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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.

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Sincerely yours,

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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.

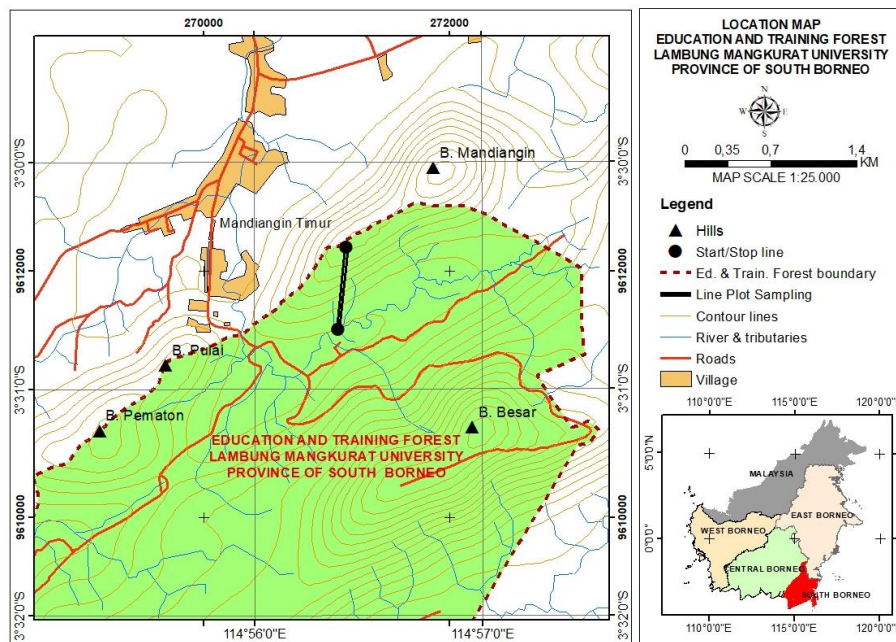
This study aimed to inventory the potential of medicinal plants that naturally distributed in LMEF and their utilization by local community living around this area. This information is not only as a complement to report on database of medicinal plants in many special purpose forest area of Indonesia,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

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

50 MATERIALS AND METHODS

51 Study area

52 The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site
53 is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiingin
54 Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data
55 about community perception for medicinal plants utilization were collected from the local people who only live in the East
56 Mandiingin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.
57



58
59

60 Data collection

61 The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the
62 cruise method in an area of about 20,000 m². This rectangular area is formed from a straight cruising path of one kilometer
63 long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups
64 of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody
65 plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a
66 climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term
67 for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings
68 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
69 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
70 range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have
71 three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

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

77 Data analysis

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

84 Medicinal plants species in Lambung Mangkurat Education Forest

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

88 First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only
89 0.12% of the total area of LMFE which reaches 1,627 hectares.

90 Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data
91 collection area. Four of these species are balik angin (*Alphitonia excelsa*) (Rusida et al. 2019), kimalaka (*Phyllanthus*
92 *emblica*) (Matnasir et al. 2020), pulantan (*Alstonia scholaris*) (Wibisono et al. 2020), and tikusan (*Clausena excavata*)
93 (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for
94 chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal
95 bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini
96 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity
97 (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al.
98 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as
99 antimicrobial, antidiarrheal, antidycentric, antiasthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020).
100 Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al.
101 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

102

103

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 | | | |
| <i>Anacardium occidentale</i> ; jambu mete | Tree | Leaves | Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (\pm 500 ml). This boiled water is then drunk. |
| Annonaceae | | | |
| <i>Cyathostemma viridiflorum</i> ; larak pisang | Liana | Fruits | Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head. |
| <i>Annona muricata</i> ; sirsak | Tree | Leaves | Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel. |
| Apocynaceae | | | |
| <i>Alstonia angustiloba</i> ; tampar badak | Tree | Sap | Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk. |
| Areaceae | | | |
| <i>Arenga pinnata</i> ; aren | Tree | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Calamus caesius</i> ; rotan | Liana | Stem | Headache medicine. The dried stems are burned and the smoke is inhaled. |
| <i>Korthalsia ferox</i> ; rotan pilak | Liana | Stem | Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly. |
| Asparagaceae | | | |
| <i>Dracaena</i> 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 | | | |
| <i>Chromolaena odorata</i> ; kirinyuh | Shrub | Leaves | Antibiotics for wounds. The crushed leaves are attached to the injured part. |
| <i>Elephantopus scaber</i> ; tapak liman | Herb | Leaves | Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area. |
| <i>Gynura procumbens</i> ; daun sambung | Herb | Leaves | Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing. |
| Blechnaceae | | | |
| <i>Stenochlaena palustris</i> ; kelakai | Shrub | Leaves | Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng). |
| Cannabaceae | | | |
| <i>Trema tomentosa</i> ; 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 | | | |
| <i>Merremia peltate</i> ; 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 | | | |
| <i>Euphorbia lathyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; 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. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angsana | Tree | Stem (bark) | Genital medicine. The bark is boiled and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> 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 | | | |
| <i>Donax cenniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent. |
| <i>Syzigium polyanthum</i> ; 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 |
|--|---------------|---------------------|---|
| <i>Tristaniopsis merguensis</i> ; pelawan | Tree | Stem | Liver medicine. The stem is cut and the dripping liquid is drunk. |
| Oxalidaceae | | | |
| <i>Averrhoa bilimbi</i> ; 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 | | | |
| <i>Passiflora foetida</i> ; 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 | | | |
| <i>Baccaurea javanica</i> ; limpasu | Tree | Root | Fever medicine. The roots are boiled and the boiled water is drunk. |
| <i>Phyllanthus debilis</i> ; ambin-ambin buah, meniran | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| Poaceae | | | |
| <i>Imperata cylindrica</i> ; 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 | | | |
| <i>Labisia pumila</i> ; rumput fatimah | Herb | Root | Natural contraceptives. The roots are boiled and the boiled water is drunk every day. |
| Rhamnaceae | | | |
| <i>Ziziphus</i> sp.; teja | Tree | Root | Post-partum recovery. The roots are boiled and the boiled water is drunk. |
| Rubiaceae | | | |
| <i>Morinda citrifolia</i> ; carikan, mengkudu | Tree | Stem | Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk. |
| Rutaceae | | | |
| <i>Luvunga eleutheandra</i> ; seluang belum | Liana | Root | Stamina-boosting drug. The roots are boiled and the boiled water is drunk. |
| <i>Euodia aromatica</i> ; wangun gunung | Tree | Leaves | Remedy for itching and hives. The young leaves are ground and then applied to the itchy area. |
| Salicaceae | | | |
| <i>Flacourtia rukam</i> ; 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 | | | |
| <i>Santalum album</i> ; cendana | Tree | Stem (bark) | Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk. |
| Sapotaceae | | | |
| <i>Mimusops elengi</i> ; 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 | | | |
| <i>Brucea javanica</i> ; marsihung | Shrub | Fruits | Malaria drugs. Ripe fruit is pounded and then swallowed directly. |
| <i>Eurycoma longifolia</i> ; 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 | | | |
| <i>Muntingia calabura</i> ; kersen | Tree | Leaves | Diabetes medication. The leaves are boiled and the boiled water is drunk. |
| Urticaceae | | | |
| <i>Laportea macrostachya</i> ; 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 | | | |
| <i>Peronema canescens</i> ; 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 | | | |
| <i>Tetrastigma</i> 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. |
| <i>Leea indica</i> ; 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 | | | |
| <i>Zingiber cassumunar</i> ; 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. |

104

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

108 The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from
 109 high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their
 110 secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al.
 111 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more
 112 abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct
 113 impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

114

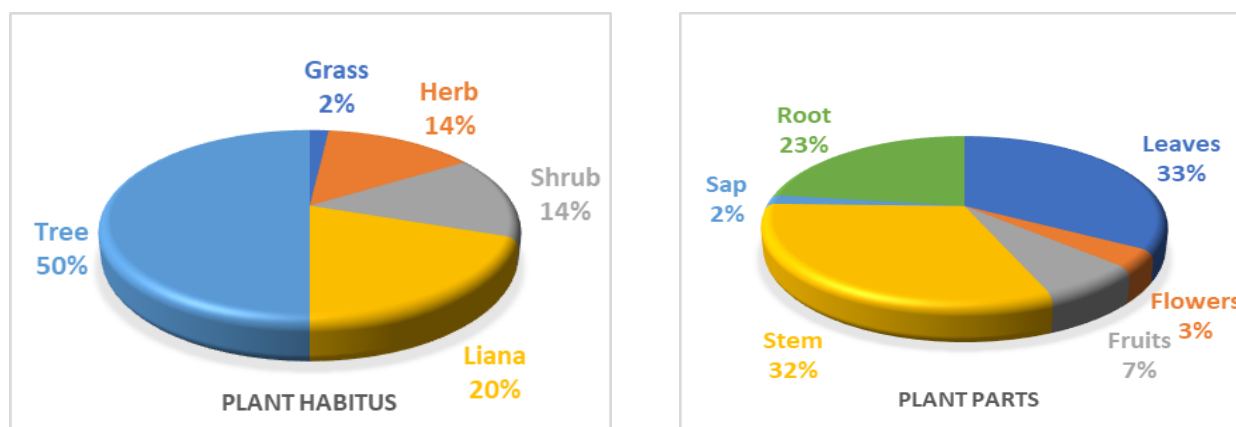


Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

115

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

126

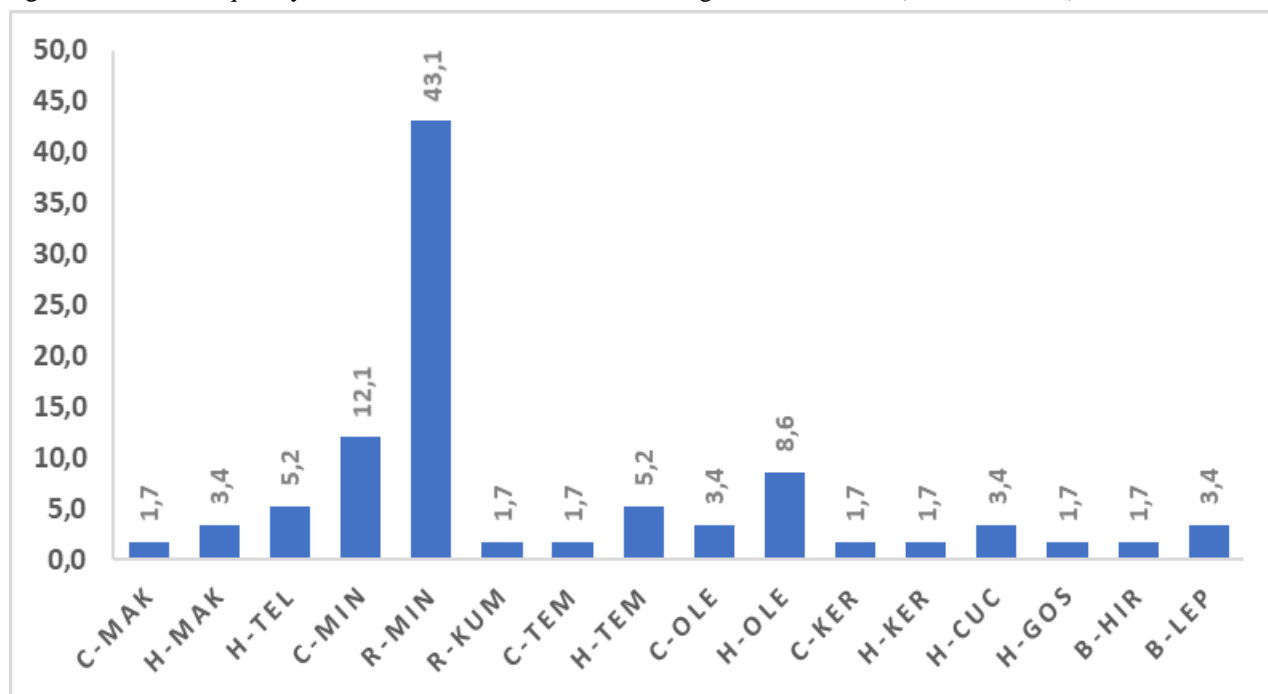
127 Preparation of Plants in Medicine

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

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

134 There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1)
 135 solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant
 136 parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume
 137 of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjo et al. (2014) revealed
 138 that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which
 139 there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained
 140 regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container
 141 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
 142 cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this
 143 time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there
 144 are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes
 145 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
 146 body when drunk.

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



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

151

152 Keterangan:

153 C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients

154 H-MAK = medicinal plant parts are crushed before being eaten

155 H-TEL = medicinal plant parts are crushed before being swallowed

156 C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients

157 R-MIN = parts of medicinal plants are boiled before the boiled water is drunk

158 R-KUM = parts of medicinal plants are boiled before gargling the boiled water air

159 C-TEM = parts of medicinal plants affixed with or without a mixture of other materials

160 H-TEM = parts of medicinal plants are crushed before being pasted

161 C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients

162 H-OLE = medicinal plant parts are crushed before being applied

163 C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients

164 H-KER = medicinal plant parts are crushed before washing

165 H-CUC = medicinal plant parts are crushed before being used to wash things

166 H-GOS = medicinal plant parts crushed before rubbing

167 B-HIR = parts of medicinal plants are burned and the smoke from the combustion is inhaled

168 B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the air

169 **People Perception to Medicinal Plants**

170 The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the
171 nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All
172 respondents have used mobile phones as a means of communication because the internet network has been operated to this
173 village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge
174 about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine
175 that uses medicinal plants (Table 2).
176
177
178

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. |

179
180 Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a
181 particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants
182 which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the
183 experience and expertise of the healer (shaman) which allows significant differences between a healer and another. It is
184 difficult to find explanations from healers about medicinal compounds made by healers (Suharjito et al. 2014). Third,
185 medical history, body size or its components, and the user's health condition at the time of treatment (such as weight, blood
186 pressure) are rarely taken into consideration for treatment. This allows the user's illness to get worse or a new disease that
187 the user has never suffered before appears.

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

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

201 **ACKNOWLEDGEMENTS**

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

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BUKTI KEPUTUSAN EDITOR 14 DESEMBER 2021 – REVISION

The screenshot shows a Gmail interface with a search for 'biodiversitas'. The email in focus is from 'Managing Editor <unsjournals@gmail.com>' to 'Pandu Wirabuana' on 'Tue, Dec 14, 2021, 4:52 PM'. The subject is 'Request revisions'. The email content includes a decision regarding a submission to 'Biodiversitas Journal of Biological Diversity, "Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan"'. The decision is 'Revisions Required' with a note to send a revised paper to a professional proofreader. The reviewer's name is 'Reviewer C.', and the email concludes with a thank you and a list of three major comments for revision.

Request revisions External Inbox x

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Pandu Wirabuana:

We have reached a decision regarding your submission to **Biodiversitas** Journal of Biological Diversity, "Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan".

Our decision is: Revisions Required
Note: Kindly send your revised paper to a professional proofreader prior to resubmission.

Reviewer C.

Dear authors,

Thank you for the valuable research work done, this is precious literature and will be very useful for future medicinal plant related research.

However I have a few major comments:

- 1) Please check my comment on objective of the study
- 2) Please elaborate in detail the methods used (please check my comments on further details)
- 3) Suggest for professional proof reader as there are many language related corrections throughout. Please note that my suggestions on English corrections are not evaluative and it is recommended to...

23:44
23/06/2022

1 **Traditional medicinal plants and their utilization by local communities** 2 **around Lambung Mangkurat Education Forests, South Kalimantan**

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12 **Abstract.** Lambung Mangkurat Education Forests (LMEF) is a special purpose forest area that has high plant diversity, including medicinal
13 plants. However, the data of medicinal plants in LMEF is still not good recorded even though it has been widely used by local communities.
14 This study aimed to document the list of medicinal plant species that naturally grown in LMEF and to analyze the community perceptions of
15 those medicinal plant utilization. Data were collected by exploratory surveys through field observation and also interview with people living
16 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
17 wide. Meanwhile, the description of medicinal plant utilization by indigenous communities was explored using interview process on fifty
18 respondents who lived around LMEF. Results showed that there were 56 medicinal plant species that naturally distributed in LMEF. The
19 majority of medicinal plants have habitus as trees wherein their leaves were commonly used by local communities as traditional medicine.
20 To obtain the benefit of medicinal plants, the extraction process using hot water was generally applied by local people. Interestingly, more
21 than 70% of respondent prefer use traditional medicine to drugs. These findings indicated that the sustainable management of LMEF has a
22 potential to support the important role of forest ecosystems for people health.

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

24 **INTRODUCTION**

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

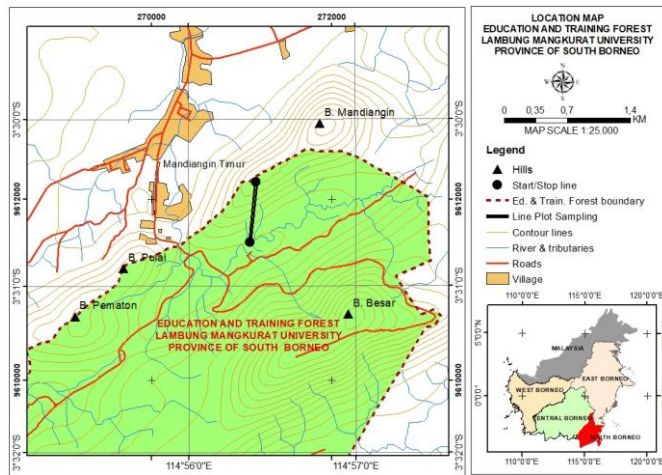
31 There are various potential resources that have been identified from LMEF. Some of the potential resources have even
32 been reported and published, such as birds (Purbaya et al. 2020), trees (Rusida et al. 2019, Wibisono et al. 2020), as well
33 as local wisdom of the community (Firdaus et al. 2018,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

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

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

50 Study area

51 The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site
 52 is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiingin
 53 Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data
 54 about community perception for medicinal plants utilization were collected from the local people who only live in the East
 55 Mandiingin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.
 56



57
 58
 59

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

60 Data collection

61 The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the
 62 cruise method in an area of about 20,000 m². This rectangular area is formed from a straight cruising path of one kilometer
 63 long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups
 64 of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody
 65 plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a
 66 climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term
 67 for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings
 68 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
 69 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
 70 range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have
 71 three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

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

77 Data analysis

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

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 | | | |
| <i>Anacardium occidentale</i> ; jambu mete | Tree | Leaves | Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (\pm 500 ml). This boiled water is then drunk. |
| Annonaceae | | | |
| <i>Cyathostemma viridiflorum</i> ; larak pisang | Liana | Fruits | Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head. |
| <i>Annona muricata</i> ; sirsak | Tree | Leaves | Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel. |
| Apocynaceae | | | |
| <i>Alstonia angustiloba</i> ; tampar badak | Tree | Sap | Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk. |
| Areaceae | | | |
| <i>Arenga pinnata</i> ; aren | Tree | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Calamus caesius</i> ; rotan | Liana | Stem | Headache medicine. The dried stems are burned and the smoke is inhaled. |
| <i>Korthalsia ferox</i> ; rotan pilak | Liana | Stem | Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly. |
| Asparagaceae | | | |
| <i>Dracaena</i> 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 | | | |
| <i>Chromolaena odorata</i> ; kirinyuh | Shrub | Leaves | Antibiotics for wounds. The crushed leaves are attached to the injured part. |
| <i>Elephantopus scaber</i> ; tapak liman | Herb | Leaves | Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area. |
| <i>Gynura procumbens</i> ; daun sambung | Herb | Leaves | Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing. |
| Blechnaceae | | | |
| <i>Stenochlaena palustris</i> ; kelakai | Shrub | Leaves | Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng). |
| Cannabaceae | | | |
| <i>Trema tomentosa</i> ; balik angin | Tree | Stem | Anti mosquito bites. The bark is directly applied to the body. |
| Convolvulaceae | | | |
| <i>Merremia peltate</i> ; 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 |
|---|---------------|---------------------|---|
| <i>Euphorbia latyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; 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. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angšana | Tree | Stem (bark) | Genital medicine. The bark is boiled and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> 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 | | | |
| <i>Donax cerniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent. |
| <i>Syzigium polyanthum</i> ; salam | Tree | Leaves | Hypertension medication. Five leaves are boiled and the water is drunk. |
| <i>Tristaniopsis merguensis</i> ; pelawan | Tree | Stem | Liver medicine. The stem is cut and the dripping liquid is drunk. |
| Oxalidaceae | | | |
| <i>Avorhoa bilimbi</i> ; 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.

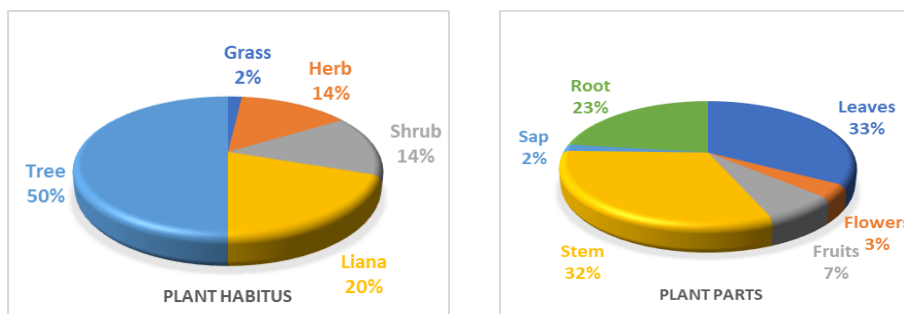
Commented [MK6]: Plants used as insect repellents cannot be considered medicinal plants.

| Family, species, and local name | Plant habitus | Parts of plant used | Types of diseases/disorders and preparation of medicinal plants |
|--|---------------|---------------------|--|
| <i>Passiflora foetida</i> ; permot, bilaran kusam | Liana | Stem | Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk. |
| Phyllanthaceae | | | |
| <i>Baccaurea javanica</i> ; limpasu | Tree | Root | Fever medicine. The roots are boiled and the boiled water is drunk. |
| <i>Phyllanthus debilis</i> ; ambin-ambin buah, meniran | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| Poaceae | | | |
| <i>Imperata cylindrica</i> ; 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 | | | |
| <i>Labisia pumila</i> ; rumput fatimah | Herb | Root | Natural contraceptives. The roots are boiled and the boiled water is drunk every day. |
| Rhamnaceae | | | |
| <i>Ziziphus</i> sp.; teja | Tree | Root | Post-partum recovery. The roots are boiled and the boiled water is drunk. |
| Rubiaceae | | | |
| <i>Morinda citrifolia</i> ; carikan, mengkudu | Tree | Stem | Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk. |
| Rutaceae | | | |
| <i>Luvunga eleutheadra</i> ; seluang belum | Liana | Root | Stamina-boosting drug. The roots are boiled and the boiled water is drunk. |
| <i>Euodia aromatica</i> ; wangun gunung | Tree | Leaves | Remedy for itching and hives. The young leaves are ground and then applied to the itchy area. |
| Salicaceae | | | |
| <i>Flacourtia rukam</i> ; 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 | | | |
| <i>Santalum album</i> ; cendana | Tree | Stem (bark) | Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk. |
| Sapotaceae | | | |
| <i>Mimusops elengi</i> ; 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 | | | |
| <i>Brucea javanica</i> ; marsihung | Shrub | Fruits | Malaria drugs. Ripe fruit is pounded and then swallowed directly. |
| <i>Eurycoma longifolia</i> ; 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 | | | |
| <i>Muntingia calabura</i> ; kersen | Tree | Leaves | Diabetes medication. The leaves are boiled and the boiled water is drunk. |
| Urticaceae | | | |
| <i>Laportea macrostachya</i> ; 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 | | | |
| <i>Peronema canescens</i> ; 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 | | | |
| <i>Tetrastigma</i> 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. |
| <i>Leea indica</i> ; 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 | | | |
| <i>Zingiber cassumunar</i> ; 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. |

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

109 The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from
110 high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their
111 secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al.
112 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more
113 abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct
114 impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

115



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

117

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

128

128 **Preparation of Plants in Medicine**

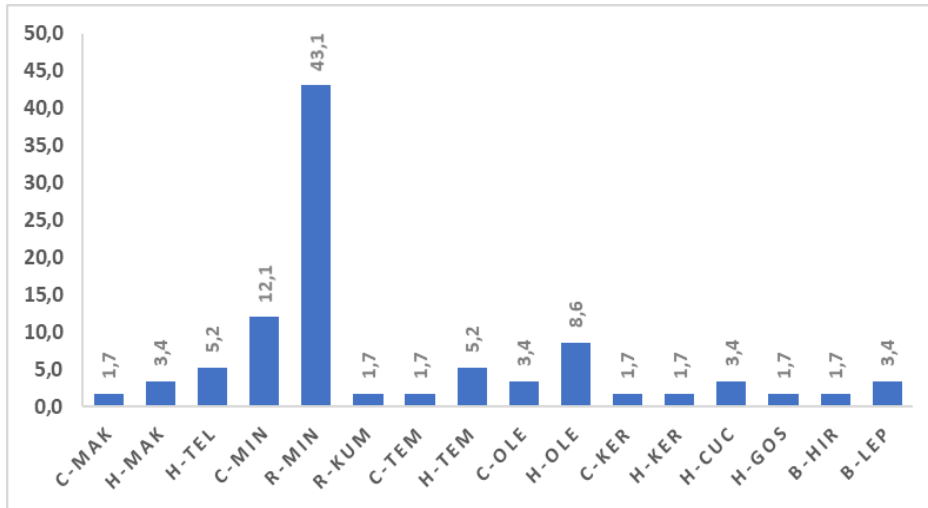
129

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

136

137 There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1)
138 solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant
139 parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume
140 of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjito et al. (2014) revealed
141 that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which
142 there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained
143 regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container
144 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
145 cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this
146 time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there
147 are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes
148 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
149 body when drunk.

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



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

163 **People Perception to Medicinal Plants**

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

172 **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. |

174 Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a
 175 particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants
 176 which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the
 177

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

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

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

196 ACKNOWLEDGEMENTS

197 We express our gratitude to the Chairperson of LMFE who gave us permission to enter this forest area. We also
198 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

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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Commented [U3]: have been reported and published such as ...

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Commented [U5]: the naturally available medicinal plants is among of the key area to be explored

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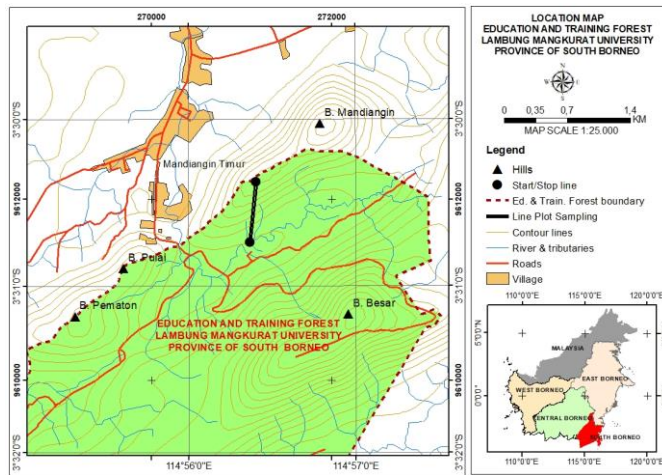
Commented [U14]: After reading the entire manuscript, there is no specific methodology for evaluating the potential of medicinal plant. Recommend to either remove the word potential or elaborate in detail how was the potential of medicinal plant evaluated systematically and objectively.

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50 Study area

51 The medicinal plants inventory were conducted at the northern area of LMEF. The geographic coordinates for this site
 52 is located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is administratively located in East Mandiingin
 53 Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). On another side, the data
 54 about community perception for medicinal plants utilization were collected from the local people who only live in the East
 55 Mandiingin Village. This village is the closest rural to the LMEF and can be accessed using motorcycle or car.
 56



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58

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

60 Data collection

61 The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the
 62 cruise method in an area of about 20,000 m². This rectangular area is formed from a straight cruising path of one kilometer
 63 long and 20 m wide. Plants are grouped into five habitus, namely grasses, herbs, shrubs, lianas, and trees. Grass are groups
 64 of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or shrubs refer to non-woody
 65 plants. Shrubs refer to woody plants with many branches but a maximum height of about 3 m. Meanwhile, Liana is a
 66 climbing plant that need other plants (hosts) for standing upright as a place to propagate or climb. Tree is a general term
 67 for woody plants that actually have three or four stages of growth, namely seedlings, saplings, poles, and trees. Seedlings
 68 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
 69 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
 70 range of 10 <20 cm, while trees are those with a diameter of 20 cm (Soendjoto et al. 2014). For woody plants that have
 71 three growth stages (without the categorization of pole growth stage), a diameter of 10 cm is categorized as tree.

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

77 Data analysis

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

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 81 of three categories: positive, negative, and no opinion. All three are expressed in percentage which is the ratio of the total
 82 number of answers to the questionnaire submitted to the public.

Commented [U22]: Can you elaborate further on the identification methods, is there a botanist involved and are there any voucher specimens deposited

Commented [U23]: function

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Commented [U25]: can you elaborate more on how did you identify these healers? Is it through word of mouth of the villagers?

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Commented [U27]: 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 questionnaire to standardize the obtained information and provide a sample of the questionnaire form.

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 | | | |
| <i>Anacardium occidentale</i> ; jambu mete | Tree | Leaves | Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (\pm 500 ml). This boiled water is then drunk. |
| Annonaceae | | | |
| <i>Cyathostemma viridiflorum</i> ; larak pisang | Liana | Fruits | Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head. |
| <i>Annona muricata</i> ; sirsak | Tree | Leaves | Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel. |
| Apocynaceae | | | |
| <i>Alstonia angustiloba</i> ; tampar badak | Tree | Sap | Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk. |
| Areaceae | | | |
| <i>Arenga pinnata</i> ; aren | Tree | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Calamus caesius</i> ; rotan | Liana | Stem | Headache medicine. The dried stems are burned and the smoke is inhaled. |
| <i>Korthalsia ferox</i> ; rotan pilak | Liana | Stem | Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly. |
| Asparagaceae | | | |
| <i>Dracaena</i> 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 | | | |
| <i>Chromolaena odorata</i> ; kirinyuh | Shrub | Leaves | Antibiotics for wounds. The crushed leaves are attached to the injured part. |
| <i>Elephantopus scaber</i> ; tapak liman | Herb | Leaves | Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area. |
| <i>Gynura procumbens</i> ; daun sambung | Herb | Leaves | Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing. |
| Blechnaceae | | | |
| <i>Stenochlaena palustris</i> ; kelakai | Shrub | Leaves | Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng). |
| Cannabaceae | | | |
| <i>Trema tomentosa</i> ; balik angin | Tree | Stem | Anti mosquito bites. The bark is directly applied to the body. |
| Convolvulaceae | | | |
| <i>Merremia peltate</i> ; 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 [U28]: 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)

Commented [U29]: Please check carefully the grammar of all the sentences used here

Commented [U30]: Check formatting as for the section above, you have a space in between the lines of each separate plant but not here

Commented [U31]: Just to clarify, is this for treating high blood pressure or low blood pressure?

| Family, species, and local name | Plant habitus | Parts of plant used | Types of diseases/disorders and preparation of medicinal plants |
|--|---------------|---------------------|---|
| <i>Euphorbia latyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; 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. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angšana | Tree | Stem (bark) | Genital medicine. The bark is boiled and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> 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 | | | |
| <i>Donax cerniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent. |
| <i>Syzigium polyanthum</i> ; salam | Tree | Leaves | Hypertension medication. Five leaves are boiled and the water is drunk. |
| <i>Tristaniopsis merguensis</i> ; pelawan | Tree | Stem | Liver medicine. The stem is cut and the dripping liquid is drunk. |
| Oxalidaceae | | | |
| <i>Avrrrhoa bilimbi</i> ; 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 |
|--|---------------|---------------------|--|
| <i>Passiflora foetida</i> ; permot, bilaran kusam | Liana | Stem | Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk. |
| Phyllanthaceae | | | |
| <i>Baccaurea javanica</i> ; limpasu | Tree | Root | Fever medicine. The roots are boiled and the boiled water is drunk. |
| <i>Phyllanthus debilis</i> ; ambin-ambin buah, meniran | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| Poaceae | | | |
| <i>Imperata cylindrica</i> ; 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 | | | |
| <i>Labisia pumila</i> ; rumput fatimah | Herb | Root | Natural contraceptives. The roots are boiled and the boiled water is drunk every day. |
| Rhamnaceae | | | |
| <i>Ziziphus</i> sp.; teja | Tree | Root | Post-partum recovery. The roots are boiled and the boiled water is drunk. |
| Rubiaceae | | | |
| <i>Morinda citrifolia</i> ; carikan, mengkudu | Tree | Stem | Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk. |
| Rutaceae | | | |
| <i>Luvunga eleuthandra</i> ; seluang belum | Liana | Root | Stamina-boosting drug. The roots are boiled and the boiled water is drunk. |
| <i>Euodia aromatica</i> ; wangun gunung | Tree | Leaves | Remedy for itching and hives. The young leaves are ground and then applied to the itchy area. |
| Salicaceae | | | |
| <i>Flacourtia rukam</i> ; 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 | | | |
| <i>Santalum album</i> ; cendana | Tree | Stem (bark) | Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk. |
| Sapotaceae | | | |
| <i>Mimusops elengi</i> ; 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 | | | |
| <i>Brucea javanica</i> ; marsihung | Shrub | Fruits | Malaria drugs. Ripe fruit is pounded and then swallowed directly. |
| <i>Eurycoma longifolia</i> ; 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 | | | |
| <i>Muntingia calabura</i> ; kersen | Tree | Leaves | Diabetes medication. The leaves are boiled and the boiled water is drunk. |
| Urticaceae | | | |
| <i>Laportea macrostachya</i> ; 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 | | | |
| <i>Peronema canescens</i> ; 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 | | | |
| <i>Tetrastigma</i> 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. |
| <i>Leea indica</i> ; 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 | | | |
| <i>Zingiber cassumunar</i> ; 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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Habitat of medicinal plants that are most often used were trees (50%). The next habitat, 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).

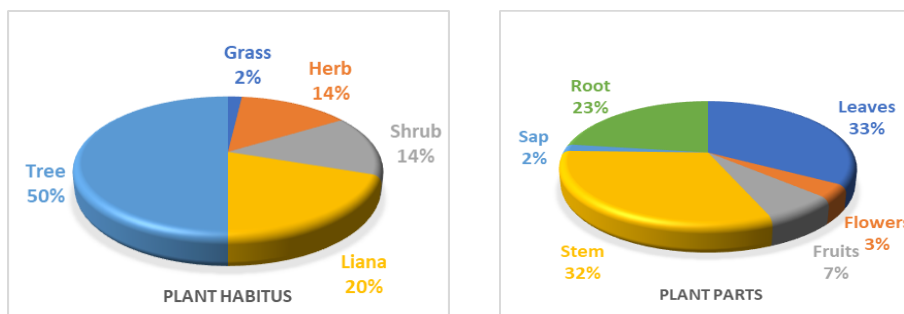


Figure 2. Ratio of utilization of plant habitus and plant parts as a source of medicine

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 Sheikhpura, Pakistan (Zahoor et al. 2017).

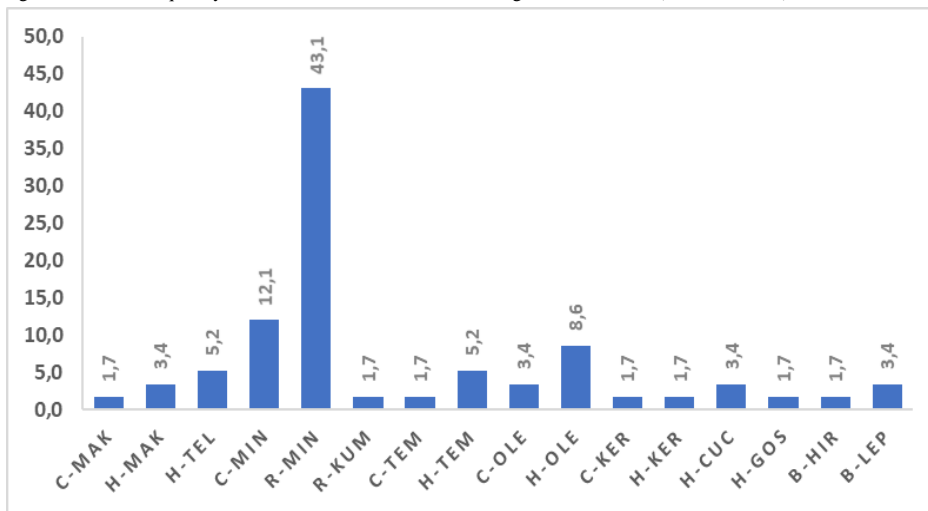
Preparation of Plants in Medicine

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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Consider more accurate word choices

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



151 **Figure 3.** Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a
 152 mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are
 153 crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts
 154 of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled
 155 water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants
 156 are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE =
 157 medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other
 158 ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used
 159 from the combustion is inhaled; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke
 160 from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the
 161 air
 162

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163 **People Perception to Medicinal Plants**

164 The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the
 165 nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All
 166 respondents have used mobile phones as a means of communication because the internet network has been operated to this
 167 village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge
 168 about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine
 169 that uses medicinal plants (Table 2).
 170
 171

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172 **Tabel 2.** People perception of treatment using medicinal plants
 173

| 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. |

174 Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a
 175 particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants
 176 which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the
 177

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

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

193 In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus
194 (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases,
195 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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196 ACKNOWLEDGEMENTS

197 We express our gratitude to the Chairperson of LMFE who gave us permission to enter this forest area. We also
198 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

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

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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.

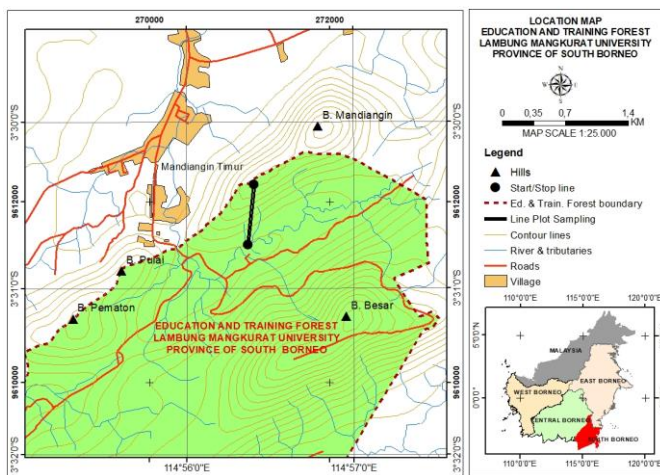


Figure 1. Map of study site in Lambung Mangkurat Education Forest

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 m². 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 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.

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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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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 | | | |
| <i>Anacardium occidentale</i> L.; jambu mete | Tree | Leaves | Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (\pm 500 ml). This boiled water is then drunk. |
| Annonaceae | | | |
| <i>Cyathostemma viridiflorum</i> ; larak pisang | Liana | Fruits | Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head. |
| <i>Annona muricata</i> ; sirsak | Tree | Leaves | Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel. |
| Apocynaceae | | | |
| <i>Alstonia angustiloba</i> ; tampar badak | Tree | Sap | Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk. |
| Areaceae | | | |
| <i>Arenga pinnata</i> ; aren | Tree | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Calamus caesius</i> ; rotan | Liana | Stem | Headache medicine. The dried stems are burned and the smoke is inhaled. |
| <i>Korthalsia ferox</i> ; rotan pilak | Liana | Stem | Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly. |
| Asparagaceae | | | |
| <i>Dracaena</i> 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 | | | |
| <i>Chromolaena odorata</i> ; kirinyuh | Shrub | Leaves | Antibiotics for wounds. The crushed leaves are attached to the injured part. |
| <i>Elephantopus scaber</i> ; tapak liman | Herb | Leaves | Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area. |
| <i>Gynura procumbens</i> ; daun sambung | Herb | Leaves | Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing. |
| Blechnaceae | | | |
| <i>Stenochlaena palustris</i> ; kelakai | Shrub | Leaves | Low blood pressure medication. Young leaves are boiled for later use as culinary or food (oseng-oseng). |
| Cannabaceae | | | |
| <i>Trema tomentosa</i> ; balik angin | Tree | Stem | Anti mosquito bites. The bark is directly applied to the body. |
| Convolvulaceae | | | |
| <i>Merremia peltate</i> ; 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 [S8]: all the name of species should be written in italics

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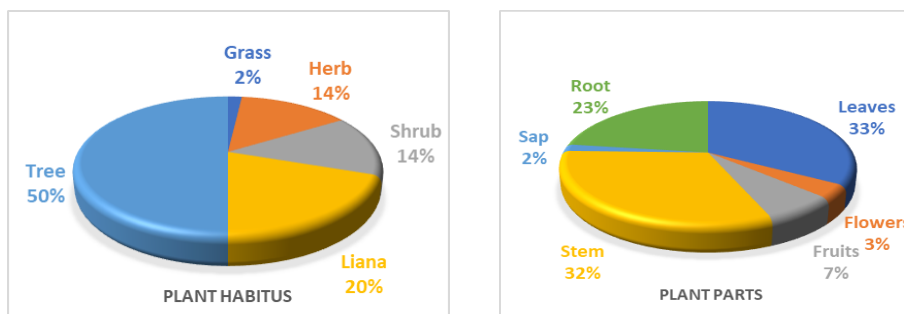
| Family, species, and local name | Plant habitus | Parts of plant used | Types of diseases/disorders and preparation of medicinal plants |
|--|---------------|---------------------|---|
| <i>Euphorbia latyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> sp.; sembilang, 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; 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. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angšana | Tree | Stem (bark) | Genital medicine. The bark is boiled and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> 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 | | | |
| <i>Donax cerniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent. |
| <i>Syzigium polyanthum</i> ; salam | Tree | Leaves | Hypertension medication. Five leaves are boiled and the water is drunk. |
| <i>Tristaniopsis merguensis</i> ; pelawan | Tree | Stem | Liver medicine. The stem is cut and the dripping liquid is drunk. |
| Oxalidaceae | | | |
| <i>Averrhoa bilimbi</i> ; 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 |
|--|---------------|---------------------|--|
| <i>Passiflora foetida</i> ; permot, bilaran kusam | Liana | Stem | Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk. |
| Phyllanthaceae | | | |
| <i>Baccaurea javanica</i> ; limpasu | Tree | Root | Fever medicine. The roots are boiled and the boiled water is drunk. |
| <i>Phyllanthus debilis</i> ; ambin-ambin buah, meniran | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| Poaceae | | | |
| <i>Imperata cylindrica</i> ; 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 | | | |
| <i>Labisia pumila</i> ; rumput fatimah | Herb | Root | Natural contraceptives. The roots are boiled and the boiled water is drunk every day. |
| Rhamnaceae | | | |
| <i>Ziziphus sp.</i> ; teja | Tree | Root | Post-partum recovery. The roots are boiled and the boiled water is drunk. |
| Rubiaceae | | | |
| <i>Morinda citrifolia</i> ; carikan, mengkudu | Tree | Stem | Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk. |
| Rutaceae | | | |
| <i>Luvunga eleutheandra</i> ; seluang belum | Liana | Root | Stamina-boosting drug. The roots are boiled and the boiled water is drunk. |
| <i>Euodia aromatica</i> ; wangun gunung | Tree | Leaves | Remedy for itching and hives. The young leaves are ground and then applied to the itchy area. |
| Salicaceae | | | |
| <i>Flacourtia rukam</i> ; 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 | | | |
| <i>Santalum album</i> ; cendana | Tree | Stem (bark) | Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk. |
| Sapotaceae | | | |
| <i>Mimusops elengi</i> ; 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 | | | |
| <i>Brucea javanica</i> ; marsihung | Shrub | Fruits | Malaria drugs. Ripe fruit is pounded and then swallowed directly. |
| <i>Eurycoma longifolia</i> ; 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 | | | |
| <i>Muntingia calabura</i> ; kersen | Tree | Leaves | Diabetes medication. The leaves are boiled and the boiled water is drunk. |
| Urticaceae | | | |
| <i>Laportea macrostachya</i> ; 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 | | | |
| <i>Peronema canescens</i> ; 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 | | | |
| <i>Tetrastigma sp.</i> ; 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. |
| <i>Leea indica</i> ; 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 | | | |
| <i>Zingiber cassumunar</i> ; 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. |

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

110 The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from
 111 high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their
 112 secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al.
 113 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more
 114 abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct
 115 impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).
 116



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

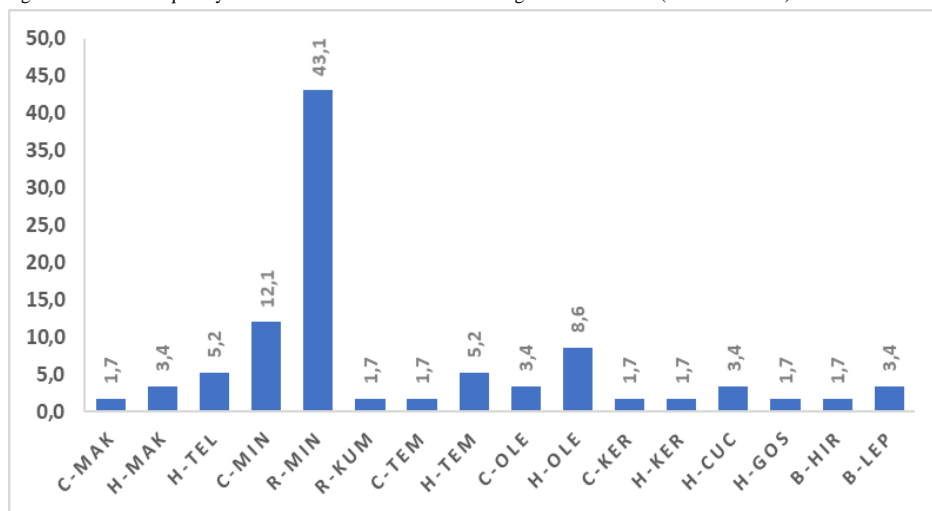
118 Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups or the world community,
 119 although the level of utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo
 120 ethnicity in North Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the
 121 Tengger ethnic group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West
 122 Java (Malini et al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan
 123 (Radam et al. 2016), Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West
 124 Kalimantan (Yusro et al. 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants
 125 in medicine include the Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines
 126 (Dapar et al. 2020), the Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et
 127 al. 2018), and the community in Sheikhpura, Pakistan (Zahoor et al. 2017).
 128

129 Preparation of Plants in Medicine

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

136 There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1)
 137 solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant
 138 parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume
 139 of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjo et al. (2014) revealed
 140 that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which
 141 there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained
 142 regarding the container and stirrer. In a study in Semarang, Central Java, Sumarni et al. (2019) mentions that the container
 143 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
 144 cauldron reduces the efficacy in medicinal herbs. We received information that the people of Kalimantan Selatan at this
 145 time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there
 146 are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes
 147 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
 148 body when drunk.

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



152 **Figure 3.** Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a
 153 mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are
 154 crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts
 155 of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled
 156 water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants
 157 are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE =
 158 medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other
 159 ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used
 160 to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke
 161 from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the
 162 air
 163

164 **People Perception to Medicinal Plants**

165 The people of Mandiangin Timur Village have been touched by modern culture. People can go back and forth to the
 166 nearest town (Banjarbaru) which is only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads. All
 167 respondents have used mobile phones as a means of communication because the internet network has been operated to this
 168 village. With this tool, people can communicate with each other faster and on the other hand, can get or access knowledge
 169 about modern medicines more easily. However, most people (74.0%) have a positive perception of traditional medicine
 170 that uses medicinal plants (Table 2).
 171

172 **Tabel 2.** People perception of treatment using medicinal plants
 173
 174

| 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. |

175
 176 Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a
 177 particular disease is uncertain. This uncertainty arises from the method of transferring knowledge about medicinal plants
 178 which is more often orally than in writing. Second, the parts and species of medicinal plants selected depend heavily on the

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

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

194 In conclusion, the research has been able to identify 56 medicinal plant species of 35 families found in all habitus
195 (underplants, shrubs, lianas and trees) in LMFE. Of the 56 species identified that can be used to treat 28 types of diseases,
196 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 grow~~ in LMEF and ~~to~~ analyze the community perceptions of ~~these 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

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

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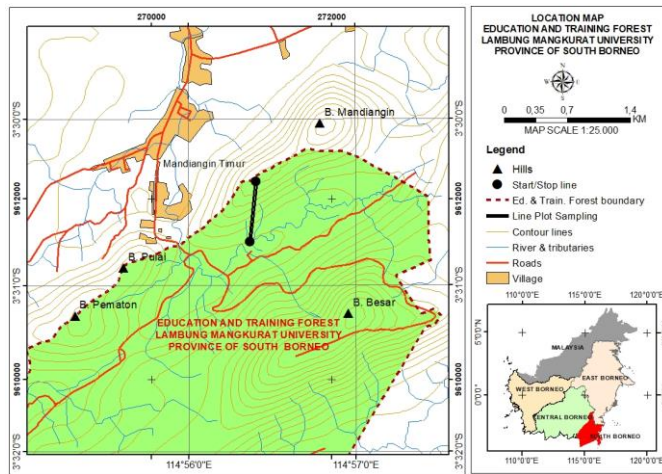
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49 sustainability of these biological resources to the community around LMEF and also as research material to enrich
50 pharmaceutical science and technology, particularly for academic members of Lambung Mangkurat University.

51 MATERIALS AND METHODS

52 Study area

53 The medicinal plants ~~inventory were~~ inventory was conducted at the northern area of LMEF. The geographic
54 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
55 located in East Mandiingin Village and Kiram Village, Karang Intan District, Banjar Regency, South Kalimantan (Figure
56 1). ~~On another side, the d Data~~ ~~on about community perception for~~ medicinal plants utilization were collected from the
57 local people who only live in the East Mandiingin Village. ~~The is~~ village is ~~the closest in the rural~~ ~~area and close~~ to the
58 LMEF and can be accessed using motorcycle or car.
59



60
61
62 **Figure 1.** Map of study site in Location of Lambung Mangkurat Education Forest

63 Data collection

64 The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the
65 cruise method in an area of about 20,000 m². This rectangular area is formed from a straight cruising path of one kilometer
66 long and 20 m wide. Medicinal Plants were are grouped into five habits habitus, namely grasses, herbs, shrubs, lianas, and
67 trees. Grass are groups of plants that belong to the Poaceae and Cyperaceae families (Soendjoto et al. 2014). Herbs or
68 shrubs refer to non-woody plants (expound). Shrubs refer to woody plants with many branches but a maximum height of
69 about 3 m. Meanwhile, Lianas is are a climbing plants that need other plants (hosts) or objects for standing upright as a
70 place to propagate or climb. Tree is a general term for woody plants that actually have three or four stages of growth,
71 namely seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground.
72 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)
73 <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
74 cm (Soendjoto et al. 2014). For woody plants that have three growth stages (without the categorization of pole growth
75 stage), a diameter of 10 cm is categorized as tree.

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

81 Data analysis

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

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

87 **RESULTS AND DISCUSSION**

88 **Medicinal plants species in Lambung Mangkurat Education Forest**

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

92 First, medicinal plant species were obtained from an area of 2 hectares. This area is classified as very small, only
 93 0.12% of the total area of LMFE which reaches 1,627 hectares.

94 Second, there are other species that are categorized as medicinal plants in LMFE but were not found in the data
 95 collection area. Four of these species are balik angin (*Alphitonia excelsa*) (Rusida et al. 2019), kimalaka (*Phyllanthus*
 96 *emblica*) (Matnasir et al. 2020), pulantan (*Alstonia scholaris*) (Wibisono et al. 2020), and tikusan (*Clausena excavata*)
 97 (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019) has the potential, among others, for
 98 chemical therapy for the prevention and treatment of urinary infections, autoimmune diseases, and gastrointestinal
 99 bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation (Krishnaveni and Mirunalini
 100 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al. 2013), and anti-obesity
 101 (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014), antidiabetic (Tambunan et al.
 102 2016), and antioxidant (Zuraida et al. 2017, Thahira et al. 2021) and has been confirmed to function, among others, as
 103 antimicrobial, anti-diarrheal, anti-dysenteric, anti-asthmatic, anticancer, and mollusk killer (Dey 2011, Bhandary 2020).
 104 Tikusan has the potential as antioxidants and anticancer (Arbab et al. 2011), anticancer and wound healing (Albaayit et al.
 105 2015), as well as antioxidants and antidiabetic (Thant et al. 2019).

106 **Table 1.** List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by local community
 107
 108

| Family, species, and local name | Plant habitus | Parts of plant used | Types of diseases/disorders and preparation of medicinal plants |
|---|---------------|---------------------|---|
| Anacardiaceae | | | |
| <i>Anacardium occidentale</i> ; jambu mete | Tree | Leaves | Diarrhea treatment. Seven leaves are boiled in 2 cups of boiling water (\pm 500 ml). This boiled water is then drunk. |
| Annonaceae | | | |
| <i>Cyathostemma viridiflorum</i> ; larak pisang | Liana | Fruits | Blackening hair. Ripe fruit is kneaded, mixed with enough water, and rubbed on the hair of the head. |
| <i>Annona muricata</i> ; sirsak | Tree | Leaves | Stomach pain medicine. The leaves are dipped in kerosene and then placed on the belly or navel. |
| Apocynaceae | | | |
| <i>Alstonia angustiloba</i> ; tampar badak | Tree | Sap | Blood vomiting medicine. The sap from the stem wound is mixed with sugar and then drunk. |
| Areaceae | | | |
| <i>Arenga pinnata</i> ; aren | Tree | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Calamus caesius</i> ; rotan | Liana | Stem | Headache medicine. The dried stems are burned and the smoke is inhaled. |
| <i>Korthalsia ferox</i> ; rotan pilak | Liana | Stem | Medicine for heartburn/stomach pain. Umbut (main stem that just grows) is cleaned and then eaten directly. |
| Asparagaceae | | | |
| <i>Dracaena</i> 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 | | | |
| <i>Chromolaena odorata</i> ; kirinyuh | Shrub | Leaves | Antibiotics for wounds. The crushed leaves are attached to the injured part. |
| <i>Elephantopus scaber</i> ; tapak liman | Herb | Leaves | Glandular swelling medication. The kneaded young leaves are mixed with a little salt and then applied to the swollen area. |
| <i>Gynura procumbens</i> ; daun sambung | Herb | Leaves | Remedy for itching. The crushed leaves are put in a bucket of water. This water is used for bathing. |
| Blechnaceae | | | |
| <i>Stenochlaena palustris</i> ; 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 |
|--|---------------|---------------------|---|
| <i>Trema tomentosa</i> ; balik angin | Tree | Stem | Anti mosquito bites. The bark is directly applied to the body. |
| Convolvulaceae | | | |
| <i>Merremia peltate</i> ; 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 | | | |
| <i>Euphorbia latyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; 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. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angšana | Tree | Stem (bark) | Genital medicine. The bark is boiled and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey-hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> 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 | | | |
| <i>Donax cerniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned and the smoke is used as an insect repellent. |
| <i>Syzigium polyanthum</i> ; salam | Tree | Leaves | Hypertension medication. Five leaves are boiled and the water is drunk. |
| <i>Tristaniopsis merguensis</i> ; 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 |
|--|---------------|---------------------|---|
| <i>Averrhoa bilimbi</i> ; 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 | | | |
| <i>Passiflora foetida</i> ; permot, bilaran kusam | Liana | Stem | Diabetes medication or blood glucose lowering. The 40 cm long stem is boiled and the boiled water is drunk. |
| Phyllanthaceae | | | |
| <i>Baccaurea javanica</i> ; limpasu | Tree | Root | Fever medicine. The roots are boiled and the boiled water is drunk. |
| <i>Phyllanthus debilis</i> ; ambin-ambin buah, meniran | Herb | Root | Back pain medicine. The roots are boiled and the boiled water is drunk. |
| Poaceae | | | |
| <i>Imperata cylindrica</i> ; 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 | | | |
| <i>Labisia pumila</i> ; rumput fatimah | Herb | Root | Natural contraceptives. The roots are boiled and the boiled water is drunk every day. |
| Rhamnaceae | | | |
| <i>Ziziphus</i> sp.; teja | Tree | Root | Post-partum recovery. The roots are boiled and the boiled water is drunk. |
| Rubiaceae | | | |
| <i>Morinda citrifolia</i> ; carikan, mengkudu | Tree | Stem | Bloody stool medicine. The stems are chopped and boiled. The boiled water is drunk. |
| Rutaceae | | | |
| <i>Luvunga eleuthandra</i> ; seluang belum | Liana | Root | Stamina-boosting drug. The roots are boiled and the boiled water is drunk. |
| <i>Euodia aromatica</i> ; wangun gunung | Tree | Leaves | Remedy for itching and hives. The young leaves are ground and then applied to the itchy area. |
| Salicaceae | | | |
| <i>Flacourtia rukam</i> ; 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 | | | |
| <i>Santalum album</i> ; cendana | Tree | Stem (bark) | Internal medicine (gastric ulcers, stomach pain, stomach acid). The bark is boiled and the boiled water is then drunk. |
| Sapotaceae | | | |
| <i>Mimusops elengi</i> ; 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 | | | |
| <i>Brucea javanica</i> ; marsihung | Shrub | Fruits | Malaria drugs. Ripe fruit is pounded and then swallowed directly. |
| <i>Eurycoma longifolia</i> ; 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 | | | |
| <i>Muntingia calabura</i> ; kersen | Tree | Leaves | Diabetes medication. The leaves are boiled and the boiled water is drunk. |
| Urticaceae | | | |
| <i>Laportea macrostachya</i> ; 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 | | | |
| <i>Peronema canescens</i> ; 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 | | | |
| <i>Tetrasigma</i> 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. |
| <i>Leea indica</i> ; 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. |

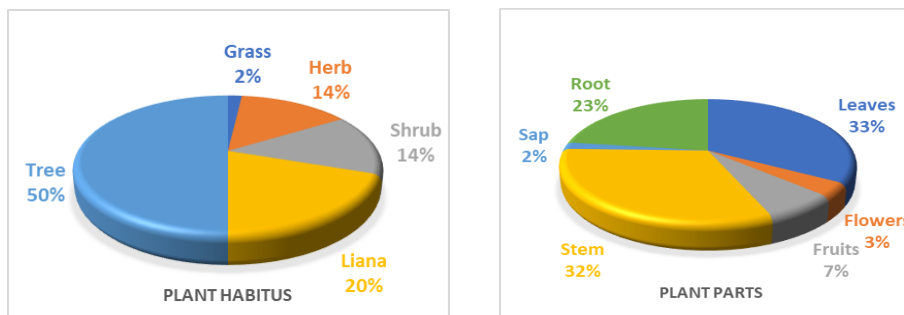
| Family, species, and local name | Plant habitus | Parts of plant used | Types of diseases/disorders and preparation of medicinal plants |
|---|---------------|---------------------|---|
| Zingerberaceae <i>Zingiber cassumunar</i> ; banglai warik | Herb | Root (rhizome) | Medicine for itching or allergies.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

109

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

113 The part of the plant with the highest utilization ratio (33%) was the leaf. Other parts that are used (respectively from
 114 high to low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their
 115 secondary metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al.
 116 2019), the content of medicinal ingredients is strong or high (Malini et al. 2017), the availability of leaves are more
 117 abundant (Mustofa et al. 2020), harvesting leaves is easier (Malini et al. 2017, Mustofa et al. 2020) and has no direct
 118 impact on plant death (Qomariah et al. 2020), and after harvesting, leaves are easy to grow back (Qomariah et al. 2020).

119



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

121

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

132

132 Preparation of Plants in Medicine

133

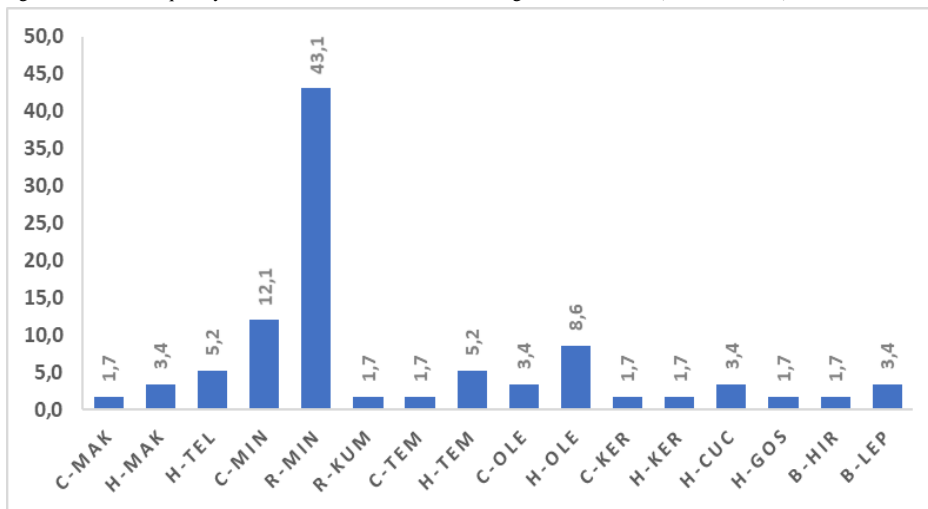
134 To treat diseases or cure disorders that exist or come from within the body, the parts of the plant are eaten (including
 135 chewing), swallowed, drunk, or gargled, while what is outside the body of the medicinal plant is attached, smeared,
 136 washed, splashed (or used as a washing agent), rubbed,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

140

141 There are four boiling records identified from this study. First, after boiling, there are two forms that are used: (1)
 142 solids from medicinal plants are eaten or (2) boiled liquids are drunk. Second, boiling refers to the process of putting plant
 143 parts into a container filled with water with a certain volume and cooking it over a fire until the water boils or the volume
 144 of water decreases. Boiling is not a process of soaking plant parts in hot or boiling water. Suharjo et al. (2014) revealed
 145 that boiling is carried out in two ways and depends on the part of the medicinal plant used: (1) boiling the water in which
 146 there are medicinal plant parts or (2) soaking the medicinal plant part in hot water. Third, no specific data were obtained
 147 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

148 time are not familiar with the boiling and stirring tools that are commonly used by the people in Central Java. Fourth, there
 149 are no data related to the drying of medicinal plants before being served or given treatment. Sumarni et al. (2019) notes
 150 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
 151 body when drunk.

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



155
 156 **Figure 3.** Frequency of drug preparation from plants and how to use them. C-MAK = parts of medicinal plants eaten with or without a
 157 mixture of other ingredients; H-MAK = medicinal plant parts are crushed before being eaten; H-TEL = medicinal plant parts are
 158 crushed before being swallowed; C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients; R-MIN = parts
 159 of medicinal plants are boiled before the boiled water is drunk; R-KUM = parts of medicinal plants are boiled before gargling the boiled
 160 water air; C-TEM = parts of medicinal plants affixed with or without a mixture of other materials; H-TEM = parts of medicinal plants
 161 are crushed before being pasted; C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients; H-OLE =
 162 medicinal plant parts are crushed before being applied; C-KER = parts of medicinal plants are washed with or without a mixture of other
 163 ingredients; H-KER = medicinal plant parts are crushed before washing; H-CUC = medicinal plant parts are crushed before being used
 164 to wash things; H-GOS = medicinal plant parts crushed before rubbing; B-HIR = parts of medicinal plants are burned and the smoke
 165 from the combustion is inhaled; B-LEP = Parts of medicinal plants are burned and the smoke from the combustion is released into the
 166 air

167 **People Perception to Medicinal Plants**

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

174
 175
 176
 177

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. |

178

179

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.

187

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).

197

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.

199

200

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201

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202

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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 | <p>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.</p> | <p>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</p> |
| Materials and Methods | <p>- is there any importance to highlight that they 'only' live in the said area?</p> <p>- Can you elaborate further on the identification methods, is there a botanist involved and are there any voucher specimens deposited</p> <p>- can you elaborate more on how did you identify these healers? Is it through word of mouth of the villagers?</p> <p>- 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 questionnaire to standardize the obtained information and provide a sample of the questionnaire form.</p> | <p>- Yes, since in the LMFE there are two groups of community, namely local people and transmigration people.</p> <p>- We only use the guide book for species identification in tropical rainforest ecosystems. There is not a botanist contribution in this research</p> <p>- the healers are identified based on the information from villagers since they are classified as traditional healers</p> <p>- We use a set of questionnaire to explore the utilization of medicinal plants. One of the surveyor member is a pharmacy student</p> |
| Results and Discussion | <p>- Please provide full name in italic of each plant e.g., <i>Alphitonia excelsa</i> (Fenzl) Reissek ex Benth. (including author name etc, this is also required in the author's guide)</p> <p>- Just to clarify, is this for treating high blood pressure or low blood pressure?</p> | <p>- Some article in this journal is also permitted to write species without the name of author https://doi.org/10.13057/biodiv/d160106</p> <p>- it is for high blood pressure</p> |

Reviewer L

| Part of Article | Reviewer's Comment | Author's Response |
|-------------------------------|---|--|
| Results and Discussion | <ul style="list-style-type: none"> - "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 | <ul style="list-style-type: none"> - 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 | <ul style="list-style-type: none"> - all the name of species should be written in italics - name of the author? You should add the all the species 'author name' | <ul style="list-style-type: none"> - 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 <p>https://doi.org/10.13057/biodiv/d160106</p> |

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.

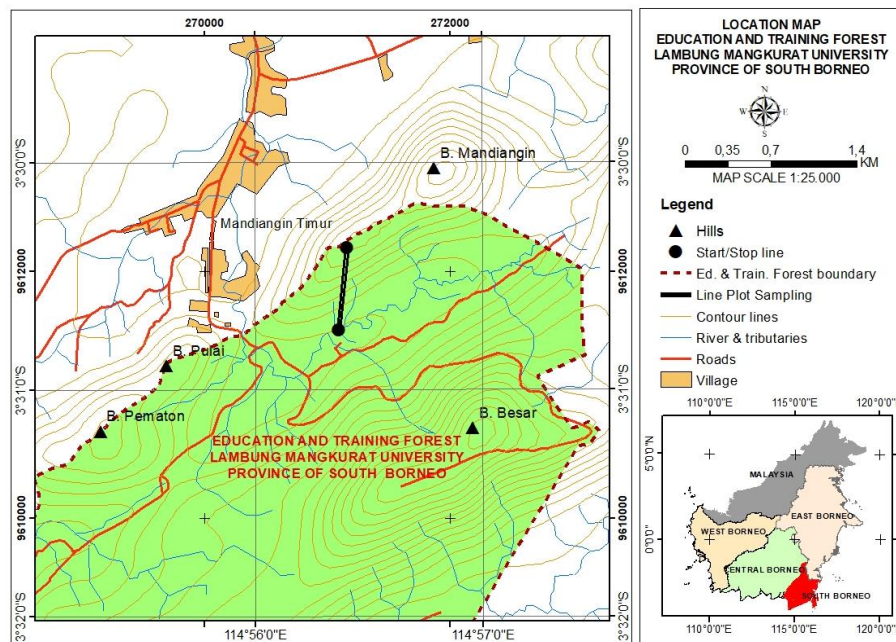
This study aimed to analyze the potential of medicinal plants naturally distributed in LMEF and their utilization by the local community living around this area. This information is not only a complement to the report on the database of many special-purpose forest areas of Indonesia. However, it can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

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

48 MATERIALS AND METHODS

49 Study area

50 The medicinal plants' inventory was conducted at the northern area of LMEF. The geographic coordinates for this site
51 are located in E114°54'00" to 114°58'00" and S3°30'00" 3°34'00". This area is in East Mandiingin and Kiram Village,
52 Karang Intan District, Banjar Regency, South Kalimantan (Figure 1). Meanwhile, the data about community perception for
53 medicinal plants utilization were collected from the local people in the East Mandiingin Village. This village is the closest
54 rural to the LMEF and can be accessed using a motorcycle or car.
55



56
57 **Figure 1.** Map of study site in Lambung Mangkurat Education Forest

58 Data collection

59 The process of data collection was undertaken from June to August 2020. Medicinal plants were recorded using the
60 cruise method in about 20,000 m², and this rectangular area is formed from a straight cruising path of one-kilometer-long
61 and 20 m wide. Plants are grouped into five habitus: grasses, herbs, shrubs, lianas, and trees. Grasses belong to the Poaceae
62 and Cyperaceae families (Soendjoto et al. 2014), while herbs or shrubs refer to non-woody plants. Shrubs refer to woody
63 plants with many branches but a maximum height of about 3 m. Meanwhile, liana is a climber who needs other plants
64 (hosts) to stand upright to propagate or climb. Tree is a general term for woody plants with three or four growth stages:
65 seedlings, saplings, poles, and trees. Seedlings are woody plants whose height is <1.5 m above the ground. Saplings are
66 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.
67 Poles are woody plants whose diameter is in the range of 10 <20 cm, while trees are those with a diameter of 20 cm
68 (Soendjoto et al., 2014). For woody plants with three growth stages by excluding the pole growth stage, a diameter of 10
69 cm is categorized as a tree.

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

75 Data analysis

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

82 Medicinal plants species in Lambung Mangkurat Education Forest

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

86 First, medicinal plant species were obtained from an area of 2 hectares or only 0.12% of the total area of LMFE. This is
 87 classified as very small considering LMFE reaches 1,627 hectares. Second, other species are categorized as medicinal
 88 plants in LMFE but were not found in the data collection area. Four of these species are balik angin (*Alphitonia excelsa*)
 89 (Rusida et al. 2019), kimalaka (*Phyllanthus emblica*) (Matnasir et al. 2020), pulantan (*Alstonia scholaris*) (Wibisono et al.
 90 2020), and tikusan (*Clausena excavata*) (Paradika et al. 2021). Balik angin known as the soap tree (Thompson et al. 2019),
 91 has the potential, among others, for chemical therapy for the prevention and treatment of urinary infections, autoimmune
 92 diseases, and gastrointestinal bleeding (Cock 2020). Kimalaka has potential as a treatment for diarrhea, inflammation
 93 (Krishnaveni and Mirunalini 2010), sore throat and as a refreshing drink (Rahman et al. 2013), antioxidant (Suzery et al.
 94 2013), and anti-obesity (Ardiansyah et al. 2018). Pulantan has potential as an antitoxoplasma (Abraham et al. 2014),
 95 antidiabetic (Tambunan et al. 2016), antioxidant (Zuraida et al. 2017, Thahira et al. 2021), and antimicrobial. Finally,
 96 tikusan has the potential as antioxidants (Arbab et al. 2011), anti-cancer, wound healing (Albaayit et al. 2015), as well as
 97 antioxidants and anti-diabetic (Thant et al. 2019).

98 **Table 1.** List of medicinal plants found in Lambung Mangkurat Education Forest and their utilization by the local community
 99

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

| | | | |
|--|-------|-------------------|---|
| <i>Euphorbia lathyris</i> ; sampai ringan | Herb | Leaves | Blood cough medicine. Young leaves (shoots) are chewed. After feeling crushed, the chew is swallowed. |
| Fabaceae | | | |
| <i>Caesalpinia</i> 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. |
| <i>Cassia alata</i> ; 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. |
| <i>Derris</i> 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. |
| <i>Archidendron pauciflorum</i> ; akar jengkol | Tree | Root | Medication to lower blood glucose levels. Roots about 5 cm are boiled, and the boiled water is drunk. |
| <i>Mimosa pudica</i> ; putri malu | Herb | Root | Back pain medicine. The roots are boiled, and the boiled water is drunk. |
| <i>Pterocarpus indicus</i> ; angsana | Tree | Stem (bark) | Genital medicine. The bark is boiled, and the boiled water is drunk. |
| Flagellariaceae | | | |
| <i>Flagellaria indica</i> ; 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 | | | |
| <i>Vitex ovata</i> ; alaban tulang | Tree | Stem (bark) | Diabetes medication. The bark of 5 cm wide is boiled, and the boiled water is drunk. |
| Lauraceae | | | |
| <i>Eusideroxylon zwageri</i> ; ulin | Tree | Leaves | Blackening hair or anti grey hair. Leaves (shoots) are washed on the hair. |
| <i>Litsea</i> sp.; matang 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 | | | |
| <i>Donax cenniformis</i> ; 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 | | | |
| <i>Melastoma malabatricum</i> ; senduduk | Shrub | Flowers | Cough medicine. Flowers are pulverized or crushed until smooth and then eaten or swallowed. |
| Meliaceae | | | |
| <i>Aglaia</i> 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. |
| <i>Lansium domesticum</i> ; langsung | Tree | Stem (bark) | Medication for diarrhea or stomach problems. The bark is boiled, and the boiled water is drunk. |
| <i>Swietenia mahagoni</i> ; 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 | | | |
| <i>Arcangelicia flava</i> ; akar kuning | Liana | Root | Liver or hepatitis drugs. The roots are boiled, and the boiled water is then drunk. |
| Moraceae | | | |
| <i>Artocarpus dadah</i> ; tampang | Tree | Leaves | Stomach problem medicine. The young leaves are boiled, and the boiled water is drunk. |
| Myrtaceae | | | |
| <i>Tristaniopsis</i> sp.; jawaling | Tree | Leaves | Insect repellent (such as mosquitoes). The leaves are burned, and the smoke is insect repellent. |
| <i>Syzigium polyanthum</i> ; salam | Tree | Leaves | Hypertension medication. Five leaves are boiled, and the water is drunk. |
| <i>Tristaniopsis merguensis</i> ; pelawan | Tree | Stem | Liver medicine. The stem is cut, and the dripping liquid is drunk. |
| Oxalidaceae | | | |
| <i>Averrhoa bilimbi</i> ; 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.

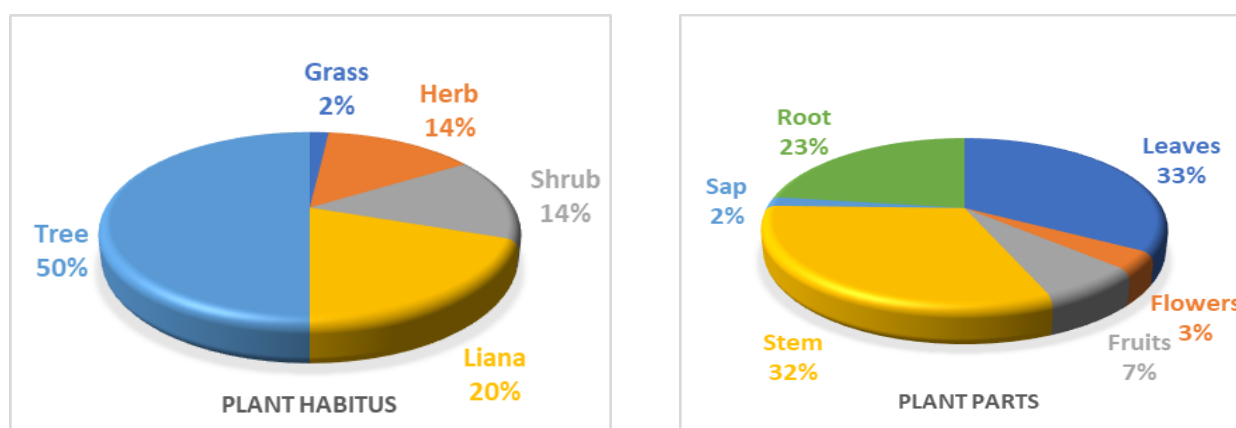
| | | | |
|--|-------|----------------|---|
| <i>Leea indica</i> ; mali-mali | Shrub | Fruits | Wart remover. Ripe fruit (blackish color) pounded until crushed. This fruit mash is applied to the wart site for several repetitions. |
| Zingiberaceae <i>Zingiber cassumunar</i> ; banglai warik | Herb | Root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

100

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

104 The plant with the highest utilization ratio (33%) was the leaf, and other parts that were used (respectively from high to
 105 low ratio) were stems, roots, fruit, flowers, and sap (Figure 2b). Leaves are more widely used because their secondary
 106 metabolite content is more diverse (Assi et al. 2017, Fatmawati et al. 2020, Gurning and Sinaga 2020, Jain et al. 2019), the
 107 content of medicinal ingredients is strong or high (Malini et al. 2017), the availability are more abundant (Mustofa et al.
 108 2020), harvesting is easier (Malini et al. 2017, Mustofa et al. 2020). Furthermore, leaves do not directly impact plant death
 109 (Qomariah et al. 2020), and after harvesting, they can quickly grow back (Qomariah et al. 2020).

110



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

112

113 Leaves are part of medicinal plants with the highest utilization ratio by various ethnic groups. However, the level of
 114 utilization ratio for each ethnic group is different. In Indonesia, such a situation is found in the Karo ethnicity in North
 115 Sumatra (Affandi and Batubara 2019), the Kaili ethnic group, Central Sulawesi (Ifandi et al. 2016), the Tengger ethnic
 116 group in East Java (Jadid et al. 2020) et al. 2015), the community of Karangwangi Village, Cianjur, West Java (Malini et
 117 al. 2017), three ethnic groups (Banjar, Bugis, Dayak) in Tanah Bumbu Regency, Kalimantan Selatan (Radam et al. 2016),
 118 Ethnic Mamuju, Sulawesi West (Syamsiah et al. 2016), and four Dayak sub-ethnics in West Kalimantan (Yusro et al.
 119 2014). Outside Indonesia, ethnic groups or communities that use leaves as the main part of plants in medicine include the
 120 Tolai community, Papua New Guinea (Bureng et al. 2016), the Manobo Tribe, the Philippines (Dapar et al. 2020), the
 121 Bilaspur Village community, India. (Patel 2014), the Ayta community, Philippines (Tantengco et al. 2018), and
 122 Sheikhpura, Pakistan (Zahoor et al. 2017).

123

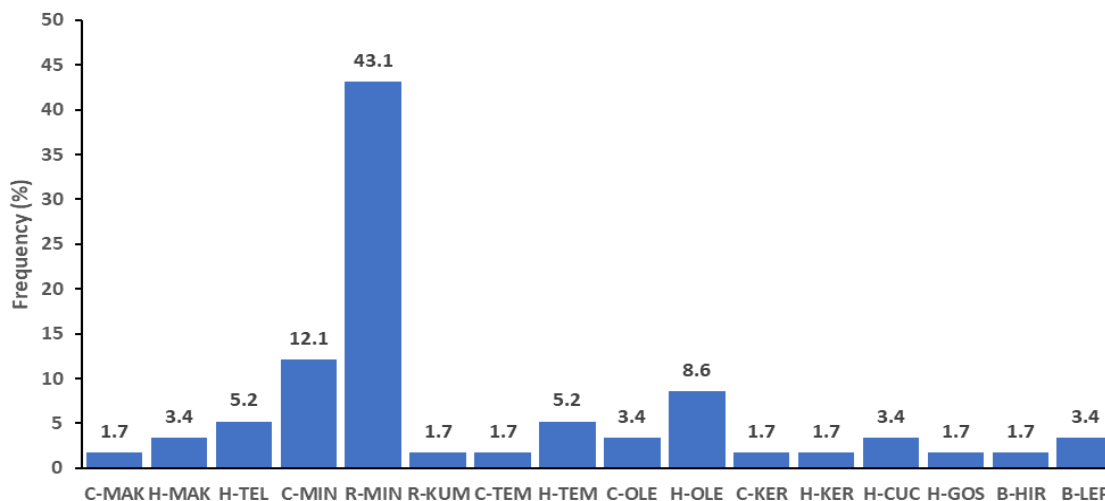
124 Preparation of Plants in Medicine

125 The plant parts are eaten (including chewing), swallowed, drunk, or gargled to treat diseases or cure disorders from
 126 within the body. Outside the body, the medicinal plant is attached, smeared, washed, splashed or used as a washing agent,
 127 rubbed, inhaled, or left in the air to repel nuisance animals. However, the plant should be prepared by additional
 128 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.

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

139 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
 140 when drunk.

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



144
 145 **Figure 3.** Frequency of drug preparation from plants and how to use them
 146

147 Keterangan:

- 148 C-MAK = parts of medicinal plants eaten with or without a mixture of other ingredients
- 149 H-MAK = medicinal plant parts are crushed before being eaten
- 150 H-TEL = medicinal plant parts are crushed before being swallowed
- 151 C-MIN = liquid medicinal plants taken with or without a mixture of other ingredients
- 152 R-MIN = parts of medicinal plants are boiled before the boiled water is drunk
- 153 R-KUM = parts of medicinal plants are boiled before gargling the boiled water air
- 154 C-TEM = parts of medicinal plants affixed with or without a mixture of other materials
- 155 H-TEM = parts of medicinal plants are crushed before being pasted
- 156 C-OLE = parts of medicinal plants are applied with or without a mixture of other ingredients
- 157 H-OLE = medicinal plant parts are crushed before being applied
- 158 C-KER = parts of medicinal plants are washed with or without a mixture of other ingredients
- 159 H-KER = medicinal plant parts are crushed before washing
- 160 H-CUC = medicinal plant parts are crushed before being used to wash things
- 161 H-GOS = medicinal plant parts crushed before rubbing
- 162 B-HIR = parts of medicinal plants are burned, and the smoke from the combustion is inhaled
- 163 B-LEP = parts of medicinal plants are burned, and the smoke from the combustion is released into the air

164 **People Perception of Medicinal Plants**

165 The people of Mandiangin Timur Village have been touched by modern culture. For example, they can go back and
 166 forth to the nearest town (Banjarbaru), only about 15 km away by 2-wheeled or 4-wheeled vehicles via asphalt roads.
 167 Subsequently, all respondents have used mobile phones to communicate because the internet network has been operated in
 168 this village. With this tool, people can communicate faster and get or access knowledge about modern medicines more
 169 efficiently. However, most people (74.0%) positively perceive traditional medicine that uses medicinal plants (Table 2).
 170

171 **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. |

172
 173 Positive perceptions overcome the negative stigma associated with the use of medicinal plants. First, the dose to treat a
 174 particular disease is uncertain. This uncertainty arises from transferring knowledge more often orally than in writing.
 175 Second, the parts and species selected depend heavily on the experience and expertise of the healer (shaman), which
 176 allows significant differences between a healer and another. This is because it is not easy to find explanations about

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

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

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

190

191

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194

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We have reached a decision regarding your submission to [Biodiversitas](#) Journal of Biological Diversity, "Traditional medicinal plants and their utilization by local communities around Lambung Mangkurat Education Forests, South Kalimantan, Indonesia".

Our decision is to: Accept Submission

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