total area of LMFE which reaches 1,627 hectares.

Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (*Alphitonia excelsa*) (Rusida et al. 2019), kimalaka (Phyllanthus emblica) (Matnasir et al. 2020), pulantan (Alstonia scholaris) (Wibisono et al. 2020), and tikusan (Clausena excavata) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as antimicrobial, antidiarrheal, antidysentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020). Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al. 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

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Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale L.; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng).
Cannabaceae			
Trema tomentosa; balik angin	Tree	Stem	Anti mosquito bites. The bark is directly applied to the body.
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut and the water that comes out of the cut stem is drunk.
Euphorbiaceae			

Commented [S9]: name of the author? You should add the all the species 'author name'

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a little kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots with a length of about 5 cm are boiled and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boostering/maintaining stamina or male virility. Leaves or young leaves are boiled and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example when in the forest. The bark is burned and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent.
Syzigium polyanthum; salam	Tree	Leaves	Hypertension medication. Five leaves are boiled and the water is drunk.
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut and the dripping liquid is drunk.
Oxalidaceae			
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and then rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled and the boiled water is used for gargling.
Passifloraceae			

Commented [S10]: t Could the species not be identified? Which species or all the taxa of genus used for this disease?

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about 10 clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled and the boiled water is drunk. Roots can still be reused for at least 3 times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled and the boiled water is then drunk.
Vitaceae			
Tetrastigma sp.; ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut and the water that drips from the stems is then drunk.
Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.
Zingerberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

Habitus of medicinal plants that are most often used were trees (50%). The next habitus, from the most frequent to the least used were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are plant habitus which are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

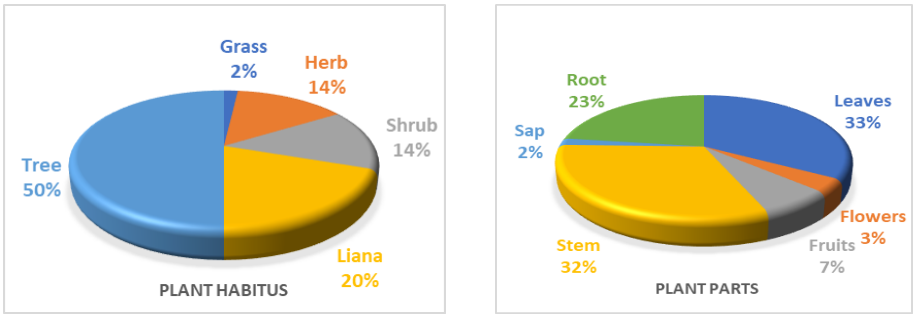

Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community, although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and the community in Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared, washed, splashed (or used as a washing agent), rubbed, inhaled, or left in the air to repel nuisance animals. However, the plants previously must be prepared by adding or not adding additional ingredients, crushing, or burning. To crush it, the medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled. This process depends on the hardness of the plant parts.

There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1) solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *kuali* (a clay cauldron/pot/kettle) and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes that drying is an initial process before parts of medicinal plants are boiled and the aim is so that no sap is absorbed in the body when drunk.

Boiling is the process most often done in the preparation of drugs. The frequency reaches more than 43% (Figure 3). Boiling parts of medicinal plants is believed by the Kanayatn Dayak Ethnic, West Kalimantan so that the active ingredients dissolve quickly in water and heal faster after drinking the boiled water (Sari et al. 2021).

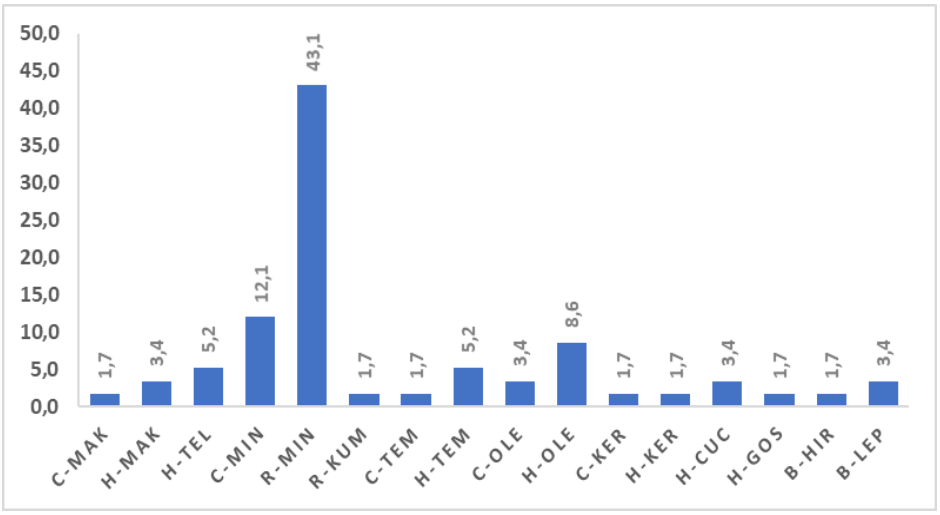

Figure 3. Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE = medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

People Perception to Medicinal Plants

The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All respondents have used mobile phones as a means of communication because the internet network has been operated to this village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine that uses medicinal plants (Table 2).

Tabel 2. People perception of treatment using medicinal plants

People perception	Ratio (%)	Reasons
Positive	74,0	Traditional medicine is natural, has no side effects, is cheap, and easy to get; is an alternative choice of chemical drugs; does not require a doctor's prescription.
Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor, it is feared that it has side effects, is not practical, and is inefficient.
No opinion	6,0	People don't know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the

experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third, medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that the user has never suffered before appears.

The positive perception is in line with the condition that in the midst of modern medicine efforts with improved health services, traditional treatment or healing with medicinal plants is still applied by almost 80% of the world's population (Mbuni et al. 2020), starting from people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); even on the European continent, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, it is not impossible that the positive trend of returning to nature continues to increase, especially until now the Covid-19 pandemic continues to spread throughout the world and the treatment of diseases caused by the virus has not been found. Plants that have the potential to prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases, with the plant part that is widely used for treatment is the leaves and the processing method is mostly by boiling.

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Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan, Indonesia

Abstract. Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal plants. However, an inventory ~~, the data~~ of medicinal plants in LMEF has not been ~~, is still not good~~ recorded even though it has been widely used by local communities. This study aimed to document the list of medicinal plant species that naturally grow ~~grown~~ in LMEF and ~~to~~ analyze the community perceptions of ~~those~~ the medicinal plant utilization in the region. Data were collected by exploratory surveys through field observation and also interviewing ~~, with~~ people living in villages around LMEF. The inventory of medicinal plants were conducted by line transect method with a size of 1,000 m long and 20 m wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty respondents who lived around LMEF. Results showed that there were 56 medicinal plant species ~~that~~ naturally distributed in LMEF. The majority of medicinal plants are ~~have habitus as~~ trees wherein their leaves are ~~were~~ commonly used by local communities as traditional medicine. To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more than 70% of respondent prefer the use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF ~~has a~~ potentially ~~to~~ support ~~the important role of~~ forest ecosystems for people health.

Key words: forest ecosystems, local communities, people health, plant diversity, traditional medicine

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INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area located in South Kalimantan. This area is managed by Universitas Lambung Mangkurat based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with high diversity of flora and ~~dan~~ fauna. Besides being managed ~~ing~~ as an educational and training forest, this site is also ~~directed~~ used as one of the conservation area. Therefore, the activity of natural resources utilization inside of LMEF is relatively limited in order to protect this area from various disturbance and threats.

There are various potential resources that have been identified from LMEF. Some of the potential resources have even been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, there are other potentials that have not been revealed. Among those potential resources, the existence of medicinal plants become one of the most important information that should be investigated.

Medicinal plants are important resources because they are required by many people for healing diseases. Compared to chemical drugs, the medicinal plants are more safely for consumption due to the low risk of side effect. The distribution of medicinal plants in a special purpose forest area has been also reported by several previous studies from different location. For examples, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area located in Rantau found forty-one species of medicinal plants from various plant habitus (Suryanto and Syaifuddin 2017). Meanwhile, another similar study in Samboja found approximately thirty-seven of medicinal plants that naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still not available even though this information is required to preserve biodiversity in this area.

This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia, but also can be used as materials for socializing the

sustainability of these biological resources to the community around LMEF and also as research material to enrich pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

MATERIALS AND METHODS

Study area

The medicinal plants ~~inventory were~~inventory was conducted at the northern area of LMEF. The geographic coordinates for this site are ~~is located in~~ E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiangin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). ~~On another side, the d~~ Data on~~about community perception for~~ medicinal plants utilization were collected from the local people who only live in the East Mandiangin Village. The ~~is~~ village is ~~the closest~~ in the rural area and close to the LMEF and can be accessed using motorcycle or car.

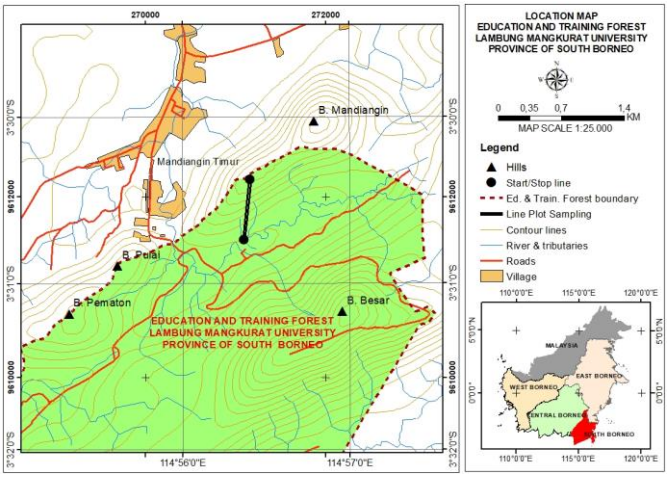

Figure 1. ~~Map of study site in~~ Location of Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in an area of about 20,000 m^2. This rectangular area is formed from a straight cruising path of one kilometer long and 20 m wide. Medicinal Plants were ~~are~~ grouped into five habits ~~habitus,~~ namely grasses, herbs, shrubs, lianas, and trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs ~~or~~ shrubs refer to non-woody plants(expound). Shrubs refer to woody plants with many branches but a maximum height of about 3 m. ~~Meanwhile,~~ Lianas ~~is~~are ~~a~~ climbing plants that need other plants (hosts) or objects for standing upright as a place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. ~~Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at a height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.~~

To identify the plant components that functioned as medicine and their utilization, interviews were conducted with fifty respondents who are considered to be healers~~, and the public directly using medicinal plants~~. All of these respondents are residents of East Mandiangin Village, whose total population is 496 households. From this interview the specific information can be obtained including plant species and how to use them so that they are called medicinal plants as well as people's perceptions of these plants. The information collected on medicinal plants was documented.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into specific table, consisting of family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, as well as the

name of the disease or disorder that is cured and the method of processing that part of the plant. Public perception consists of three categories: positive, negative, and of no opinion. All three are expressed in percentage which is the ratio of the total number of answers to the questionnaire submitted to the public.

RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). This number is higher than the number of medicinal plant species reported from several KHDTKs in Indonesia as mentioned above. However, based on the following two situations, that number is actually quite small.

First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only 0.12% of the total area of LMFE which reaches 1,627 hectares.

Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (Alphitonia excelsa) (Rusida et al. 2019), kimalaka (Phyllanthus emblica) (Matnasir et al. 2020), pulantan (Alstonia scholaris) (Wibisono et al. 2020), and tikusan (Clausena excavata) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as antimicrobial, antidiarrheal, antidysentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020). Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al. 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng).
Cannabaceae			

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Trema tomentosa; balik angin	Tree	Stem	Anti mosquito bites. The bark is directly applied to the body.
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut and the water that comes out of the cut stem is drunk.
Euphorbiaceae			
Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a little kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots with a length of about 5 cm are boiled and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boostering/maintaining stamina or male virility. Leaves or young leaves are boiled and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example when in the forest. The bark is burned and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent.
~~*Syzigium polyanthum;*~~ salam	Tree	Leaves	Hypertension medication. Five leaves are boiled and the water is drunk.
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut and the dripping liquid is drunk.
Oxalidaceae			

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Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and then rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled and the boiled water is used for gargling.
Passifloraceae			
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about 10 clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled and the boiled water is drunk. Roots can still be reused for at least 3 times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled and the boiled water is then drunk.
Vitaceae			
Tetrastigma sp.; ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut and the water that drips from the stems is then drunk.
Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.

Family, species, and local name	Plant habitus	Parts of plant used	Types of diseases/disorders and preparation of medicinal plants
Zingerberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

Habitus of medicinal plants that are most often used were trees (50%). The next habitus, from the most frequent to the least used were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are plant habitus which are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

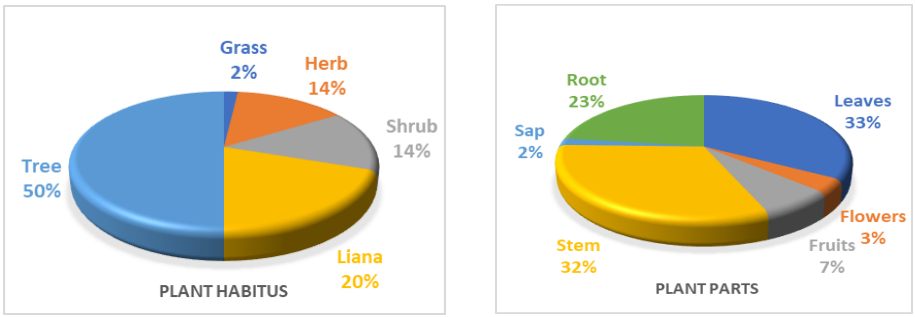

Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community, although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and the community in Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared, washed, splashed (or used as a washing agent), rubbed, inhaled, or left in the air to repel nuisance animals. However, the plants previously must be prepared by adding or not adding additional ingredients, crushing, or burning. To crush it, the medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled. This process depends on the hardness of the plant parts.

There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1) solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *kuali* (a clay cauldron/pot/kettle) and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this

time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes that drying is an initial process before parts of medicinal plants are boiled and the aim is so that no sap is absorbed in the body when drunk.

Boiling is the process most often done in the preparation of drugs. The frequency reaches more than 43% (Figure 3). Boiling parts of medicinal plants is believed by the Kanayatn Dayak Ethnic, West Kalimantan so that the active ingredients dissolve quickly in water and heal faster after drinking the boiled water (Sari et al. 2021).

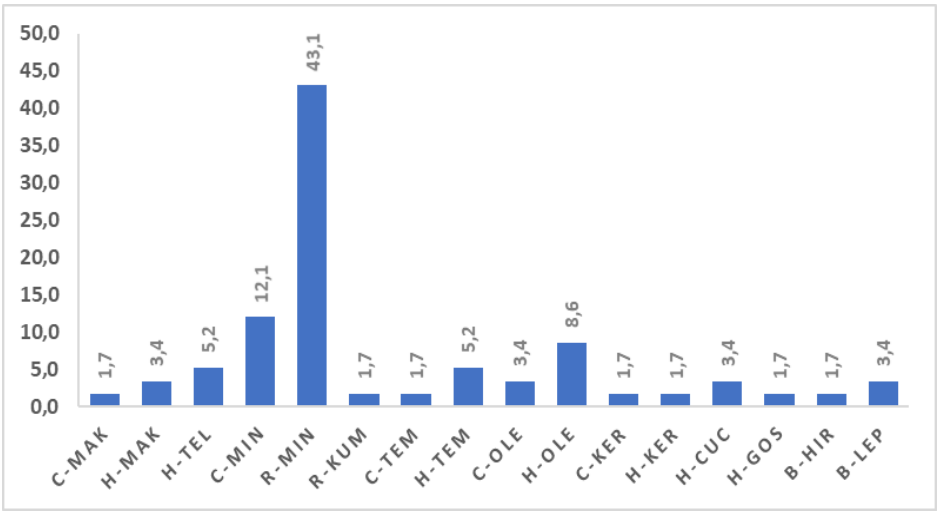

Figure 3. Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE = medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

People Perception to Medicinal Plants

The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All respondents have used mobile phones as a means of communication because the internet network has been operated to this village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine that uses medicinal plants (Table 2).

Tabel 2. People perception of treatment using medicinal plants

People perception	Ratio (%)	Reasons
Positive	74,0	Traditional medicine is natural, has no side effects, is cheap, and easy to get; is an alternative choice of chemical drugs; does not require a doctor's prescription.
Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor, it is feared that it has side effects, is not practical, and is inefficient.
No opinion	6,0	People don't know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third, medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that the user has never suffered before appears.

The positive perception is in line with the condition that in the midst of modern medicine efforts with improved health services, traditional treatment or healing with medicinal plants is still applied by almost 80% of the world's population (Mbuni et al. 2020), starting from people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); even on the European continent, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, it is not impossible that the positive trend of returning to nature continues to increase, especially until now the Covid-19 pandemic continues to spread throughout the world and the treatment of diseases caused by the virus has not been found. Plants that have the potential to prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases, with the plant part that is widely used for treatment is the leaves and the processing method is mostly by boiling.

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December 17, 2021

Subject: Revision and re-submission of manuscript ID 9756

Dear Editor Biodiversitas Journal of Biological Diversity,

Thank you for your decision e-mail and the opportunity to revise our article entitled "**Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan**". The suggestions provided by the reviewers have been immensely helpful to revise several aspects in our article. Most suggestions are related to the language editing, therefore the authors also have sent the revised paper to professional English proofreader.

The revised article has been approved by authors. Our response to reviewer's comment have been enclosed below. We hope the revised article will be better suit to the Biodiversitas Journal of Biological Diversity.

Sincerely yours,
Pandu Yudha Adi Putra Wirabuana

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Response to Reviewer's Comment

Reviewer C

Part of Article	Reviewer's Comment	Author's Response
Introduction	After reading the entire manuscript, there is no specific methodology for evaluating the potential of medicinal plant. Recommend to either remove the word potential or elaborate in detail how was the potential of medicinal plant evaluated systematically and objectively.	In this article, the term of potential medical plant is evaluated based on the point of view from local community since this paper tries to build up an ethnobotanical study regarding the utilization of non-timber forest product from tropical forest ecosystems
Materials and Methods	- is there any importance to highlight that they 'only' live in the said area? - Can you elaborate further on the identification methods, is there a botanist involved and are there any voucher specimens deposited - can you elaborate more on how did you identify these healers? Is it through word of mouth of the villagers? - Can you elaborate more on the process of interview. How was it conducted, by who, is there any cross checking process to ensure that accurate information is transcribed, what are the qualifications of the interviewers to understand the traditional medical knowledge, is there a structured questionaiire to standardize the obtained information and provide a sample of the questionnaire form.	- Yes, since in the LMFE there are two grups of community, namely local people and transmigration people. - We only use the guide book for species identification in tropical rainforest ecosystems. There is not a botanist contribution in this research - the healers are identified based on the information from villagers since they are classfied as traditional healers - We use a set of questionnaire to explore the utilization of medicinal plants. One of the surveyor member is a pharmacy student
Results and Discussion	- Please provide full name in italic of each plant e.g., Alphitonia excelsa (Fenzl) Reissek ex Benth. (including author name etc, this is also required in the author's guide) - Just to clarify, is this for treating high blood pressure or low blood pressure?	- Some article in this journal is also permitted to write species without the name of author https://doi.org/10.13057/biodiv/d160106 - it is for high blood pressure

Reviewer L

Part of Article	Reviewer's Comment	Author's Response
Results and Discussion	- "Medicine, drug, etc." The use of such terms should be avoided. Because in order to be a drug, they have to pass the necessary stages by the health boards and so on. The definition of "treatment" would be more appropriate here. - Plants used as insect repellents cannot be considered medicinal plants	- We think the term of medicine is well to use in an ethnobotanical study - Since it is an ethnobotanical study, we still classify this plant into medicinal plants

Reviewer M

Part of Article	Reviewer's Comment	Author's Response
Abstract	Abstract should not be more than 200 words, yours 221	The abstract has been reduced into 198 words
Materials and Methods	In this section, you could add the subtitle 'demographic characteristics of the local people interviewed (age, sex, education level etc.)	The information about local people interviewed have been added in the manuscript, particularly related to age and sex. We don't document their education in interview.
Results and Discussion	- all the name of species should be written in italics - name of the author? You should add the all the species 'author name'	- the name of species have been written in italic. Some mistakes have been revised - Some article in this journal is also permitted to write species without the name of author https://doi.org/10.13057/biodiv/d160106

Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan

Abstract. Lambung Mangkurat Education Forests (LMEF) is a unique forest area with high plant diversity, including medicinal plants. This study aimed to document the list of natural medicinal plant species in LMEF and analyze the community perceptions on utilizing them. Exploratory surveys collected data through field observation and interviews with people living in villages around LMEF. The inventory of medicinal plants was conducted by line transect method with 1,000 m long and 20 m wide. Meanwhile, indigenous communities' description of medicinal plant utilization was explored using an interview process on fifty respondents. The results showed that 56 medicinal plant species were naturally distributed in LMEF. Most plants have habitus as trees, wherein local communities commonly use their leaves as traditional medicine. Local people generally applied the extraction process using hot water to obtain the benefit of these plants. Interestingly, more than 70% of respondents prefer traditional medicine to drugs. These findings indicated that the sustainable management of LMEF can support the vital role of forest ecosystems for people's health.

Keywords: forest ecosystems, local communities, people health, plant diversity, traditional medicine

Running title: Traditional medicinal plant and their utilization

INTRODUCTION

Lambung Mangkurat Education Forests (LMEF) is a special-purpose forest area in South Kalimantan. Universitas Lambung Mangkurat manages this area based on the Decree of the Ministry of Environment and Forestry Number SK. 900/MenLHK/Setjen/PLA.0/12/2016. According to the type of ecosystems, LMEF is classified as a tropical rain forest with a high diversity of flora and fauna. Besides managing as education and training forest, this site is also a conservation area. Therefore, the activity of natural resources utilization is relatively limited to protect this area from various disturbances and threats.

Various potential resources have been identified from LMEF. Some have been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well as local wisdom of the community (Firdaus et al. 2018, Andiani et al. 2019, Ariokta et al. 2020). However, other potentials have not been revealed, and among those potential resources, the existence of medicinal plants has become one of the essential information that should be investigated.

Medicinal plants are essential resources because many people require them for healing diseases. Moreover, these plants are safer for consumption than chemical drugs due to the low risk of side effects. Several previous studies from different locations have also reported the distribution of medicinal plants in a special-purpose forest area. For example, a study conducted by the Research and Development Center for Environment and Forestry at the special purpose forest area in Rantau found forty-one species from various plant habitus (Suryanto and Syaifuddin 2017). Another similar study in Samboja found approximately thirty-seven medicinal plants naturally distributed in the special purpose forest area (Wibisono and Azham 2017). However, the data of medicinal plants from LMEF are still unavailable even though this information is required to preserve biodiversity in this area.

This study aimed to analyze the potential of medicinal plants naturally distributed in LMEF and their utilization by the local community living around this area. This information is not only a complement to the report on the database of many special-purpose forest areas of Indonesia. However, it can be used as materials for socializing the sustainability of these

biological resources to the community around LMEF and as research material to enrich pharmaceutical science and technology for academic members of Lambung Mangkurat University.

MATERIALS AND METHODS

Study area

The medicinal plants' inventory was conducted at the northern area of LMEF. The geographic coordinates for this site are located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is in East Mandiangin and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). Meanwhile, the data about community perception for medicinal plants utilization were collected from the local people in the East Mandiangin Village. This village is the closest rural to the LMEF and can be accessed using a motorcycle or car.

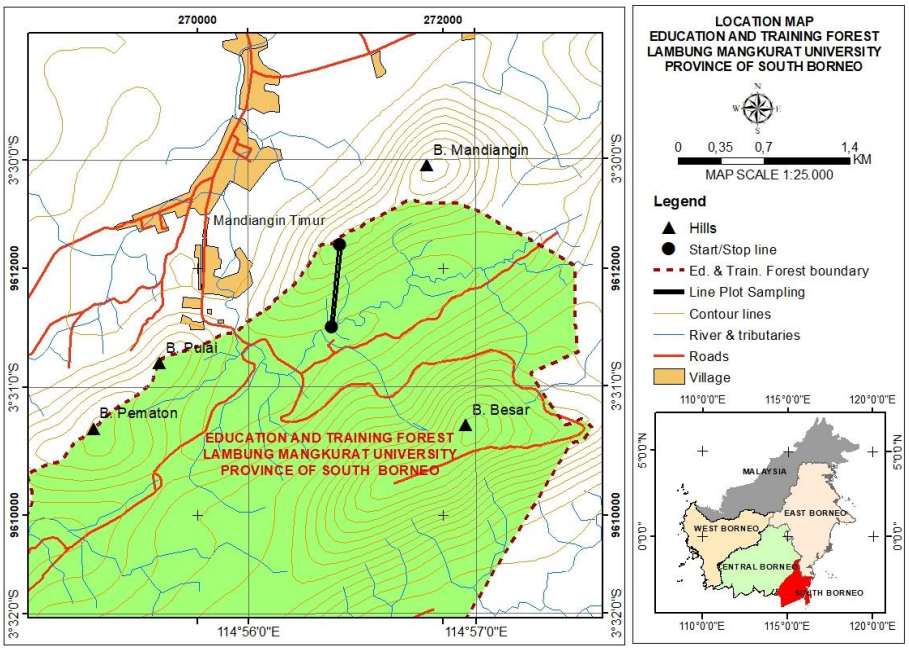

Figure 1. Map of study site in Lambung Mangkurat Education Forest

Data collection

The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the cruise method in about 20,000 m,^{2} and this rectangular area is formed from a straight cruising path of one-kilometer-long and 20 m wide. Plants are grouped into five habitus: grasses, herbs, shrubs, lianas, and trees. Grasses belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014), while herbs or shrubs refer to non-woody plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, liana is a climber who needs other plants (hosts) to stand upright to propagate or climb. Tree is a general term for woody plants with three or four growth stages: seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are woody plants with a height of 1.5 m and a diameter at breast height (at the height of 1.3 m from ground level) <10 cm. Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al., 2014). For woody plants with three growth stages by excluding the pole growth stage, a diameter of 10 cm is categorized as a tree.

Interviews were conducted with fifty respondents considered healers and the public directly using medicinal plants to identify the components that functioned as medicine and their utilization. The respondents consisted of 40 men and 10 women with more than 40 years of age. All of these respondents are residents of East Mandiangin Village, whose total population is 496 households. From this interview, specific information can be obtained, including plant species and how to use them as medicinal plants and people's perceptions of these plants.

Data analysis

Descriptive analysis was applied to demonstrate the results by tabulating the information into a specific table. This consists of a family name, scientific name, and local name of the plant, plant habitus, plant part used as medicine, the name of the disease or disorder that is cured, and the method of processing that part of the plant. Public perception consists of positive, negative, and no opinion. All three are expressed in percentage, which is the ratio of the answers to the questionnaire submitted.

RESULTS AND DISCUSSION

Medicinal plants species in Lambung Mangkurat Education Forest

Fifty-six species belonging to 37 medicinal plant families were found in LMFE (Table 1). As mentioned above, this number is higher than the plant species reported from several KHDTKs in Indonesia. However, based on the following two situations, that number is relatively small.

First, medicinal plant species were obtained from an area of 2 hectares or only 0.12% of the total area of LMFE. This is classified as very small considering LMFE reaches 1,627 hectares. Second, other species are categorized as medicinal plants in LMFE but were not found in the data collection area. Four of these species are balik angin (*Alphitonia excelsa*) (Rusida et al. 2019), kimalaka (*Phyllanthus emblica*) (Matnasir et al. 2020), pulantan (*Alstonia scholaris*) (Wibisono et al. 2020), and tikusan (*Clausena excavata*) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019), has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al. 2016), antioxidant (Zuraida et al. 2017, Thahira et al. 2021), and antimicrobial. Finally, tikusan has the potential as antioxidants (Arbab et al. 2011), anti-cancer, wound healing (Albaayit et al. 2015), as well as antioxidants and anti-diabetic (Thant et al. 2019).

Table 1. List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by the local community

Family, species, and local name	Plant habitus	Parts of the plant used	Types of diseases/disorders and preparation of medicinal plants
Anacardiaceae			
Anacardium occidentale; jambu mete	Tree	Leaves	Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (± 500 ml). This boiled water is then drunk.
Annonaceae			
Cyathostemma viridiflorum; larak pisang	Liana	Fruits	Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the head's hair.
Annona muricata; sirsak	Tree	Leaves	Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel.
Apocynaceae			
Alstonia angustiloba; tampar badak	Tree	Sap	Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk.
Areaceae			
Arenga pinnata; aren	Tree	Root	Back pain medicine. The roots are boiled, and the boiled water is drunk.
Calamus caesius; rotan	Liana	Stem	Headache medicine. The dried stems are burned, and the smoke is inhaled.
Korthalsia ferox; rotan pilak	Liana	Stem	Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly.
Asparagaceae			
Dracaena sp.; pudak gunung	Herb	Leaves	Anti-venom from animal bites. Leaves that have been chewed or kneaded and given enough water are attached to the affected part of the bite.
Asteraceae			
Chromolaena odorata; kirinyuh	Shrub	Leaves	Antibiotics for wounds. The crushed leaves are attached to the injured part.
Elephantopus scaber; tapak liman	Herb	Leaves	Glandular swelling medication. The kneaded young leaves are mixed with salt and then applied to the swollen area.
Gynura procumbens; daun sambung	Herb	Leaves	Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing.
Blechnaceae			
Stenochlaena palustris; kelakai	Shrub	Leaves	Low blood pressure medication. Young leaves are boiled for later as culinary or food (oseng-oseng).
Cannabaceae			
Trema tomentosa; balik angin	Tree	Stem	Anti-mosquito bites. The bark is directly applied to the body.
Convolvulaceae			
Merremia peltate; bilaran tapah	Liana	Stem	Cough medicine and anti-cancer. The stem is cut, and the water from the cut stem is drunk.
Euphorbiaceae			

Euphorbia latyris; sampai ringan	Herb	Leaves	Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed.
Fabaceae			
Caesalpinia sp.; sembilikan, asam daun	Liana	Stem	Cough medicine. The stems are cut, and the water that comes out is drunk. Another way is to boil the stems and drink the boiled water.
Cassia alata; gulinggang	Shrub	Leaves	Medication for tinea versicolor or ringworm. The leaves are kneaded and then rubbed on the affected body parts. Another way, after kneading, the leaves are mixed with a bit of kerosene and then rubbed on the body.
Derris sp.; tatau	Liana	Stem	Medicine for bloody stools or internal sores. The stem is cut, and the water that drips or comes out of the cut stem is drunk.
Archidendron pauciflorum; akar jengkol	Tree	Root	Medication to lower blood glucose levels. Roots about 5 cm are boiled, and the boiled water is drunk.
Mimosa pudica; putri malu	Herb	Root	Back pain medicine. The roots are boiled, and the boiled water is drunk.
Pterocarpus indicus; angsana	Tree	Stem (bark)	Genital medicine. The bark is boiled, and the boiled water is drunk.
Flagellariaceae			
Flagellaria indica; paikat laki	Liana	Leaves	Drugs for boosting/maintaining stamina or male virility. Leaves or young leaves are boiled, and the boiled water is drunk.
Lamiaceae			
Vitex ovata; alaban tulang	Tree	Stem (bark)	Diabetes medication. The bark of 5 cm wide is boiled, and the boiled water is drunk.
Lauraceae			
Eusideroxylon zwageri; ulin	Tree	Leaves	Blackening hair or anti grey hair. Leaves (shoots) are washed on the hair.
Litsea sp.; madang telur	Tree	Stem (bark)	Mosquito repellent, for example, when in the forest. The bark is burned, and the smoke is used to repel mosquitoes.
Marantaceae			
Donax cenniformis; bamban batu	Shrub	Stem	Cough medicine. The stem is cut, and the water that drips or comes out of the cut stem is then drunk directly.
Melastomaceae			
Melastoma malabatrichum; senduduk	Shrub	Flowers	Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed.
Meliaceae			
Aglaia sp.; kilayu	Tree	Leaves	Medication for chickenpox or herpes. The leaves are ground and then applied to the body parts, especially those affected by chickenpox.
Lansium domesticum; langsat	Tree	Stem (bark)	Medication for diarrhea or stomach problems. The bark is boiled, and the boiled water is drunk.
Swietenia mahagoni; mahoni	Tree	Stem (bark)	Medication for wet wounds or scabs. Bark measuring about 10 cm x 10 cm is cut into small pieces and boiled. Boiling water is used to wash scabs.
Menispermaceae			
Arcangelicia flava; akar kuning	Liana	Root	Liver or hepatitis drugs. The roots are boiled, and the boiled water is then drunk.
Moraceae			
Artocarpus dadah; tampang	Tree	Leaves	Stomach problem medicine. The young leaves are boiled, and the boiled water is drunk.
Myrtaceae			
Tristaniopsis sp.; jawaling	Tree	Leaves	Insect repellent (such as mosquitoes). The leaves are burned, and the smoke is insect repellent.
Syzigium polyanthum; salam	Tree	Leaves	Hypertension medication. Five leaves are boiled, and the water is drunk.
Tristaniopsis merguensis; pelawan	Tree	Stem	Liver medicine. The stem is cut, and the dripping liquid is drunk.
Oxalidaceae			
Averrhoa bilimbi; belimbing wuluh/tunjuk	Tree	Flowers or fruits	1. Drugs for tinea versicolor. The flowers or fruit are ground and rubbed on the affected body parts. 2. Sprue medication. Flowers or fruit are boiled, and the boiled

			water is used for gargling.
Passifloraceae			
Passiflora foetida; permot, bilaran kusam	Liana	Stem	Diabetes medication or blood-glucose-lowering. The 40 cm long stem is boiled, and the boiled water is drunk.
Phyllantaceae			
Baccaurea javanica; limpasu	Tree	Root	Fever medicine. The roots are boiled, and the boiled water is drunk.
Phyllanthus debilis; ambin-ambin buah, meniran	Herb	Root	Back pain medicine. The roots are boiled, and the boiled water is drunk.
Poaceae			
Imperata cylindrica; alang-alang	Grasses	Root	Back pain medicine. The roots of about ten clumps are tied up and then boiled. The boiled water is drunk.
Primulaceae			
Labisia pumila; rumput fatimah	Herb	Root	Natural contraceptives. The roots are boiled, and the boiled water is drunk every day.
Rhamnaceae			
Ziziphus sp.; teja	Tree	Root	Post-partum recovery. The roots are boiled, and the boiled water is drunk.
Rubiaceae			
Morinda citrifolia; carikan, mengkudu	Tree	Stem	Bloody stool medicine. The stems are chopped and boiled. Finally, the boiled water is drunk.
Rutaceae			
Luvunga eleutheandra; seluang belum	Liana	Root	Stamina-boosting drug. The roots are boiled, and the boiled water is drunk.
Euodia aromatica; wangun gunung	Tree	Leaves	Remedy for itching and hives. The young leaves are ground and then applied to the itchy area.
Salicaceae			
Flacourtia rukam; rukam	Tree	Leaves	Eye pain medicine. Young leaves (7 pieces) crushed by pounding and mixed with water. The obtained liquid is filtered. The filtered liquid is used to clean the eye.
Santalaceae			
Santalum album; cendana	Tree	Stem (bark)	Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled, and the boiled water is then drunk.
Sapotaceae			
Mimusops elengi; tanjung	Tree	Stem (bark)	Drugs for insomnia (difficulty sleeping). The bark measuring about 5 cm x 5 cm is boiled with a glass of water until it boils. Boiled water that has been cooled and then drunk.
Simaroubaceae			
Brucea javanica; marsihung	Shrub	Fruits	Malaria drugs. Ripe fruit is pounded and then swallowed directly.
Eurycoma longifolia; pasak bumi	Tree	Root	Back pain medicine and stamina-boosting drug. The roots are boiled, and the boiled water is drunk. Roots can still be reused at least three times of use.
Tilliaceae			
Muntingia calabura; kersen	Tree	Leaves	Diabetes medication. The leaves are boiled, and the boiled water is drunk.
Urticaceae			
Laportea macrostachya; jelatang	Shrub	Root	Medicine for itching and swelling due to touching or being touched by jelatang leaves. The root is applied to the itchy or swollen part.
Verbenaceae			
Peronema canescens; sungkai	Tree	Leaves	1. Malaria drugs. The tops of the leaves are crushed and swallowed immediately. 2. Stamina-boosting drug. The leaves are boiled, and the boiled water is then drunk.
Vitaceae			
Tetrastigma sp.*;* ulur-ulur	Liana	Stem	Medication for vomiting blood, internal bleeding, or ambient. The stems are cut, and the water that drips from the stems is then drunk.

Leea indica; mali-mali	Shrub	Fruits	Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions.
Zingiberaceae			
Zingiber cassumunar; banglai warik	Herb	Root (rhizome)	Medicine for itching or allergies. The rhizomes are cleaned, peeled, and then grated. Grated rhizome attached to the itchy parts.

The habitus of medicinal plants that are most often used were trees (50%). The next habitus were lianas, herbs or shrubs, and grasses (Figure 2a). Trees are also the most widely used as a source of medicine by the Manobo Tribe, Philippines (Dapar et al. 2020).

The plant with the highest utilization ratio (33%) was the leaf, and other parts that were used (respectively from high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability are more abundant (Mustofa et al. 2020), harvesting is easier (Malini et al. 2017, Mustofa et al. 2020). Furthermore, leaves do not directly impact plant death (Qomariah et al. 2020), and after harvesting, they can quickly grow back (Qomariah et al. 2020).

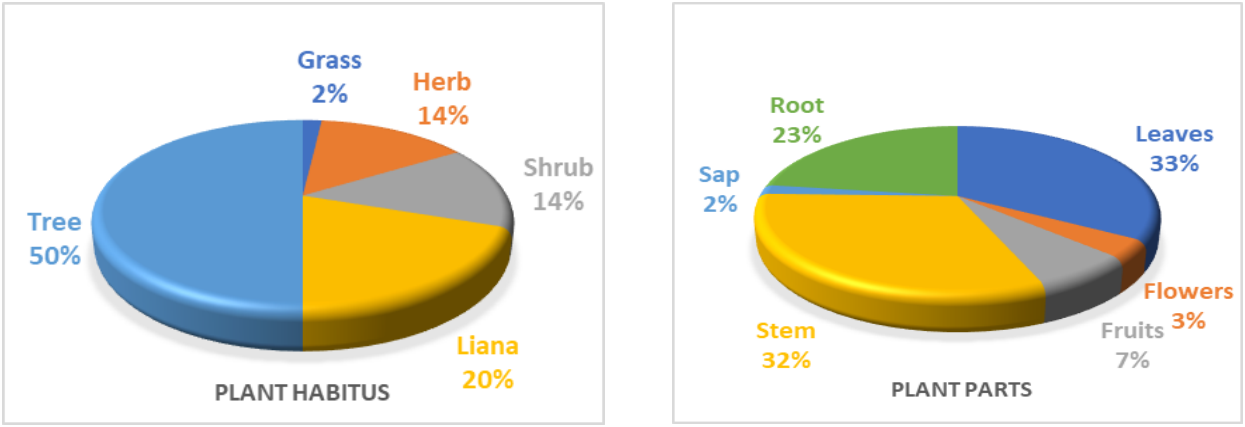

Figure 2. The ratio of utilization of plant habitus and plant parts as a source of medicine

Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups. However, the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and Sheikhupura, Pakistan (Zahoor et al. 2017).

Preparation of Plants in Medicine

The plant parts are eaten (including chewing), swallowed, drunk, or gargled to treat diseases or cure disorders from within the body. Outside the body, the medicinal plant is attached, smeared, washed, splashed or used as a washing agent, rubbed, inhaled, or left in the air to repel nuisance animals. However, the plant should be prepared by additional ingredients, crushing, or burning. The medicinal plant parts are chewed, kneaded, pulverized, pounded, or boiled to crush it, depending on the hardness of the parts.

There are four boiling records identified from this study. First, two forms are used after boiling: (1) solids from medicinal plants are eaten, or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant parts into a container filled with water with a specific volume and cooking over a fire until the water boils or the volume decreases. Suharjito et al. (2014) revealed that the boiling carried out in two ways depends on the part of the medicinal plant used: (1) boiling the water in which there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container used to boil the medicinal plant parts is *Kuali* (a clay cauldron/pot/kettle), and the stirrer is made of wood or stone. The clay cauldron reduces the efficacy of medicinal herbs. It was reported that the people of Kalimantan Selatan are not familiar with the boiling and stirring tools commonly used in Central Java. Fourth, there are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) noted that

drying is an initial process before parts of the plants are boiled, and the aim is to prevent the absorption of sap in the body when drunk.

Boiling is the process most often conducted in the preparation of drugs, and the frequency reaches more than 43% (Figure 3). For example, the Kanayatn Dayak Ethnic in West Kalimantan boils medicinal plants to dissolve the active ingredients quickly in water and heal faster after drinking the boiled water (Sari et al., 2021).

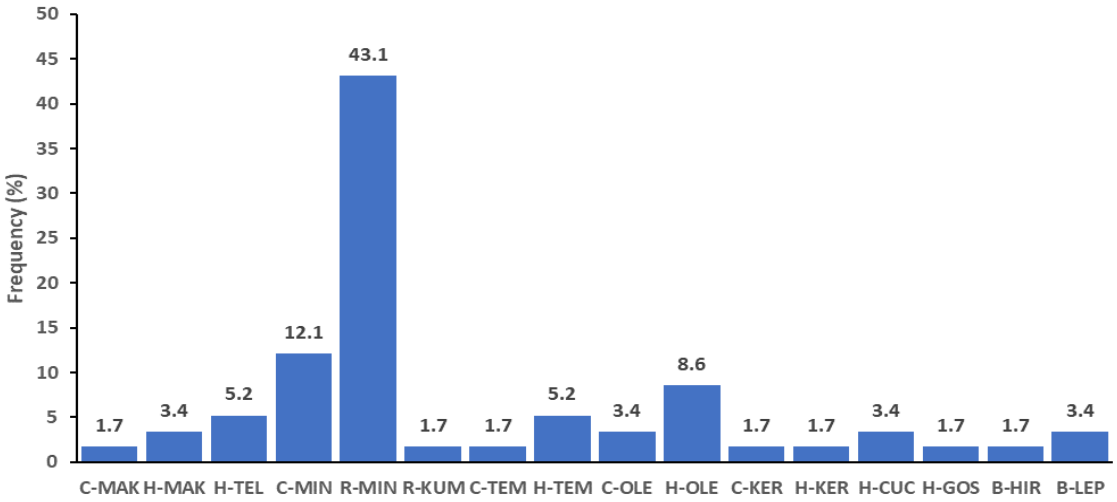

Figure 3. Frequency of drug preparation from plants and how to use them

Keterangan:
C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients
H-MAK = medicinal plant parts are crushed before being eaten
H-TEL = medicinal plant parts are crushed before being swallowed
C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients
R-MIN = parts of medicinal plants are boiled before the boiled water is drunk
R-KUM = parts of medicinal plants are boiled before gargling the boiled water air
C-TEM = parts of medicinal plants affixed with or without a mixture of other materials
H-TEM = parts of medicinal plants are crushed before being pasted
C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients
H-OLE = medicinal plant parts are crushed before being applied
C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients
H-KER = medicinal plant parts are crushed before washing
H-CUC = medicinal plant parts are crushed before being used to wash things
H-GOS = medicinal plant parts crushed before rubbing
B-HIR = parts of medicinal plants are burned, and the smoke from the combustion is inhaled
B-LEP = parts of medicinal plants are burned, and the smoke from the combustion is released into the air

People Perception of Medicinal Plants

The people of Mandiangin Timur Village have been touched by modern culture. For example, they can go back and forth to the nearest town (Banjarbaru), only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. Subsequently, all respondents have used mobile phones to communicate because the internet network has been operated in this village. With this tool, people can communicate faster and get or access knowledge about modern medicines more efficiently. However, most people (74.0%) positively perceive traditional medicine that uses medicinal plants (Table 2).

Tabel 2. People perception of treatment using medicinal plants

No	People perception	Ratio (%)	Reasons
1	Positive	74,0	Traditional medicine is natural, has no side effects, is cheap and easy to get; is a choice of chemical drugs; does not require a doctor's prescription.
2	Negative	20,0	Traditional medicine is doubtful because there has been no test from a doctor; it is feared that it has side effects, is not practical, and is inefficient.
3	No opinion	6,0	People do not know and have never used it.

Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a particular disease is uncertain. This uncertainty arises from transferring knowledge more often orally than in writing. Second, the parts and species selected depend heavily on the experience and expertise of the healer (shaman), which allows significant differences between a healer and another. This is because it is not easy to find explanations about

medicinal compounds made by healers (Suharjito et al., 2014). Third, medical history, body size or components, and the user's health condition at the time of treatment (such as weight and blood pressure) are rarely considered.

The positive perception is in line with the condition that traditional treatment is still applied by almost 80% of the world's population (Mbuni et al. 2020). This constitutes people on the African continent, such as communities around Cherangani Hills, Western Kenya (Mbuni et al. 2020); Asian continents, such as the Temiar Tribe in Kelantan, Peninsular Malaysia (Zaki et al. 2019); Americas, such as Mexico, Central America, and the Caribbean (Alonso-Castro et al. 2016); Australian continent, such as Dharawal Aboriginal people, Australia (Akhtar et al. 2016); European countries, such as Belgium, France, Germany, and the Netherlands (Hoareau and DaSilva 1999). In this perspective, the positive trend of returning to nature may increase since the pandemic spread worldwide, and treatment has not been found. Plants that can prevent or treat Covid-19 were studied, among others, by Khan et al. (2021), Lim et al. (2021).

In conclusion, the study identified 56 medicinal plant species of 35 families found in all habitus (underplants, shrubs, lianas, and trees) in LMFE. These identified species can be used to treat 28 types of diseases; the part widely used for treatment is the leaves, and the processing method is mostly by boiling.

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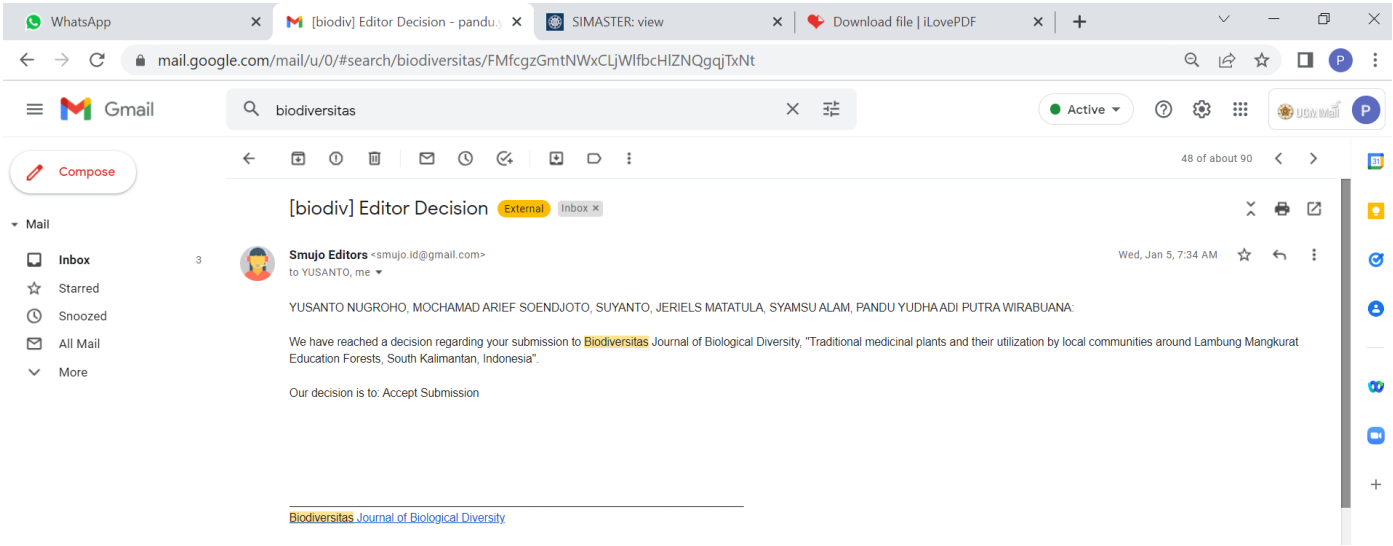

Source details

Biodiversitas

Open Access

Scopus coverage years: from 2014 to Present

Publisher: Biology department, Sebelas Maret University Surakarta

ISSN: 1412-033X E-ISSN: 2085-4722

Subject area: Agricultural and Biological Sciences: Animal Science and Zoology | Agricultural and Biological Sciences: Plant Science | Biochemistry, Genetics and Molecular Biology: Molecular Biology

Source type: Journal

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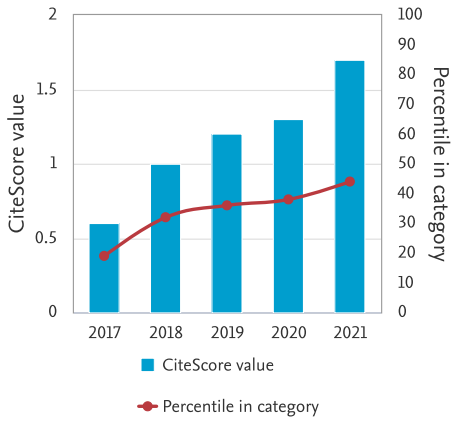
Biodiversitas 1.7 44th percentile

Rank	Source title	CiteScore 2021	Percentile
#1	Annual Review of Plant Biology	38.3	99th percentile
#2	Trends in Plant Science	28.4	99th percentile
#3	Annual Review of Phytopathology	23.7	99th percentile
#4	Nature Plants	20.8	99th percentile
#5	Molecular Plant	19.5	99th percentile
#6	Plant Biotechnology Journal	16.6	98th percentile
#7	Plant Cell	16.5	98th percentile
#8	New Phytologist	15.7	98th percentile
#9	Current Opinion in Plant Biology	14.7	98th percentile
#10	Mycosphere	13.9	98th percentile
#11	NJAS - Wageningen Journal of Life Sciences	13.4	97th percentile
#12	Plant Physiology	12.7	97th percentile
#13	Plant, Cell and Environment	12.5	97th percentile
#14	Journal of Integrative Plant Biology	11.8	97th percentile

CiteScore trend



☆	Rank	Source title	CiteScore 2021	Percentile
☆	#15	Phytochemistry Reviews	11.6	96th percentile
☆	#16	Molecular Plant Pathology	11.0	96th percentile
☆	#17	Journal of Experimental Botany	10.9	96th percentile
☆	#18	Plant Journal	10.4	96th percentile
☆	#19	Journal of Pest Science	10.1	96th percentile
☆	#20	Journal of Ecology	9.9	95th percentile
☆	#21	Plant and Cell Physiology	9.2	95th percentile
☆	#22	European Journal of Agronomy	9.1	95th percentile
☆	#23	Environmental and Experimental Botany	9.1	95th percentile
☆	#24	Plant Methods	8.9	95th percentile
☆	#25	Annals of Botany	8.6	94th percentile
☆	#26	Horticulture Research	8.5	94th percentile
☆	#27	BMC Biology	8.4	94th percentile
☆	#28	Plant Reproduction	8.3	94th percentile
☆	#29	Critical Reviews in Plant Sciences	8.2	94th percentile
☆	#30	Harmful Algae	8.1	93rd percentile
☆	#31	Plant Science	8.0	93rd percentile
☆	#32	Frontiers in Plant Science	8.0	93rd percentile
☆	#33	Metabarcoding and Metagenomics	7.9	93rd percentile
☆	#34	Rice	7.9	93rd percentile
☆	#35	Plant Cell Reports	7.8	92nd percentile
☆	#36	Plant Communications	7.6	92nd percentile
☆	#37	Plant Molecular Biology	7.4	92nd percentile
☆	#38	Journal of Plant Interactions	7.4	92nd percentile
☆	#39	Annals of Agricultural Sciences	7.4	92nd percentile
☆	#40	Plant Physiology and Biochemistry	7.3	91st percentile
☆	#41	Plant and Soil	7.3	91st percentile
☆	#42	Tree Physiology	7.1	91st percentile
☆	#43	Physiologia Plantarum	7.1	91st percentile
☆	#44	Journal of Plant Growth Regulation	7.0	90th percentile

Rank	Source title	CiteScore 2021	Percentile
#45	Journal of Plant Physiology	6.9	90th percentile
#46	BMC Plant Biology	6.9	90th percentile
#47	Crop Journal	6.9	90th percentile
#48	Planta	6.9	90th percentile
#49	Perspectives in Plant Ecology, Evolution and Systematics	6.7	89th percentile
#50	Protoplasma	6.7	89th percentile
#51	Fungal Ecology	6.6	89th percentile
#52	Journal of Systematics and Evolution	6.6	89th percentile
#53	Life Science Alliance	6.5	89th percentile
#54	Photosynthesis Research	6.4	88th percentile
#55	Photosynthetica	6.3	88th percentile
#56	Phytochemistry	6.2	88th percentile
#57	Phytobiomes Journal	6.2	88th percentile
#58	Journal of Agronomy and Crop Science	6.1	88th percentile
#59	Mycorrhiza	6.1	87th percentile
#60	Phytopathology	6.0	87th percentile
#61	Plant Growth Regulation	6.0	87th percentile
#61	Rice Science	6.0	87th percentile
#63	Preslia	6.0	87th percentile
#64	NeoBiota	5.8	86th percentile
#65	Horticultural Plant Journal	5.8	86th percentile
#66	Plant Biology	5.8	86th percentile
#67	EFSA Journal	5.7	86th percentile
#68	Plant Genome	5.7	85th percentile
#69	Environmental Technology and Innovation	5.7	85th percentile
#70	Phytocoenologia	5.6	85th percentile
#71	International Journal of Phytoremediation	5.6	85th percentile
#71	Natural Products and Bioprospecting	5.6	85th percentile
#73	Journal of Integrative Agriculture	5.6	84th percentile

Rank	Source title	CiteScore 2021	Percentile
#74	Journal of Applied Phycology	5.5	84th percentile
#75	American Journal of Botany	5.5	84th percentile
#76	Phytochemical Analysis	5.5	84th percentile
#77	Molecular Breeding	5.4	84th percentile
#78	Functional Plant Biology	5.3	83rd percentile
#79	Fermentation	5.3	83rd percentile
#80	Current Plant Biology	5.2	83rd percentile
#81	Journal of Applied Research on Medicinal and Aromatic Plants	5.1	83rd percentile
#82	Plant Biosystems	5.1	83rd percentile
#83	Botanical Journal of the Linnean Society	5.1	82nd percentile
#84	AoB PLANTS	5.1	82nd percentile
#85	Plants People Planet	5.1	82nd percentile
#86	The Botanical Review	5.0	82nd percentile
#87	Botanical Studies	5.0	82nd percentile
#88	Dendrochronologia	5.0	81st percentile
#89	Plant Phenome Journal	4.9	81st percentile
#90	Plant Pathology	4.9	81st percentile
#91	Weed Science	4.9	81st percentile
#92	Journal of Plant Nutrition and Soil Science	4.9	80th percentile
#92	Vegetation History and Archaeobotany	4.9	80th percentile
#94	Microbes and Environments	4.9	80th percentile
#95	Phycologia	4.8	80th percentile
#96	Plant Direct	4.7	80th percentile
#97	Journal of Integrated Pest Management	4.7	79th percentile
#98	Annual Plant Reviews Online	4.7	79th percentile
#99	Applications in Plant Sciences	4.6	79th percentile
#100	Journal of Plant Research	4.6	79th percentile
#101	European Journal of Phycology	4.6	79th percentile
#102	Plant Diversity	4.6	78th percentile

Rank	Source title	CiteScore 2021	Percentile
#103	Plant Ecology and Diversity	4.6	78th percentile
#104	Fottea	4.6	78th percentile
#105	Italian Botanist	4.6	78th percentile
#106	European Journal of Forest Research	4.5	78th percentile
#107	Journal of Vegetation Science	4.5	77th percentile
#108	Trees - Structure and Function	4.5	77th percentile
#109	Wood Science and Technology	4.5	77th percentile
#110	Journal of Phycology	4.4	77th percentile
#111	Weed Research	4.4	77th percentile
#112	Advances in Botanical Research	4.3	76th percentile
#113	Acta Physiologiae Plantarum	4.3	76th percentile
#114	South African Journal of Botany	4.3	76th percentile
#115	Foods	4.1	76th percentile
#116	Journal of Fungi	4.1	76th percentile
#117	Physiological and Molecular Plant Pathology	4.0	75th percentile
#118	Crop and Pasture Science	4.0	75th percentile
#118	Current protocols in plant biology	4.0	75th percentile
#120	Plant Disease	4.0	75th percentile
#121	Alpine Botany	4.0	75th percentile
#122	Canadian Journal of Plant Pathology	4.0	74th percentile
#123	Natural Product Research	4.0	74th percentile
#124	In Vitro Cellular and Developmental Biology - Plant	3.9	74th percentile
#125	Journal of Soil Science and Plant Nutrition	3.9	74th percentile
#126	Economic Botany	3.9	73rd percentile
#127	Algae	3.9	73rd percentile
#128	Opuscula Philolichenum	3.9	73rd percentile
#129	Journal of Plant Biology	3.8	73rd percentile
#130	Breeding Science	3.8	73rd percentile
#131	International Journal of Plant Sciences	3.8	72nd percentile

Rank	Source title	CiteScore 2021	Percentile
#132	Physiology and Molecular Biology of Plants	3.8	72nd percentile
#133	Systematics and Biodiversity	3.7	72nd percentile
#134	Journal of Forestry	3.7	72nd percentile
#135	Soil Science and Plant Nutrition	3.7	72nd percentile
#136	Aerobiologia	3.7	71st percentile
#137	European Journal of Plant Pathology	3.7	71st percentile
#138	Phytopathologia Mediterranea	3.7	71st percentile
#139	Aquatic Botany	3.6	71st percentile
#140	Plants	3.6	71st percentile
#141	Flora: Morphology, Distribution, Functional Ecology of Plants	3.6	70th percentile
#142	New Zealand Journal of Agricultural Research	3.6	70th percentile
#143	Integrative Organismal Biology	3.6	70th percentile
#144	Horticulture Environment and Biotechnology	3.6	70th percentile
#145	Records of Natural Products	3.5	70th percentile
#146	IAWA Journal	3.5	69th percentile
#147	Plant Breeding	3.5	69th percentile
#148	Rhizosphere	3.5	69th percentile
#149	Forest and Society	3.5	69th percentile
#150	Euphytica	3.4	68th percentile
#151	Plant Biotechnology Reports	3.4	68th percentile
#152	Biologia Plantarum	3.4	68th percentile
#153	Botany Letters	3.4	68th percentile
#154	International Journal of Plant Production	3.4	68th percentile
#155	Plant Signaling and Behavior	3.4	67th percentile
#156	Australian Systematic Botany	3.3	67th percentile
#157	Journal of Berry Research	3.3	67th percentile
#158	Seed Science Research	3.3	67th percentile
#159	Taxon	3.3	67th percentile
#160	Egyptian Journal of Biological Pest Control	3.3	66th percentile

Rank	Source title	CiteScore 2021	Percentile
#161	Phycological Research	3.3	66th percentile
#162	Cryptogamie, Algologie	3.2	66th percentile
#163	Journal of Plant Ecology	3.2	66th percentile
#164	Plant Gene	3.2	66th percentile
#165	Theoretical and Experimental Plant Physiology	3.1	65th percentile
#166	Annals of the Missouri Botanical Garden	3.1	65th percentile
#167	Plant Ecology	3.1	65th percentile
#168	Journal of Bryology	3.1	65th percentile
#169	Agriculture (Switzerland)	3.1	65th percentile
#170	Phytochemistry Letters	3.1	64th percentile
#171	In Silico Plants	3.1	64th percentile
#172	California Agriculture	3.0	64th percentile
#173	Journal of Phytopathology	3.0	64th percentile
#174	Botanica Marina	3.0	64th percentile
#175	Acta Botanica Brasilica	3.0	63rd percentile
#176	Plant Molecular Biology Reporter	3.0	63rd percentile
#177	Hacquetia	2.9	63rd percentile
#178	Sydowia	2.9	63rd percentile
#179	Tropical Plant Pathology	2.9	62nd percentile
#180	Weed Technology	2.9	62nd percentile
#181	Plant Systematics and Evolution	2.9	62nd percentile
#182	Asian Pacific Journal of Reproduction	2.9	62nd percentile
#183	aBIOTECH	2.9	62nd percentile
#184	Bryologist	2.8	61st percentile
#185	Legume Science	2.8	61st percentile
#186	Turkish Journal of Botany	2.8	61st percentile
#187	Genetic Resources and Crop Evolution	2.8	61st percentile
#188	Journal of Crop Improvement	2.8	61st percentile
#189	Folia Cryptogamica Estonica	2.8	60th percentile

Rank	Source title	CiteScore 2021	Percentile
#190	Plant Genetic Resources: Characterisation and Utilisation	2.7	60th percentile
#191	Australasian Plant Pathology	2.7	60th percentile
#192	Archives Animal Breeding	2.7	60th percentile
#193	Folia Geobotanica	2.7	60th percentile
#194	Journal of Plant Diseases and Protection	2.7	59th percentile
#195	Plant Sociology	2.7	59th percentile
#196	New Zealand Journal of Forestry Science	2.6	59th percentile
#197	Grassland Science	2.6	59th percentile
#198	Australian Journal of Botany	2.6	59th percentile
#199	Journal of Applied Botany and Food Quality	2.6	58th percentile
#200	Annals of Forest Research	2.5	58th percentile
#201	Phytopathology Research	2.5	58th percentile
#202	Edinburgh Journal of Botany	2.5	58th percentile
#203	Journal of Ethnobiology	2.5	57th percentile
#204	Acta Agrobotanica	2.5	57th percentile
#205	Acta Botanica Hungarica	2.5	57th percentile
#206	Genetica	2.5	57th percentile
#207	Tropical Plant Biology	2.4	57th percentile
#208	Acta Societatis Botanicorum Poloniae	2.4	56th percentile
#209	Lindbergia	2.4	56th percentile
#210	Phytoparasitica	2.4	56th percentile
#211	Tuexenia	2.4	56th percentile
#212	Gayana - Botanica	2.3	56th percentile
#213	Comparative Cytogenetics	2.3	55th percentile
#214	International Journal of Vegetable Science	2.3	55th percentile
#215	Botany	2.3	55th percentile
#216	Russian Journal of Plant Physiology	2.3	55th percentile
#217	Acta Botanica Croatica	2.3	55th percentile
#218	Willdenowia	2.2	54th percentile

Rank	Source title	CiteScore 2021	Percentile
#219	Horticulture Journal	2.2	54th percentile
#220	Bulletin of the Peabody Museum of Natural History	2.2	54th percentile
#221	Dendrobiology	2.2	54th percentile
#222	PhytoKeys	2.1	54th percentile
#223	Journal of Plant Biochemistry and Biotechnology	2.1	53rd percentile
#224	Biotechnology, Agronomy and Society and Environment	2.1	53rd percentile
#224	Plant Ecology and Evolution	2.1	53rd percentile
#226	Journal of General Plant Pathology	2.1	53rd percentile
#227	Agricultural Research	2.1	53rd percentile
#228	Journal of Crop Science and Biotechnology	2.1	52nd percentile
#229	Grana	2.1	52nd percentile
#230	Plant Physiology Reports	2.1	52nd percentile
#231	Acta Biologica Cracoviensia Series Botanica	2.1	52nd percentile
#232	Revista Brasileira de Botanica	2.1	51st percentile
#233	Biologia (Poland)	2.1	51st percentile
#234	Plant Breeding and Biotechnology	2.1	51st percentile
#235	Blumea: Journal of Plant Taxonomy and Plant Geography	2.0	51st percentile
#236	Pakistan Journal of Botany	2.0	51st percentile
#237	Mediterranean Botany	2.0	50th percentile
#237	Urban Agriculture and Regional Food Systems	2.0	50th percentile
#239	Nova Hedwigia	2.0	50th percentile
#240	Natural Product Communications	2.0	50th percentile
#241	Plant Species Biology	2.0	50th percentile
#242	Czech Journal of Genetics and Plant Breeding	2.0	49th percentile
#243	Ethnobiology and Conservation	2.0	49th percentile
#244	Tropical Ecology	2.0	49th percentile
#245	Eurasian Journal of Soil Science	1.9	49th percentile
#246	Plant Biotechnology	1.9	49th percentile
#247	New Zealand Journal of Botany	1.9	48th percentile

Rank	Source title	CiteScore 2021	Percentile
#248	Invasive Plant Science and Management	1.9	48th percentile
#249	Annali di Botanica	1.9	48th percentile
#250	Tropical Grasslands - Forrajes Tropicales	1.9	48th percentile
#251	Notulae Botanicae Horti Agrobotanici Cluj-Napoca	1.9	48th percentile
#252	Systematic Botany	1.9	47th percentile
#253	EPPO Bulletin	1.9	47th percentile
#254	USDA Forest Service - General Technical Report RMRS-GTR	1.9	47th percentile
#255	Phytotaxa	1.8	47th percentile
#256	Horticulturae	1.8	46th percentile
#257	Plant Health Progress	1.8	46th percentile
#258	Journal of Plant Pathology	1.8	46th percentile
#259	Reference Series in Phytochemistry	1.8	46th percentile
#260	Journal of Biologically Active Products from Nature	1.8	46th percentile
#261	International Journal of Fruit Science	1.8	45th percentile
#262	Biodiversity Data Journal	1.8	45th percentile
#263	Revista Brasileira de Fruticultura	1.8	45th percentile
#264	Allelopathy Journal	1.8	45th percentile
#265	Journal of Plant Protection Research	1.7	45th percentile
#266	Biodiversitas	1.7	44th percentile
#267	Agrosystems, Geosciences and Environment	1.7	44th percentile
#267	Rodriguesia	1.7	44th percentile
#269	Karstenia	1.7	44th percentile
#270	Kew Bulletin	1.7	44th percentile
#271	Journal of Plant Nutrition and Fertilizers	1.7	43rd percentile
#272	Journal of Asia-Pacific Biodiversity	1.7	43rd percentile
#273	Bothalia	1.7	43rd percentile
#274	Chinese Journal of Eco-Agriculture	1.7	43rd percentile
#275	Planta Daninha	1.7	43rd percentile
#276	Ecologica Montenegrina	1.7	42nd percentile

Rank	Source title	CiteScore 2021	Percentile
#277	Chinese Journal of Plant Ecology	1.7	42nd percentile
#278	Journal of the Indian Academy of Wood Science	1.6	42nd percentile
#279	Canadian Journal of Plant Science	1.6	42nd percentile
#280	Webbia	1.6	42nd percentile
#281	Revista de la Facultad de Ciencias Agrarias	1.6	41st percentile
#282	Agriculture	1.6	41st percentile
#283	Forest Products Journal	1.6	41st percentile
#284	South African Journal of Plant and Soil	1.6	41st percentile
#285	Plant and Fungal Systematics	1.6	40th percentile
#286	Nordic Journal of Botany	1.6	40th percentile
#287	Acta Mycologica	1.6	40th percentile
#288	Israel Journal of Plant Sciences	1.6	40th percentile
#289	Chinese Journal of Rice Science	1.6	40th percentile
#290	Brittonia	1.5	39th percentile
#291	Ethnobotany Research and Applications	1.5	39th percentile
#292	Journal of Apicultural Science	1.5	39th percentile
#293	Cryptogamie, Bryologie	1.5	39th percentile
#294	Journal of the Professional Association for Cactus Development	1.5	39th percentile
#295	Herba Polonica	1.5	38th percentile
#296	Ornamental Horticulture	1.5	38th percentile
#297	Boletin Latinoamericano y del Caribe de Plantas Medicinales y Aromaticas	1.5	38th percentile
#298	New Disease Reports	1.5	38th percentile
#299	Haseltonia	1.5	38th percentile
#300	Plant OMICS	1.4	37th percentile
#301	Current Research in Environmental and Applied Mycology	1.4	37th percentile
#302	Horticultura Brasileira	1.4	37th percentile
#303	Cytologia	1.4	37th percentile
#304	Botanica Pacifica	1.4	37th percentile
#305	Hellenic Plant Protection Journal	1.4	36th percentile

Rank	Source title	CiteScore 2021	Percentile
#306	Novosti Sistematiki Nizshikh Rastenii	1.4	36th percentile
#307	Beitrage zur Tabakforschung International/ Contributions to Tobacco Research	1.4	36th percentile
#308	Australasian Plant Disease Notes	1.4	36th percentile
#309	Journal of Plant Biotechnology	1.4	35th percentile
#310	Indian Journal of Genetics and Plant Breeding	1.4	35th percentile
#311	Natural Sciences Education	1.3	35th percentile
#312	Journal of Biological Research (Italy)	1.3	35th percentile
#313	International Journal of Forestry Research	1.3	35th percentile
#314	Acta Scientiarum Polonorum, Hortorum Cultus	1.3	34th percentile
#315	Phyton	1.3	34th percentile
#316	Acta Phytopathologica et Entomologica Hungarica	1.3	34th percentile
#317	Flora Mediterranea	1.3	34th percentile
#318	Journal of Horticultural Research	1.3	34th percentile
#319	Genetika	1.3	33rd percentile
#320	Botanical Sciences	1.3	33rd percentile
#321	Chemistry of Natural Compounds	1.3	33rd percentile
#322	Acta Agronomica Sinica(China)	1.3	33rd percentile
#323	Egyptian Journal of Botany	1.3	33rd percentile
#324	Acta Botanica Mexicana	1.3	32nd percentile
#325	Annales Botanici Fennici	1.2	32nd percentile
#326	Czech Mycology	1.2	32nd percentile
#327	American Fern Journal	1.2	32nd percentile
#328	Australian Journal of Crop Science	1.2	31st percentile
#328	Legume Research	1.2	31st percentile
#330	Feddes Repertorium	1.2	31st percentile
#331	Seed Science and Technology	1.2	31st percentile
#332	Biotechnologia	1.2	31st percentile
#333	Pakistan Journal of Agricultural Sciences	1.2	31st percentile
#334	International Journal of Plant Biology	1.2	30th percentile

Rank	Source title	CiteScore 2021	Percentile
#335	Maydica	1.2	30th percentile
#336	Novon	1.2	30th percentile
#337	Iranian Journal of Plant Physiology	1.2	30th percentile
#338	Darwiniana	1.2	29th percentile
#339	Tarim Bilimleri Dergisi	1.2	29th percentile
#340	USDA Forest Service - Research Papers PNW-RP	1.2	29th percentile
#341	Iheringia - Serie Botanica	1.1	29th percentile
#342	Korean Journal of Plant Taxonomy	1.1	29th percentile
#343	Botanica	1.1	28th percentile
#343	Journal of Crop Protection	1.1	28th percentile
#345	Turczaninowia	1.1	28th percentile
#346	Journal of the Torrey Botanical Society	1.1	28th percentile
#347	Anales del Jardin Botanico de Madrid	1.1	28th percentile
#348	Indian Phytopathology	1.1	27th percentile
#349	Neotropical Biology and Conservation	1.1	27th percentile
#350	Crop, Forage and Turfgrass Management	1.1	27th percentile
#351	Natura Croatica	1.1	27th percentile
#352	Coffee Science	1.1	26th percentile
#352	Vegetos	1.1	26th percentile
#354	Plant Science Today	1.1	26th percentile
#355	Environmental Control in Biology	1.1	26th percentile
#356	Nuytsia	1.1	26th percentile
#357	Journal of Animal and Plant Sciences	1.1	26th percentile
#358	Agriculture and Forestry	1.1	25th percentile
#359	Collectanea Botanica	1.0	25th percentile
#360	Telopea	1.0	25th percentile
#361	Acta Prataculturae Sinica	1.0	25th percentile
#362	Check List	1.0	25th percentile
#363	Rastitel'nost' Rossii	1.0	24th percentile
#364	Acta Phytotaxonomica et Geobotanica	1.0	24th percentile

Rank	Source title	CiteScore 2021	Percentile
#365	Journal of Applied Biology and Biotechnology	1.0	24th percentile
#366	Indian Journal of Biotechnology	1.0	23rd percentile
#366	Italian Journal of Mycology	1.0	23rd percentile
#366	Lankesteriana	1.0	23rd percentile
#369	Revista Chapingo, Serie Horticultura	1.0	23rd percentile
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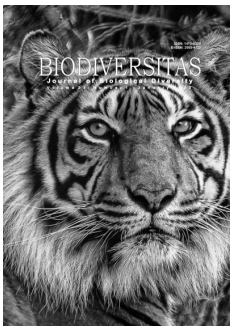

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