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An Ethnobotanical Study of the Manggarai Indigenous Community In Nusa Tenggara Timur, Indonesia

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ABSTRACT

Objective: The Manggarai indigenous community in Nusa Tenggara Timur, Indonesia, maintains a deep and dynamic relationship with the natural environment, fostering the development of local wisdom for the sustainable management of natural resources. This study aims to document and analyze the various forms of plant utilization practiced by the Manggarai community.

Methods and Materials: A six-month field survey was conducted using a qualitative descriptive approach, involving semi-structured interviews, guided plant specimen collection with key informants, and botanical identification. Data were categorized into primary use groups.

Findings: A total of 124 plant species were documented, classified into three major categories: food sources (n = 68 species; 54.8%), medicinal purposes (n = 65 species; 52.4%), and traditional ceremonial uses (n = 10 species; 8.1%). Leaves were the most frequently utilized plant part for both food (27.9% of recorded species) and medicinal purposes (47.7%). Several species served multiple functions, notably Corypha utan (lanu), used in both food and ritual contexts.

Conclusion: The findings highlight the significant ethnobotanical knowledge embedded in the Manggarai community, emphasizing its potential contributions to biodiversity conservation, nutrition diversification, and culturally appropriate pharmacological applications.

Keywords: Ethnobotany, Manggarai ethnic group, Nusa Tenggara Timur, plant utilization, traditional knowledge.

Introduction

Before 2003, Manggarai was a single, expansive regency that covered nearly two-thirds of Flores Island. Today, it has been administratively divided into three regencies: Manggarai, West Manggarai, and East Manggarai. Manggarai is spoken by the majority of residents in these three regions, who collectively identify as Manggarai. Speakers of the Manggarai language coexist with speakers of the Bajo and Komodo languages and share borders with communities speaking the Ngada and Ende languages.

The Manggarai people predominantly rely on rice farming and plantation agriculture for their livelihoods. The region is widely known as the "rice granary" of Nusa Tenggara Timur and surrounding areas (Jama et al., 2020). Additionally, the three Manggarai regencies are notable producers of coffee, cocoa, and vanilla. Since the 1960s, monoculture plantations and farms have rapidly expanded across the Manggarai region (Yulistyarini et al., 2020). While this development has brought economic benefits, it has also resulted in significant ecological and cultural drawbacks. The rise of monoculture agriculture has gradually displaced traditional agroforestry systems, in which farming is integrated with forested areas. Before the widespread adoption of monoculture farming, Manggarai communities cultivated maize, rice, coffee, cocoa, and vanilla on small plots adjacent to forests (Yulistyarini et al., 2020). The decline of agroforestry practices among the Manggarai is concerning, as these practices are deeply intertwined with other cultural aspects, including language, social structures, and local ideologies. Reviving traditional agroforestry is therefore urgent, as the disappearance of a single cultural element can threaten the community's overall identity.

Moreover, forested areas in Manggarai have continued to shrink. According to a study by Berta Adelina Ria and colleagues (Moi et al., 2025), forest areas in the three Manggarai regencies have been steadily declining each year, primarily due to increasing land demand for housing and monoculture crops. Interviews with residents living near forest edges revealed that, on average, approximately 0.5 hectares of forest are lost annually. Data from the Central Statistics Agency (Badan Pusat Statistik) recorded that in 2020, the total forest area in Manggarai was 94,501 hectares (http://ntt.bps.go.id, accessed July 10, 2023). Given the continuous decline observed by Ria et al., Manggarai's forest ecosystems face serious threats over the next 10–20 years.

Preservation efforts must include cultural revitalization. Ethnobotany can serve as an entry point for such revitalization, as it bridges local knowledge systems with cultural approaches. Local ecological knowledge, which is often underrecognized even by the communities that hold it, can be revived by identifying and reassembling remaining cultural features into a coherent conceptual framework.

Such findings also illustrate the link between linguistic research and pharmaceutical development. The intersection of these disciplines demonstrates that linguistic documentation can significantly advance pharmaceutical science. Himmi's research inventories traditional healing technologies and the collaborative relationship between indigenous communities and their environments, while Holton's work enriches Indonesia's botanical knowledge through unique lexical contributions from the Abui language. A similar interdisciplinary spirit drives the present study.

Ethnobotany emphasizes the connections between cultural practices and plant resources, both directly and indirectly. It serves as a valuable tool for documenting traditional knowledge concerning the use of plants in daily life—including for food, medicine, construction, ritual ceremonies, cultural expressions, natural dyes, and more (Pei et al., 2020). Documenting such knowledge supports biodiversity conservation and the sustainable domestication of high-priority medicinal plants (Zhao et al., 2020).

The traditional ecological knowledge of the Manggarai people, particularly regarding plant use, is a vital cultural resource that must be preserved to prevent the loss of traditional management systems. The use of local food plants is increasingly marginalized. One contributing factor is the government's policy emphasis on rice as a national staple, which often disregards other local food sources. This trend has diminished the cultural identity and resilience of communities that rely on non-rice food staples (Afrianto et al., 2021). The cultivation and utilization of wild food plant species is now largely confined to remote forest communities or indigenous groups, and limited to local-scale use for household needs (Afrianto, 2024). This study seeks to examine the various ways in which the Manggarai indigenous

community in Nusa Tenggara Timur utilizes plants, particularly those with potential relevance to the pharmaceutical field.

Methods and Materials

Study Design

This study was conducted over six months, from June to November 2024, in the traditional territory of Ruteng, inhabited by the indigenous Manggarai community in East Nusa Tenggara, Indonesia. The research site is characterized by a tropical lowland rainforest ecosystem interspersed with savanna, located at elevations of 500–980 meters above sea level, with average annual rainfall of 2,000–3,000 mm and daily temperatures ranging between 18–28°C. The area hosts diverse plant species, including Vitex pubescens, Intsia bijuga, Ficus spp., Pandanus spp., and bamboo.

1. Research Design

A mixed qualitative–quantitative ethnobotanical approach was adopted, combining literature review, field observation, structured and semi-structured interviews, guided field walks (transect walks), and specimen collection. This multi-method approach was chosen to capture both the depth of traditional ecological knowledge and the breadth of plant species utilized by the community.

2. Informant Selection

Informants were selected using purposive sampling—to ensure inclusion of individuals with recognized ethnobotanical expertise—and complemented by snowball sampling to identify additional knowledgeable participants recommended by initial informants. The selection process was facilitated by village heads and customary leaders to ensure cultural appropriateness and community trust.

Inclusion criteria were aged 30 years or older; Permanent resident of the study area for at least 15 years; Recognized by peers as having deep knowledge of plant use, either through practice as a traditional healer, farmer, herbalist, or ceremonial leader; and Willingness to participate voluntarily after informed consent.

Exclusion criteria were temporary visitors to the village and individuals with no active engagement in plant-related practices.

A total of 42 informants were interviewed, consisting of 14 customary leaders (tua adat), 10 forest-dependent individuals (farmers, foragers, hunters), 12 traditional healers (dukun or mosalaki), and 6 community herbalists.

Gender representation was considered important; therefore, both male and female informants were included (27 men, 15 women), as women often play a key role in food processing and herbal medicine preparation.

Data Collection Procedures

Data were collected in three main stages.

A. Preliminary Stage

Literature review of ethnobotanical studies in Flores and adjacent islands to identify potential species lists and local terminologies. Preparation of interview guides and plant identification sheets.

B. Field Data Collection

Structured and semi-structured interviews: Interviews were conducted in the Manggarai language and/or Indonesian, depending on informant preference. Each session lasted 60–90 minutes and was recorded (audio) with participant permission. Questions covered plant local names, uses, preparation methods, parts used, and cultural significance. Guided field walks (transect walks): Informants accompanied the research team to forest edges, agroforestry plots, and sacred groves to identify plants in situ. Specimen collection and documentation: For each plant mentioned, a voucher specimen was collected, labeled, photographed, and preserved using standard herbarium techniques (70% ethanol, plant press, sample bags).

C. Secondary Data

Geographic coordinates of plant collection sites were recorded using GPS. Climatic and ecological data were gathered from the local agriculture office and meteorological agency.

4. Data Validation

To ensure accuracy and reliability, multiple validation strategies were applied:

Triangulation of sources – Cross-checking plant names, uses, and preparation methods across different informants and occupations.

Botanical verification – Plant specimens were identified and confirmed by taxonomists at the Herbarium Bogoriense (Indonesian Institute of Sciences), using both morphological comparison and existing herbarium references.

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Member checking – Preliminary plant-use lists and interpretations were returned to selected informants for feedback and correction.

Comparison with literature – Species lists and uses were compared with previous ethnobotanical records from Nusa Tenggara Timur to detect unique or newly recorded uses.

5. Data Analysis

Transcription and Translation: All interviews were transcribed verbatim and translated into Indonesian and English.

Coding and Categorization: Data were coded inductively using NVivo software, grouping plant uses into three main categories: food, medicine, and ritual. Subcategories were based on plant parts used (leaf, fruit, tuber, bark, root, etc.).

Quantitative measures:

Frequency of citation (FC) was calculated for each species to assess its relative importance in the community. Use Value (UV) was determined to measure the diversity of uses per species. Comparative analysis: Results were compared with ethnobotanical data from similar ecological zones in Indonesia to highlight both overlaps and unique knowledge.

6. Ethical Considerations

The research followed the principles of the Declaration of Helsinki for ethical research involving human participants. Informed consent was obtained orally and in writing. Participation was entirely voluntary, and informants could withdraw at any stage. Sensitive cultural knowledge deemed sacred was excluded from public reporting unless community elders granted explicit permission.

Findings and Results

Cultural Context and Characteristics

The Manggarai people reside in communal settlements known as nggolo, organized by patrilineal kinship. Villages follow a circular spatial layout with two main zones: an inner area and an outer area. The inner area centers around a menhir (stone monument), which functions as a sacred site for ritual ceremonies and is surrounded by traditional structures such as the rumah gendang (drum house), rumah tambur (tambour house), and residential dwellings. These are enclosed by yards, rice paddies, and burial grounds, forming the village's immediate living space.

The outer area consists of savanna and forest ecosystems, both of which hold cultural and ecological importance. The savanna is composed of grasslands with sparse vegetation, while the forest contains high-value tropical hardwoods such as Tectona grandis (teak), Falcataria moluccana (sengon), and Agathis spp. (resin trees). Despite being peripheral, the forest is vital to Manggarai cultural identity, functioning as both an ecological buffer and a communal agroforestry resource. Land is divided into private (homes, gardens, fields) and communal (ritual sites, forests, savannas) ownership under customary law (Sanubarianto et al., 2025).

The Manggarai classify forests by function: ponceng refers to village-managed forest edges for agroforestry; puar denotes sacred, restricted forests used only during specific rituals, especially for sourcing timber for house construction; and pong refers to marginal lands such as swamps or peat, typically avoided due to health concerns. These forest distinctions reflect the deep ecological knowledge and cultural embeddedness of the Manggarai people within their environment.

Plant Utilization

According to Law No. 5 of 1990, plants are defined as all forms of plant-based natural resources, whether terrestrial or aquatic. Government Regulation No. 8 of 1999 further stipulates that the utilization of plants and wildlife must aim to ensure their sustainable use for the maximum prosperity of the people. The tradition of local ecological knowledge regarding plant use for daily needs has existed for generations among rural and indigenous communities. This knowledge emerged from experimentation with various plant species to meet basic survival needs. Many of these traditional plant uses—particularly those related to medicinal plants—have since been scientifically validated.

The richness of plant biodiversity is a vital foundation for national development and community welfare. However, such utilization must be aligned with ecological carrying capacity, species characteristics, and ecological function. The findings of this study indicate that the Manggarai indigenous community uses 124 plant species, distributed across three primary categories: 68 for food, 65 for medicinal purposes, and 10 for traditional ritual practices. Some species serve multiple functions; for example, the lanu plant (Corypha

utan) is used both as a food source and in customary ceremonies. The proportion of plant parts utilized by the Manggarai community is illustrated in Figure 1 below.

Distribution of plant parts used by the Manggarai indigenous community for food purposes.

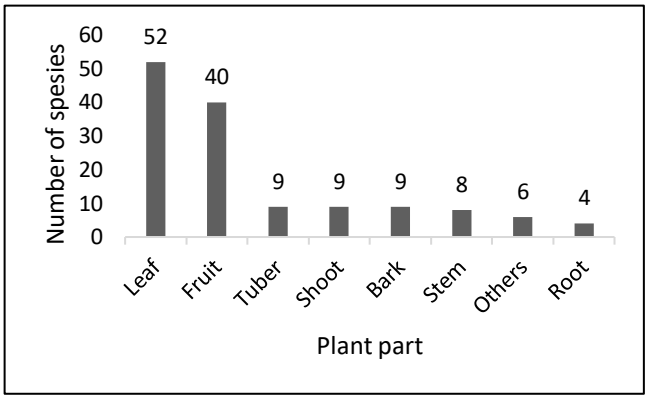

Figure 1

Plant Parts Utilized by the Manggarai Indigenous Community

As shown in Figure 1, the most frequently utilized plant part by the Manggarai indigenous community is the leaf, with 52 recorded species, followed by fruits (40 species). Tubers, shoots, and bark are each represented by 9 species, while stems account for 8 species, sap (categorized as "others") for 6 species, and roots for 4 species.

A similar pattern was observed in a study by Barokah et al. (2025), which found that in communities living around Mount Merapi National Park, the leaf was the most frequently used part (47 species), while the root was the least used (1 species). This finding is consistent with research by Santhyami (2021), which reported that among 131 medicinal plant species documented in the traditional Dukuh community in Garut, West Java, leaves were the most commonly used plant part, whereas roots were among the least used.

Utilization Of Plants For Food Sources

Food plants are defined as any living organisms that grow, possess stems, roots, and leaves, and are edible or consumable by humans. Food sources in this context include staple foods, supplementary foods, beverages, cooking spices, and seasonings. In total, the Manggarai indigenous community utilizes 68 plant species as food sources. This figure is notably higher than the number recorded in the Tangale Nature Reserve, Gorontalo Province, where only 33 food plant species were identified, most of which consist of fruits and vegetables (Harisha & Ravikanth, 2021).

The use of forest plants as food by the Manggarai community can be classified into three categories: (1) substitute sources for staple foods (carbohydrates), (2) leafy vegetables, and (3) fruits. Forest plants used as carbohydrate substitutes include Arenga pinnata (sugar palm), Dioscorea hispida (bitter yam), Marantha arunginaceae (arrowroot), Colocasia esculenta (taro), and Metroxylon sago (sago palm). Among these, Metroxylon sago and Dioscorea hispida are the most commonly utilized and are still actively harvested in the Hukaea-Laea customary area.

The processing of sago (Metroxylon sago) involves felling the tree and cutting the trunk into two-meter sections. The trunk is then split open, and the pith is grated. The grated material is squeezed while being rinsed with water or trampled underfoot, and then filtered. The filtered liquid is allowed to settle for about two hours. Once the water is discarded, the sediment—now in the form of starch—is dried in the sun and ready for use as food flour.

The processing of Ondo (Dioscorea hispida) begins with peeling and thinly slicing the tubers, which are then soaked in water mixed with Wilalo bark for 3 days, after which they are drained. The tubers are subsequently soaked in clean water for an additional two to three nights, with stirring three times daily. After draining, they are either steamed or sun-dried and prepared for frying. This multi-stage soaking process with Wilalo bark functions to neutralize the tuber's toxins. Alternatively,

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the tubers can be eaten raw after peeling by skewering them on a stalk of the Onese plant and roasting them. Once cooked, the tubers around the stalk are ready to eat.

The community also identifies 33 forest plant species as sources of leafy vegetables. Among the most popular are Huka leaves (Gnetum gnemon), Lanu (Corypha utan), and Tokulo (Kleinhovia hospita). The use of Huka leaves is widespread not only among the Manggarai but also among the Moronene people, with the plant still abundantly available in the forest. Lanu holds special significance in Manggarai culture and is considered indispensable in traditional culinary practices, particularly in ceremonial dishes.

Furthermore, 32 forest plant species have been identified as sources of fruits. The most commonly used and widely available near the forest areas is the wild mangosteen (Garcinia sp.). Plant-based food resources are obtained from a variety of plant parts, including leaves, fruits, stems, and others. Figure 2 illustrates the distribution of plant parts used by the Manggarai indigenous community for food purposes.

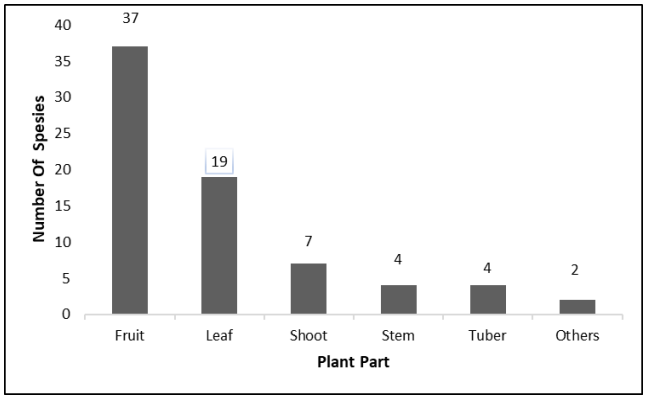

Figure 2

The utilization of plants for food

As shown in Figure 2, the plant parts most frequently utilized for food purposes, in order of prevalence, are fruits (37 species), leaves (19 species), shoots (7 species), stems (4 species), tubers (4 species), and other parts, which include mushrooms and bamboo shoots, comprising 2 species.

Utilization Of Plants For Medicinal Purposes

Medicinal plants refer to all plant species that are known or believed to possess therapeutic properties (Goyal et al., 2019). These plants are generally categorized into three groups: (1) traditional medicinal plants, (2) modern medicinal plants, and (3) potential medicinal plants. The use of plants for medicinal purposes has existed since humans first interacted with forest environments. According to data from the World Health Organization (WHO), approximately 80% of the global population relies on plant-based (herbal) medicine for primary healthcare (Qadir & Raja, 2021). Herbal medicines are considered to have minimal side effects due to their natural ingredients, which leave no chemical residue in the human body, unlike synthetic substances found in modern pharmaceuticals (Global Herbal Medicine Market Analysis, 2024). This advantage has led to an increased demand for herbal medicine products. The growing commercial demand, coupled with reliance on wild-harvested medicinal plants, has contributed to the depletion of these resources in their natural habitats. The global market for medicinal plants and herbal medicines is estimated at around USD 233 billion in 2024 (Global Herbal Medicine Market Size & Growth Report, 2025).

The Manggarai indigenous community residing around the TN. The RAW forest area has long practiced a form of traditional medicine that incorporates medicinal plants, preserved and passed down through generations. Within the community, diseases are categorized into two types: common illnesses and those believed to be caused by supernatural forces. Common illnesses include fever, cough, fatigue, and other conditions resulting from weather changes or infections. In contrast, illnesses of a magical nature are believed to arise from violations of customary law or disturbances by spirits. Designated

traditional leaders or shamans typically treat such ailments.

Based on survey and interview data, the Manggarai community recognizes 65 forest plant species used for medicinal purposes. This number is slightly lower than that recorded among the Angkola community near the Dolok Sibual-buali Nature Reserve in South Tapanuli Regency, where 67 species are reportedly used for medicinal purposes (Asmara & Silalahi, 2020).

Generally, the plant species used by the Manggarai for traditional medicine are wild plants that grow naturally in forested areas. In terms of habitus, these include trees, shrubs, and lianas. The parts of the plants used for medicinal purposes vary and may include leaves, bark, fruits, tubers, sap, roots, stems, shoots, flowers, or the entire plant. In many cases, only a specific part of the plant is used—such as only the leaves or tubers—while the other parts are disregarded. However, there are instances in which the entire plant is utilized. Examples of the medicinal use of specific plant parts are provided in Table 1.

Table 1

Utilization of Plant Parts for Medicinal Purposes by the Manggarai Indigenous Community

No.	Plant Part	Local Name	Scientific Name	Illness Treated	Method of Use
1	Leaf	Pisa akorea	Psidium guajava	Diarrhea, stomachache	Boil 5–10 young leaves in 2–3 cups of water until reduced to 1 cup. Strain and drink before meals, three times a day.
2	Bark	Kayu Jawa	Spondias mombin	Bloating, gastritis	The outer layer of 10–20 cm bark is removed, and the inner bark is scraped and squeezed. The liquid is mixed with coconut milk and egg yolk, then consumed three times daily.
3	Fruit	Tangkule	Averrhoa bilimbi	Hypertension	The ripe fruit is consumed raw daily.
4	Tuber	Kunyit	Curcuma domestica	Diabetes	Slice and boil the tuber in 1 liter of water until it is reduced by half. Strain and drink three times daily.
5	Sap	Pulai	Alstonia angustiloba	External wounds	The sap is applied directly to the affected area.
6	Root	Alang-alang	Imperata cylindrica	Internal ailments	The root is washed, boiled, and the warm decoction is consumed daily.
7	Stem	Ngguni (Akar kuning)	Arcangelisia flava	Diabetes, hepatitis, bloating	Stems are cut, crushed, and boiled in 1 liter of water until reduced to ½ liter. Drink three times daily.
8	Whole plant	Benalu	Loranthus europaeus	Diabetes, internal illness	The entire plant (roots, stems, and leaves) is boiled in 1 liter of water until it is reduced by half. Strain and drink three times daily.
9	Shoot	Wua (Umbut pinang)	Areca catechu	Intestinal worms	The shoot is consumed raw daily.
10	Flower	Tunjung biru	Nymphaea stellata	Internal ailments	The flower is boiled in 1 liter of water until it is reduced by half. Strain and drink warm, three times daily.

In general, traditional healing practices among the Manggarai indigenous community can be classified into two categories: external treatments and internal treatments. External treatments are typically used for ailments such as eye infections, wounds caused by sharp objects, toothaches, swelling or bruises, skin diseases, abscesses, and ulcers. Internal treatments involve ingesting plant-based preparations. Diseases treated through internal remedies include diabetes, tuberculosis, malaria, hypertension, hemoptysis (vomiting blood), liver disorders, kidney diseases, and others.

The techniques used for external treatments vary depending on the type of illness. Typically, these treatments involve a single plant species. For skin wounds and dermatological conditions, leaves are

the most commonly used plant part. The preparation method usually involves pounding the leaves and applying the pounded leaves directly to the affected area. For instance, to treat swelling, the leaves of Ceiba pentandra (kapok tree) are crushed and applied topically to the affected area.

In contrast, internal treatments require more complex preparations. Plants are typically boiled or ground to extract their active compounds. These remedies often involve multiple plant species. For example, to treat coughs, a mixture consisting of dried roots of Imperata cylindrica (alang-alang), coconut roots, and guava leaves is ground and combined with a small amount of pepper.

The mixture is then consumed like drinking coffee. Figure 3 below illustrates the plant parts used by the Manggarai indigenous community for medicinal purposes.

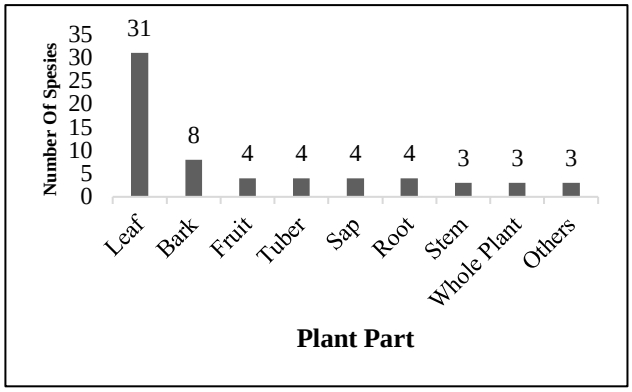

Figure 3

Utilized Plant Parts for Medicinal Purposes

As illustrated in Figure 3, the most frequently utilized plant part for medicinal purposes is the leaf, with 31 species identified. This is followed by bark with 8 species. Fruits, tubers, sap, and roots are each represented by 4 species. Stems, whole plants, and other parts—including shoots and flowers—are each used from 3 species. These data indicate that leaves play a central role in traditional medicine practices among the Manggarai indigenous community, reflecting their accessibility and perceived efficacy.

Utilization Of Plants For Traditional Ceremonial Purposes

In addition to their roles in food and medicine, plants are also utilized by the Manggarai indigenous community for various customary and ritual purposes. Based on survey and interview findings, the community recognizes 10 forest plant species commonly used in traditional ceremonies. This number is slightly lower than that found in the Malay communities around Bukit Tigapuluh National Park, where 13 species are used for similar customary purposes (Suwardi et al. 2025).

Figure 4 below illustrates the plant parts utilized by the Manggarai people specifically for traditional ceremonial functions.

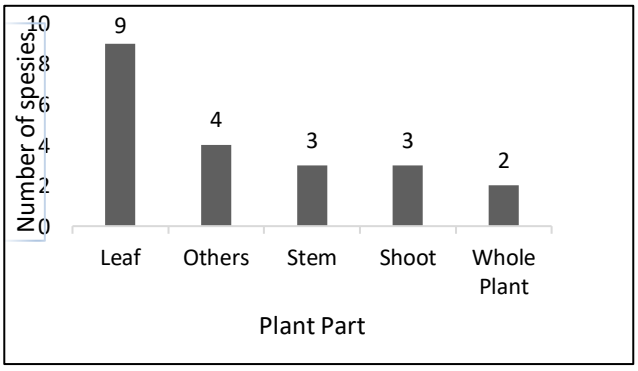

Figure 4

Utilized Plant Parts for Traditional Ceremonies

As illustrated in Figure 4, the most frequently utilized plant part for traditional ceremonial purposes is the leaf, with nine species recorded. This is followed by miscellaneous parts—including plantlets, flowers, fruits, and roots—comprising four species. Stems and shoots

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are each used from three species, while the entire plant is used from two species.

Traditional ceremonies in which these plants play a role include spirit-banishment rituals, funerals, engagement and wedding ceremonies, house-construction rituals, and birth celebrations. Several notable plant species used in these ceremonies include rattan (Calamus inops), lanu or gebang (Corypha utan), and pandan (Pandanus sp.).

Discussion and Conclusion

Cross-Study Comparisons, Ecological Insights, and Practical Implications

Compared with other ethnobotanical research in Indonesia, the Manggarai community's use of 124 plant species demonstrates one of the highest recorded levels of plant diversity in the archipelago. For instance, Jadid et al. (2020) documented 87 medicinal plant species among the Tengger people of East Java, while Suwardi et al. (2025) reported only 13 species used for ritual purposes among Malay communities in Sintang. Similarly, in the Tangale Nature Reserve, Harisha & Ravikanth (2021) recorded 33 species used as food sources—fewer than half of those reported in the present study. This comparative richness may be attributed to the Manggarai's continued integration of agroforestry practices, even amid pressures from monoculture expansion, and to the ecological heterogeneity of their territory, which spans lowland rainforests, savanna, and agroforestry mosaics.

From an ecological perspective, the documented knowledge reflects a sophisticated adaptation to environmental variability. The dominance of leaf use—mirroring patterns observed in the Dukuh community of West Java (Santhyami, 2021)—suggests a sustainability-oriented strategy, as harvesting leaves generally exerts less destructive pressure on plant populations than harvesting roots or bark. Furthermore, the classification of forests into ponceng, puar, and pong zones indicates an embedded conservation ethic, whereby certain forest patches are strictly protected for cultural and ecological reasons. Such systems align with the concept of "biocultural refugia" in conservation science, where culturally governed landscapes serve as reservoirs of biodiversity and traditional knowledge.

Rattan is used to make ceremonial baskets that serve as containers for betel leaves and areca nuts, especially during engagement and wedding rituals. The shoots (umbut) of the gebang are cooked and served as a required dish during traditional ceremonies. Pandan leaves are woven into mats that are commonly used in a variety of ceremonial contexts.

The practical implications of these findings extend into multiple domains. In the field of public health, several recorded species—such as *Curcuma domestica*, *Psidium guajava*, and *Averrhoa bilimbi*—possess pharmacological properties supported by modern phytochemical studies, offering opportunities to develop locally produced, culturally acceptable herbal remedies. In nutrition, the diversity of non-rice carbohydrate sources (e.g., *Metroxylon sago* and *Dioscorea hispida*) could inform food security strategies to diversify staple diets and reduce vulnerability to rice supply disruptions. For conservation policy, recognizing the role of indigenous management systems can strengthen community-based forest governance models. Collaborations between local leaders, government agencies, and scientific institutions could facilitate the integration of traditional ecological knowledge into biodiversity conservation, climate change adaptation, and sustainable rural development programs.

Limitations and Potential Applications

This study has several limitations that should be acknowledged. First, the data were collected over six months and focused primarily on communities in the Ruteng area, which may not fully represent the ethnobotanical knowledge across the broader Manggarai cultural landscape. Second, seasonal variation in plant availability was not fully captured because fieldwork was conducted within a single annual cycle. Third, the study relied heavily on self-reported information from informants, which, despite triangulation and botanical verification, may still contain recall bias or omissions of knowledge considered sacred or restricted.

Despite these limitations, the findings hold significant potential for application in pharmacology, nutrition, and conservation. In pharmacology, the identification of 65 medicinal plant species—including *Curcuma domestica*, *Psidium guajava*, and *Arcangelisia flava*—provides a valuable resource for screening bioactive compounds

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and developing culturally acceptable herbal remedies. In nutrition, the documented diversity of carbohydrate-rich plants, such as Metroxylon sago and Dioscorea hispida, could inform initiatives to diversify staple food sources, thereby enhancing dietary resilience and reducing dependence on rice. In conservation, the traditional forest classification system (ponceng, puar, pong) provides a culturally grounded model for community-based forest management, aligning with contemporary approaches to biodiversity preservation and the enhancement of ecosystem services.

The Manggarai indigenous community demonstrates extensive use of local biodiversity, with 124 plant species utilized across three primary categories: 68 for food, 65 for medicinal purposes, and 10 for traditional ceremonial activities. This classification highlights the integral role of plants in the community's daily life and cultural practices. Their deep connection with forest resources reflects a longstanding ethnobotanical knowledge system passed down through generations.

The use of forest plants for food is further divided into three subcategories: staple food substitutes, leafy vegetables, and fruits. Among the most important staple sources are Metroxylon sago Rottb (sago palm) and Dioscorea hispida Daenst (ondo). As for vegetables, Gnetum gnemon (melinjo leaves) is the most widely used, while Garcinia sp. (wild mangosteen) is the most commonly consumed forest fruit. These species are not only essential for sustenance but also embedded in cultural and ceremonial contexts, reinforcing the value of traditional plant-based knowledge in maintaining food security and cultural resilience.

Acknowledgments

The authors express their gratitude and appreciation to all participants.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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