

The diversity of edible plants traded in Ir. Soekarno Market, a traditional market in Sukoharjo District, Indonesia

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Abstract. *Deanova AK, Pristiawati CM, Aprilia D, Solikah I, Nurcahyati M, Liza N, Partasasmita R, Setyawan AD. 2021. Title. Biodiversitas 22: 4095-4105.* Market is one of the most important economic sectors in a country. One type of market is a traditional market that is synonymous with squalid, overcrowded and slum conditions. However, traditional markets provide essential commodities that are relatively cheaper and fresher than modern markets. The purpose of this research was to record the diversity of species and varieties of edible plants traded in Ir. Soekarno Market, a traditional market in Sukoharjo District. Plant commodities observed were vegetables, spices, fruits, and staples sold by the sellers in this market. The method used in this research was qualitative based on the ethnobotany approach. Meanwhile, to collect primary data, several field techniques were used, namely direct observation such as market commodity surveys, trader observations, and trader interviews. The direct survey results showed that the edible plant commodities consisted of 105 plant species representing 28 families. The variations found included 9 types of rice, 4 types of onions, 7 types of bananas, and 9 types of beans. The decline in the number of traded commodities and the lack of visitors was due to the increase in COVID-19 cases in Sukoharjo and disputes between traders and local government. Thus until recently, Ir. Soekarno Market, which was originally the main market full of visitors, became a market that was empty of visitors and traders.

Keywords: Biodiversity conservation, food diversification, food security

INTRODUCTION

Economy is the most important sector in a country and can also be a reference for making decisions. One of the important economic sectors is the market (Aminursita and Abdullah 2018). A market is a place where there are transactions between buyers and sellers to exchange goods and services due to demand and supply (Indrawati and Yovita 2014). The market mechanism brings together the two parties to make transactions both in the form of services and goods in the form of production and price determination (Aliyah 2017).

The market is divided into two types, namely traditional and modern markets. Modern markets sell goods at fixed prices and with self-service systems, for example, supermarkets and malls (Arianty 2013). Meanwhile, a traditional market is a place that brings together buyers and sellers in which direct transactions and bargaining occurs (Malano 2011; Syarifuddin 2018). Traditional markets are usually synonymous with squalid, crowded, slum conditions, and manipulation by traders (Arianty 2013). Without revitalization and improvement, the traditional market might experience a declining number of visitors,

which leads to shifting consumer preference to the modern one, such as supermarket and online shopping (Jeong and Ban 2020; Septiari and Kusuma 2016). This worrisome fact can cause depletion of traditional markets in the future, though many people depend much on it such as farmers that sell their products only to local resellers (Sahban and Perwira 2018; Susilowati 2014).

However, current presence of modern markets is more desirable than traditional markets because modern markets provide convenience, so customers tend to shop there and are reluctant to shop in traditional markets (Rusham 2016). However, traditional markets have more advantages than modern markets, such as direct transactions and bargaining, relatively affordable prices, goods sold completely, and food that does not contain preservatives (Susanto 2018). In addition, the sellers in the traditional market remember the customer's name, resulting in visitors' satisfaction, which makes them return to the traditional market in the future (Rahadi 2011; Suhud et al. 2019). Interactions within local markets can improve relationships between people and neighborhoods and strengthen the sense of belonging in a community (Agboola et al. 2018). These emotional bindings can be found more in local markets than in

modern ones that use self-service approach (Lima-Filho et al. 2009).

Diversity and availability of goods in traditional markets are high (Ela et al. 2016), in the forms of dry food, wet food products, and industrial products. In traditional markets, there are also agricultural commodities such as staple food, including rice (Yurlisa et al. 2017). Traditional markets have various local potentials that are used by residents to market agricultural products, namely vegetables and plantation crops (Kharisma 2014). Traditional markets usually promote fresher vegetable commodities as they are supplied directly from local farmers. However, the modern ways are more effective and efficient in distributing vegetables to consumers than the traditional methods (Cadilhon et al. 2006).

One of the traditional markets in Indonesia is Ir. Soekarno Market, located in Sukoharjo District, Central Java Province, Indonesia. This study aimed to determine the diversity of plant species and their variations traded in Ir. Soekarno Market.

MATERIALS AND METHODS

Study locations

This research was conducted in Ir. Soekarno Market, a traditional market, situated in the capital town of Sukoharjo, Sukoharjo District, Central Java, Indonesia (Figures 1 and 2) from November to December 2020 in the COVID-19 pandemic period where community activities are limited. This market is located in Jendral Sudirman Street. It is approximately 12.3 km south of Surakarta city center and quite reachable using private and public transportation, including city buses, and local minibusses (*angkot*). Ir. Soekarno Market opens on the weekdays from Monday to Friday between 01.00 am to 17.00 pm, divided into two 2 shifts. The morning market opens from 01.00 am to 07.00 am and the afternoon market from 08.00 am to 17.00 pm (Majiid et al. 2020). Various plants are traded in this market (Figure 3).



Figure 1. Research location situated in the Ir. Soekarno Market, Sukoharjo District, Central Java Province, Indonesia. Note: 1. The market, 2. District office, 3. Public plaza (*alun-alun*), 4. Great masjid (*Masjid Agung*), 5. Train station, 6. Bus terminal, 7. Industrial area. The rest area is dominated by housing and *sawahs* (rice fields).



Figure 2. The Ir. Soekarno Market Building, Sukoharjo District, Central Java Province, Indonesia. A. Front view, B. Back view, C. Side view, D. Inside view

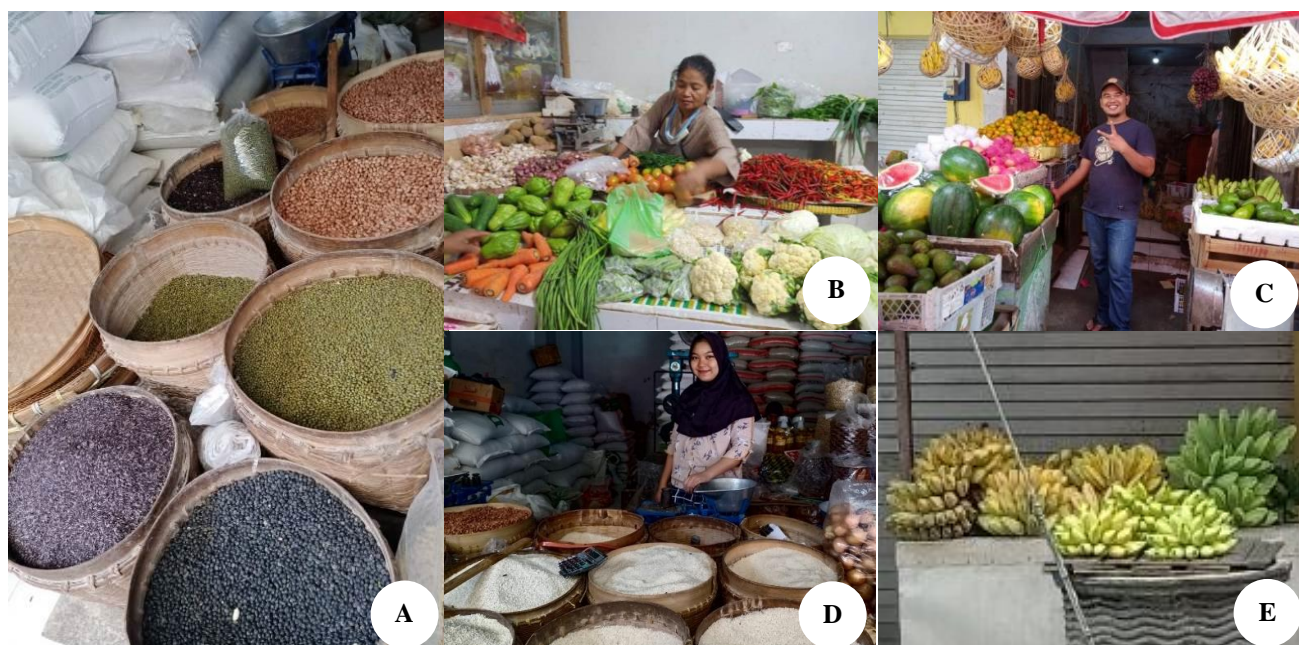


Figure 3. Plants commodities traded in Ir. Soekarno Market, Sukoharjo, Indonesia. A. Various legumes, B. Various vegetables, C. Various fruits, D. Rice varieties, E. Banana varieties

Ir. Soekarno Market is the largest traditional market in Sukoharjo District with a total area of approximately 6,353.44 m². The area of this traditional market consists of 400 stalls divided into two areas, namely the inner and outer areas. However, many kiosks have been forced to close due to the Covid-19 pandemic. The standard size of the kiosk in this market is about 2x3 m. The outside is used as a parking area for the customers and traders. This market is also equipped with public facilities, such as a vast parking site for traders and visitors, restrooms, and security posts (Majiid et al. 2020; Ar Rosyidi et al. 2016).

Mostly, sellers have their own kiosk and place the commodities on a table. This market provides various daily needs, such as foods (vegetables, spices, fish, meat, market snacks, traditional drinks (*jamu*), household appliances, and clothes. The food traders often bring a stove and other cooking utensils to process the customer's orders on-site. However, the rest of sellers tend to trade their products outside the kiosks provided, such as on pedestrian sites. The accessibility is the main reason why they refuse to sell in kiosks as their current sites are more reachable for visitors (Aprilianawati et al. 2018). This is also due to revitalization of Ir. Soekarno Market in 2014 caused conflict between traders and the authorities. Aprilianawati (2018) mentioned in her study based on data from the Department of Trade of Sukoharjo District, that there were more than 900 traders who rented the kiosks before revitalization, but the number decreased to only about 600 stalls after the revitalization.

Research procedure

This research used a qualitative descriptive method, where the data were collected in the form of observation tables and pictures with an ethnobotany approach (Iskandar

et al. 2018). Observation, interviews, and documentation were conducted to obtain primary data, namely food commodities that are widely traded, and variations in edible species that are traded in the market. In-depth interviews were done with 30 respondents chosen randomly, consisting of traders (24), consumers (4), and market management (2).

Data analysis

The primary data were classified based on its family, edible portion, and commodity categories, including carbohydrate staple foods including potatoes, vegetables, fruits and spices, and then analyzed descriptively. Plant species were identified using a variety of online source (<http://www.plantsoftheworldonline.org/>), books (Backer and Bakhuizen van den Brink 1963, 1965, 1968) and botanical standards (Verheij and Coronel 1991; Lemmens et al. 1991, 2003; Siemonsma and Piluek 1991; Grubben and Partohardjono 1996; de Guzman and Siemonsma 1999; de Padua et al. 1999; van der Vossen and Umali 2001; van Valkenburg and Bunyapraphatsara 2002). In addition, reference studies were also carried out from field observations through references to journals, books, proceedings, and others to support the data needed and refer to research conducted by (Iskandar et al. 2018).

RESULTS AND DISCUSSION

History of Ir. Soekarno Market

Ir. Soekarno Market in Sukoharjo is the largest traditional markets in Sukoharjo District. This district was originally part of Kawedanan Larangan, and then in 1874 it was turned to Sukoharjo District by Sunan Pakubuwono

IX, king of Surakarta, a kingdom under Nederland Indies influence. According to history, this district is experiencing continuous development. With population growth and over time, there have been protection efforts by the local government to increase the competitiveness of traditional markets. One of the efforts made was market revitalization. For that reason, the cornerstone for rebuilding was laid on June 8, 2012. This market was previously named Sukoharjo Market, then, the name turned into Ir. Soekarno Market after revitalization (Ar Rosyidi et al. 2016).

This market is called Ir. Soekarno Market to appreciate the struggle of Indonesian hero, i.e., the Indonesian independence proclaimer (Soekarno) and to continue Mr. Soekarno’s ambition for community welfare and make Indonesia an independent nation. The market improvement was carried out to provide extended space for trader kiosks 2x3 meters square in size with approximately 400 stalls, spread in two floors of the market. To increase the competitiveness of traditional markets in this developing community, the commodities sold in this market have been increased and varied goods selling, ranging from vegetables, spices, fish, meat, local snacks (*jajan pasar*), traditional drinks, groceries and household tools such as electronics, as well as services such as bank, barber and beauty salon, restaurants, etc. (Majiid et al. 2020).

This revitalization of this market was done in order to improve the service quality. The considerable improvements such as adding the number of officers, improving the public facilities, and improving the cleanliness of the market have been conducted to attract more customers (Ar Rosyidi et al. 2016).

Species diversity and variation

There were 105 species or its varieties of plants from 28 families traded in Ir. Soekarno Market, divided into several commodities. Most plants traded belong to the families Fabaceae, Poaceae, Solanaceae and Zingiberaceae, while Amaranthaceae, Asteraceae, Bromeliaceae, Cactaceae, Caricaceae, Moraceae, Myristicaceae, Pandanaceae, Vitaceae made up the least proportion, only represented by one species each (Table 1, Figure 3). These commodities were then divided into four categories: vegetables, fruits, herb and spices, and staple foods (Figure 4).

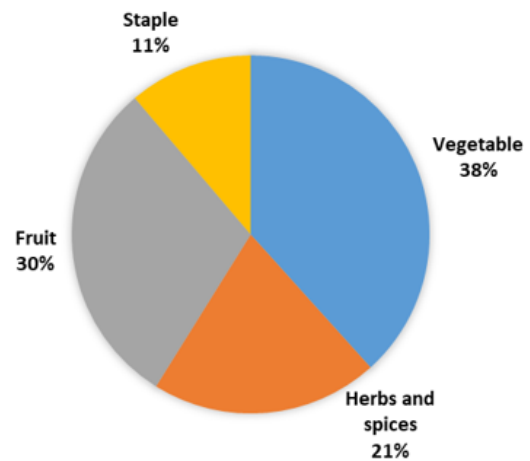


Figure 4. Categories of food plants traded in Ir. Soekarno Market, Sukoharjo, Indonesia

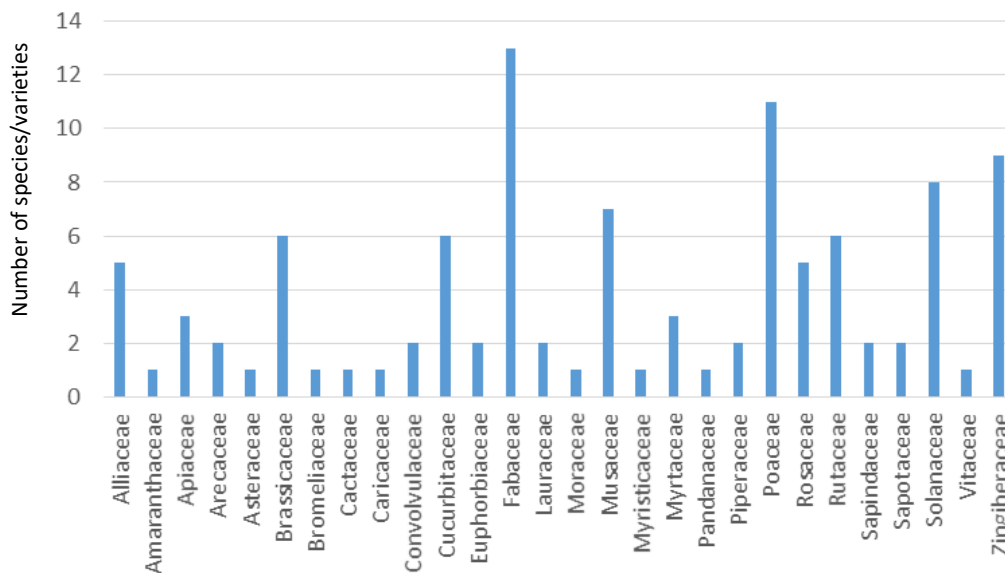


Figure 3. Family groups of food plants traded in Ir. Soekarno Market, Sukoharjo, Indonesia

Table 1. List of food plant commodities that are widely traded in Ir. Soekarno Market, Sukoharjo, Indonesia

Common name	Local name	Family	Scientific name	Category	The part used
Onion	Bawang bombay	Alliaceae	<i>Allium cepa</i> L. var. <i>cepa</i> L.	Vegetable	Bulbs
Shallot	Bawang merah	Alliaceae	<i>Allium cepa</i> var. <i>aggregatum</i> G.Don	Vegetable	Bulbs
Garlic	Bawang putih	Alliaceae	<i>Allium sativum</i> L.	Vegetable	Bulbs
Leek	Bawang prei	Alliaceae	<i>Allium ampeloprasum</i> L.	Vegetable	Leaf
Spring onion	Bawang daun	Alliaceae	<i>Allium fistulosum</i> L.	Vegetable	Leaf
Spinach	Bayam	Amaranthaceae	<i>Amaranthus hybridus</i> L.	Vegetable	Leaf
Celery leaves	Seledri	Apiaceae	<i>Apium graveolens</i> L.	Vegetable	Leaf
Coriander	Ketumbar	Apiaceae	<i>Coriandrum sativum</i> L.	Herbs-spices	Fruit
Carrot	Wortel	Apiaceae	<i>Daucus carota</i> L.	Vegetable	Tubers
Snakefruit	Salak	Arecaceae	<i>Salacca zalacca</i> (Gaertn.) Voss	Fruit	Fruit
Coconut	Kelapa	Arecaceae	<i>Cocos nucifera</i> L.	Fruit	Fruit
Wild cosmos	Kenikir	Asteraceae	<i>Cosmos caudatus</i> Kunth	Vegetable	Leaf
Broccoli	Brokoli	Brassicaceae	<i>Brassica oleracea</i> var. <i>italic</i> Plenck	Vegetable	Leaf
Cauliflower	Kembang kol	Brassicaceae	<i>Brassica oleracea</i> var. <i>botrytis</i> L.	Vegetable	Leaf
Cabbage	Kubis	Brassicaceae	<i>Brassica oleracea</i> var. <i>capitata</i> L.	Vegetable	Leaf
Mustard	Sawi	Brassicaceae	<i>Brassica juncea</i> (L.) Czern	Vegetable	Leaf
Lettuce	Selada	Brassicaceae	<i>Lactuca sativa</i> L.	Vegetable	Leaf
Kale	Kale	Brassicaceae	<i>Brassica oleracea</i> var. <i>sabellica</i> L.	Vegetable	Leaf
Pineapple	Nanas	Bromeliaceae	<i>Ananas comosus</i> (L.) Merr.	Fruit	Fruit
Dragon fruit	Buah naga	Cactaceae	<i>Hylocereus costaricensis</i> (F.A.C.Weber) Britton & Rose	Fruit	Fruit
Papaya	Pepaya	Caricaceae	<i>Carica papaya</i> L.	Fruit	Fruit
Sweet potato	Ubi jalar	Convolvulaceae	<i>Ipomoea batatas</i> (L.) Lam.	Staple	Tubers
Water spinach	Kangkung	Convolvulaceae	<i>Ipomoea aquatica</i> Forssk	Vegetable	Leaf
Pumpkin	Labu	Cucurbitaceae	<i>Cucurbita maxima</i> Duchesne	Vegetable	Fruit
Chayote	Labu siam	Cucurbitaceae	<i>Sechium edule</i> (Jacq.) Sw.	Vegetable	Fruit
Melon	Melon	Cucurbitaceae	<i>Cucumis melo</i> L.	Fruit	Fruit
Cucumber	Mentimun	Cucurbitaceae	<i>Cucumis sativus</i> L.	Vegetable	Fruit
Bitter melon	Pare	Cucurbitaceae	<i>Momordica charantia</i> L.	Vegetable	Fruit
Watermelon	Semangka	Cucurbitaceae	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Fruit	Fruit
Candlenut	Kemiri	Euphorbiaceae	<i>Aleurites moluccanus</i> (L.) Wild.	Herbs-spices	Fruit
Cassava	Singkong	Euphorbiaceae	<i>Manihot esculenta</i> Crantz	Staple	Tubers
Bean	Buncis	Fabaceae	<i>Phaseolus vulgaris</i> L.	Vegetable	Leaf
Jengkol	Jengkol	Fabaceae	<i>Archidendron pauciflorum</i> (Benth) I.C.Nielsen	Vegetable	Fruit
Mungbean	Kacang hijau	Fabaceae	<i>Vigna radiata</i> (L.) R.Wilczek	Vegetable	Fruit
Pea	Kacang kapri	Fabaceae	<i>Pisum sativum</i> L.	Vegetable	Fruit
Pea	Kacang ercis	Fabaceae	<i>Pisum sativum</i> L.	Vegetable	Fruit
Soya bean	Kacang kedelai	Fabaceae	<i>Glycine max</i> L. Merr	Vegetable	Fruit
Edamame	Edamame	Fabaceae	<i>Glycine max</i> L. Merr	Vegetable	Fruit
Cashew nut	Jambu monyet	Fabaceae	<i>Anacardium occidentale</i> L.	Vegetable	Fruit
Long bean	Kacang panjang	Fabaceae	<i>Vigna unguiculata</i> (L.) Walp.	Vegetable	Fruit
Peanut	Kacang tanah	Fabaceae	<i>Arachis hypogaea</i> L.	Vegetables, spices	Seed
Sappan wood	Secang	Fabaceae	<i>Caesalpinia sappan</i> L.	Herbs-spices	Bark
Sprouts	Kecambah	Fabaceae	Not identified	Vegetable	Bark
Stink bean	Petai	Fabaceae	<i>Parkia speciosa</i> Hassk.	Vegetable	Fruit
Avocado	Alpukat	Lauraceae	<i>Persea americana</i> Mill.	Fruit	Fruit
Cinnamon	Kayu manis	Lauraceae	<i>Cinnamomum verum</i> J.Presl	Herbs-spices	Bark
Jackfruit	Nangka	Moraceae	<i>Artocarpus heterophyllus</i> Lam.	Fruit	Fruit
Cavendish	Pisang ambon	Musaceae	<i>Musa X sapientum</i> L.	Fruit	Fruit
Kapas banana	Pisang kapas	Musaceae	<i>Musa X paradisiaca</i> L.	Fruit	Fruit
Kepok banana	Pisang kepok	Musaceae	<i>Musa acuminata X balbisiana</i> L.	Fruit	Fruit
Mas banana	Pisang mas	Musaceae	<i>Musa X paradisiaca</i> L.	Fruit	Fruit
Plantain	Pisang raja	Musaceae	<i>Musa X paradisiaca</i> L.	Fruit	Fruit
Susu banana	Pisang susu	Musaceae	<i>Musa acuminata "lady finger"</i>	Fruit	Fruit
Uli banana	Pisang uli	Musaceae	<i>Musa X paradisiaca</i> L.	Fruit	Fruit
Nutmeg	Pala	Myristicaceae	<i>Myristica fragrans</i> Houtt.	Herbs-spices	Seed
Clove	Cengkeh	Myrtaceae	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Herbs-spices	Fruit
Guava	Jambu biji	Myrtaceae	<i>Psidium guajava</i> L.	Fruit	Fruit
Bay leaf	Salam	Myrtaceae	<i>Syzygium polyanthum</i> (Wight) Walp.	Herbs-spices	Leaf
Pandanus	Pandan wangi	Pandanaceae	<i>Pandanus amaryllifolius</i> Roxb.	Herbs-spices	Leaf
Pepper	Lada	Piperaceae	<i>Piper nigrum</i> L.	Herbs-spices	Seed

Betel	Sirih	Piperaceae	<i>Piper betle</i> L.	Herbs-spices	Leaf
Lemongrass	Serai	Poaceae	<i>Cymbopogon citratus</i> (DC.) Stapf	Herbs-spices	Leaf
Rice	Burung naga	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	C4	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Beras ketan	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Ketan putih	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Menthik wangi	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Beras merah	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Naga Mas	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Pandan wangi	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Rice	Super Premium RMI	Poaceae	<i>Oryza sativa</i> L.	Staple	Seed
Corn	Jagung	Poaceae	<i>Zea mays</i> L.	Staple, vegetables	Fruit
Apple	Apel	Rosaceae	<i>Pyrus malus</i> L.	Fruit	Fruit
Red apple	Apel merah	Rosaceae	<i>Malus domestica</i> Borkh.	Fruit	Fruit
Stayman apple	Apel Stayman	Rosaceae	<i>Malus domestica</i> Borkh.	Fruit	Fruit
Pear	Pir	Rosaceae	<i>Pyrus</i> sp.	Fruit	Fruit
Strawberry	Strowberi	Rosaceae	<i>Fragaria ananassa</i> (Duchesne ex Weston) Duchesne ex Rozier	Fruit	Fruit
Sweet orange	Jeruk manis	Rutaceae	<i>Citrus sinensis</i> (L.) Osbeck	Fruit	Fruit
Pummelo	Pamelo	Rutaceae	<i>Citrus maxima</i> (Burm.) Merr.	Fruit	Fruit
Tangerine	Jeruk keprok	Rutaceae	<i>Citrus reticulata</i> Blanco	Fruit	Fruit
Santang orange	Jeruk santang	Rutaceae	<i>Citrus</i> sp.	Fruit	Fruit
Key lime	Jeruk nipis	Rutaceae	<i>Citrus medica</i> f. <i>aurantifolia</i> (Christm.) M.Hiroe	Fruit	Fruit
Kaffir lime	Jeruk purut	Rutaceae	<i>Citrus hystrix</i> DC.	Herbs-spices	Leaf
Longan	Kelengkeng	Sapindaceae	<i>Dimocarpus longan</i> Lour.	Fruit	Fruit
Rambutan	Rambutan	Sapindaceae	<i>Nephelium lappaceum</i> L.	Fruit	Fruit
Manilkara	Sawo kecil	Sapotaceae	<i>Manilkara kauki</i> (L.) Dubard	Fruit	Fruit
Manilkara	Sawo duren	Sapotaceae	<i>Chrysopillum cainito</i> L.	Fruit	Fruit
Chili	Cabe	Solanaceae	<i>Capsicum annuum</i> L.	Vegetable	Fruit
Red chilli	Cabe kriting merah	Solanaceae	<i>Capsicum annuum</i> L.	Vegetable	Fruit
Green chilli	Cabe kriting hijau	Solanaceae	<i>Capsicum annuum</i> L.	Vegetable	Fruit
Paprika	Paprika	Solanaceae	<i>Capsicum annuum</i> L. var. <i>grossum</i>	Vegetable	Fruit
Potato	Kentang	Solanaceae	<i>Solanum tuberosum</i> L.	Vegetable	Tubers
Green eggplant	Terong hijau	Solanaceae	<i>Solanum melongena</i> L.	Vegetable	Fruit
Purple eggplant	Terong ungu	Solanaceae	<i>Solanum melongena</i> L.	Vegetable	Fruit
Tomato	Tomat	Solanaceae	<i>Solanum lycopersicum</i> L.	Vegetable	Fruit
Red grape	Anggur merah	Vitaceae	<i>Vitis vinifera</i> L.	Fruit	Fruit
Ginger	Jahe	Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Herbs-spices	Rhizome
Red ginger	Jahe merah	Zingiberaceae	<i>Zingiber officinale</i> var. <i>rubrum</i>	Herbs-spices	Rhizome
Cardamom	Kapulaga	Zingiberaceae	<i>Amomum compactum</i> Sol. ex Maton	Herbs-spices	Seed
Galangal	Lengkuas	Zingiberaceae	<i>Alpinia galanga</i> L. Willd	Herbs-spices	Rhizome
Aromatic ginger	Kencur	Zingiberaceae	<i>Kaempferia galanga</i> L.	Herbs-spices	Rhizome
Turmeric	Kunir	Zingiberaceae	<i>Curcuma domestica</i> Valetton	Herbs-spices	Rhizome
Curcuma	Temu lawak	Zingiberaceae	<i>Curcuma zanthorrhiza</i> Roxb.	Herbs-spices	Rhizome
Pink and blue ginger	Temu ireng	Zingiberaceae	<i>Curcuma aeruginosa</i> Roxb.	Herbs-spices	Rhizome
White ginger	Temu putih	Zingiberaceae	<i>Curcuma zedoaria</i> (Christm.) Roscoe	Herbs-spices	Rhizome

Herbs and spices

Fabaceae. The most commonly traded plant was from the family Fabaceae, consisting of 13 species. Other studies in Indonesia also showed that Fabaceae was the most sold vegetable in vegetable markets in Bengkulu (Wiryo and Nurliana 2019) and Yogyakarta (Nurliana and Wiryo 2021). Likewise, two studies abroad also reported that Fabaceae was the most frequently sold family in the herbal market in Pakistan (Zahoor et al. 2021) and in the local market in Tanzania (Hilonga et al. 2019). Both studies showed the most popular usage of Fabaceae was to treat human ailments including rheumatism and urinary problems (Uzun and Koca 2020). In Ir Soekarno Market, Fabaceae was mostly sold as vegetables and the rest as herbs, 12 species, and spices, 1 species. *Caesalpinia*

sappan was the only spices category from Fabaceae sold in Ir. Soekarno Market, which was used, in combination with other spices, as a traditional drink beverage from Yogyakarta, called 'wedang uwuh' (Pudjowati et al. 2021) and with sugar cube as traditional spicy drink from Sasak tribe, Lombok Island, named *Ai'sepang* (Sukenti et al. 2019).

Zingiberaceae. Zingiberaceae also dominated this market mainly because they are one of the most sought by customers. In this market, the genus *Curcuma* (locally known as *temu*) was the most commonly found commodity from Zingiberaceae family, for instance, *C. domestica*, *C. zanthorrhiza*, *C. aeruginosa*, and *C. zedoaria*. These plants have profound functions and are widely used by society as herbal medicines. Due to the high demand, Central Java

has become the highest producer of turmeric, i.e., 42,400 tons/year (Salim et al. 2017). In seven local markets in Yogyakarta, Jalil et al. (2021) found that turmeric became the most frequently sold, which constituted 92.10% of the total rhizomes.

Ir. Soekarno Market's customers purchased Zingiberaceae commodities mainly for herbs and spices. A species of Zingiberaceae, *Alpinia galanga*, commonly found in this research area, is native to Java (Wu et al. 2021), which grows well in wet and shady habitats (Hanh et al. 2014). *A. galanga* is mainly used to create a unique flavor and seasoning food in Tamiang tribe, Aceh (Navia et al. 2020). In Kudus, Central Java, *A. galanga* is used to cure tinea versicolor (*panu*) as well as seasoning (Khusna 2019), while in Mt. Ungaran foothill, Central Java, *A. galanga* is used for treatment of headache and stomachache (Utami et al. 2019). Apart from their usage as spices in many cuisines, Zingiberaceae is also known for their function as the main ingredient of *jamu* (Indonesian traditional concoction made from various herbal products). Silalahi (2020) reported the usage of *Kaempferia galanga* as the major component of *jamu* in Central Java. Even though there is no clear evidence yet about the effectiveness and drawbacks of *jamu* consumption (Lim and Pranata 2020), the demand from the consumers due to the pandemic clearly caused the price increases of spices.

Vegetables

In terms of category, both vegetable and fruit sales made the highest proportion that accounted for 38% and 30% respectively, followed by spices and herbs at 21%, while staple food only made up 11% (Figure 4). This finding is supported by Iskandar et al. (2018) study that the highest food crop commodity was vegetables. The number of vegetable species was 103. This proves that each place has different commodities and quantities due to each region's economic, socio-cultural, and ecological factors. Vegetable and fruit diversity strongly correlates with ecological factors that make the product available in certain areas. Sarjono et al. (2019) mentioned that Central Java was one of the largest producers of both vegetables and fruits. Furthermore, Ir. Soekarno market is close to the Tawangmangu area, a mountainous agricultural region and many fruit and vegetable suppliers come from this place. Other neighboring villages also have different farming commodities offered to big sellers in this market. Central Java is also the biggest shallot producer in Indonesia according to Sholihah and Karsinah (2019). Thus, the high availability of those commodities makes buyers tend to purchase them. Kosaka et al. (2018) also said that food availability and diversity and accessibility became the main determinants for food consumption in society.

Staple foods

Most Indonesian people have a significantly high dependence on rice as the main source of carbohydrates (Nasikh et al. 2021). Even though the availability of rice substitutes is relatively high in Ir. Soekarno market, for instance, *Ipomoea batatas*, *Manihot esculenta*, and *Zea mays*, it cannot completely change society consumption

behavior. Often, these rice substitutes were eaten as side dishes and desserts. The high availability of this alternative food showed the main contribution of the traditional market in strengthening national food security and helping the authorities promote food diversification (Saediman et al. 2019).

Intraspecies variation

Apart from variations of the staple food, Ir. Soekarno Market also has several intra-species variants of several species of edible plants and fruits. Besides rice, there are onions, bananas, and legumes (nuts).

Rice

People have their own preferences which affect the diversity of commodities that are traded in traditional markets. In Ir. Soekarno Market, 9 varieties of rice (*Oryza sativa*) have different qualities and prices (Table 2). The research by Muthayya et al. (2014) showed that before trading process, the rice was processed in rice mill for free and the miller get rice bran as an exchange. Rice sold in this market can be classified based on the rice grain's color, aroma, texture, and shape. Based on its quality, the rice can be categorized as superior and non-superior. Rice with superior quality includes *C4*, *ketan putih*, *menthik wangi*, and *naga mas*.

Meanwhile, rice with less superior quality includes *beras merah*, *burung naga*, *beras ketan*, *pandan wangi*, and *super premium RMI*. Almost all of those variations have excellent fragrances, except *beras merah* and *burung naga*. Some researchers mentioned that farmers are not really interested in planting *pandan wangi* because of some reasons mainly from lack of socialization from the local government and that the harvest cannot cover the initial price (Lisarini et al. 2018; Supyandi et al. 2019). By botanists, rice is grouped into two varieties: *Oryza sativa japonica* and *Oryza sativa indica* (Widjaja et al. 2014).

Onions

Onions as a commodity can be grouped into 4 variations, namely onion, shallot, spring onion, and garlic. The variations from one onion to another can be distinguished from their aroma, color, and morphology (Table 3). However, some traders cannot differentiate between onion and shallot only based on their shape and size. According to Risfaheri et al. (2019) flavor content measurement become the effective way to distinguish between those two varieties.

Bananas

The banana trading is considerably high because of the many plantations owned by local residents. Furthermore, variation of bananas can be grouped into *pisang ambon*, *kapas*, *kapok*, *mas*, *raja*, *susu*, and *uli*. The naming system from locals is usually based on their local knowledge inherited through generations. The variations from one banana to another can be detected by the taste, color, and morphological factors. Banana with the best quality is *pisang raja* because it has a delicious taste, and a large and long shape (Table 4). Moreover, it plays essential role in

Javanese culture especially on special occasions, so commonly it has a higher price (Hapsari et al. 2017) than the other banana varieties, such as *pisang kapok*.

Legumes

In addition, there are also 9 variations of legumes, namely mungbean, peas, pea, black soybeans, red soybeans, cashews, long beans, and peanuts. Their color, taste and morphology can distinguish the variety of legumes. Mungbean, black soybeans, red soybeans,

cashews, mungbean, and peanuts belong to superior quality, while pea (*kacang kapri*) and pea (*kacang ercis*) are considered not superior. Interestingly, all of the variations have delicious tastes (Table 5). This pleasant taste becomes one of the supporting factors for buyers to purchase these items. Similarly, the study of Sminglak-Krajewska et al. (2020) in Poland found that flavor and price are the main things of consumers' decision to buy legumes as substitutes for meat-based food.

Table 2. Variations of rice traded in Ir. Soekarno Market, Sukoharjo, Indonesia

Variation	Quality	Smell	Texture	Rice color	Rice grain morphology
Beras merah	Less superior	It doesn't smell good	Sticky	Red	Small slim size
Burung naga	Less superior	Not Fragrant	Not sticky	Yellow	Medium size
C4	Superior	Fragrant	Not sticky	Clean yellow	Medium size
Beras ketan	Less superior	Fragrant	Sticky	Black	Medium size, slim
Ketan putih	Superior	Fragrant	Sticky	Clean yellow	Medium size, slim
Menthik wangi	Superior	Fragrant	Not sticky	Clean yellow	Short round size
Naga Mas	Superior	Fragrant	Not sticky	Clean yellow	Long slender size
Pandan wangi	Less superior	Fragrant	Not sticky	Yellow	Medium size
Super Premium RMI	Less superior	Fragrant	Not sticky	Clean yellow	Slim long size

Table 3. Variations of onions traded in Ir. Soekarno Market, Sukoharjo, Indonesia

Variation	Smell and quality	Color	Morphology
Onion	The aroma is fragrant, the slices make eyes stinging	The outside is brown inside white	Large round shape and thick fleshy
Shallot	The aroma is fragrant, the slices make eyes stinging	Reddish purple	Round with blunt tip wraps 2-3 seeds
Spring onion	The aroma is fragrant, the slices make the eyes slightly watery	Green and white seeds	Flat long but have no tubers
Garlic	The aroma is fragrant, the slices do not make eyes watery	White	Round with a diameter of 4-6 cm

Table 4. Variations of bananas traded at Ir. Soekarno Market, Sukoharjo, Indonesia

Variation	Taste and quality	Color	Morphology
Pisang ambon	Delicious and superior, slightly hard texture	Greenish-yellow	Long
Pisang kapas	Fragrant and not superior, slightly soft texture	Dirty light yellow	Small and short in size
Pisang kapok	Delicious and superior, slightly hard texture	Dirty dark yellow	Medium and wide sizes
Pisang mas	Somewhat good and not superior, slightly soft texture	Clean bright yellow	Medium and small sizes
Pisang raja	Delicious and superior, soft texture	A little dark yellow	Large size and long
Pisang susu	Delicious and superior, soft texture	Clean bright yellow	Small and short in size
Pisang uli	Not tasty and not superior, a little tough	A little dark yellow	Medium size

Table 5. Variations of legume traded in Ir. Soekarno Market, Sukoharjo, Indonesia

Variation	Taste and quality	Color	Morphology
String bean	Delicious and not superior	Green	Slightly wide, shorter
Mungbean	Delicious and superior	Dark green	Round
Pea	Delicious and not superior	Light green	Round
Black soybeans	Delicious and superior	Dark black	Round
Red soybeans	Delicious and superior	Dark red	Round
Cashew nut	Delicious and superior	Light yellow	Shaped like the letter C
Long beans	Delicious and superior	Green	Slim, long
Peas	Delicious and not superior	Green	Round
Peanuts	Delicious and superior	Sorrel	Oval round

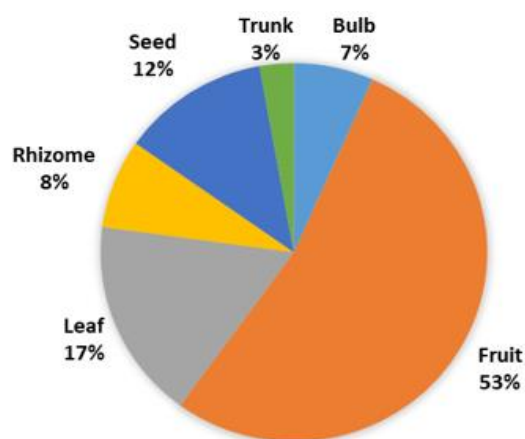


Figure 5. Parts of plants that can be consumed and traded in Ir. Soekarno Market

Plant parts

There were six parts of plants commonly used as food commodities in Ir. Soekarno Market, namely fruit, seed, leaf, rhizome, tuber (bulb), and bark (trunk) (Table 1, Figure 5). Most food plants were sold in the form of fruit, i.e., 56 out of 105 species (53%), followed by leaves 18 species, seed 13 species, rhizomes 8 species, tuber 7 species, and bark 3 species. Fabaceae, Solanaceae, and Musaceae dominated the fruit commodities in Ir. Soekarno Market.

Fruits

This market traded various kind of oranges, the most favorite one was Pummelo that has been widely cultivated in Magetan District, East Java. Some of pummelo farmers from Magetan sold their harvests in this market. Orange can be consumed as fresh fruit or as ingredient of food or beverage. Both *Citrus hystrix* and *Citrus aurantifolia* are commonly used to add unique flavor to food and drink beverages (Enejoh et al. 2015).

Leaves

Seventeen percent of plant commodities were sold in the form of leaf, which was dominated by the family Brassicaceae. Mostly, they were included in vegetable groups, such as leek (*Allium ampeloprasum*), broccoli (*Brassica oleracea* var. *italic*), leeks (*Allium fistulosum*), celery (*Apium graveolens*), kale (*Brassica oleracea* var. *sabellica*), cauliflower (*Brassica oleracea* var. *botrytis*), wild cosmos (*Cosmos caudatus*), cabbage (*Brassica oleracea* var. *capitata.*), pandanus (*Pandanus amaryllifolius*), and green mustard (*Brassica juncea* L).

Rhizomes and seeds

This research found that there is a high diversity of varieties within a plant species in Ir. Soekarno Market. Rhizome constituted 8 % of the food plant in this study, and was totally from the family Zingiberaceae. *Amomum compactum* was the only exception of Zingiberaceae that

was generally sold as seed (Table 1). *A. compactum* is endemic to West Java (Lim 2021) and is known as *kapulaga* in Javanese and has been used for many purposes, mainly for spice and herbal medicine. Seed and grain selling alone composed more than 10% of the total products, mainly came from Poaceae as staple food.

Tubers

Carbohydrate staple food source can also be obtained from tuber. In this market, the tuber availability was 7% including *Daucus carota*, *Ipomoea batatas*, *Manihot esculenta*, and *Solanum tuberosum* (Table 1). However, the sellers mostly sold tuber from Alliaceae mainly used as food ingredient, spices and vegetables.

Barks

Lastly, bark was the least sold part of plants (3%), composed of Fabaceae and Lauraceae, indicating that bark was not commonly sold as food in community, unlike in the Philippines where the utilization of trunk/bark ranked second after leaf (Pizon et al. 2016).

Traditional markets and biodiversity

Ir. Soekarno Market offered diverse products, especially in food crop commodities, including carbohydrates, spices, vegetables, and fruits. The food crop commodities traded in this market were mostly supplied from the Tawangmangu area, Karanganyar, Central Java, Indonesia. Various vegetables and fruits became the major goods from this rural area, for instance, carrots, cabbage, and strawberries (Sarjono et al. 2019). Traditional markets provide a more diverse community, both as traders and consumers than modern markets. Along with the increasing demand for various agricultural products, there is also an increase in the variety of agricultural plant products offered in traditional markets. Vegetable commodity which is usually traded in Ir. Soekarno Market has high diversity due to the high demand from the customers.

The purpose of the local market is to meet the needs of buyers and provide job opportunities and strengthen social interaction. This also leads to reducing poverty and contributing to national economy (Agboola et al. 2018). Montalbano et al. (2018) mentioned a profound correlation between farmers' food security and their involvement in the market chain. Thus, urban traditional markets play an essential role in trading the diverse local agricultural products and providing food for the locals (Vlkova et al. 2015). Another benefit of traditional market is to retain the local knowledge about herbal medicine (Salim et al. 2019). One clear example is that *jamu* trade in Ir. Soekarno Market helps to give knowledge about this traditional drink to their customers that might be young people. Subsequently, this local wisdom can be transferred through generations.

In this study, the commodities traded were mostly local products. Ir. Soekarno Market has a role in offering a variety of edible food crops produced by farmers from the surrounding areas. In addition, this market also plays a considerable part in preserving biodiversity, especially

edible plants. If the market demand increases, the initiative of the vegetable farmers will also increase to provide the demands, so this will prevent biological extinction. This includes the actions of cultivating and conserving biodiversity through agricultural land. Similarly, Arellanes et al. (2013) argued that people tend to treat well plant species with an economic value if the plants are endangered. However, over-selling and over-consumption without preventive action such as regulation and cultivation will lead to species extinction.

To conclude, Ir. Soekarno Market has an important role as a place for trading activities between sellers and buyers in the economic sector that offers a variety of food plants, consisting of 105 species from 28 families, sold in the form of fruit, seeds or grain, leaf, rhizome, tuber, and stem. The variety of staple products helps to increase food diversification and food security and to conserve plant diversity.

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