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Ethnobotanical Study on the Use of Mangroves as a Food Source in Pesawaran Regency, Lampung Province

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ABSTRACT
The current global food crisis requires heightened attention from various countries, including Indonesia. In addressing this issue, mangrove plants present significant potential to be developed as alternative sources of functional food. This study aimed to document ethnobotanical practices related to the use of mangrove plants as food sources in Pesawaran Regency, Lampung Province. The research was conducted from March to June 2024 in Sidodadi and Gebang Villages, Teluk Pandan District, Pesawaran Regency. A snowball sampling technique was employed to collect comprehensive data regarding the use of mangrove plants as food ingredients. The information gathered included the plant species utilized, specific plant parts used, processing methods, food products derived, and their perceived benefits. Data were obtained through interviews, observations, and documentation, and were analyzed using a descriptive-analytical approach to elucidate usage patterns and processing methods of mangroves as functional food sources. The findings revealed that coastal communities in Pesawaran Regency utilize two types of mangrove plants for food: Legundi (*Vitex trifolia*) and Bakau (*Rhizophora mucronata*). These species are processed into various food products, including kitchen spices, flour, syrup, and coffe, which serve not only as nutritional items but are also believed to possess medicinal and health-promoting properties.

Keyword: Blue Ecosystem, Crisis, Climate, Coastal, Diversification, Food

1. Introduction

The current global food crisis is an issue that demands greater attention from various countries, including Indonesia. One of the primary contributing factors to this crisis is climate change, which affects multiple aspects of life, including cultivation practices, planting seasons, crop yields, and the quality of agricultural products [1]. Fluctuations in temperature, altered rainfall patterns, and extreme weather events lead to a decline in agricultural productivity. Climate change is a critical component influencing the success of food production, ranging from the availability of sufficient water for irrigation to meeting human consumption needs [2, 3]. The reduction in food production can result in trade imbalances, thereby threatening food supply stability, causing food shortages, and driving food price inflation [4]. One strategy to mitigate the effects of the food crisis is the optimization of blue ecosystems, which have the potential to provide resources that can enhance community food security [5, 6].

Blue ecosystem refer to marine and coastal resources that are regarded as vital assets, offering long-term economic benefits and the potential to improve the welfare of coastal communities [7, 8]. The development of coastal areas through the optimization of blue ecosystems is considered an effective solution to address food crisis challenges by providing abundant and sustainable food sources [9]. According to [10], coastal resources include fish, coral reefs, seagrass beds, mangrove forests, and various other marine organisms.

Mangrove forests, in particular, hold significant potential as alternative sources of raw food materials that can be processed into consumable products and support global food security efforts [11-13].

The utilization of mangrove plants as food sources has increasingly been recommended, involving not only the fruit but also other plant parts. According to [13], the community of Ambulu Village, Losari Subdistrict, processes mangrove fruits into a variety of food and beverage products, such as chips, jam, dodol (a traditional sweet), syrup, and flour for baking. Similarly, [14] reported that the residents of Bedono Village, Sayung, Demak, consume mangrove species such as *Avicennia* sp. and *Bruguiera gymnorrhiza* by processing them into flour-based products. Moreover, [15] noted that the sour taste of *Sonneratia* sp. (young pedada fruit) makes it a suitable natural substitute for vinegar. Another study in Kayong Utara Regency found that *Nypa fruticans* Wurmb is widely used as an ingredient in local desserts, including iced beverages, cendol, and palm fruit mixtures [16]. These examples reflect the rich and diverse use of mangroves as food sources across various regions in Indonesia. However, ethnobotanical utilization of mangroves as food sources in Lampung Province has yet to be documented. According to [17], Pesawaran Regency contains approximately 141.94 hectares of mangrove forests. The local communities living in close proximity to these ecosystems possess diverse cultural traditions. Therefore, an investigation into the ethnobotanical use of mangroves as food in Pesawaran Regency is deemed both relevant and necessary.

The utilization of mangroves as a food source is becoming increasingly important in efforts to address the threat of hunger in various regions, particularly considering that approximately 21% (3,490,000 hectares) of the world's mangrove forests are located in Indonesia [18]. The use of mangroves as a food source holds significant relevance for developing and maritime countries. Mangrove ecosystems harbor rich biodiversity, including fish, shrimp, crabs, shellfish, and various edible plant species [19]. The optimal use of mangroves as part of the blue ecosystem can offer a viable solution to the food crisis affecting coastal areas and small islands. Unlocking the potential of mangroves as a food source can also encourage coastal communities to actively participate in the conservation and protection of mangrove forests [20]. Therefore, the aim of this study is to document ethnobotanical practices related to the utilization of mangrove species as food sources in Pesawaran Regency.

2. Research Methods

The research was conducted from March to June 2024 in Sidodadi Village and Gebang Village, located in Teluk Pandan District, Pesawaran Regency. Geographically, Sidodadi Village is situated at coordinates 05°33′ S and 105°15′ E, while Gebang Village lies between 105°11′0″ E – 105°17′0″ E and 5°32′0″ S – 5°36′0″ S (Figure 1).

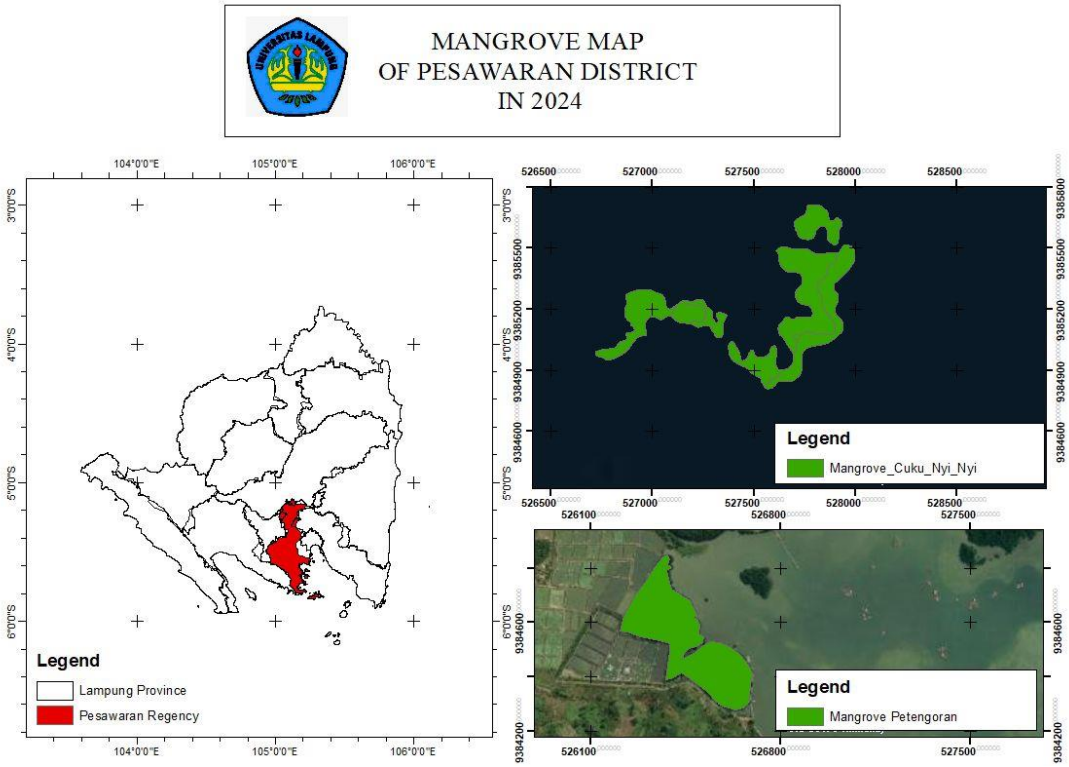

Figure 1. Research Map

Sampling in this study was conducted using the snowball sampling method, which is particularly appropriate for ethnobotanical research due to the localized and community-specific nature of traditional knowledge especially in relation to the use of mangroves as a food source. The process began with consultations with village officials to identify the initial informant. Subsequent participants were recruited through referrals provided by prior informants, forming a continuous referral chain. This approach enabled the inclusion of individuals with relevant and in-depth ethnobotanical knowledge, thereby allowing for a more comprehensive and contextual understanding of mangrove utilization practices. A total of 13 respondents participated in this study, consisting of 10 males and 3 females**.** The majority were of Bugis ethnicity (38%)**,** followed by Lampung (23%)**,** Javanese (15%)**,** Cirebonese (15%)**,** and Makassarese (8%)**.** The ethnic diversity among respondents offered a broader and richer perspective on local ethnobotanical knowledge concerning mangrove utilization.

Data collection in this study primarily focused on qualitative methods, including direct field observations and semi-structured interviews with local community members. These interviews explored various key aspects, such as the types of mangrove species used as food sources, the specific plant parts utilized (including leaves, fruits, and roots), the methods of processing and the resulting food products, as well as the perceived nutritional and medicinal benefits. In addition, traditional practices related to the preparation and consumption of mangrove-based foods were also documented. The use of open-ended questions allowed participants to freely express their knowledge and personal experiences in utilizing mangroves as food sources, ensuring the richness and depth of the information obtained.

The collected data were analyzed using a descriptive-analytical approach to uncover patterns in mangrove utilization within coastal communities. The analysis examined the relationship between traditional knowledge and utilization practices, and identified several influencing factors such as resource accessibility and availability, local awareness, socio-cultural norms, and economic motivations. Ultimately, this analysis aimed to provide a deeper understanding of the role of mangrove resources in supporting local food security and to explore potential strategies for enhancing their sustainable utilization.

3. Results and Discussion

The results of the study showed that there are two types of mangrove plants that are used as food sources by coastal communities in Pesawaran Regency. The two types of mangroves are Legundi (*Vitex trifolia*) and Bakau (*Rhizopora mucronata*). Types, parts, processing methods, food products and benefits of mangroves are presented in Table 1.

Table 1. Utilization of Mangroves as Food Ingredients in Pesawaran Regency

No	Type	Part	Processing Method	Food Product	Efficacy
1	Legundi (*Vitex trifolia* L*)*	Fruit	The mature Legundi fruit, which turns dark brown in color, is first roasted. After roasting, the fruit is pounded or ground into a fine powder. This powdered Legundi fruit is then used as a flavoring agent in cooking, imparting a savory taste and distinctive aroma to dishes.	Specis	Antioxidant, antidiabetic, anti-inflammatory, and tonic
2	Bakau (*Rhizophora mucronata*)	Fruit without roots	The outer skin of the fruit is peeled, then the fruit is boiled for 30 minutes to reduce bitterness. It is subsequently soaked in clean water for two to three days, with the water replaced daily to support the detoxification process. After soaking, the fruit is oven-dried and finely ground into flour.	Flour	Anti-inflammatory, antibacterial, anticancer, analgesic, tonic and antiallergic.
		Fruit without roots	The ripe mangrove fruit, which is characterized by its reddish color, is first collected. The fruit is then cleaned to remove any dirt or foreign matter and washed with clean water. After cleaning,	Drink/syrup	The content of vitamin C, antidiarrhea, and iodine is useful for growth and

No	Type	Part	Processing Method	Food Product	Efficacy
			the fruit is boiled in water for 15–20 minutes until it becomes soft. The boiled fruit is then separated from the cooking water. Once softened, the fruit is blended or mashed using a blender or a fruit crusher. The resulting mangrove pulp is then filtered to separate the residue and obtain the juice extract.		development..
		Fruit (without extended propagule)	The mangrove propagules are separated into the tip and base, after which the base is split open to extract the seeds. The extracted flesh is then soaked in a lime water solution for three days, with the water changed daily. After soaking, the flesh is thoroughly washed, thinly sliced, and sun-dried until completely dry. The dried slices are then roasted until blackened and sifted. The final product can be brewed into a beverage with the addition of sugar, palm sugar, or powdered creamer.	Coffe	Antioxidant, analgesic, body-warming tonic

Based on Table 1, it was identified that only two species of mangrove plants—*Vitex trifolia* (Legundi) and *Rhizophora mucronata* (Bakau) are utilized as food sources through ethnobotanical practices by coastal communities in Pesawaran Regency. The number of mangrove species used for food purposes is relatively low, considering that according to [21], there are 21 mangrove species growing along the coastal areas of Pesawaran Regency. Thus, only approximately 9.52% of the known mangrove species are utilized by local communities as food sources. A comparison with other regions within Lampung Province reveals a greater diversity in the utilization of mangrove species as food. In South Lampung Regency, the community has processed three mangrove species *Rhizophora mucronata*, *Avicennia marina*, and *Acanthus ilicifolius* into a variety of functional food products [22]. Meanwhile, in East Lampung Regency, studies indicate a higher degree of diversification in the use of mangroves as food sources, with five species identified and utilized by local communities: *Sonneratia caseolaris* (Pidada), *Avicennia marina* (Api-api putih), *Acanthus ilicifolius* (Jeruju), *Rhizophora mucronata*, and *Bruguiera gymnorrhiza* [23].

The utilization of mangroves as food sources by communities in Pesawaran Regency remains relatively low compared to other regions in Indonesia. For instance, in Percut Sei Tuan Subdistrict, Deli Serdang Regency, North Sumatra Province, local communities have been reported to utilize five mangrove species for food purposes, namely *Sonneratia caseolaris* (berembang), *Avicennia marina* (api-api), *Acanthus ilicifolius* (jeruju), *Sonneratia alba* (perepat), and *Nypa fruticans* (nipah), all of which have been processed into various food products [24]. Similarly, the number of mangrove species used as food sources in Pesawaran is also limited when compared to Sidoarjo Regency, East Java. A study by [25] reported that eight mangrove species in Sidoarjo are recognized for their potential as alternative food sources. These include *Avicennia marina*, *A. alba*, *A. lanata*, *Bruguiera gymnorrhiza*, *Sonneratia alba*, *S. caseolaris*, *S. ovata*, and *Nypa fruticans*.

The findings indicate that the utilization of mangrove plants as a food source in Pesawaran Regency remains relatively low, with considerable local potential yet to be optimally explored. This condition is presumed to be closely linked to the relatively low level of formal education among the local population. According to data from the Central Statistics Agency (BPS) of Pesawaran Regency in 2023 (accessed January 2025), 42.67% of the working-age population (≥15 years) have only completed primary education, while only 5.28% have attained higher education. This limited access to formal education has implications for the community's capacity to receive, process, and apply new information or innovations, particularly in diversifying food products based on local knowledge. As reported by [26], low educational attainment hinders community participation and innovation in utilizing mangrove resources as alternative food products with economic value. This is supported by [27], who state that higher educational levels are positively associated with an individual's ability to absorb and implement innovations. Further studies [28]-[29]

emphasize that formal education indirectly influences the cognitive framework of individuals; those with higher educational backgrounds tend to exhibit greater motivation in developing local food-based innovations. In the context of ethnobotany, this relationship is highly relevant, as education not only enhances awareness of the importance of preserving traditional knowledge but also facilitates access to broader information sources that enrich ethnobotanical practices. In line with this, [30] revealed a positive correlation between formal education and ethnobotanical knowledge among communities utilizing palm species, where individuals with higher education levels were more inclined to acquire and develop ethnobotanical knowledge from various sources. Therefore, the level of education plays a critical role in shaping, preserving, and advancing ethnobotanical knowledge, particularly in the traditional use of mangroves as a food resource.

The findings of this study indicate that processed mangrove products produced by communities in Pesawaran Regency remain relatively limited in variety, with only four types identified: kitchen spices, flour, syrup, and coffe. In fact, mangrove plant raw materials have the potential to be processed into a wide range of food products with medicinal and functional food properties from an ethnobotanical perspective. As reported by [31], the community in Wonorejo District, East Surabaya has utilized pedada fruit (*Sonneratia* spp.) as a functional ingredient to produce six types of processed foods, including high-fiber and antioxidant-rich Pedada Cookies, high-fiber Pedada Onion Sticks, high-vitamin C Pedada Fruit Jam, and Pedada Jelly Candy enriched with collagen and vitamin C. Furthermore, research by [32] revealed that communities in Jangkaran Village, Kulon Progo Regency process mangrove fruits into various products such as syrup and jam from *Sonneratia alba* (perepat), chips from *Acanthus ilicifolius* (jeruju) leaves, dodol from *Sonneratia* fruits, compote from *Nypa fruticans*, tea from jeruju leaves, mangrove flour from *Bruguiera gymnorrhiza* (lindur), and mangrove coffee. Nevertheless, the diversity of mangrove-based food products produced by coastal communities in Pesawaran Regency is relatively higher compared to that in Purworejo Regency. According to [33], the community in Purworejo processes mangrove fruits into only three products: Caseolaris syrup, Frutica sweets, and Jeruju tea bags. Additionally, research by [34] notes that the community in North Maitara Village, North Tidore District, exclusively utilizes *Rhizophora apiculata* mangrove fruits as ingredients for mangrove coffee beverages.

The diversification of processed mangrove-based food products in coastal areas of Pesawaran Regency remains relatively uninspired and lacks innovation. According to [35], the community in Gunung Anyar Village, Surabaya, utilizes bogem or pedada fruit (*Sonneratia caseolaris*) to produce beverages such as *es puter* (traditional ice cream) and ice cream. These innovations not only expand product diversity but are also expected to provide health benefits. Meanwhile, in Kartika Jaya Village, Kendal Regency, communities have processed the tancang mangrove (*Bruguiera* sp.) into various food products such as crackers (KruMang), sponge cake (Bolu), brownies (BoMang), and sticks (SiMang) [36]. The development of mangrove plant processing technology is seen as a solution to increase the marketability and competitiveness of mangrove-based products [37]. Processing is essential to produce food products with consistent functional properties, high nutritional value, and safety for consumers. Modern processed products can be further developed to promote and raise public awareness of mangroves as potential food ingredients. This effort also aligns with government programs aimed at managing and conserving mangrove ecosystems sustainably [38].

The results of the study showed that processed mangrove products consumed by the people of Pesawaran Regency not only function as a food source, but also have properties as medicine or disease prevention. There are nine health functions of processed mangrove products produced by the coastal communities of Pesawaran Regency, namely antioxidants, antidiabetics, anti-inflammatory, antibacterial, anticancer, analgesics, antiallergic, have vitamin C content, tonic and others. The discovery of antioxidants in mangrove plants indicates that mangroves have great potential for future treatment. High antioxidant activity in mangrove plants can be a source of external antioxidants that have the potential to prevent tumors and cancer. Cancer is the number 2 killer after cardiovascular disease which causes 12% of deaths in the world [39]. The use of mangroves as antioxidants can neutralize free radicals that attack our body cells [40]. In line with research [41], it states that traditionally in several regions in Indonesia such as Java, Sulawesi and Maluku, mangrove plants have been used as medicines and functional antioxidant drinks that are resistant to high temperatures, can ward off premature aging and various other diseases.

The popularity and utilization of mangrove plants by local communities can enhance public awareness of the importance of conserving mangrove ecosystems and preventing degradation of coastal environments.

Through the sustainable use of natural resources, communities can simultaneously preserve ecosystems while gaining economic benefits. Therefore, mangrove forest planning should integrate the functions of ecotourism, conservation, education, and the economy as part of a comprehensive sustainable management strategy [42]. Communities living near coastal mangrove areas can directly benefit from mangrove plants. In addition to serving as pollutant filters, microclimate regulators, and carbon reserves, mangroves also hold potential as food sources that can improve the quality of life for local populations [43]. Mangrove forests, which were once considered to have little economic value, are now recognized as natural resources with significant potential to generate foreign exchange and serve as livelihoods for coastal communities [44]. The utilization of mangrove plants as food sources is expected to further raise public awareness and participation in mangrove management, as local communities play a crucial frontline role in preserving mangrove ecosystems [45].

4. Conclusion

The results show that coastal communities in Pesawaran Regency use two types of mangroves as food sources. The two types of mangroves are Legundi (*Vitex trifolia*) and Bakau (*Rhizopora mucronata*). There are only parts of the mangrove fruit that have been utilized by coastal communities in Pesawaran Regency. There are four processed mangrove plant products produced by coastal communities in Pesawaran Regency, namely as kitchen spices, flour, syrup and coffe. Processed mangrove plant products consumed by coastal communities in Pesawaran Regency not only function as food sources, but also have properties as medicines or disease prevention. The findings of this study reveal that mangrove-based food products consumed by coastal communities in Pesawaran Regency are believed to have potential health benefits, including antioxidant, antidiabetic, anti-inflammatory, antibacterial, anticancer, analgesic, and antiallergic properties, as well as containing vitamin C, and tonic effects. This study is only limited to knowing the medical function of food through literature studies and interview studies. Efforts need to be made to verify the content of substances in mangrove plants as functional foods that are in accordance with the analysis of literature studies. Therefore, further research is needed regarding *profiling* tests of bioactive compounds contained in functional food products produced from mangrove plants.

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