

Food Security and Biodiversity Benefits of Home Gardens in Pujon, East Java

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Abstract. Home gardens have long been a vital traditional agroforestry system supporting the livelihoods of Indonesian communities, particularly in terms of food security. This study aims to deepen the understanding of the role of home gardens in national food security by focusing on a case study of the Local User Value Index (LUVI) for food crops in home gardens in Pujon, Malang Regency, East Java. The research methodology involved collecting local knowledge from the community and applying the Pebble Distribution Method (PDM) to calculate the significance value of plants across various utility categories (LUVI). The findings indicate that home gardens play a significant role in meeting local food needs, particularly through the production of food crops, vegetables, fruits, herbs, and natural dyes. Crops such as maize and cassava serve as important staple food alternatives in areas with limited agricultural land. The preference for plant usage is influenced by geographical factors, community preferences, and the utility of the plants. This study provides deeper insights into the potential of home gardens and their role in supporting food security, with the aim of contributing to the advancement of knowledge and agricultural policy development in the future.

Keywords: Food Security; Home Gardens; Local Knowledge; LUVI.

I. INTRODUCTION

The home garden, or "pekarangan," represents a traditional agroforestry system that plays a pivotal role in sustaining its owners. This system not only provides essential food and medicinal resources but also contributes significantly to biodiversity conservation by preserving local species and offers economic benefits [1, 2]. In Indonesia, there is growing recognition of the importance of such traditional agroforestry systems, including home gardens. These systems are increasingly studied for their potential to address forest land degradation and socio-economic challenges in both rural and urban contexts.

One prominent socio-economic challenge in Indonesia is the country's insufficient food security. The Global Food Security Index 2021 highlights Indonesia's struggle with food diversification, placing it 69th out of 113 countries with a score of 59.2 out of 100, which marks a decline from the previous year [3]. The Food Security Agency's Performance Report further underscores this issue, noting variability in food consumption quality. The Expected Food Pattern Score (PPH) for 2020 fell short of the target, achieving only 86.3% of the 90.4% goal [4].

This indicates ongoing challenges in improving food security and diversification.

Home gardens contribute significantly to food security and health, enhancing the aesthetic appeal of residential areas while serving as critical sources of food and medicine, especially in rural communities [5]. In urban areas, these gardens also support the cultivation of various food plants, including tubers, vegetables, fruits, spices, and medicinal herbs [6]. Despite their importance, the role of home gardens in food security has been increasingly overshadowed by urbanization and a growing reliance on processed and imported foods. This shift heightens vulnerability to global food price fluctuations and reduces the availability of local food sources.

Recent advancements in agroforestry research emphasize the multifaceted benefits of home gardens. Studies reveal that home gardens not only provide diverse food sources but also play a critical role in enhancing local food resilience and biodiversity. Mixed crop livestock system like home garden contribute to food availability by recycling nutrients to food utilisation through meat and milk consumption [7].

This study focuses on the role of home gardens in supporting national food security, with a particular emphasis on the food crops cultivated in the home gardens of Pujon, Malang Regency, East Java. By employing the Local User's Value Index (LUVI) as a case study tool, this research aims to elucidate the local significance of home garden agriculture and evaluate its contribution to meeting local food needs and enhancing community food security. Through this analysis, the study seeks to provide insights into how traditional agroforestry systems can address contemporary challenges in food security and sustainability.

II. METHODS

Time and Location

This research was conducted from 2018 to 2019, at Pujon Sub-district, Malang Regency, East Java, Indonesia.

Research Procedure

The research was conducted in Pujon Sub-district, Malang Regency, East Java Province. Data collection on the local knowledge of home gardens and the utilization of plants within these gardens was carried out through interviews with home garden owners, using both structured and semi-structured interview formats.

To evaluate the types of plants within each category, scoring was conducted with 45 respondents, who were divided into three different environmental settings: near the river, along major roads, and close to the forest. Additionally, respondents were categorized into three age groups: young informants (aged < 30 years), adult informants (aged 30–60 years), and elderly informants (aged > 60 years).and gender two gender gorup: woman and man. The utilization of plants by category was quantified using the Pebble Distribution Method (PDM). The resulting data was then used to compute the Local User's Value Index (LUVI) for each usage category, employing the LUVI formula based on Sheill et al. (2004):

$$LUVI = G_{ij} = \sum (\text{category } j)$$

$$G_{ij} = RW_j \times RW_i$$

- I = Plant species identified through the scoring activity
- j = Type of use
- G_{ij} = Individual value
- RW_j = Weight assigned to a specific activity (j)
- RW_{ij} = Relative weight of the utilization of plant species i for use category j, based on respondents who meet for category j.

III. RESULTS AND DISCUSSION

Although home gardens are not typically the primary food source, their significance is increasing as agricultural land becomes more scarce [8, 9]. According to the Local User's Value Index (LUVI), corn (*Zea mays*) and cassava (*Manihot esculenta*) are highly valued in communities located near rivers, roads, and forests, as indicated by their high LUVI scores (Figures 1, 2, 3). These crops are preferred and frequently utilized, with other plants mainly serving as substitutes when corn and cassava are unavailable.

In riverine communities, older generations hold unripe jackfruit (*Artocarpus heterophyllus*) and banana (*Musa × paradisiaca*) in high regard as important food sources. These traditional foods are particularly well-known among the elderly, while younger and middle-aged individuals may be less acquainted with them. Historically, unripe jackfruit and banana were crucial during times of scarcity of staples like rice and corn, though their use has waned over time. Bananas, valued for their rich content of minerals, vitamins, and carbohydrates, are a key staple food, particularly in East Africa and the Fiji Islands, where they serve as a low-cost energy reserve [10, 11].

Currently, staple foods are often combined with rice, and tubers are increasingly enjoyed as snacks, whether steamed or roasted, and are commonly featured in local eateries throughout Pujon Sub-district. These traditional foods not only appeal to tourists with their unique flavors but also enhance the local appeal of staples such as corn, cassava, and tubers. Among these tubers, *Colocasia esculenta* (taro) stands out for its significant nutritional and medicinal benefits. Research has demonstrated that taro contains various bioactive compounds—including tarin, polysaccharides (TPS1 and TPS2), alkaloids, polyphenols, and saponins—that offer anti-carcinogenic, anti-compulsive, anti-hyperglycemic, anti-hypertensive, anti-inflammatory, hepatoprotective, immunoprotective, and neuroprotective effects [12].

In forest-adjacent communities, there is a heavier reliance on secondary staple foods. Reports suggest that corn is prepared almost daily due to the unsuitability of farmland for rice cultivation. To conserve rice, it is often mixed with other foods. Conversely, rice is mainly grown in fields and paddies, while home gardens are utilized for cultivating secondary carbohydrate sources like tubers. This approach to incorporating non-rice carbohydrates helps reduce Indonesia's dependence on rice. As traditional food practices become increasingly overshadowed by rice and noodles, acknowledging and valuing local food sources is essential for their nutritional and culinary benefits [13].

In Indonesia, crops such as *Colocasia esculenta*, *Canna edulis*, *Alocasia macrorrhiza*, and *Xanthosoma sagittifolium* are classified as orphan crops, also known as underutilized or neglected crops [14, 15, [16]. While these crops are not traded internationally, they are well-suited to local conditions and play a crucial role in regional nutritional security (Food and Agriculture Organization of the United Nations, 2017). They provide essential nutrients, including carbohydrates, proteins, minerals, vitamins, dietary fibers, and resistant starch [12, 17]. *Colocasia esculenta*, in particular, is recognized as a promising food for addressing chronic malnutrition and hidden hunger in Asia [17].

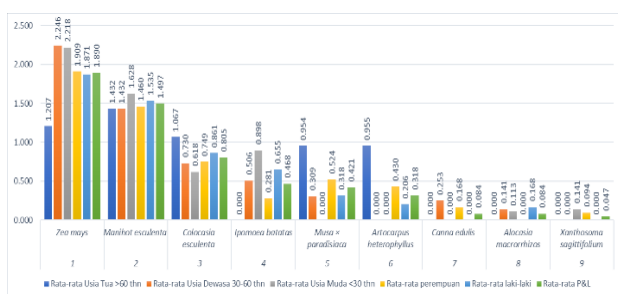


Figure 1. LUVI values for food categories in home gardens near the river.

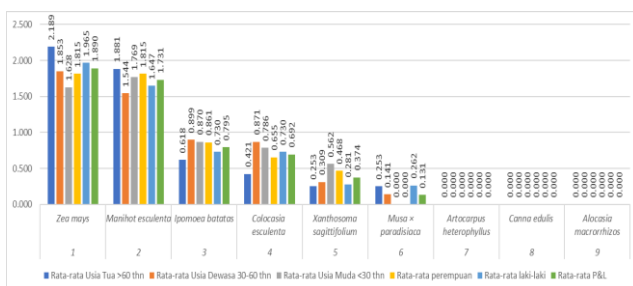


Figure 2. LUVI values for food categories in home gardens near the road access.

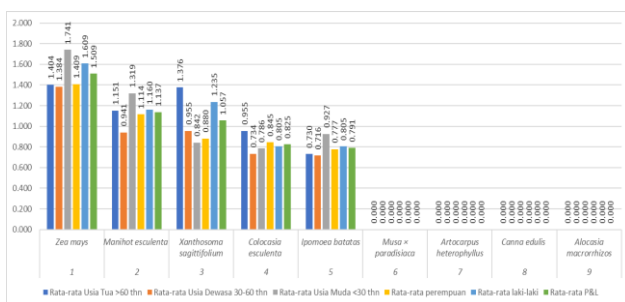


Figure 3. LUVI values for food categories in home gardens near the forest.

Home gardens play a crucial role in providing a variety of vegetables essential for daily nutrition [18], [19]. According to research by Marsh [20], home gardens contribute up to half of the vegetable needs for households. Each community group values different

vegetables based on their preferences and needs, leading to a rotation of vegetables in meals to prevent monotony and ensure a diverse diet. This practice typically results in similar usefulness scores across various vegetable types.

For example, in communities near forests, *Daucus carota* receives a higher importance score among men compared to women. This is attributed to the value of carrot leaves as livestock feed, which is more significant than for other vegetables. Vegetables that rank high in LUVI scores are often those grown with economic purposes in mind, serving both personal consumption and commercial sale. The frequent consumption of these vegetables makes it challenging to determine the exact reasons for LUVI score variations, although factors such as superior organoleptic qualities, lower prices, and greater availability generally contribute to higher LUVI scores.

Overall, LUVI scores for vegetables are minimally affected by gender or age (Figure 4,5,6). The top 10 vegetables with high LUVI scores are typically cultivated in large quantities for sale, making them more accessible to consumers. In contrast, vegetables with lower LUVI scores, such as *Solanum torvum* and *Crossocephalum crepidioides*, may be less available or have distinctive tastes and aromas. Large home gardens often focus on growing a single vegetable in bulk for commercial purposes, whereas smaller gardens usually cultivate a variety of vegetables for personal consumption [21, 22].

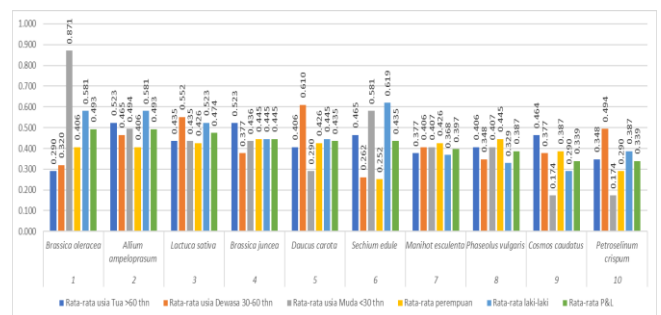


Figure 4. LUVI values for vegetable categories in home gardens near the river.

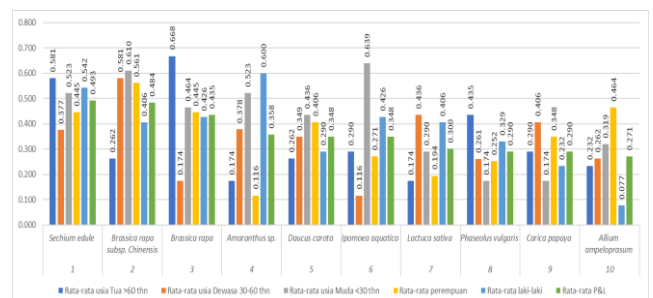


Figure 5. LUVI values for vegetable categories in home gardens near road access.

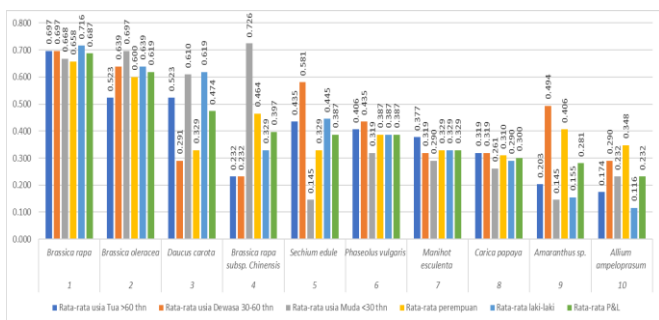


Figure 6. LUVI values for vegetable categories in home gardens near the forest.

Home gardens in Pujon Sub-district play a vital role in providing a diverse array of fruits, which are especially significant in this popular tourist area. Among the most frequently used fruits are *Musa × paradisiaca*, *Citrus reticulata*, and *Malus domestica* (Figures 7, 8, 9). A notable example is *Fragaria × ananassa* (strawberry), which is commonly cultivated in gardens near main roads. The availability and usage of strawberries are influenced by the local government's distribution of strawberry seedlings. These strawberries are sold in various forms, including seedlings, fresh fruit, and juice

The primary purpose of growing fruits in home gardens is for personal consumption, a finding that aligns with Alemu et al. [23] in Burie District, Ethiopia. Fruits are highly valued for their taste and nutritional benefits, which contribute to overall health [24]. Moreover, fruit trees in home gardens fulfill multiple household needs, providing not only food but also medicine, animal feed, firewood, and other household items [25].

In Pujon Sub-district, home gardens showcase a wide variety of fruit types, including trees, shrubs, and herbs. This diversity supports the findings of Bhandari et al. [26], which highlight home gardens as sources of a broad range of vegetables and fruits. The varied food products from these gardens—such as vegetables, fruits, staple foods, and animal proteins—enhance food security at both local and national levels.

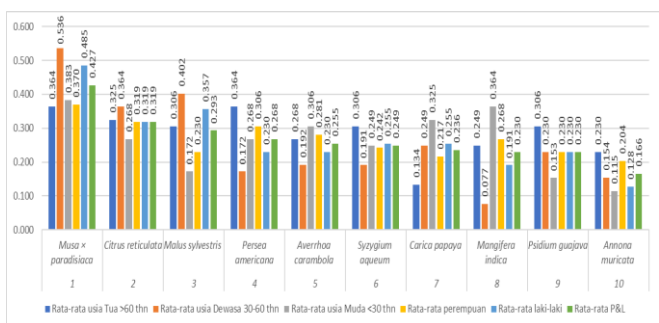


Figure 7. LUVI values for fruit categories in home gardens near the river.

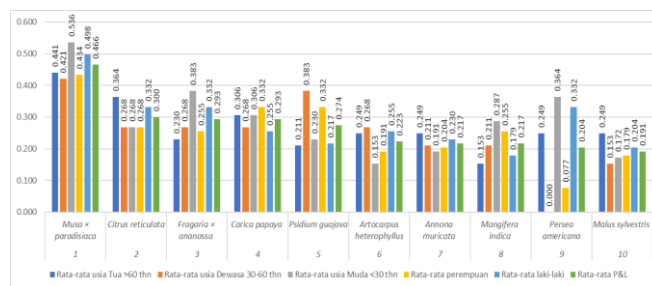


Figure 8. LUVI values for fruit categories in home gardens near road access.

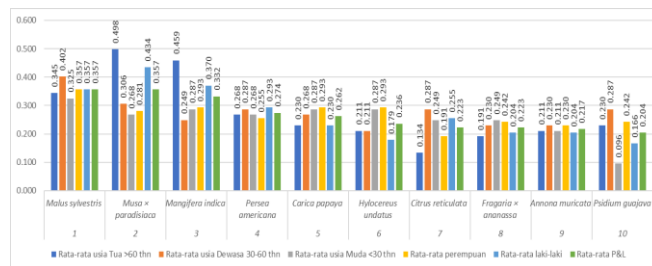


Figure 9. LUVI values for fruit categories in home gardens near the forest.

Residents of Pujon also engage in sharing surplus fruits with neighbors and selling excess produce, typically at local markets or through makeshift stalls in front of their homes. This practice not only bolsters the local economy but also attracts tourists, who often stop to purchase these fruits, thereby adding a market dimension to the role of home gardens. Home gardens provide a variety of plants used to make beverages, and the Local User's Value Index (LUVI) for these plants varies among different community groups. This variation is influenced by factors such as occupation. For example, individuals involved in producing apple and lemongrass juices often rate these plants higher than others. In Pujon, *Coffea sp.* (coffee) and *Zingiber officinale* (ginger) are commonly used for making beverages (Figure 10,11,12).

Many of these plants also have additional uses beyond beverage production. For instance, *Zingiber officinale* (ginger) is valued not only for its role in making drinks but also for its medicinal properties and culinary applications.

Ginger is often added to fresh milk to create a warming effect, which is particularly appreciated in Pujon Sub-district. This practice is especially relevant because Pujon Sub-district is a major dairy-producing area with relatively cool temperatures. The addition of ginger helps to provide a comforting warmth to the milk, making it more suitable for the local climate. This observation aligns with research by Wiryono et al. [27] in Bengkulu, Indonesia, which found that jackfruit (*Artocarpus heterophyllus*) is utilized in various forms, including as a vegetable, fruit, and drink.

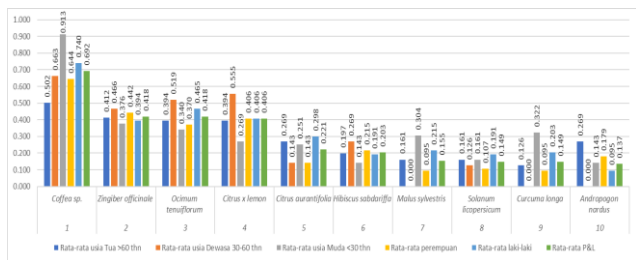


Figure 10. LUVI values for beverage categories in home gardens near road access.

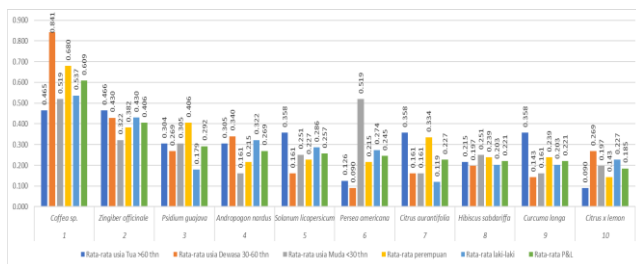


Figure 11. LUVI values for beverage categories in home gardens near road access.

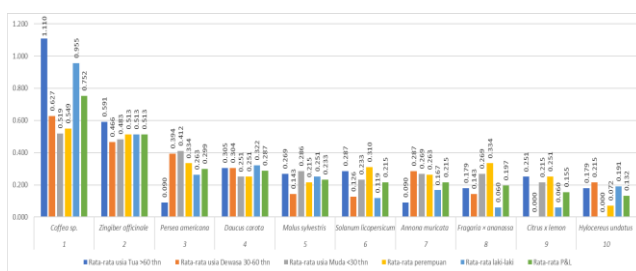


Figure 12. LUVI values for beverage categories in home gardens near the forest.

Home gardens play a crucial role in cultivating traditional spices, with *Capsicum frutescens* (chili) and *Allium cepa* (onion) being particularly significant in Pujon Sub-district. The Local User's Value Index (LUVI) values for these spices, illustrated in Figures 13, 14, and 15, underscore their importance in various environments, including areas near rivers, roads, and forests.

Generally, women have more extensive knowledge about the use of spice plants, whereas men are usually familiar only with basic spices like chili, shallots, and garlic. Consequently, the LUVI values for less familiar spices tend to be lower among men compared to women.

Most spice plants in home gardens are herbs, which produce active compounds, often aromatic, through secondary plant processes like phytochemistry. This process generates substances such as essential oils. These chemical compounds make spices valuable not only for enhancing the flavor of food but also for their medicinal properties [28]. Spices are typically used in small quantities to add flavor to dishes.

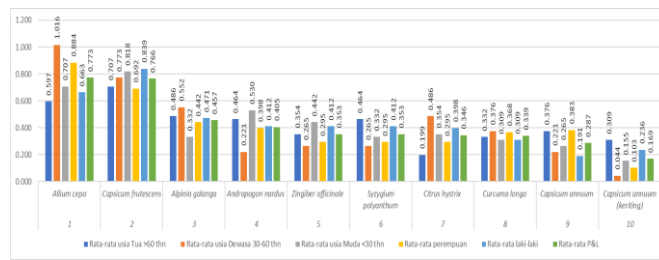


Figure 13. LUVI values for spice categories in home gardens near the river.

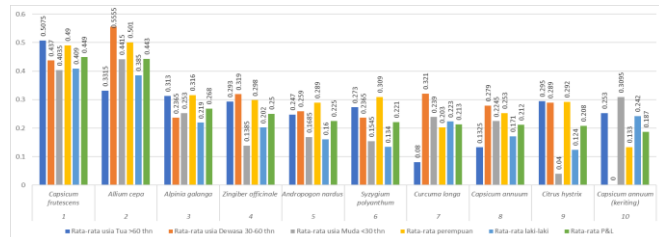


Figure 14. LUVI values for spice categories in home gardens near road access.

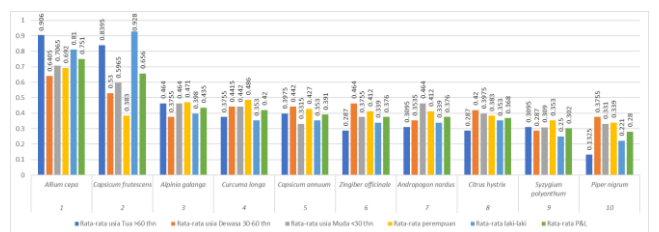


Figure 15. LUVI values for spice categories in home gardens near the forest.

Food colorants are extensively used to enhance the appearance of everyday dishes, snacks, and baked goods. In Pujon Sub-district, several plants utilized as natural food colorants have high Local User's Value Index (LUVI) scores in various environments. Among these, *Curcuma longa* (turmeric) and *Capsicum annuum* are particularly notable (Figures 16, 17, 18). Turmeric is highly prized for its vibrant yellow color, commonly used to tint dishes such as yellow rice and coconut milk-based soups. *Capsicum annuum*, known for its rich red hue, is frequently used to enhance dishes and special rice preparations like nasi tumpeng for local competitions.

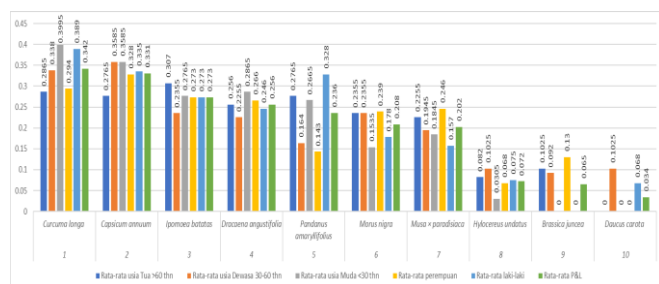


Figure 16. LUVI values for food colorants in home gardens near the river.

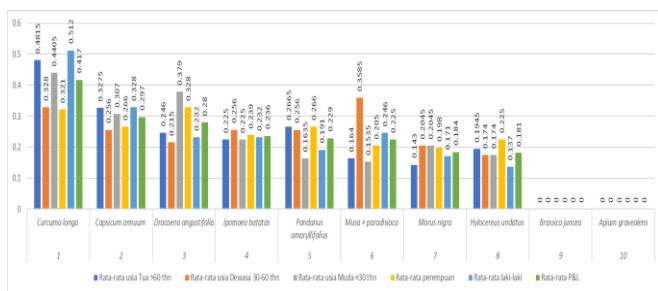


Figure 17. LUVI values for food colorants in home gardens near road access.

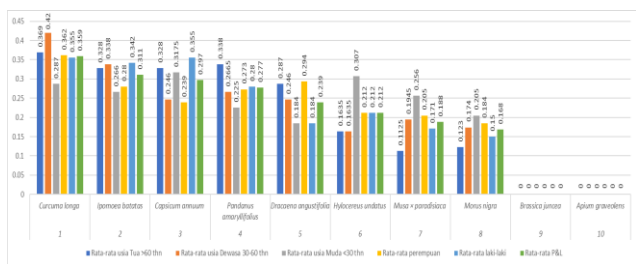


Figure 18. LUVI values for food colorants in home gardens near the forest.

Other important natural colorant plants include *Brassica juncea*, which imparts a green color to snacks and noodles; *Dracaena angustifolia*, valued for its distinctive green color and aroma in cakes and desserts; and *Ipomoea batatas* (purple sweet potato), which adds a natural purple tint to pastries. Additionally, dried banana leaves, known as *klaras*, are used for black coloring by burning them until charred and then grinding them [22].

The use of these natural colorants not only enhances the visual appeal of food but also aligns with the growing trend towards natural and sustainable practices [29]. This increasing demand for natural colorants highlights the significant potential of the plants in Pujon Sub-district for developing natural food colorants, supporting both local culinary traditions and broader industry needs.

IV. CONCLUSION

Home gardens significantly contribute to national food security by providing essential food sources, especially in areas with limited agricultural land. These gardens offer a variety of plants, including staple crops, vegetables, fruits, spices, and food colorants. For instance, crops like corn and cassava have become popular as alternative staple foods to rice, addressing the need for diverse food sources. The use of home gardens for food production has grown, particularly in regions where agricultural land is becoming scarce. Preferences for different plants are influenced by factors such as geographic location, community preferences, and the specific uses of the plants. Additionally, there are differences in preferences based on gender and age regarding the use of plants for food, beverages, spices, and colorants.

contains a brief summary of the results of the research and discussion as well as answers to the formulation of the problem..

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