

# 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, Himawan W, Partasasmita R, Setyawan AD. 2021. The diversity of edible plants traded in Ir. Soekarno Market, a traditional market in Sukoharjo District, Indonesia. 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

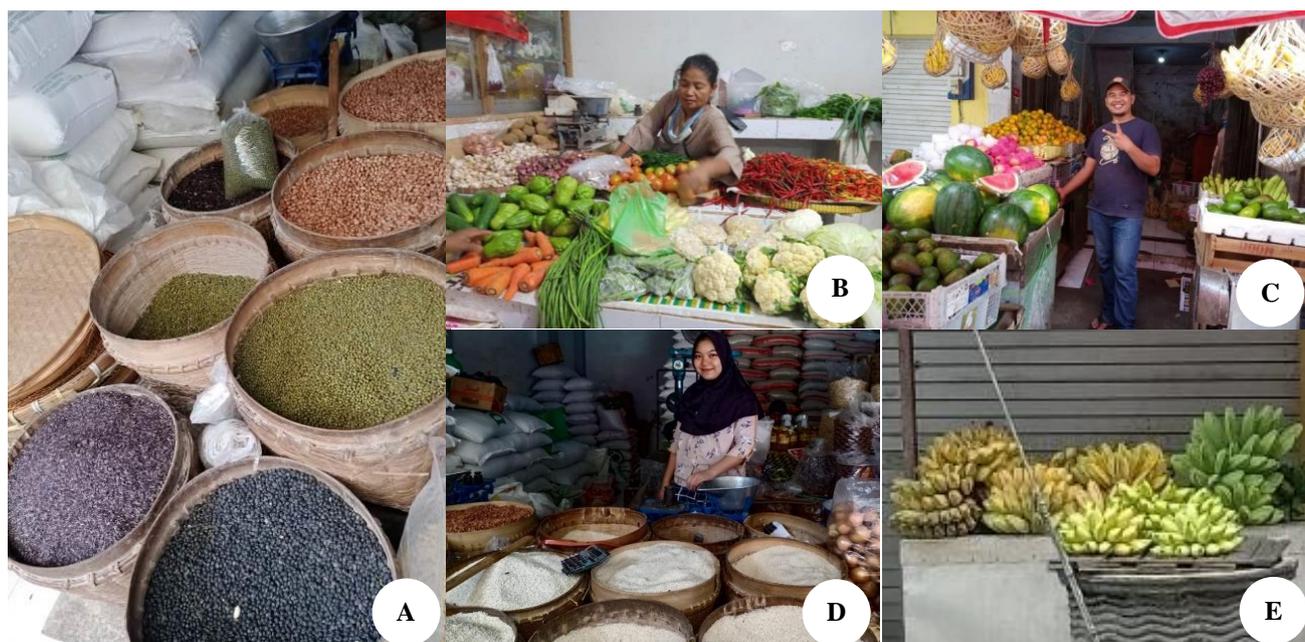
This research was conducted in Ir. Soekarno Market, a traditional market, situated in the capital town of Sukoharjo, Sukoharjo District, Central Java, Indonesia (Figures 1 and 2) from November to December 2020 in the COVID-19 pandemic period where community activities are limited. This market is located 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 m<sup>2</sup>. 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 Bunyaphatsara 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

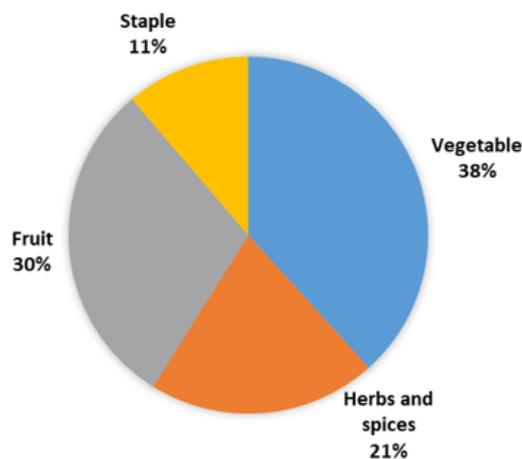
IX, king of Surakarta, a kingdom under Nederland Indies influence. According to history, this district is experiencing continuous development. With population growth and over time, there have been protection efforts by the local government to increase the competitiveness of traditional markets. One of 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).

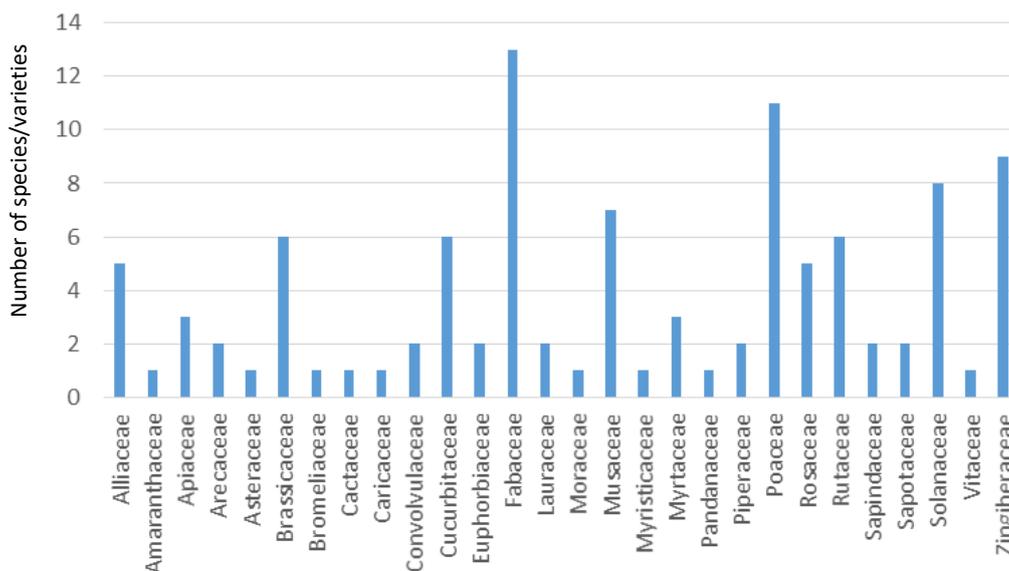
This revitalization of this market was done in order to improve the service quality. The considerable improvements such as adding the number of officers, improving the public facilities, and improving the cleanliness of the market have been conducted to attract more customers (Ar Rosyidi et al. 2016).

**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

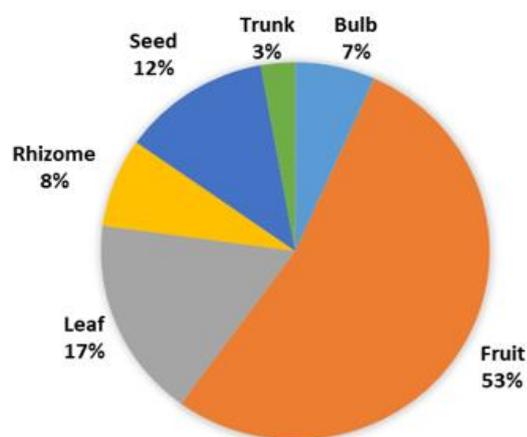
| Variation    | Smell and quality   | Color                             | Morphology                           |
|--------------|---|-----------------------------------|--------------------------------------|
| Onion        | The aroma is fragrant, the slices make eyes stinging            | The outside 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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