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Non-edible plants traded in traditional markets of Beringharjo, Yogyakarta and Pasar Baru, East Kalimantan, Indonesia: The role of biocultural system

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Abstract. *Iskandar BS, Iskandar J, Suroso, Alfian RL, Mulyanto D. 2022. Non-edible plants traded in traditional markets of Beringharjo, Yogyakarta and Pasar Baru, East Kalimantan, Indonesia: The role of biocultural system. Biodiversitas 23: 4657-4669.* The trade of various non-edible plants in some traditional Indonesian markets has a close relationship with the biological and cultural diversity, as well as local knowledge of the community. Therefore, this study aims to examine the non-edible plant diversity used to make products sold in traditional markets, their various functions and parts, as well as the market chain. The study was conducted in Beringharjo, Yogyakarta, and Pasar Baru, Balikpapan, East Kalimantan to resemble regions with different cultural backgrounds. Data collection used the qualitative method with an ethnobotanical approach. The results showed that 25 species belonging to 16 families of non-edible plants were traded in the traditional markets of Beringharjo and Pasar Baru. The various parts being traded in both markets had numerous functions, including pilgrimage ceremonies at the cemetery, handicraft/decoration, and betel chewing. The market chain begins with farmers from villages, middlemen, traders in the traditional market, and then finally to consumers. The diversity of non-edible plants traded was determined by the biophysical and cultural aspects of the local community where the market is located. Therefore, traditional markets play an important role as hallmarks of a particular social culture by reproducing on a small scale the cultural and biological diversity. They are also essential in the acquisition and transmission of traditional knowledge of biodiversity.

Keywords: Biocultural system, Indonesia, non-edible market plant, traditional market

INTRODUCTION

Traditional markets in Indonesia, as well as in several cities worldwide, have become special places for traders and buyers with various cultural backgrounds (Arellanes et al. 2013; Sulaimi and Sabran 2018; Iskandar et al. 2018a; Nguyen et al. al. 2019; Franco et al. 2020). This cultural diversity is reflected in the form of the local language, knowledge, value systems, worldviews, and lifestyles. Visitors usually come to traditional markets to buy various necessities for their daily life. Additionally, visitors can also gather with each other, meet relatives, friends, taste distinctive local food specialties, chat, share information and experiences, as well as disseminate local knowledge on the biodiversity of fruits, vegetables, medicinal plants, and fishes (Nguyen et al. 2019; Alfian et al. 2020; Franco et al. 2020; Geertsma et al. 2021).

Several kinds of stuff sold in traditional markets can be generated from edible plant species, for example, foods (staple foods and additional staple foods, fruits, vegetables, species, edible oil, stimulants, and beverage) and medicinal plants, while non-edible plants constitute material cultures, including handicraft materials, decoration, and ritual ceremonies as well as non-edible traditional medicine (Bahru et al. 2012; Lim 2014; Silalahi et al. 2015; Yassin et al. 2015; Iskandar et al. 2018a; Sujarwo et al. 2018; Sutrisno et al. 2020; Iskandar et al. 2020). Therefore, generally the plants and plant-based products commonly traded in traditional markets may be divided into two groups, namely edible and non-edible plants. Similar to edible plants products, the production of such materials from non-edible plants sold in the traditional market are important role source of income, employment and cultural aspects for local people (Nedelcheva et al. 2011; Permanasari 2017; Baez-Lizarazo et al. 2018; Rahayu et al. 2020; Thondhlana et al. 2020).

Generally, the various plant-based products traded in traditional markets are products of some agroecosystem types and natural ecosystems in rural areas (Iskandar et al. 2020). In this respect, the traditional market system can build a reciprocal relationship between farmers and their local environment in producing various agricultural products collected from the local rural ecosystems, as well as traders and consumers with varying socio-cultural backgrounds. Various products originated from both agroecosystem types and local natural ecosystems in rural areas are the results of cultural dynamics occurring in the villages. These dynamics are influenced by diversity in the

environmental and biological resources in the village, thereby forming a bio-cultural system (Maffi 2014). In this system, Traditional Ecological Knowledge (TEK) and language are key concepts to describe some aspects of the inextricable links between cultural and biological diversity (Maffi 2014; Seele et al. 2019; Franco et al. 2020).

The variety of plant-based products traded in traditional markets reflects the culture of society, including communities living in Indonesia (Iskandar et al 2018; Sujarwo et al 2018; Ratnani et al. 2021). In other words, the market is influenced by the demand of buyers with different cultural backgrounds, as well as the supply of rural farmers. Therefore, traditional markets in Indonesia generally function as hallmarks of a particular community or culture of a society, showcasing the relationship between cultural and biological diversity (cf. Albuquerque et al. 2014).

Several studies have been conducted on the various plant species which generate edible foodstuffs and medicinal products traded in some traditional markets in Indonesia (Silalahi et al. 2015; Iskandar et al. 2018a; 2020; 2021). However, investigations on plant species that generate non-edible products, as well as their relationship with the biocultural system are rare. There are several reasons why Beringharjo, Yogyakarta and Pasar Baru, Balikpapan were chosen for this study. Firstly, because Beringharojo market is the largest traditional market in Yogyakarta. Secondly, the market is located in the middle of the city and not far from the Yogyakarta Palace. As a result, the local traders who sell various non-edible plants at the Beringharjo market are predominantly Javanese with Javanese culture (cf. Aliyah et al. 2016). Thirdly, the traditional market is visited by many buyers in the form of local residents, as well as domestic and foreign tourists. Thus, various types of commodities, such as non-edible plants, are influenced by the demand of buyers in the form of local residents and tourists. The effect of traded commodities, such as various non-edible plants, may be predominantly influenced by the demand of local residents and ethnic Javanese culture. Meanwhile, Pasar Baru Balikpapan was chosen as the research location with the following considerations. Firstly, the market is the largest traditional market and is located in the middle of the city of Balikpapan. Secondly, because the location of Pasar Baru is in the middle of the city, the market is crowded with traders and buyers in the form of local residents and immigrant traders with different cultural backgrounds. The traders of the Beringharjo were dominated by Javanese ethnic, whereas the traders of Pasar Baru had mixing of different ethnicities. It is widely accepted that traditional markets are a pool of Traditional Ecological Knowledge (TEK), and various plants traded in the traditional markets are influenced by the local culture of consumers and traders (Sujarwo et al. 2018). Traditional markets are normally located in the center of cities and perform not only the functions of markets but also regional economic, cultural, social functions, and special places for trading agricultural products of regional farmers (Park and Chung 2016). This may cause the various commodities traded in the market, such as non-edible plants to be influenced by the cultural background of the traders and buyers. In addition, the rural ecosystems where various non-edible plant commodities are produced in the Yogyakarta area and the Balikpapan area and surrounding areas are also different. Accordingly, various non-edible plant commodities traded in the both markets may be influenced by cultural and ecosystem diversity, which form a biocultural system (Maffi 2014).

This study aims to examine the (1) various non-edible plant species used to make products traded in traditional markets in two cities in Indonesia, namely the traditional market of Beringharjo, Yogyakarta and the Pasar Baru in Balikpapan, East Kalimantan; (2) functions of the products and part of the plant used to make the products, and (3) the market chain of the products. The selection of the markets on the two islands is to resemble regions with different cultural backgrounds.

MATERIALS AND METHODS

Study location

This research was conducted in two traditional markets in Indonesia, namely the traditional market of the Pasar Baru in Balikpapan, East Kalimantan (Figure 1 A), and the Beringharjo, Yogyakarta, Indonesia (1 B).

Beringharjo traditional market is located in the center of Yogyakarta, precisely on Jl. Ahmad Yani No. 1, southern end of Malioboro, close to the Vredeburg fort, Gedung Agung, Yogyakarta Cultural Park, Smart Park and Shopping Center (Iskandar et all. 2021). On the hand, the traditional market in Pasar Baru is located in Klandasan Ilir Village, 3 km to the center of Balikpapan City, East Kalimantan. Pasar Baru Balikpapan is managed by a private party, namely PT Hasta Kreasi Mandiri which act with the Balikpapan city government. Considering that the location of Beringharjo market is one of the tourist areas in Yogyakarta, this market is usually visited by various domestic and foreign tourists. In contrast, Pasar Baru Balikpapan is not visited by many tourists, rather the visitors are mainly local residents, hence, the atmosphere at the gate is not too crowded as shown in Figure 2.

The traditional market is different from a modern or supermarket in that it involves many traders with various sociocultural backgrounds. In the traditional market of Beringharjo and Pasar Baru, there were 5,533 and 409 traders, respectively (Table 1). As can be seen from Table 1 that Beringharjo Market had a bigger proportion of female traders than that Pasar Baru. The traders in Beringharjo were dominated by Javanese from the surrounding areas, including Yogyakarta, Magelang, Klaten, Temanggung, and Wonosobo. While the traders in Pasar Baru were a mixture of various ethnicities, including Javanese (Central Java, East Java), South Sulawesi (Bugis, Buton, Selayar, Makasar), West Sumatra (Minang), East Kalimantan (Melayu), and South Kalimantan (Melayu Banjar). The traders both in Beringharjo and Pasar Baru have been trading for a very long time, and usually, such occupation was inherited from their parents. Various commodities, including edible and non-edible plants are commonly traded in the two traditional markets. Thus, it can be

inferred that the traditional market serves as a showcase of various diversity of life in all of its manifestations, i.e. biological, cultural and linguistic, which are interrelated within a complex socio-ecological adaptive system (Franco et al. 2020).

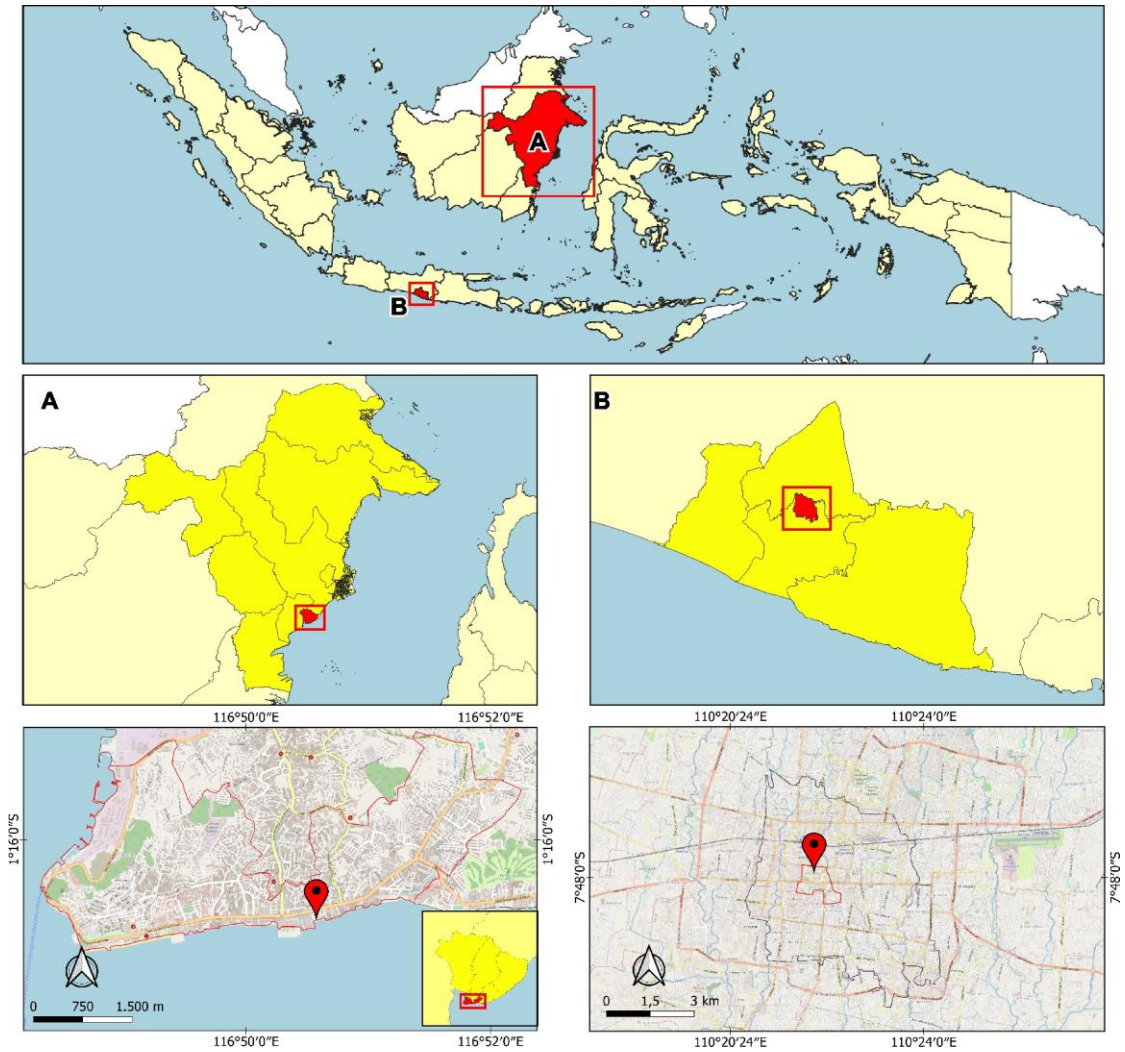

Figure 1. Study area (A) Pasar Baru market, Balikpapan, and (B) Beringharjo market, Yogyakarta, Indonesia

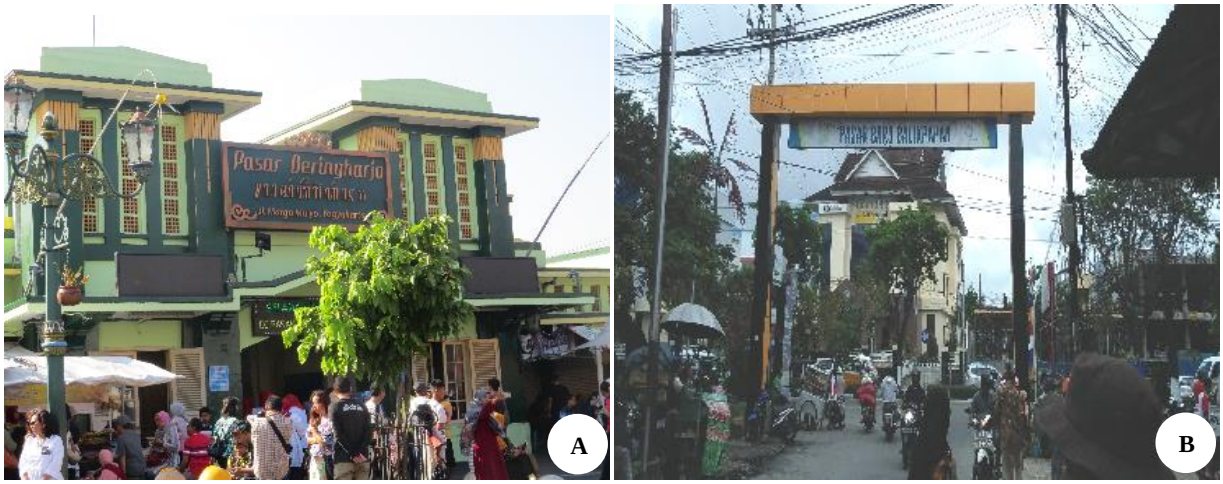

Figure 2. A. Entrance gate to Beringharjo traditional market, Yogyakarta and B. Entrance gate to Pasar Baru traditional market Balikpapan, East Kalimantan, Indonesia

Table 1. Sociocultural of traders of Beringharjo, Yogyakarta and Pasar Baru, Balikpapan, Indonesia

Sociocultural aspect	Traditional market	
	Beringharjo	**Pasar Baru**
Traders		
• Male traders	1,808 individuals	210 individuals
• Female traders	3,655 individuals	199 individuals
• Total traders	5,533 individuals	409 individuals
Trader origin	Dominant: Javanese (Yogyakarta, Magelang, Klaten, Temanggung, Wonosobo. Others: Sundanese (West Java), West Sumatra (Minang)	Mixed ethnics: Javanese (Central Java, East Java), South Sulawesi (Bugis, Buton, Selayar, Makasar), West Sumatra (Minang), East Kalimantan (Melayu), South Kalimantan (Melayu Banjar)
Experience of trading duration		
• Very long time (more than 10 years)	85 %	90 %
• Long time (3-5 years)	7.5 %	8 %
• Recently (1-2 years)	7.5 %	2 %
Traded commodities	High diversity of edible (food, medicinal plants) and non-edible commodities (material for cultural uses)	High diversity of edible and non-edible commodities (material for cultural uses)

Data collection

This study was conducted using a qualitative method with an ethnobotanical approach (Martin 1995; Cunningham 2001; Albuquerque et al. 2014). Ethnobotanical studies are used to explore local knowledge and people's perception of the uses of plants (Martin 1995). Subsequently, field data collection techniques were carried out by observation, surveys of products produced from non-edible plant species traded in traditional markets, and deep interviews with relevant informants.

As common in ethnobotanical studies, the first approach, namely seeking the consent of the authority and the traditional market communities, was implemented by meeting the staff at the Agency of Trade, Industry and Market of Beringharjo, Yogyakarta and Pasar Baru, Balikpapan to report and to get permission and approval. Moreover, the team also established rapport and sought the consent of the traditional market communities by explaining the aim of the study.

Observations were conducted by visiting the market repeatedly for a month in Beringharjo and Pasar Baru in March and August 2019, respectively. The visits were carried out in the morning until noon when the markets were busy. Observations were made on the condition of the market environment and the various activities of traders and visitors. The products from non-edible plant species traded in Yogyakarta and traditional markets were also surveyed with documentation of each species, including both the vernacular and the scientific name. When there was a species that could not be identified directly in the market, then a sample was taken to be identified further and more thoroughly in the plant taxonomy laboratory of the Biology Study Program Padjadjaran University. Furthermore, some books were also used for the identification process, including Flora of Java volumes I, II, III written by Backer and Bakkuizen van Den Brink (1963); Species of Ornamental Plants (Agromedia Editor 2008; Triwahyuni and Kadir 2011), Landscape Ornamental Plants (Lestari and Kencana 2015), and Useful Plants of Indonesia volume I, II, III by Heyne (1987).

Deep interviews were conducted to identify the vernacular names of non-edible plant species as materials of the market products, the parts and their uses, as well as the origin. Some informants were selected, namely the staff of the agency of trade, industry, and market of the province, as well as 3-5 traders from various non-edible plant commodities, such as handicraft/decoration, pilgrimage ceremonies at the cemetery, and betel chewing.

Data analysis

The vernacular and scientific names were analyzed using some literature from botanical books, while the similarity of plant species traded was assessed using the Sorensen Similarity Index (Mueller-Dumbois and Ellenberg 1974; Iskandar and Iskandar 2016) with the equation below:

$$ISS = \frac{2c}{a+b} \times 100\%$$,

Where:

ISS: Similarity Index of Sorensen

a: total number of non-edible plant species recorded in Beringharjo marketplace

b: total number of non-edible plant species recorded in Pasarbaru marketplace

c: number of non-edible plant species recorded in both marketplace

Sorensen's similarity index value ranges from 0-100%, the greater the index, the higher the species of non-edible plant species traded in the two traditional markets, and vice versa. Subsequently, socio-cultural data from interviews with informants, namely traders of products from non-edible plant species were analyzed by cross-checking, summarizing and synthesizing from different sources, comprising observation and semi-structured interviews (Newing et al. 2011). Cross-checking was carried out on data obtained from various informants as well as from the results of field observations. The cross-checked data were

summarized, synthesized, and narrated using descriptive analysis.

RESULTS AND DISCUSSION

Various commodities are commonly traded in the Beringharjo traditional market, including a variety of non-edible plants. Among the various non-edible plants, there were *rampe* flowers (*bunga rampe*), dry grasses, dried plants, and dried fruit plants for decoration materials and handicrafts. The *rampe* flower vendors are located on the third floor, while the sellers of dried grass, dried plants, and fruits are located on the second flower. The *rampe* flower traders are mainly women. Among them, there are those from outside the city of Yogyakarta. For example, there is a woman seller of *rampe* flowers from Boyolali, Central Java Regency. She obtained *rampe* flowers by buying from her relatives who owned gardens. In addition, she also buys various *rampe* flowers from village middlemen in some regions, such as roses (*Rosa hybrida*) from Boyolali and Magelang, Central Java, kananga (*Cananga odorata*) from Bantul, Yogyakarta and Magelang, Central Java, and kantil/champaka (*Magnolia champaca*) from Kaliurang, Yogyakarta.

Every morning, all the *rampe* flowers after being collected are brought to the Beringharjo market by motorbike. All these *rampe* flowers are usually sold in the passageways of the stalls on the third floor. During the late day, the remained *rampe* flowers that are not sold are usually brought back home to be resold the next day. In addition, some *rampe* remnants, particularly Kananga flowers (*R. hybrida*) are sold to regular buyer who has a flower refining place to be processed into *kananga* perfume. Generally, *rampe* demand usually increases on Thursday *wage* (a Javanese calendar), Friday *kliwon*. This is because these days are considered sacred days by Javanese culture, and some people usually perform traditional ceremonies.

Unlike *rampe* traders, some traders of dried plant handicraft materials usually sell their products in their kiosks and stalls on the third floor of Beringharjo market. They obtain various raw materials for dry plants from village middlemen. They sell merchandise of dry plants from morning to evening. Merchandise that is not sold out is usually stored in his stall and the next morning usually traded again.

Both Beringharjo and Pasar Baru are similar in that they both have some *rampe* traders. The women sellers of various *rampe* flowers in Pasar Baru usually sell the *rampe* flowers in kiosks or at roadside stalls. Usually, they sell various kinds of *rampe* flowers in the morning until noon. They sell at Pasar Baru every day, but some of them sell *rampe* flowers only on Thursday and Friday since the demand for *rampe* flowers increases on those days because of the traditional ritual on sowing flowers on the grave. The *rampe* flowers traded by women traders are commonly obtained from their homegardens. However, some types of flowers, such as bunga mawar (*R. hybrida*) and kacapiring (*Gardenia jasmoides*) which are not planted in their homegardens, are usually purchased from other local people who usually supply the flowers. In addition, to use as a ritual at graves, *kantil* flower (*M. champaca*), *kananga* (*C. odorata*) and *mawar* (*R. hybrida*) are also traditionally used for bathing. This is because, according to traditional beliefs, bathing with water mixed with flowers can cure spiritual ailments.

Based on the direct observation and documentation results, a total of 25 non-edible plant species (belonging to 16 families) were used to make products traded in Beringharjo and Pasar Baru, representing as described in Table 2.

Table 2 shows that the number of species of non-edible products traded in both traditional markets is different in which that 19 species representing 13 families are sold in Beringharjo while that in Pasar Baru, Balikpapan is 13 species representing 10 families. Various types of non-edible plants for handicraft materials, such as *Chrysopogon zizanioides*, *Lagerstroemia speciosa*, *Casuarina equsetifolia*, *Agathis alba*, *Anaphalis javanica*, *Panicum maximum*, *Pinus merkusii*, *Pennisetum purpureum*, and *Setaria pallide-fusca* are sold in the Beringhajo market because the demand for such plant species is high for handicraft materials, while in the Pasar Baru Balikpapan market there is no demand, so they are not widely traded in the Balikpapan market (Kasdi 2016; Sujarwo et al. 2018).

The traditional market in Beringharjo had higher species diversity than Pasar Baru, Balikpapan. This is because Beringharjo also functions as a tourist center which is usually visited by both domestic and foreign tourists. Consequently, various products made from species of non-edible plants are traded in this market to meets the needs of local communities. Several handicrafts which involve basic materials from non-edible plant species are also traded to the local communities as well as to domestic and foreign tourists who visit the market. Meanwhile, trading in the traditional market of Pasar Baru is to primarily meet the needs of local communities.

The species of non-edible plants used to make products traded in the Beringharjo market were very unique and cannot be found in Pasar Baru. Furthermore, the similarity index value of the species traded in both markets was low at 37.50% as seen in Table 3. This implies that the species of non-edible plant species traded have 37.50% similarity and 62.50% difference.

Table 3 shows that the non-edible plant species used to make products traded in the two markets are very different. Factors that influence these differences include the culture of the local community and the biophysical conditions or local ecosystems that produce commodities traded in traditional markets. Regarding the cultural influence of the local community, for example, some species of non-edible plants traded in the Beringharjo traditional market include raw materials to make various handicrafts for tourists. In addition, some species were also collected from natural ecosystems. For example, Edelweiss Lawu or Edelweiss Merapi (*Anaphalis javanica* (DC.) Sch.Bip.) flowers were taken by rural people from natural ecosystems in the Mount Merapi area.

Table 2. Various non-edible plants used to make products traded in the traditional markets of Beringharjo, Yogyakarta and Pasar Baru Balikpapan, East Kalimantan, Indonesia

Vernacular name	Scientific name	Family	Beringharjo (Yogyakarta)	Pasar Baru (Balikpapan)	Use	Plant part used
Akar wangi	*Chrysopogon zizanioides* (L.) Roberty	Poaceae	√	-	Handicraft material, decoration	Root
Asoka kuning	*Ixora javanica* (Blume) DC.	Rubiaceae	-	√	Pilgrimage ceremony	Flower
Asoka merah	*Ixora javanica* (Blume) DC.	Rubiaceae		√	Pilgrimage ceremony	Flower
Pring wuluh	*Schizostachyum blumii* (Ness)	Poaceae	√	-	Handicraft material	Stem
Bati cina	*Tabernaemontana* spp.	Apocynaceae	-	√	Pilgrimage ceremony	Flower
Bogenvil	*Bougainvillea spectabilis* Willd.	Nyctaginaceae	-	√	Pilgrimage ceremony	Flower
Buah rotan	*Calamus* sp.	Arecaceae	√	-	Handicraft material	Fruit
Bungur, wungu	*Lagerstroemia speciosa* (L.) Pers.	Lythraceae	√		Handicraft material	Fruit
Cemara, cemara laut	*Casuarina equsetifolia* L.	Casuarinaceae	√		Handicraft material	Fruit
Damar, kayu damar	*Agathis alba* (Lam.) Foxw.	Araucariaceae	√		Handicraft material	Fruit
Edelwis Lawu, edelwis Merapi	*Anaphalis javanica* (DC.) Sch.Bip.	Asteraceae	√		Handicraft material/ Decoration	Flower
Green grass, suket londa	*Panicum maximum* Jacq.	Poaceae	√		Handicraft material/ Decoration	Flower
Kaca piring, peciring, cepiring	*Gardenia jasminoides* J.Ellis	Rubiaceae	-	√	Pilgrimage ceremony at the cemetery	Flower
Kamboja	*Adenium obesum* (Forssk.) Roem. & Schult.	Apocynaceae	-	√	Pilgrimage ceremony at the cemetery	Flower
Kantil kuning, cempaka	*Magnolia champaca* (L.) Baill. ex Pierre	Magnoliaceae	√	√	Pilgrimage ceremony at the cemetery & Neutralization of negative magic power	Flower bud
Kantil putih	*Magnolia* × *alba* (DC.)	Magnoliaceae	√		Pilgrimage ceremony at the cemetery	Flower bud
Kenanga, kananga, kananga mangsa	*Cananga odorat*a (Lam.) Hook.f. & Thomson	Rosaceae	√	√	Pilgrimage ceremony at the cemetery & Neutralization of negative magic power	Flower bud
Mawar merah, mawar putih	*Rosa hybrida* E.H.L.Krause	Rosaceae	√	√	Pilgrimage ceremony at the cemetery & Neutralization of negative magic power	Flower bud
Melati, miati, menur	*Jasminum sambac* (L.) Aiton	Oleaceae	√	√	Pilgrimage ceremony at the cemetery	Flower
Pandan wangi	*Pandanus amaryllifolius* Roxb.	Pandanaceae	√	√	Pilgrimage ceremony at the cemetery	Leave
Pinang, gahat	*Areca catechu* L.	Arecaceae	-	√	Betel-chewing	Fruit
Pinus	*Pinus merkusii* Jungh. & de Vriese	Pinaceae	√		Handicraft material	Fruit
Rumput	*Pennisetum purpureum* cv Mott	Poaceae	√	-	Handicraft material	Flower
Setaria	*Setaria pallide-fusca* (Schumach) Stpaf & C.E. Hubb	Poaceae	√	-	Handicraft material	Flower
Sirih, suruh, leut	*Piper betle* L.	Piperaceae	√	√	Betel-chewing	Leave

Table 3. Similarity and dissimilarity index of various species of non-edible plants to make products traded in the traditional market of Beringharjo and Pasar Baru Balikpapan, Indonesia

Parameter analyzed	Value
Total number of non-edible plant species recorded in Beringharjo	19
Total number of non-edible plant species recorded in Pasar Baru	13
Number of non-edible plant species recorded in both Beringharjo and Pasar Baru	6
Similarity Index of non-edible plants in traditional market of Beringharjo and Pasar Baru	37.50
Disimilarity index non-edible plants in traditional market of Beringharjo and Pasar Baru	62.50

Ecologically, Edelweiss Lawu species grow on infertile soil, open, flat, sandy or rocky slopes, including the mountain rocks, especially in craters that are still active and dead. The distribution in Indonesia includes in Mount Merapi, Yogyakarta; Gunung Gede, West Java; Mount Tengger, East Java; Mount Kerinci and Mount Singgalang, Sumatra; the volcanic areas of Bali and the Indonesian archipelago (Lombok), as well as Mount Bonthain and Mount Lokon, Sulawesi (van Steenis 2010).

Given that these plants are in great demand by the local community and are found in the ecosystem at Mount Merapi, Yogyakarta, it is not surprising that this species is predominantly traded in the Beringharjo market. However, in Pasar Baru Balikpapan, Edelweiss Lawu species does not grow in the natural ecosystem in East Kalimantan and the local culture is also not accustomed to using the plant for decoration.

Although there were differences in the species of non-edible plants used to make commodities traded in the traditional markets of Beringharjo and Pasar Baru, a total of 6 species were traded in both markets as shown in Table 4. This is partly because the 6 species were culturally used by the local community of Yogyakarta and Balikpapan. Because there is a demand for non-edible types in these two markets. The implication is that many of these plant species are cultivated by residents, and are indirectly conserved by the people (Blancas et al. 2013; Iskandar et al. 2018b).

Uses and plant parts used

Parts of non-edible plants were traded for particular uses in both traditional markets at Beringharjo, Yogyakarta and Pasar Baru, Balikpapan as shown in Figure 3. Flowers became the most part to sell which were used for pilgrimage ceremonies.

Additionally, the fruits were the most predominantly used part after the flower. A variety of fruit shapes and long durability make them attractive and good material for making handicrafts and for decorations. Particularly, they were predominantly traded in the traditional market of Beringharjo.

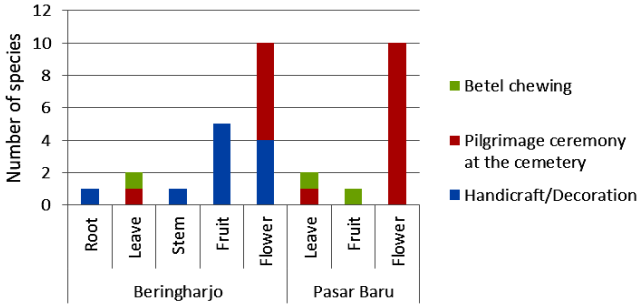

Figure 3. Various uses and parts of non-edible plants are traded in traditional markets of Beringharjo and Pasar Baru, Balikpapan, Indonesia

Table 4. Non-edible plant species used as products traded in both the traditional market of Beringharjo, Yogyakarta and Pasar Baru, Balikpapan, Indonesia

Vernacular name	Scientific name	Family
Melati	*Jasminum sambac* (L) Aiton	Oleaceae
Cempaka/kantil	*Magnolia champaca* (L.) Baill. ex Pierre	Magnoliaceae
Kenanga	*Cananga odorata* (Lam.) Hook.f. & Thomson	Magnoliaceae
Sirih, Suruh, Leut	*Piper betle* L.	Annonaceae
Pandan wangi	*Pandanus amaryllifolius* Roxb	Pandanaceae
Mawar	*Rosa hybrida*	Magnoliaceae

Figure 4. Various plants for pilgrimage ceremonies being sold in: A. Beringharjo: *Rosa hybrida, Cananga odorata, Gardenia jasmoides, Ixora javanica, Magnolia champaca, Jasminum sambac, Bougenvilea spectabilis,* and *Pandanus amaryllipolius*; B. Pasar Baru: *Adenium obesum, Rosa hybrida, Gardenia jasmoides, Pandanus amaryllipolius,* and *Cananga odorata*

Several flowers were traded in both markets because they are traditionally used as *rampe* (*bunga ranpe*) when people go on pilgrimage to graves and pray for those who have passed away. In the Javanese tradition, spreading flowers as "*Nyekar*" is part of a pilgrimage procession to graves or memorials (Muna 2016). Several species of flowers commonly used were red roses (*R. hybrida*), white roses (*R. hybrida),* jasmine (*Jasminum sambac*), kanthil (*M. champaca*), and kenanga (*C. odorata*) as shown in Figure 4.

These species of flowers *(rampe*) have certain philosophical symbols in the Javanese culture. For example, three species called *kembang telon*, namely kanthil (*M. champaca*), kenanga (*C. odorata*), and roses (*R. hybrida*) are used during a pilgrimage to the cemetery to hope for perfection and glory life, namely *sugih hidup*, *sugih banda*, *sugih ngelmu*, and *sugih kekuasaan* (Muna 2016). Generally, the use of various types of plants, including for various traditional rituals, is based on traditional ecological knowledge (TEK) and beliefs (Iskandar and Iskandar 2017; Iskandar 2018). Traditional people know the names of plant species, signs, and their uses from one generation to another, transmitted orally using the local language or mother tongue. TEK of ritual plants is also influenced by the beliefs of the population. Based on local beliefs, the three species of plants used in the ceremony are considered to bring good luck. In addition, traditionally these species of plants are believed to be suitable for decoration and are also believed to play a role in maintaining the harmony of human life with nature, as well as the balance between body and soul, with the support of ancestors or highly respected people who have died. Considering that there is a belief in Javanese as well as Sundanese ethnic communities that living in the natural world is not a free agent, but can be influenced by the power of the macrocosm. Therefore, people who have died and sacred places are considered to have power and are respected, and living in that nature must maintain harmony with their natural surroundings (Iskandar 2017; Rawat et al. 2019). So, based on the Javanese culture, various flowers can be considered as abstraction symbols, including rose, which resembles strength, courage, balancing life and admiration for those in power over life, while *kenanga*, which represents the earth as a place for human life, prosperity and simplicity (Lestari 2019). In addition, flowers of *triwarna* (i.e. *mawar*, *melati*, and *cempaka/kantil*) are commonly used for wedding ceremonies. Based on Javanese culture, these flowers can be considered a symbol of the hope that the bride will live happily ever after and keep the family's good name (Jazery and Susanto 2021) (Table 5).

The tradition of '*nyekar'* activities does not only apply in Yogyakarta, but also in Balikpapan. This is partly because, in Balikpapan City, East Kalimantan Province, there are various immigrants, especially ethnic Javanese from Java, and Bugis from Sulawesi, as well as others from areas such as Banjar, South Kalimantan. Therefore, the practice of sowing flowers on graves is mostly carried out by the people of Balikpapan city, because many ethnic Javanese immigrants practice the original tradition of their ancestors in Java. After mixing with Javanese ethnic traditions and local ethnicities, several people in Balikpapan now practice the habit of sowing flowers at graves.

The combination of the plant species used in the *'nyeka*r' ceremony varies depending on the place and the beliefs of the wearer. A florist at Beringharjo market, for example, presented a combination of red and white roses, jasmine, *kanthil*, as well as *kenanga* flowers for *'nyekar*'. Meanwhile, flower sellers at Pasar Baru Balikpapan, use a combination of red and white asoka flowers (*Ixora javanica*) and kamboja (*Adenium obesum*).

The demand for a species of flower plant for the traditional *'nyekar*' ceremony in the community can affect the supply or availability in the traditional markets. In addition, several species of flowers are used by the community as a counter-agent against disturbances related to spirituality. For example, a combination of flowers called "*kembang telon*" is believed to heal people who are affected by spiritual disorders. The three species of flowers are usually soaked in water and then used for bathing.

The need for '*nyekar*' flowers usually increases at certain times. In Beringharjo market, the demand increases during the "*Kemis Wage*" and "*Jumat Kliwon*" nights. The demand is also high during the month of *Ruwah,* before fasting and the Eid period (*Lebaran Idul Fitri*). In Pasar Baru, Balikpapan, the demand increases during fasting month (*bulan puasa*) and before Eid (*Idul Fitri*). Although the traditional markets of Beringharjo and the Pasar Baru are in different provinces, in the case of *'nyekar*' the use of plants has the same function.

Table 5. Several plant flowers that have cultural symbols and meaning

Scientific name	Vernacular name	Flower color	Symbol of color	Meaning
Rosa hybrida	Mawar	Red	Brave	A bold attitude because it is right
Jasminum sambac (L) Aiton	Melati	White	Holy	A clean and honest
Cananga odorata (Lam.) Hook.f. & Thomson	Kenanga	Yelowish green	Simple	Humanity
Rosa hybrida, *Jasminum sambac* (L) Aiton, and *Magnolia champaca* (L.) Baill. ex Pierre	Mawar, Melati, Cempaka/Kantil	Three color of mawar (red), melati (white), and cempaka/kantil (cream to yellow orange) that is called 'triwarna'.		The three flowers, mawar, melati, and cempaka contain the meaning of hope so that the bride and groom both speak sweetly, keep the good name of the family, and always be together in joy and sorrow.

Note: Adapted from Lestari (2019); Jazery and Susanto (2021)

Several species of non-edible plants traded in traditional markets were also used for betel nut chewing (*nyirih)* such as betel nut (*Areca catechu*), betel leaf (*Piper betle*), saga leaf (*Abrus precatorius*), gambier (*Uncarina gambir*), and other ingredients in the form of lime powder. The betel nut tradition is hereditary and is still practiced by the community, especially among the older generation, both men and women. Different materials for betel nut are commonly traded in various traditional markets in Indonesia (Dwinanto et al. 2019).

Various species of other non-edible plants commonly traded in the Beringharjo traditional market include materials for making handicrafts and for decoration. This is because some of these household crafts are usually made using basic materials of dried non-edible plant species in the form of roots, flowers, and fruits. For example, akar wangi (*Chrysopogon zizanioides*) was used as the basic material to make handicrafts widely traded in the Beringharjo traditional market. It is the basic material for making stuffed animals, such as horses and elephants, as presented in Figure 5. Decorative dolls such as horses and elephants, apart from functioning as decoration, are also used to repel insects. This is because the ingredients of *akar wangi* have a scent that can repel insects.

Other species of non-edible plants whose flowers were used for handicrafts include *rumput penistrum* (*Pennisetum* sp) and Bengal grass (*Panicum maximum).* The grass flowers are dried and colored to make them attractive as decorations as in Figure 6. Various parts of plants, including flowers, fruit, leaves, stalks and others, for various handicraft materials have the characteristics of having beautiful, attractive shapes and when dried, they are not damaged.

There were also flowers obtained from plants protected by law, namely the edelweiss (*A. javanica*). They were sold in the Beringharjo traditional market as decoration in the original form or colored to make them even more beautiful, as shown in Figure 7.

Figure 6. A. Roots of *Chrysopogon zizanioides* as raw material to make handicrafts, and B. various handicrafts in the form of stuffed animals traded in Beringharjo, Indonesia

Figure 6. *Panicum maximum* grasses are mainly used for decoration traded in Beringharjo traditional market, Indonesia

Figure 7. Flowers of *Anaphalis javanica,* which naturally grow in Merapi Mountain are commonly traded as decoration in Beringharjo market, Indonesia

Edelweiss is widely known as perennial flowers because they can last up to several months. They are often carried by mountain climbers when descending, making the population decrease. Consequently, mountaineers are forbidden to bring edelweiss flowers from the mountain area. By law in Indonesia, the plant is protected by PERMENLHK No. 106 of 2018 concerning protected plant and animal species (KLHK 2018).

Some products sold at the Beringharjo were made from the fruit such as rattan (*Calamus* spp), cemara (*Casuarina equsetifolia*), pinus (*Pinus merkusii*), bungur (*Lagerstroemia speciosa*), and damar (*Agathis alba*) as shown in Figure 8. The fruit parts of these plants have an attractive shape and are durable, making them suitable as craft materials. This is because the Beringharjo traditional market not only provides community needs but also functions as a tourist center. These various species which function as handicrafts and decorations, with some colors, such as brown, pink, blue, and green are not only found in the Beringharjo market, but also in Kota Baru, Balikpapapan.

Various types of handicrafts, in addition to having natural colors, are also colored with synthetic chemicals to make them more attractive, such as blue, red, and green. For instance, the rattan plant, with its original yellowish-brown color, is usually used as material for handicrafts (e.g. bracelets, wall hangings, dried flower bouquets, and gift decoration materials) since it is sturdy and easy to shape. Dried pine (*Pinus merkusii*) flowers, dried resin (*Agathis alba*) flowers, and dried bungur (*Lagerstroemia speciosa*) are commonly used as materials for artificial flower bouquets. In addition, dry grass, either naturally or synthetically colored, is commonly used for decoration materials, combined with other dried flowers for dried flower bouquets, while dried edelwiss (*A. javanica*) flowers are used as bouquets since it has long durability.

The trade chain of products made from non-edible plant species

The trading in the traditional markets of Beringharjo and Pasar Baru follows a trade chain. In this regard, the various products made from non-edible plant species that are produced by farmers as well as collected from rural ecosystems are sold to middlemen (suppliers) and then to traders. Finally, they are traded to consumers who visit the traditional market (Figure 9).

Figure 8. Fruits sold in Beringharjo, Yogyakarta, Indonesia for handicraft: A. Fruits of *Calamus* spp., B. Fruits of *Casuarina equsetifolia*, C. Various fruits are colored using synthetic color materials of brown, pink, blue, and green

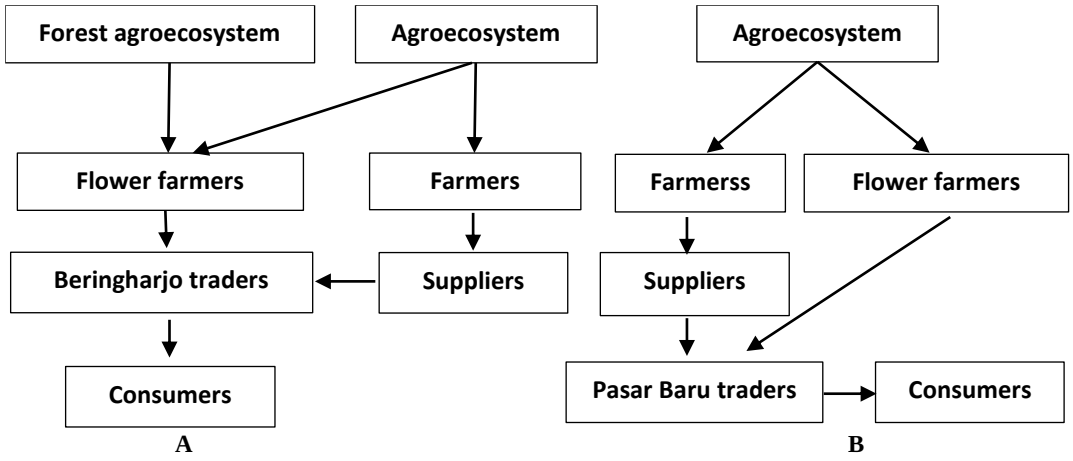

Figure 9. Market chain of commodities made from non-edible plants: (A) in Beringharjo and (B) Pasar Baru traditional markets, Indonesia

Another case of market chain in Beringharjo begins with traders that take various species of *rampe* flowers through suppliers or farmers in the village. Generally, the traders move across various rural areas of Yogyakarta. For example, the traders get roses (*R. hybrida*) by buying them from flower growers in various rural areas, such as Bandungan, Boyolali, and Magelang. Meanwhile, to get *kenanga* flowers (*C. odorata*), they buy them from rural farmers in the Bantul and Boyolali areas, while kanthil flowers (*M. champaca*) are specifically bought from farmers in Kaliurang, Boyolali, and Bantul. In contrast, handicraft traders usually obtain the material by ordering from a supplier (middlemen), then the supplier will provide and deliver the goods by buying from rural people who are ordinary collectors from various rural ecosystems, such as forests.

For the trade chain of non-edible plant species in the Pasar Baru, Balikpapan, the traders usually get their plant commodities directly from farmers in rural areas around the city. The farmers usually plant species of *rampe* flowers, such as jasmine (*J. sambac*), cempaka (*M. champaca*), and roses (*R. hybrida*) in their gardens.

Discussion

Based on the results, the majority of products made from non-edible plant species sold at Beringharjo and Pasar Baru markets originated in the agroecosystems of rural areas and were collected from forest ecosystems. Rural communities have been developing a strong relationship with various plant species, forming biocultural systems that have been jointly shaped by the biological and cultural dynamics of the people (Carlson and Maffi 2004). The existence of biodiversity has been predominantly determined by local or traditional ecological knowledge, beliefs, and practices of rural communities. In terms of beliefs, for instance, based on Balinese Hinduism, many flowers have an important role in religious ceremonies (Sujarwo et al. 2020). Like in Bali, other local communities around the world have a tradition in socio-cultural and religious aspects, including beliefs, folk religions, closely associated with health practices, rituals, festivals, ceremonies and other religious activities (Sapkota 2013; Husti and Canto 2015; Mir et al. 2018; Quiroz and van Andel 2018; Vardhana 2018; Sutrisno et al. 2020). Based on the beliefs, traditional ceremonies of the communities as part of human cultural products at a practical level cannot be separated from the use of natural resources, mainly plants. The belief system and various traditional ceremonies can be considered adaptive functions for human societies and their members. In many instances, these adaptive functions help the conservation of biodiversity, especially plant species (Pandey and Pandey 2016; Mur et al 2018). Since various plants have been traditionally used by the communities and demanded by many people for religious purposes, those plants can be conserved in both natural ecosystems and agroecosystem by rural communities.

Various species of plants from the village sold to suppliers and widely traded in the traditional markets are influenced by the interests of consumers with different backgrounds. For example, there were six species of plants in which their flowers were traded, namely *J. sambac*, *M. champaca*, *C. odorata*, *P, betle, Pandanus amaryllifolius*, and *R. hybrida*, which are traded in the Beringharjo and Pasar Baru markets because they are needed by consumers for cultural purposes, such as pilgrimage ceremonies at the cemetery in Yogyakarta and Balikpapan. These species of plants were grown and cultivated by rural communities in some types of agro-ecosystems.

Meanwhile, *A. javanica* was only traded in the Beringharjo market because it is only naturally found in mountain areas, such as Mount Merapi, Yogyakarta, and is often used as decorative flowers. This plant species was not traded in Pasar Baru because it was rarely used and was also not found in Balikpapan or Kalimantan more broadly.

Some species used for their flower and ceremonial materials, such as *C. odorata*, *A. catechu*, *M. champaca*, and *P. betel* are widely traded in the traditional market of Tabanan Regency, Bali, because they are needed for ceremonies (Sujarwo et al. 2018). Another example is the Tenganan Pegringsingan people utilize a large number of plant species amounting to 130 for *ngusamba* ceremonies. The plant's largest family is Poaceae with 16 species, while the most widely used part is the leaf, and the highest portion is obtained by purchasing from the traditional markets (Ratnani et al. 2021).

The non-edible plant species used to make products traded in the traditional markets of Beringharjo, Yogyakarta and Pasar Baru, Balikpapan reflects the relationship between human culture and nature, as well as the connections between cultural and biological diversity which is encapsulated in the term 'biocultural diversity system'. In other words, traditional ecological knowledge (TEK) as well as linguistic and biocultural diversity are key concepts in describing some of the aspects of the inextricable links between cultural and biological diversity (Maffi 2014; Geng et al. 2017; Sujarwo et al. 2019; Seele et al. 2019). The bio-cultural approach has become pivotal in the conservation of this diversity in the analysis of cultural and biological conditions, as well as the study of socio-ecological systems and TEK in traditional markets (Arellanes et al. 2013; Silalahi et al. 2015; Sulaimi and Sabran 2018; Sujarwo et al. 2019; Alfian et al. 2020; Franco et al. 2020; Iskandar et al. 2020). Moreover, biodiversity trading and TEK play an important role in achieving goals associated with Sustainable Development Goals, including poverty, health, responsible consumption, and production, as well as conservation of the environment and biodiversity (UNEP 2008; EMG 2020; Kumar et al. 2021).

Based on the results, it can be concluded that there were 25 species belonging to 16 families of non-edible plants traded in the two markets studied, in which 19 species representing 13 families and 13 species representing 10 families were traded in Beringharjo and Pasar Baru markets, respectively. The various parts traded had varying uses, including pilgrimage ceremonies at the cemetery, handicraft/decoration, and betel chewing. In addition, the market chain consisted of rural farmers, middlemen or suppliers, and traders. Basically, the various non-edible

plant species used to make products traded in both markets reflect the relationship between human culture and nature, as well as the connections between cultural and biological diversity, which is encapsulated in the term 'biocultural diversity systems'. The local knowledge, diversity, and utilization of non-edible plants traded in the Beringharjo, Yogyakarta and Pasar Baru, Balikpapan traditional market have an important role in the conservation efforts of plant biodiversity in the rural ecosystem.

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