Ethnobotanical inventory and habitat ecology of medicinal plants used by the West Muna Tribe, Southeast Sulawesi, Indonesia

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Ethnobotany Research and Applications 35:70 (2026) - http://dx.doi.org/10.32859/era.35.70.1-24
Manuscript received: 07/11/2026 - Revised manuscript received: 21/09/2026 - Published: 23/09/2026

Research

Abstract

Background: The West Muna Tribe of Southeast Sulawesi retains extensive knowledge of medicinal plants, but regional documentation integrating reported uses, field occurrence, habitat conditions, and spatial distribution remain limited. This study documented medicinal plants reported and located with community informants and described their habitat and regional compositional patterns.

Methods: We conducted a descriptive ethnobotanical-ecological survey in Barangka, Kusambi, Lawa, and Sawerigadi. 42 respondents participated, including 19 regional key informants and 8 traditional healers, the supplied register lists ages 43-65 years. Interviews documented reported uses, while guided field walks generated 288 plant-location occurrence records. We summarized regional patterns using raw richness, a family-by-region heatmap, nMDS based on Bray-Curti's dissimilarity, PERMANOVA, chi-square tests, and Kruskal-Wallis tests.

Results: The field inventory comprised 288 occurrence records representing 177 standardized species and 65 families. The respondent registers listed ages 43-65 years. Barangka contributed 151 records, Kusambi 54, Lawa 43, and Sawerigadi 40. A descriptive heatmap showed that the most frequently recorded families varied among regions. Recomputed two-dimensional nMDS had acceptable stress (0.142). PERMANOVA detected a statistically significant but small regional effect (pseudo-F = 2.97, R2 = 0.030, p = 0.0001), pairwise differences remained significant only for Barangka-Lawa and Barangka-Sawerigadi after FDR correction. Habitat type and habitus also differed among regions.

Conclusions: The West Muna inventory documents substantial medicinal-plant richness across varied lowland habitats. Regional differences were detectable but modest, and the occurrence records should not be interpreted as individual citation frequencies or direct measures of knowledge intensity. The findings support habitat-sensitive conservation, community cultivation of widely recorded medicinal species, and future respondent-level research that can evaluate knowledge variation by age and calculate standard quantitative ethnobotanical indices.

Keywords: Ethnobotany; Medicinal Plants, Traditional medicine, Muna Tribe

Background

Medicinal plants remain integral to traditional health systems and continue to support preventive care, culturally familiar treatment, and healthcare access in many communities (Hoffman & Gallaher 2007, Bulut *et al*. 2017, Faruque *et al*. 2018, Bouzabata & Mahomoodally 2020, Dutta *et al*. 2021, Chakale *et al*. 2024). The World Health Organization recognizes traditional, complementary, and integrative medicine as a public-health concern involving regulation, safety, quality, access, and responsible integration into health systems (WHO 2023).

Medicinal plants are also important sources of chemically diverse compounds for drug discovery (Li & Xing 2016, Jamshidi-Kia *et al*. 2017, Newman & Cragg 2020, Atanasov *et al*. 2021, Leonti 2022). Ethnobotanical documentation is strengthened when reported uses are considered alongside habitat and distribution because temperature, humidity, light, elevation, topography, and other environmental factors can influence plant occurrence, regeneration, and secondary metabolism (Yang *et al*. 2018, Pant *et al*. 2021, Pan *et al*. 2023, Qaderi *et al*. 2023).

Indonesia's biological and cultural diversity has generated a substantial ethnobotanical literature, yet geographic coverage remains uneven. Studies from Sumatra, Java, Kalimantan, Bali, Aceh, and Sulawesi collectively show that medicinal-plant knowledge is embedded in local health practices and cultural identity, while eastern Indonesia remains comparatively underrepresented (Sujarwo *et al*. 2015, Rahmawati *et al*. 2020, Zubaidah *et al*. 2020, Elfrida *et al*. 2021, Sitanggang *et al*. 2022, Nugroho *et al*. 2022). This imbalance supports research that documents locally specific repertoires without assuming inventory size directly measures the amount of knowledge individuals hold.

Within Sulawesi, community studies have documented diverse medicinal species and highlighted risks to intergenerational knowledge transmission. In Southeast Sulawesi, researchers reported 34 medicinal species from 20 families around Gantara Forest, while work on Muna communities has primarily emphasized species, plant parts, preparation, and uses (Jumiarni & Komalasari 2017, Rahmawati *et al*. 2020, Zubaidah *et al*. 2020, Hamzah *et al*. 2022). Habitat measurements and mapped field occurrences remain less consistently reported for West Muna.

This study therefore documents medicinal plants reported by the West Muna community and describes the habitat conditions and spatial distribution of field-located plants in Barangka, Kusambi, Lawa, and Sawerigadi. The analysis distinguishes interview-derived use information from plant-location occurrence records, cautiously evaluates regional compositional patterns, and identifies practical priorities for conservation and future respondent-level ethnobotanical research.

Materials and Methods

Approach and Types of Research

This study used a descriptive-exploratory design combining ethnobotanical interviews, guided field surveys, habitat measurements, and spatial documentation. The design aimed to document reported medicinal uses and characterize the environments where medicinal plants were found, it was not designed to estimate population abundance or compare individual knowledge scores (Crano & Brewer 2002, Walliman 2006, Bryman 2012, Tongco 2007)

Study area

Fieldwork was conducted from April to November 2025 in Barangka, Kusambi, Lawa, and Sawerigadi, Southeast Sulawesi (Figure 1). Survey locations ranged from 15 to 85 m above sea level and included yards, gardens, fields, shrublands, roadsides, limestone areas, and forest margins, which locals know as sources of medicinal plants. We purposively selected locations following initial community guidance. Geographic coordinates were recorded for mapping; reporting was generalized to the village level to reduce risks to sensitive plant locations.

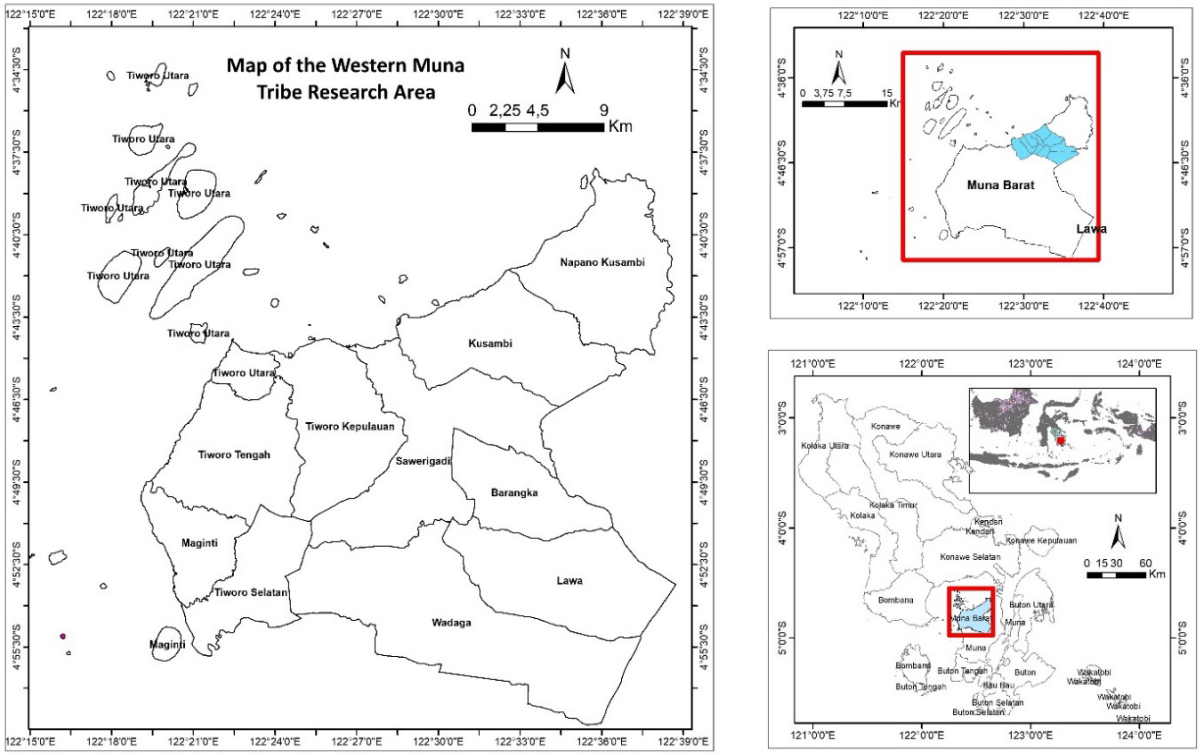


Figure 1. Administrative Map of the West Muna Tribe

Research Procedure

The research followed a process of planning, field implementation, and analysis. Planning included literature review, instrument preparation, permits, site selection, and informant identification. Field implementation combined interviews, guided plant-location surveys, replicated microclimate measurements, coordinate recording, and photographic documentation. Analysis included taxonomic checking, separation of interview-derived use information from field-occurrence data, descriptive tabulation, habitat comparison, and spatial mapping.

Data Source

We used two linked but analytically distinct primary data streams. First, interviews documented local plant names, plant parts, preparation, and reported uses. Second, guided field surveys generated 288 plant-location occurrence records (PR001-PR288) containing region, standardized species name, family, habitat, topography, temperature, humidity, light intensity, habitus, and geographic location. Respondent metadata were anonymized as R001-R042. Because the historical field sheet linked occurrence records to a regional respondent pool rather than a specific informant, the 288 records represent field occurrences and should not be interpreted as individual use citations, frequency-of-citation observations, or measures of informant knowledge. Secondary sources included scientific literature, geographic data, maps, and agency documents.

Participants and Sampling

The study involved 42 anonymized respondents who were members of the West Muna community and familiar with traditional medicinal plants. Nineteen were regional key informants: 5 from Barangka, 5 from Kusambi, 5 from Lawa, and 4 from Sawerigadi, 8 of the 42 respondents were traditional healers (an author-confirmed subset of the broader traditional-medicine user/collector pool). Other participants included medicinal-plant users, collectors, community leaders, and local knowledge holders. Purposive sampling identified knowledgeable participants, followed by snowball referrals. The supplied respondent register records an age range of 43-65 years.

Data Collection Technique

Data collection used 4 techniques. (1) Semi-structured interviews documented local names, plant parts, preparation, reported uses, and collection locations. Adult participants provided oral prior informed consent. (2) Guided field walks located plants identified by informants. (3) Microclimate measurements were made in situ at each plant-location point

during 09:00-11:00 and 13:00-15:00 WITA. Temperature and relative humidity were measured 1 m above ground with a calibrated digital thermohygrometer, and light intensity was measured in lux with a digital lux meter positioned horizontally at the level of the dominant leaf canopy. We repeated each measurement 3 times at 5-minute intervals and summarized the results for analysis. (4) Coordinates and photographs documented each plant and habitat. Coordinates were converted from DMS to decimal degrees, generalized to 3 decimal places at village level, and reported in Supplementary Table S1.

Tools and Materials

Equipment included interview guides, field notebooks, cameras, GPS receivers, calibrated digital thermohygrometers, digital lux meters, altimeters or mapping applications, specimen bags, labels, and ArcGIS. S.W.A. identified plants and standardized taxonomy using field photographs, morphological observations, and available collected material. No permanent voucher specimens were deposited in a recognized herbarium, this limits independent taxonomic verification and is acknowledged explicitly.

Data Analysis Techniques

We reduced and grouped interview-derived use information by species, plant part, preparation, and reported complaint. We cleaned field-occurrence records by unique record ID and standardized species name, family, region, habitat, habitus, temperature, humidity, and light intensity, standardization means harmonizing taxonomic labels and variable coding, not adjusting abundance or informant knowledge. We reported raw record counts, species richness, and family richness descriptively. We replaced PCA with a family-by-region heatmap because only 4 regional aggregates were available for the PCA profile. nMDS was rerun on the 288 record-level observations using Bray-Curti's dissimilarity (k = 2). PERMANOVA with 9,999 permutations tested regional differences in the combined species-family-habitat-habitus matrix. Chi-square tests examined region by habitat, habitus, and dominant family group, and Kruskal-Wallis tests compared temperature, humidity, and light intensity. Analyses were conducted in R 4.3.2 through RStudio 2023.12.1 using stats, vegan 2.6-4, and ggplot2 3.4.4, with $p < 0.05$.

Results

Participant Profile and Data Structure

The study included 42 respondents: 19 regional key informants and 8 traditional healers. The respondent register records ages of 43-65 years, no 17-year-old respondent or guardian-consent field appears in that register. Interviews generated aggregated descriptions of medicinal uses, whereas guided fieldwork produced 288 plant-location occurrence records. These 2 data streams are presented separately because the occurrence table cannot identify how many individual informants cited each species or support age-stratified knowledge comparisons.

Medicinal Plant Composition

The field inventory contained 288 occurrence records representing 177 standardized species and 65 families across Barangka, Kusambi, Lawa, and Sawerigadi (Table 1). Barangka contributed 151 records (151/288 = 52.43%), Kusambi 54 (18.75%), Lawa 43 (14.93%), and Sawerigadi 40 (13.89%). These values describe the surveyed occurrence dataset, not plant abundance, citation frequency, or respondents' knowledge.

The recorded plants represented 65 families. *Fabaceae*, *Zingiberaceae, Asteraceae, Euphorbiaceae, Poaceae, Lamiaceae, Solanaceae, Malvaceae, Moraceae,* and *Rubiaceae* had the largest numbers of field occurrences. Family richness was 63 in Barangka, 32 in Kusambi, 24 in Lawa, and 25 in Sawerigadi. Because sampling effort and key-informant numbers were unequal and individual citations were not retained, these regional totals are interpreted descriptively rather than as standardized knowledge estimates.

Table 1. Family composition and medicinal-plant field occurrences across West Muna regions.

Family	Species	Number of unique species	Field-occurrence records	Barangka	Kusambi	Lawa	Sawerigadi
Fabaceae	*Abrus precatorius, Caesalpinia bonduc, Caesalpinia sappan, Crotalaria incana, Crotalaria pallida, Dalbergia stipulacea, Erythrina variegata, Flemingia strobilifera, Mucuna sloanei, Pterocarpus indicus, Senna alata, Sesbania grandiflora, Tamarindus indica*	13	20	10	3	5	2
Zingiberaceae	*Alpinia galanga, Boesenbergia rotunda, Curcuma aeruginosa, Curcuma longa, Curcuma mangga, Curcuma xanthorrhiza, Curcuma zedoaria, Etlingera mamasarum, Kaempferia galanga, Zingiber cassumunar, Zingiber officinale, Zingiber zerumbet*	12	16	12	4	0	0
Asteraceae	*Ageratum conyzoides, Bidens pilosa, Blumea balsamifera, Chromolaena odorata, Crassocephalum crepidioides, Emilia sonchifolia, Erechtites valerianifolius, Pluchea indica, Synedrella nodiflora, Taraxacum officinale*	10	21	10	3	4	4
Euphorbiaceae	*Acalypha indica, Acalypha wilkesiana, Aleurites moluccana, Euphorbia hirta, Jatropha curcas, Jatropha multifida, Macaranga tanarius, Mallotus philippensis, Manihot esculenta, Ricinus communis*	10	17	8	5	2	2
Poaceae	*Cymbopogon nardus, Eleusine indica, Gigantochloa apus, Imperata cylindrica, Panicum sarmentosum, Paspalum scrobiculatum, Saccharum officinarum, Saccharum spontaneum*	8	12	6	2	1	3
Lamiaceae	*Ballota nigra, Clerodendrum japonicum, Clerodendrum thomsoniae, Hyptis brevipes, Ocimum tenuiflorum, Orthosiphon aristatus, Premna foetida*	7	14	6	2	3	2
Solanaceae	*Capsicum frutescens, Datura metel, Physalis angulata, Physalis peruviana, Solanum erianthum, Solanum lycopersicum, Solanum torvum*	7	11	5	2	2	2
Malvaceae	*Ceiba pentandra, Hibiscus tiliaceus, Kleinhovia hospita, Sida rhombifolia, Triumfetta rhomboidea, Urena lobata*	6	19	6	4	4	5
Moraceae	*Artocarpus altilis, Artocarpus camansi, Artocarpus heterophyllus, Ficus deltoidea, Ficus hispida, Ficus septica*	6	10	5	2	1	2
Rubiaceae	*Borreria laevicaulis, Coffea arabica, Morinda citrifolia, Neolamarckia macrophylla, Paederia foetida*	5	7	3	2	0	2
Apocynaceae	*Alstonia scholaris, Alstonia spatulata, Plumeria rubra, Wrightia arborea*	4	8	3	2	2	1
Arecaceae	*Areca catechu, Areca pumila, Calamus inops, Cocos nucifera*	4	6	4	2	0	0
Piperaceae	*Peperomia pellucida, Piper aduncum, Piper betle, Piper crocatum*	4	7	3	1	3	0
Anacardiaceae	*Anacardium occidentale, Lannea coromandelica, Mangifera indica*	3	4	2	1	1	0

Burseraceae	*Canarium hirsutum, Garuga floribunda, Protium javanicum*	3	3	1	0	1	1
Cucurbitaceae	*Luffa acutangula, Melothria affinis, Momordica charantia*	3	5	3	1	0	1
Musaceae	*Musa acuminata, Musa balbisiana, Musa paradisiaca*	3	3	2	1	0	0
Rutaceae	*Aegle marmelos, Citrus aurantiifolia, Melicope lunu-ankenda*	3	4	3	1	0	0
Sapindaceae	*Cardiospermum corindum, Cardiospermum halicacabum, Schleichera oleosa*	3	4	3	0	1	0
Verbenaceae	*Lantana camara, Stachytarpheta jamaicensis, Stachytarpheta mutabilis*	3	7	3	1	2	1
Acanthaceae	*Andrographis paniculata, Justicia gendarussa*	2	4	2	1	1	0
Amaranthaceae	*Amaranthus spinosus, Celosia argentea*	2	2	1	0	0	1
Annonaceae	*Annona muricata, Annona squamosa*	2	4	2	1	0	1
Costaceae	*Cheilocostus speciosus, Costus spiralis*	2	2	1	1	0	0
Loranthaceae	*Dendrophthoe pentandra, Scurrula ferruginea*	2	3	1	1	1	0
Meliaceae	*Aglaia argentea, Sandoricum koetjape*	2	2	1	0	0	1
Menispermaceae	*Arcangelisia flava, Tinospora crispa*	2	6	2	1	2	1
Myrtaceae	*Psidium guajava, Syzygium malaccense*	2	4	2	1	0	1
Nyctaginaceae	*Mirabilis jalapa, Pisonia grandis*	2	2	2	0	0	0
Oxalidaceae	*Averrhoa bilimbi, Oxalis corniculata*	2	3	1	1	0	1
Pandanaceae	*Pandanus amaryllifolius, Pandanus tectorius*	2	2	1	1	0	0
Phyllanthaceae	*Phyllanthus niruri, Sauropus androgynus*	2	6	2	2	1	1
Polypodiaceae	*Drynaria quercifolia, Drynaria sparsisora*	2	4	1	1	1	1
Santalaceae	*Santalum album, Viscum album*	2	2	2	0	0	0
Vitaceae	*Leea aculeata, Leea indica*	2	4	2	0	1	1
Apiaceae	*Centella asiatica*	1	2	1	0	0	0
Araliaceae	*Polyscias scutellaria*	1	1	1	0	0	0
Asphodelaceae	*Aloe vera*	1	1	1	0	0	0
Boraginaceae	*Tournefortia montana*	1	2	1	0	1	0
Bromeliaceae	*Ananas comosus*	1	1	0	1	0	0
Caricaceae	*Carica papaya*	1	2	1	1	0	0
Cleomaceae	*Cleome rutidosperma*	1	1	1	0	0	0
Commelinaceae	*Tradescantia spathacea*	1	1	1	0	0	0
Convolvulaceae	*Ipomoea quamoclit*	1	2	1	0	0	1
Crassulaceae	*Kalanchoe pinnata*	1	3	1	1	1	0
Cyperaceae	*Kyllinga monocephala*	1	2	1	0	1	0
Dilleniaceae	*Dillenia serrata*	1	1	1	0	0	0
Dioscoreaceae	*Dioscorea hispida*	1	1	1	0	0	0

Iridaceae	*Eleutherine bulbosa*	1	1	1	0	0	0
Lauraceae	*Persea americana*	1	1	1	0	0	0
Lecythidaceae	*Barringtonia racemosa*	1	1	1	0	0	0
Lygodiaceae	*Lygodium circinatum*	1	2	1	0	0	1
Lythraceae	*Lawsonia inermis*	1	1	1	0	0	0
Melastomataceae	*Melastoma malabathricum*	1	2	0	0	1	1
Moringaceae	*Moringa oleifera*	1	2	1	1	0	0
Muntingiaceae	*Muntingia calabura*	1	1	1	0	0	0
Nephrolepidaceae	*Nephrolepis biserrata*	1	1	1	0	0	0
Oleaceae	*Jasminum sambac*	1	1	1	0	0	0
Onagraceae	*Jussiaea suffruticosa*	1	1	1	0	0	0
Orchidaceae	*Rhynchostylis retusa*	1	1	1	0	0	0
Passifloraceae	*Passiflora foetida*	1	1	1	0	0	0
Plantaginaceae	*Scoparia dulcis*	1	1	1	0	0	0
Rhamnaceae	*Ziziphus mauritiana*	1	1	1	0	0	0
Simaroubaceae	*Ailanthus altissima*	1	1	1	0	0	0
Thymelaeaceae	*Phaleria macrocarpa*	1	1	1	0	0	0

Environmental Conditions of Medicinal Plant Habitats

Across the surveyed lowland sites (15-85 m above sea level), recorded temperatures were 29-31°C, relative humidity 79-83%, and light intensity approximately 13,578-21,711 lx (Figure 2). These ranges describe measurement conditions at the located plants during the specified daytime windows; they do not establish causal effects of microclimate on plant abundance or medicinal quality.

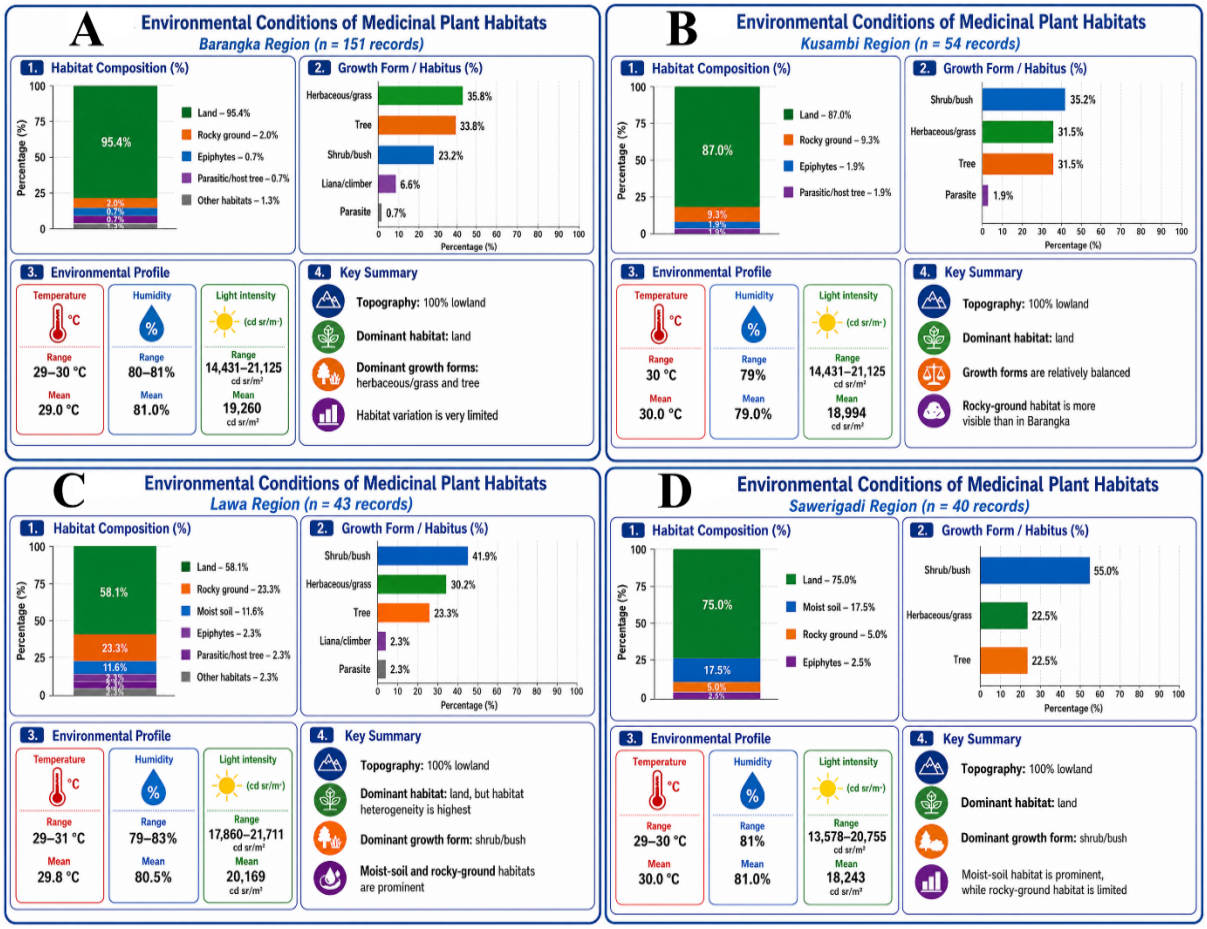


Figure 2. Environmental Conditions of Medicinal Plant Habitats in the Research Area

Barangka contributed 151 field-occurrence records. Measurements were centered near 29°C and 81% relative humidity, with light intensity of approximately 14,431-21,125 lx. Soil or terrestrial sites predominated, with fewer records from rocky ground, epiphytic settings, host trees, sandy soil, and limestone cliffs. This pattern characterizes the surveyed locations but does not by itself demonstrate greater plant abundance or stronger knowledge in Barangka.

Kusambi contributed 54 field-occurrence records. Recorded conditions were approximately 30°C and 79% relative humidity, with light intensity of 14,431-21,125 lx. Most records were terrestrial, with additional rocky-ground, epiphytic, and parasitic occurrences.

Lawa contributed 43 field-occurrence records. Temperature ranged from 29 to 31°C, relative humidity from 79 to 83%, and light intensity from 17,860 to 21,711 lx. Surveyed habitats included terrestrial soil, rocky ground, moist soil, epiphytic and parasitic settings, and limestone cliffs.

Sawerigadi contributed 40 field-occurrence records. Temperature was generally 30°C, relative humidity approximately 81%, and light intensity 13,578-20,755 lx. The study included terrestrial, moist-soil, rocky-soil, and epiphytic settings. These observations indicate microhabitat heterogeneity within the surveyed lowland landscape.

Spatial Distribution of Medicinal Plants

The distribution maps show 288 plant-location records across Barangka, Kusambi, Lawa, and Sawerigadi (Figure 3). Barangka contained 151 mapped records, Kusambi 54, Lawa 43, and Sawerigadi 40. Points occurred near settlements, roads, gardens,

fields, shrublands, limestone areas, and forest margins. The maps describe surveyed locations and accessibility; they should not be interpreted as complete species-distribution or abundance maps.

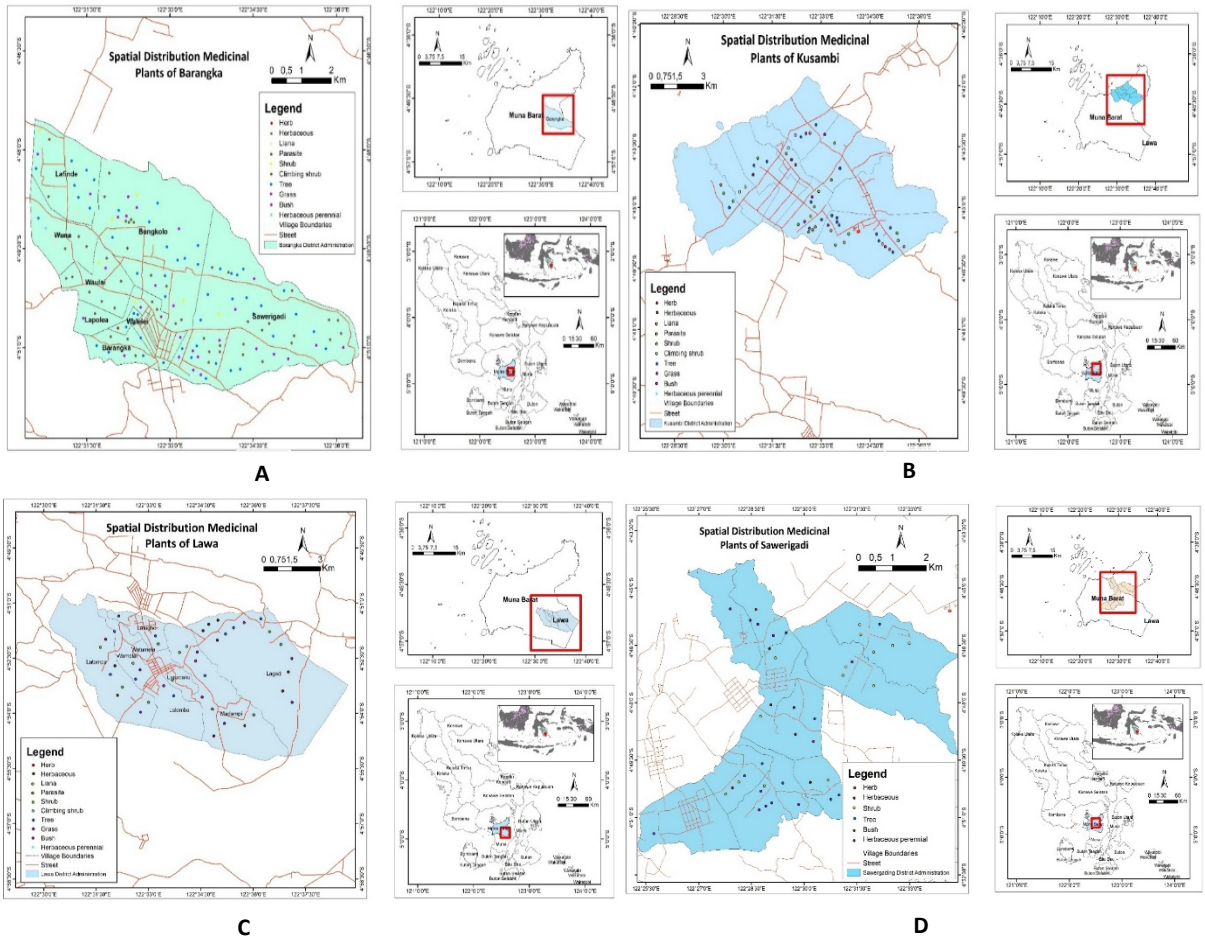


Figure 3. Map of the Distribution of Traditional Medicinal Plants of the West Muna Tribe by Region

The maps document variation in plant growth forms and habitats. Barangka had the densest surveyed point pattern, Kusambi records often followed accessible corridors, Lawa records were more dispersed, and Sawerigadi contained fewer mapped points. Because site selection was purposive, these patterns reflect the field survey and cannot establish population-level spatial intensity.

Family Composition with the Most Distribution

Across the 4 regions, 12 species were recorded in all regions, and 17 were recorded in 3 regions (Figure 4). The 12 widely recorded species were *Ageratum conyzoides*, *Blumea balsamifera*, *Chromolaena odorata*, *Euphorbia hirta*, *Ceiba pentandra*, *Hibiscus tiliaceus*, *Sida rhombifolia*, *Tinospora crispa*, *Ficus septica*, *Phyllanthus niruri*, *Imperata cylindrica*, and *Lantana camara*. Their repeated regional occurrence identifies them as cross-regional priority species for further ethnobotanical and conservation study, without implying ecological keystone status or high citation frequency.

In terms of family composition, *Asteraceae* and *Malvaceae* are the most prominent families among the species with the widest distribution. *Asteraceae* is represented by *Ageratum conyzoides*, *Blumea balsamifera*, *Chromolaena odorata*, and *Bidens pilosa*, while *Malvaceae* includes *Ceiba pentandra*, *Hibiscus tiliaceus*, *Sida rhombifolia*, *Kleinhovia hospita*, and *Urena lobata*. The presence of several species from the same family across three to four regions indicates the important role of these families in traditional community medicine systems. This pattern aligns with ethnobotanical studies in Indonesia, which also show that families such as *Fabaceae*, *Asteraceae*, *Euphorbiaceae*, *Poaceae*, *Lamiaceae*, and *Malvaceae* are often the main groups used by local communities for medicinal plants.

Seventeen additional species occurred in 3 regions. Their distribution suggests broad occurrence within the surveyed landscape, but the study cannot rank cultural importance because it did not retain individual respondent citations. We

therefore treat these species as candidates for future respondent-level and pharmacological investigation rather than as second-priority or keystone taxa.

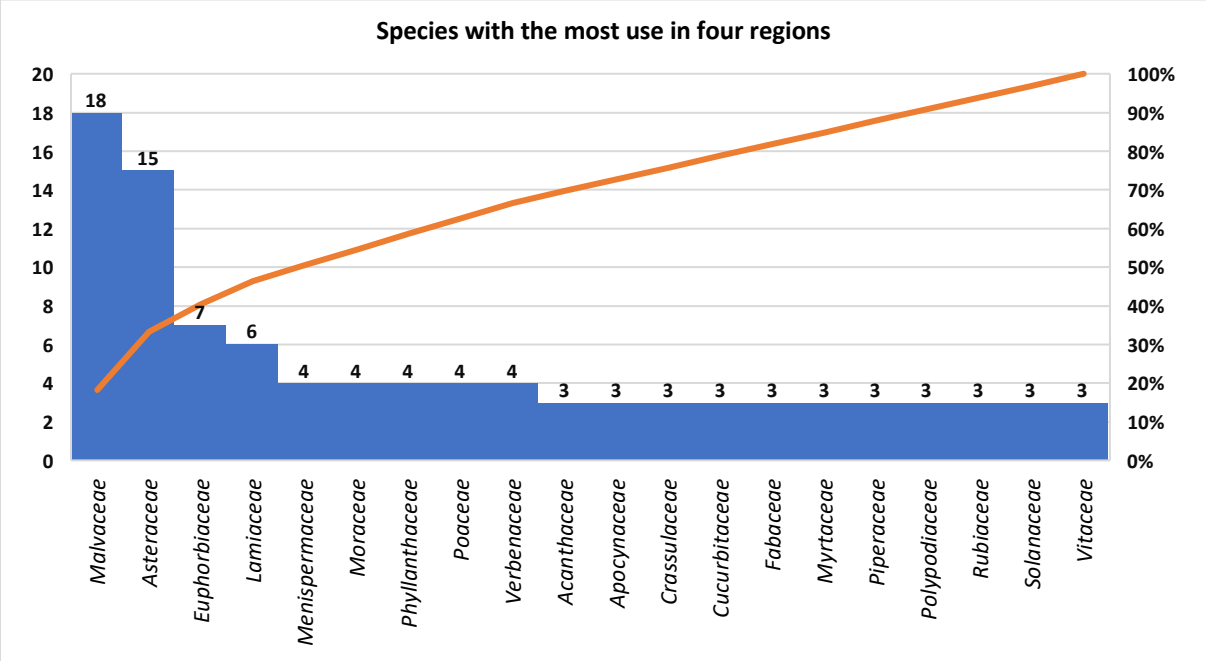


Figure 4. Composition of families and species with the largest distribution in four regions

Reported Ethnomedicinal Uses

Aggregated interview data described uses for 29 species recorded across 3 or 4 regions (Table 2). Reported complaints included fever, wounds, diarrhea, inflammation, pain, diabetes, cough, skin disorders, rheumatism, digestive disorders, asthma, malaria, hypertension, dysentery, and urinary problems. These entries summarize the collective interview record, they are not linked to individual informants and therefore cannot support frequency of citation, use value, fidelity level, informant consensus factor, or comparisons of knowledge by age.

Table 2. Aggregated ethnomedicinal uses reported for medicinal plants recorded across 3 or 4 West Muna regions.

Species	Commonly treated diseases/complaints
Ageratum conyzoides	Injury, fever, skin disease, dysentery, and respiratory disorders
Blumea balsamifera	Fever, cough, respiratory infections, stomach ache, dermatitis, eczema, rheumatism, joint pain, wounds
Chromolaena odorata	Injury, burns, diarrhea, cough, cold, toothache, skin infection
Euphorbia hirta	Asthma, cough, bronchitis, diarrhea, dysentery, worms, digestive disorders, skin diseases
Ceiba pentandra	Diarrhea, fever, pain, asthma, stomach/digestive disorders, injury
Hibiscus tiliaceus	Fever, cough, sore throat, dry throat, ear infection, chest tightness, digestive problems
Sida rhombifolia	Fever, diarrhea, rheumatism, pain, asthma, injury, skin disease, malaria, stomach disorders
Tinospora crispa	Fever, malaria, diabetes, hypertension, rheumatism, jaundice, inflammation, urinary disorders, fractures, scabies
Ficus septica	Skin injury, skin ulcer, infection, inflammation
Phyllanthus niruri	Kidney stones, urinary disorders, jaundice, diabetes, influenza, skin diseases, ulcers
Imperata cylindrica	Fever, urinary disorders, urinary retention, bacterial infections, fungal infections, worms, hypertension, inflammation, injury
Lantana camara	Fever, cough, cold, malaria, headache, rheumatism, arthritis, digestive disorders, respiratory infections, injury
Andrographis paniculata	Fever, flu, cough, respiratory tract infections, diarrhea, dysentery, malaria, jaundice, liver disorders
Alstonia scholaris	Malaria, fever, asthma, diarrhea, dysentery, epilepsy, skin diseases, snake bites

Bidens pilosa	Injury, malaria, diabetes, hypertension, inflammation, bacterial infection, pain
Kalanchoe pinnata	Injury, ulcer, kidney stones, hypertension, inflammation, cough, gastritis, diabetes, respiratory disorders
Momordica charantia	Diabetes, blood sugar disorders, dyslipidemia, obesity, digestive disorders, inflammation
Aleurites moluccana	Pain, fever, asthma, hepatitis, gastric ulcer, inflammation, diarrhea, headache, cholesterol
Flemingia strobilifera	Fever, diarrhea, digestive disorders, worms, rheumatism, inflammation, allergies
Clerodendrum japonicum	Fever, inflammation, pain, rheumatism, injury, respiratory disorders
Premna foetida	Fever, cold/cold, cough, digestive disorders, worms, pain, inflammation
Kleinhovia hospita	Hepatitis, liver disorders, scabies, skin diseases, head lice, diabetes, hypertension, allergies
Urena lobata	Fever, rheumatism, injury, antiseptic, diabetes, liver disorders
Psidium guajava	Diarrhea, dysentery, abdominal pain, gastrointestinal infections, injury, diabetes, inflammation
Piper betle	Injury, mouth infection, bad breath, cough, respiratory tract infection, digestive disorders, vaginal discharge
Drynaria quercifolia	Cough, tuberculosis, rheumatic fever, dyspepsia, bone pain, fractures, skin diseases, diarrhea, worms, diabetes
Morinda citrifolia	Diabetes, hypertension/cardiovascular disease, pain, inflammation, injury, skin disorders, respiratory disorders, fever, urinary disorders
Datura metel	Asthma, bronchitis, pain, fever, diarrhea, skin disease, swelling, burn injury, ulcer
Leea indica	Fever, diarrhea, dysentery, diabetes, joint pain, rheumatism, broken bones, body aches, injury

Many reported uses concerned wounds, burns, ulcers, dermatitis, eczema, scabies, and other visible skin conditions. This pattern indicates a broad community repertoire for external complaints. The present study records reported use and does not independently confirm antiseptic, anti-inflammatory, or wound-healing efficacy.

Reported uses also included chronic or internal conditions such as diabetes, hypertension, urinary disorders, kidney stones, hepatitis, jaundice, liver disorders, and dyslipidemia. These findings document local therapeutic claims and should not be interpreted as clinical evidence of safety or effectiveness.

Descriptive and Inferential Analysis

Each field occurrence was assigned a unique record ID. Records were harmonized for taxonomy and variable coding and were associated with a regional respondent pool, not one identifiable informant. Accordingly, regional record totals and richness are descriptive inventory measures. The unequal distribution of key informants (5, 5, 5, and 4) is reported transparently and no per-informant richness or knowledge-density estimate is presented.

Table 3. Regional key-informant pools and medicinal-plant field inventory.

Region	Regional key-informant ID pool	Key informants	Field-occurrence records	Species richness	Families
Barangka	R006, R011, R013, R014, R015	5	151	149	63
Kusambi	R020, R021, R022, R024, R025	5	54	54	32
Lawa	R027, R031, R033, R035, R036	5	43	43	24
Sawerigadi	R037, R038, R039, R040	4	40	40	25

Barangka had the largest surveyed inventory, but this difference may reflect a combination of purposive site selection, survey coverage, accessibility, ecological availability, and local knowledge. The current data cannot distinguish these mechanisms, and regional totals are not used to infer that Barangka respondents possessed greater knowledge.

Table 4. Inferential tests of regional differences in the field-occurrence dataset.

Analysis	Variable or matrix	Statistic	df / permutations	*p value*	Interpretation
PERMANOVA	Record-level species-family-habitat-habitus matrix by region	Pseudo-F = 2.97	df = 3, 284, 9,999 permutations	0.0001	R2 = 0.030
Chi-square	Region x habitat type	69.24	df = 21	4.643e-07	Significant
Chi-square	Region x habitus	32.51	df = 18	0.01911	Significant
Chi-square	Region x dominant family group	19.54	df = 30	0.9279	Not significant
Kruskal-Wallis	Temperature among regions	H = 241.35	df = 3	4.87e-52	Significant
Kruskal-Wallis	Humidity among regions	H = 217.87	df = 3	5.809e-47	Significant
Kruskal-Wallis	Light intensity among regions	H = 14.29	df = 3	0.002537	Significant

Region was associated with habitat type and habitus, whereas grouped dominant-family composition was not significantly associated with region. Temperature, humidity, and light intensity also differed statistically among regions. Because measurements were repeated at purposively located plants rather than randomly sampled independent sites, these tests describe the dataset and should be interpreted cautiously.

PCA was removed because only 4 regional aggregate profiles were available, making the ordination unstable. It was replaced with a descriptive heatmap of the 10 families with the most field occurrences (Figure 5). The heatmap displays observed family-by-region counts without treating the 4 regions as a sufficient sample for component extraction.

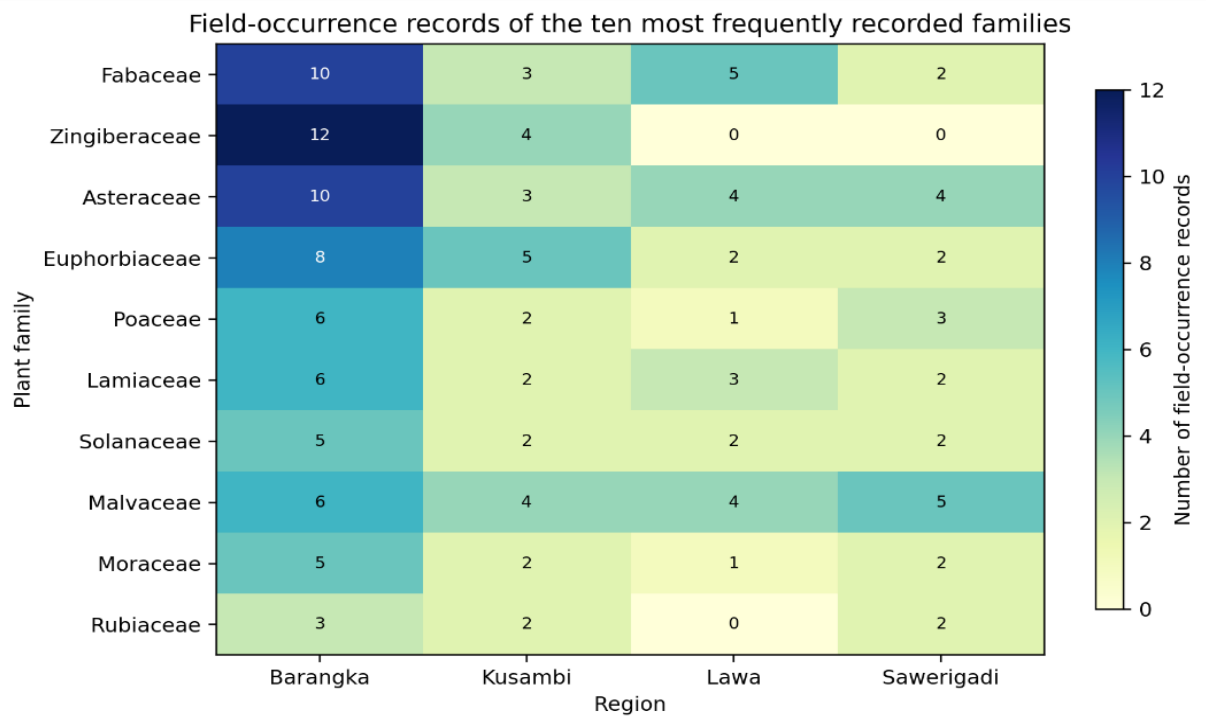


Figure 5. Heatmap of field-occurrence records for the 10 most frequently recorded plant families by region.

After correcting the computational workflow, a two-dimensional nMDS based on 288 record-level observations yielded stress = 0.142, below the conventional 0.20 threshold and adequate for cautious descriptive interpretation. Bray-Curtis dissimilarity was lowest between Lawa and Sawerigadi (0.494) and highest between Barangka and Sawerigadi (0.728). The ordination is treated as exploratory and is not described as evidence of complete or clear separation.

Table 5. Pairwise PERMANOVA of record-level floristic and habitat composition among regions.

Pairwise comparison	Pseudo-F	R2	p value	FDR adjusted p	Interpretation
Barangka vs Kusambi	0.97	0.005	0.425	0.487	Not different
Barangka vs Lawa	5.89	0.030	0.001	0.003	Different
Barangka vs Sawerigadi	4.48	0.023	0.001	0.003	Different
Kusambi vs Lawa	2.07	0.021	0.032	0.064	Not different
Kusambi vs Sawerigadi	1.42	0.015	0.159	0.239	Not different
Lawa vs Sawerigadi	0.93	0.011	0.487	0.487	Not different

The global PERMANOVA was statistically significant but explained only 3.0% of matrix variation (R2 = 0.030). After FDR correction, only Barangka-Lawa and Barangka-Sawerigadi were significant, Barangka-Kusambi was not significant (adjusted p = 0.487), and the remaining comparisons were also non-significant. Thus, the analysis does not support describing Barangka as distinct from every other region.

Discussion

This study documents 288 plant-location occurrences representing 177 species and 65 families in West Muna. Its principal contribution is the explicit integration of aggregated ethnomedicinal-use information with field-observed habitat and spatial data. The inventory is taxonomically broad, but occurrence totals are not equivalent to citation frequencies, plant abundance, or respondent knowledge scores.

The regional respondent pools were uneven, with 5 key informants in Barangka, Kusambi, and Lawa and 4 in Sawerigadi. Because we did not retain individual citations, dividing pooled field records by informant number would create a misleading appearance of standardization. The revised analysis therefore reports raw inventory measures and treats survey effort, accessibility, ecological availability, and knowledge distribution as alternative hypotheses rather than confirmed explanations for Barangka's larger total.

Near-unity regional evenness arose because nearly every field occurrence represented a different species within a region. These indices added little ecological information and were removed. Raw field-occurrence counts, species richness, and family richness provide a more transparent description of the inventory.

Habitat type and habitus differed among regional records, indicating heterogeneity within the surveyed lowland landscape. These patterns are consistent with the possibility that microhabitat influences where medicinal species are encountered, but the purposive design and lack of abundance sampling prevent causal or population-level conclusions (Yang *et al*. 2018, Pant *et al*. 2021, Pan *et al*. 2023, Qaderi *et al*. 2023).

The non-significant association for grouped dominant families suggests substantial sharing of common family-level components across regions. *Fabaceae*, *Zingiberaceae*, *Asteraceae*, *Euphorbiaceae*, *Malvaceae*, *Lamiaceae*, *Poaceae*, *Solanaceae*, *Moraceae*, and *Rubiaceae* were prominent, although their observed counts also reflect the survey design.

The original PCA was inappropriate for 4 regional aggregates and has been removed. The replacement heatmap offers a direct, assumption-light view of family-by-region field counts. It is descriptive and does not imply latent ecological gradients.

Recomputed nMDS produced acceptable stress (0.142), while PERMANOVA detected a small regional effect (R2 = 0.030). Significant adjusted pairwise differences were limited to Barangka-Lawa and Barangka-Sawerigadi. Regional composition is therefore partly structured but substantially overlapping, consistent with a shared West Muna medicinal repertoire and local habitat variation.

The 29 species recorded in 3 or 4 regions are better described as widely recorded or cross-regional priority species than as keystone species. Their broad occurrence supports further respondent-level, phytochemical, pharmacological, and propagation studies, but cultural salience cannot be ranked without individual citation data.

Aggregated interviews reported uses for common acute complaints, infections, inflammatory conditions, digestive problems, and chronic metabolic conditions. These statements document local practice and do not constitute evidence of clinical

efficacy or safety. Future work should record each use report under a single anonymized respondent to permit defensible quantitative indices and age-group comparisons.

Conservation actions should prioritize habitat diversity and harvesting practices. West Muna stakeholders could protect limestone and forest-margin microhabitats, monitor destructive harvesting of roots, rhizomes, bark, and whole plants, and establish community nurseries for widely recorded species such as *Tinospora crispa*, *Phyllanthus niruri*, *Blumea balsamifera*, and *Ageratum conyzoides*. These are management recommendations, not evidence that particular habitats or species were already quantified as threatened.

Important limitations remain. No herbarium vouchers were deposited; respondent-level use citations were unavailable even though the register records ages 43-65 years, key-informant numbers differed among regions; locations were selected purposively, and region explained only a small proportion of multivariate variation. Future research should deposit vouchers, use balanced respondent sampling, retain individual citation links, document age and consent metadata alongside each interview, and measure plant abundance through a probability-based ecological design.

Conclusion

This study documented 288 medicinal-plant field occurrences representing 177 species and 65 families across 4 West Muna regions. Barangka had the largest surveyed inventory, but the difference cannot be attributed solely to plant availability or knowledge intensity. Regional composition differed statistically, although the effect was small (PERMANOVA R2 = 0.030), and adjusted pairwise differences were limited to Barangka-Lawa and Barangka-Sawerigadi. The results support protecting diverse lowland and limestone habitats, monitoring destructive harvest practices, and developing community nurseries for widely recorded species. Future studies should use balanced sampling, herbarium vouchers, abundance measurements, and respondent-level citation data to calculate quantitative ethnobotanical indices and assess variation by age.

Declarations

Ethics approval: The supplied respondent register lists 42 participants aged 43-65 years, it contains no 17-year-old participant and no consent/guardian field. Adult participants provided oral prior informed consent. Because the register identifies no minors, guardian permission is not applicable to the supplied dataset, however, the original consent log should still be retained for audit.

Data availability: Generalized village-level coordinates for all 288 plant-location records are provided in Supplementary Table S1. We converted coordinates from the supplied DMS records to decimal degrees and rounded them to 3 decimal places to reduce disclosure risk for sensitive plant locations. Exact raw coordinates are retained by the corresponding author.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

Competing interests: Not applicable

Funding: Not applicable

Author contributions: D.D. handled conceptualization, methodology, supervision, project management, validation, and both original and review & editing of the manuscript. L.O.M.M. contributed to methodology, investigation, field data collection, data curation, formal analysis, and review & editing. A.S. focused on investigation, ecological observation, habitat assessment, spatial data interpretation, visualization, and review & editing. K.K. was responsible for ethnobotanical data collection, interview coordination, validation of local knowledge, cultural interpretation, and review & editing. S.W.A. performed plant identification, data curation, formal analysis, validation, and review & editing. S.C.R.K. contributed through mapping, GIS-based spatial analysis, visualization, documentation, and review & editing.

Acknowledgements

We thank the rector and the head of the Research and Community Service Institute of Halu Oleo University for their support and advice regarding this research. We also appreciate the informants who took the time to participate, especially the healers and community leaders from West Muna.

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Supplementary Table 1.

Coordinate ID	NO	Country	Province	Regency	District	Village	Latitude	Longitude
BKA-001	1	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.845	122.548
BKA-002	2	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.841	122.548
BKA-003	3	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.836	122.548
BKA-004	4	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.85	122.548
BKA-005	5	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.854	122.548
BKA-006	6	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.845	122.553
BKA-007	7	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.845	122.557
BKA-008	8	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.845	122.544
BKA-009	9	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.845	122.539
BKA-010	10	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.841	122.553
BKA-011	11	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.841	122.544
BKA-012	12	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.85	122.553
BKA-013	13	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.85	122.544
BKA-014	14	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.836	122.553
BKA-015	15	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.836	122.544
BKA-016	16	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.854	122.553
BKA-017	17	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.854	122.544
BKA-018	18	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.841	122.557
BKA-019	19	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.841	122.539
BKA-020	20	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.85	122.557
BKA-021	21	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.85	122.539
BKA-022	22	Indonesia	Southeast Sulawesi	West Muna	Barangka	Barangka	-4.838	122.555
BKA-023	23	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.799	122.518
BKA-024	24	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.794	122.518
BKA-025	25	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.79	122.518
BKA-026	26	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.803	122.518
BKA-027	27	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.808	122.518
BKA-028	28	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.799	122.522
BKA-029	29	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.799	122.527
BKA-030	30	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.799	122.513
BKA-031	31	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.799	122.509
BKA-032	32	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.794	122.522
BKA-033	33	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.794	122.513
BKA-034	34	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.803	122.522
BKA-035	35	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.803	122.513
BKA-036	36	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.79	122.522
BKA-037	37	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.79	122.513
BKA-038	38	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.808	122.522
BKA-039	39	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.808	122.513
BKA-040	40	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.794	122.527
BKA-041	41	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.794	122.509
BKA-042	42	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.803	122.527
BKA-043	43	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lafinde	-4.803	122.509
BKA-044	44	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.833	122.551

BKA-045	45	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.828	122.551
BKA-046	46	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.824	122.551
BKA-047	47	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.837	122.551
BKA-048	48	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.842	122.551
BKA-049	49	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.833	122.555
BKA-050	50	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.833	122.56
BKA-051	51	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.833	122.546
BKA-052	52	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.833	122.542
BKA-053	53	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.828	122.555
BKA-054	54	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.828	122.546
BKA-055	55	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.837	122.555
BKA-056	56	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.837	122.546
BKA-057	57	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.824	122.555
BKA-058	58	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.824	122.546
BKA-059	59	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.842	122.555
BKA-060	60	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.842	122.546
BKA-061	61	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.828	122.56
BKA-062	62	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.828	122.542
BKA-063	63	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.837	122.56
BKA-064	64	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.837	122.542
BKA-065	65	Indonesia	Southeast Sulawesi	West Muna	Barangka	Lapolea	-4.826	122.557
BKA-066	66	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.857	122.555
BKA-067	67	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.852	122.555
BKA-068	68	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.848	122.555
BKA-069	69	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.861	122.555
BKA-070	70	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.866	122.555
BKA-071	71	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.857	122.56
BKA-072	72	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.857	122.564
BKA-073	73	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.857	122.551
BKA-074	74	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.857	122.546
BKA-075	75	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.852	122.56
BKA-076	76	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.852	122.551
BKA-077	77	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.861	122.56
BKA-078	78	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.861	122.551
BKA-079	79	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.848	122.56
BKA-080	80	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.848	122.551
BKA-081	81	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.866	122.56
BKA-082	82	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.866	122.551
BKA-083	83	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.852	122.564
BKA-084	84	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.852	122.546
BKA-085	85	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.861	122.564
BKA-086	86	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.861	122.546
BKA-087	87	Indonesia	Southeast Sulawesi	West Muna	Barangka	Sawerigadi	-4.85	122.562
BKA-088	88	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.841	122.537
BKA-089	89	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.837	122.537
BKA-090	90	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.832	122.537
BKA-091	91	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.846	122.537

BKA-092	92	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.85	122.537
BKA-093	93	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.841	122.541
BKA-094	94	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.841	122.546
BKA-095	95	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.841	122.532
BKA-096	96	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.841	122.528
BKA-097	97	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.837	122.541
BKA-098	98	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.837	122.532
BKA-099	99	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.846	122.541
BKA-100	100	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.846	122.532
BKA-101	101	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.832	122.541
BKA-102	102	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.832	122.532
BKA-103	103	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.85	122.541
BKA-104	104	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.85	122.532
BKA-105	105	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.837	122.546
BKA-106	106	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.837	122.528
BKA-107	107	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.846	122.546
BKA-108	108	Indonesia	Southeast Sulawesi	West Muna	Barangka	Walelei	-4.846	122.528
BKA-109	109	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.829	122.535
BKA-110	110	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.825	122.535
BKA-111	111	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.82	122.535
BKA-112	112	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.834	122.535
BKA-113	113	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.838	122.535
BKA-114	114	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.829	122.539
BKA-115	115	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.829	122.544
BKA-116	116	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.829	122.53
BKA-117	117	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.829	122.526
BKA-118	118	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.825	122.539
BKA-119	119	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.825	122.53
BKA-120	120	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.834	122.539
BKA-121	121	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.834	122.53
BKA-122	122	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.82	122.539
BKA-123	123	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.82	122.53
BKA-124	124	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.838	122.539
BKA-125	125	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.838	122.53
BKA-126	126	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.825	122.544
BKA-127	127	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.825	122.526
BKA-128	128	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.834	122.544
BKA-129	129	Indonesia	Southeast Sulawesi	West Muna	Barangka	Waulai	-4.834	122.526
BKA-130	130	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.827	122.521
BKA-131	131	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.823	122.521
BKA-132	132	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.818	122.521
BKA-133	133	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.832	122.521
BKA-134	134	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.836	122.521
BKA-135	135	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.827	122.525
BKA-136	136	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.827	122.53
BKA-137	137	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.827	122.516
BKA-138	138	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.827	122.512

BKA-139	139	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.823	122.525
BKA-140	140	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.823	122.516
BKA-141	141	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.832	122.525
BKA-142	142	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.832	122.516
BKA-143	143	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.818	122.525
BKA-144	144	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.818	122.516
BKA-145	145	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.836	122.525
BKA-146	146	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.836	122.516
BKA-147	147	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.823	122.53
BKA-148	148	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.823	122.512
BKA-149	149	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.832	122.53
BKA-150	150	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.832	122.512
BKA-151	151	Indonesia	Southeast Sulawesi	West Muna	Barangka	Wuna	-4.82	122.527
KSB-001	1	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.748	122.54
KSB-002	2	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.743	122.54
KSB-003	3	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.752	122.54
KSB-004	4	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.748	122.545
KSB-005	5	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.748	122.535
KSB-006	6	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.743	122.545
KSB-007	7	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.743	122.535
KSB-008	8	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.752	122.545
KSB-009	9	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.752	122.535
KSB-010	10	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.745	122.543
KSB-011	11	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.74	122.517
KSB-012	12	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.736	122.517
KSB-013	13	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.745	122.517
KSB-014	14	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.74	122.522
KSB-015	15	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.74	122.512
KSB-016	16	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.736	122.522
KSB-017	17	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.736	122.512
KSB-018	18	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.745	122.522
KSB-019	19	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.745	122.512
KSB-020	20	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.738	122.52
KSB-021	21	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.734	122.568
KSB-022	22	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.729	122.568
KSB-023	23	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.738	122.568
KSB-024	24	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.734	122.573
KSB-025	25	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.734	122.563
KSB-026	26	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.729	122.573
KSB-027	27	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.729	122.563
KSB-028	28	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.738	122.573
KSB-029	29	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.738	122.563
KSB-030	30	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.731	122.571
KSB-031	31	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.741	122.535
KSB-032	32	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.737	122.535
KSB-033	33	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.746	122.535
KSB-034	34	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.741	122.54

KSB-035	35	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.741	122.53
KSB-036	36	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.737	122.54
KSB-037	37	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.737	122.53
KSB-038	38	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.746	122.54
KSB-039	39	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.746	122.53
KSB-040	40	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.739	122.538
KSB-041	41	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.743	122.545
KSB-042	42	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.737	122.533
KSB-043	43	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.73	122.558
KSB-044	44	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.747	122.523
KSB-045	45	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.736	122.554
KSB-046	46	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.751	122.547
KSB-047	47	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.739	122.516
KSB-048	48	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.733	122.565
KSB-049	49	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.744	122.539
KSB-050	50	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.749	122.529
KSB-051	51	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Konawe	-4.731	122.575
KSB-052	52	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Guali	-4.746	122.552
KSB-053	53	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Lapokainse	-4.738	122.548
KSB-054	54	Indonesia	Southeast Sulawesi	West Muna	Kusambi	Kasakamu	-4.736	122.51
LAW-001	1	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.858	122.622
LAW-002	2	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.853	122.622
LAW-003	3	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.849	122.622
LAW-004	4	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.858	122.627
LAW-005	5	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.858	122.617
LAW-006	6	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.853	122.627
LAW-007	7	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lagadi	-4.853	122.617
LAW-008	8	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.933	122.592
LAW-009	9	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.928	122.592
LAW-010	10	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.923	122.592
LAW-011	11	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.933	122.597
LAW-012	12	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.933	122.587
LAW-013	13	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.928	122.597
LAW-014	14	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lalemba	-4.928	122.587
LAW-015	15	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.894	122.544
LAW-016	16	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.89	122.544
LAW-017	17	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.885	122.544
LAW-018	18	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.894	122.549
LAW-019	19	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.894	122.539
LAW-020	20	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.89	122.549
LAW-021	21	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latompe	-4.89	122.539
LAW-022	22	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.856	122.544
LAW-023	23	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.851	122.544
LAW-024	24	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.846	122.544
LAW-025	25	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.856	122.549
LAW-026	26	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.856	122.539
LAW-027	27	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.851	122.549

LAW-028	28	Indonesia	Southeast Sulawesi	West Muna	Lawa	Latugho	-4.851	122.539
LAW-029	29	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.869	122.627
LAW-030	30	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.864	122.627
LAW-031	31	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.86	122.627
LAW-032	32	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.869	122.632
LAW-033	33	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.869	122.622
LAW-034	34	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.864	122.632
LAW-035	35	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.864	122.622
LAW-036	36	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.874	122.568
LAW-037	37	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.869	122.568
LAW-038	38	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.864	122.568
LAW-039	39	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.874	122.573
LAW-040	40	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.874	122.563
LAW-041	41	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.869	122.573
LAW-042	42	Indonesia	Southeast Sulawesi	West Muna	Lawa	Lapadaku	-4.869	122.563
LAW-043	43	Indonesia	Southeast Sulawesi	West Muna	Lawa	Madampi	-4.866	122.597
SWG-001	1	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Nihi	-4.784	122.524
SWG-002	2	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Nihi	-4.791	122.533
SWG-003	3	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Nihi	-4.78	122.527
SWG-004	4	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Nihi	-4.795	122.53
SWG-005	5	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Nihi	-4.788	122.54
SWG-006	6	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lakalamba	-4.817	122.464
SWG-007	7	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lakalamba	-4.829	122.469
SWG-008	8	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lakalamba	-4.829	122.469
SWG-009	9	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lakalamba	-4.82	122.47
SWG-010	10	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lakalamba	-4.825	122.465
SWG-011	11	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lawada Jaya	-4.855	122.442
SWG-012	12	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lawada Jaya	-4.855	122.442
SWG-013	13	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lawada Jaya	-4.85	122.445
SWG-014	14	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lawada Jaya	-4.86	122.44
SWG-015	15	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lombu Jaya	-4.787	122.488
SWG-016	16	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lombu Jaya	-4.814	122.481
SWG-017	17	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lombu Jaya	-4.79	122.49
SWG-018	18	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Lombu Jaya	-4.785	122.485
SWG-019	19	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Maperaha	-4.777	122.54
SWG-020	20	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Maperaha	-4.775	122.535
SWG-021	21	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Maperaha	-4.78	122.542
SWG-022	22	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Maperaha	-4.778	122.538
SWG-023	23	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Marobea	-4.842	122.487
SWG-024	24	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Marobea	-4.842	122.487
SWG-025	25	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Marobea	-4.827	122.471

SWG-026	26	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Marobea	-4.845	122.485
SWG-027	27	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Marobea	-4.84	122.49
SWG-028	28	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Ondoke	-4.835	122.517
SWG-029	29	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Ondoke	-4.834	122.517
SWG-030	30	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Ondoke	-4.83	122.52
SWG-031	31	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Ondoke	-4.84	122.515
SWG-032	32	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Wakoila	-4.783	122.467
SWG-033	33	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Wakoila	-4.78	122.47
SWG-034	34	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Wakoila	-4.785	122.465
SWG-035	35	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Wakoila	-4.782	122.468
SWG-036	36	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Waukuni	-4.765	122.465
SWG-037	37	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Waukuni	-4.765	122.465
SWG-038	38	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Waukuni	-4.77	122.471
SWG-039	39	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Waukuni	-4.768	122.468
SWG-040	40	Indonesia	Southeast Sulawesi	West Muna	Sawerigadi	Waukuni	-4.762	122.462