

Agronomy, Utilization and Economics of Indigenous Vegetables in West Java, Indonesia

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ABSTRACT

*Indigenous vegetables have become popular in recent Indonesian diet, but agronomic and economic studies on these crops are limited. The objective of this research was to investigate the cultural technique of indigenous vegetables, their uses and economic importance in West Java, Indonesia. Initial market observation was conducted in Bogor to determine the economic value of indigenous vegetables. In depth observations of the indigenous vegetables and interviews with merchants, farmers and consumers were conducted in three districts, i.e., Bogor, Cianjur and Tasikmalaya, focusing on four indigenous vegetables familiar to local people, i.e., genjer (*Limnocharis flava* (L.) Buchenau), kenikir (*Cosmos caudatus* Kunth.), leunca (*Solanum americanum* Miller) and poh-pohan (*Pilea melastomoides* (Poir.) Wedd.). This study showed that indigenous vegetables have been produced in extensive and semi-intensive cultivations and are sold in local markets daily, although local people do not consume them frequently. Indigenous vegetables held a market share of less than 5% at local markets, and accounted for less than 10% in household vegetable consumption. The reasons for consumers to choose indigenous vegetables were familiarity to these crops, moderate prices, family members' preference, availability and ease of preparation. Generally, younger family members (<30 years old) bought indigenous vegetables less frequently than older ones (>30 years old), possibly due to lack of information on its use, unfamiliar flavor and high availability of other commercial vegetables commonly grown worldwide.*

Keywords: *Cosmos caudatus*, *Limnocharis flava*, local knowledge, *Pilea melastomoides*, *Solanum americanum*

ABSTRAK

Popularitas sayuran indigenus terus meningkat di Indonesia, namun studi agronomi dan ekonominya masih terbatas. Penelitian bertujuan mengkaji budidaya, pemanfaatan dan nilai ekonomis sayuran indigenus di Jawa Barat, Indonesia. Penelitian pendahuluan dilakukan di pasar di wilayah Bogor. Penelitian mendalam dilakukan dengan mewawancarai pedagang, petani dan konsumen, serta mengamati di lahan petani di tiga kabupaten yakni Bogor, Cianjur dan Tasikmalaya untuk empat sayuran indigenus utama yakni genjer (*Limnocharis flava* (L.) Buchenau), kenikir (*Cosmos caudatus* Kunth.), leunca (*Solanum americanum* Miller) dan poh-pohan (*Pilea melastomoides* (Poir.) Wedd.). Studi menunjukkan bahwa sayuran indigenus diproduksi secara intensif dan semi intensif, serta dijual di pasar setiap hari, walaupun penduduk setempat tidak mengkonsumsi secara teratur. Sayuran indigenus mengisi celung pasar kurang dari 5% dan memenuhi kurang dari 10% kebutuhan sayuran rumah tangga. Konsumen memilih sayuran indigenus karena sudah terbiasa mengkonsumsi, harga terjangkau, disukai anggota keluarga, ketersediaan dan kemudahan mengolah. Secara umum, anggota keluarga muda (usia < 30 tahun) lebih jarang membeli sayuran indigenus dibanding yang lebih tua (usia > 30 tahun), kemungkinan disebabkan keterbatasan informasi nilai guna, adanya aroma asing, dan ketersediaan sayuran lain.

Kata kunci: *Cosmos caudatus*, *Limnocharis flava*, pengetahuan lokal, *Pilea melastomoides*, *Solanum americanum*

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INTRODUCTION

Before 2000 indigenous vegetables such as *genjer* (*Limnocharis flava* (L.) Buchenau), *kenikir* (*Cosmos caudatus* Kunth.), *leunca* (*Solanum americanum* Miller), *poh-pohan* (*Pilea melastomoides* (Poir.) Wedd.), young leaves of papaya (*Carica papaya*) and cashew (*Anacardium occidentale*) were only consumed in local areas in Java, Indonesia. However, the demand for indigenous vegetables is increasing significantly with the development of ethnic restaurants mainly Javanese and Sundanese restaurants, including street vendors/restaurants (*warung kaki lima*) in most big cities all over Indonesia, which resulted in the demands for agronomic and nutritional studies on indigenous vegetables.

Indigenous vegetables are usually defined as native or traditional vegetables (Kusmana and Suryadi, 2004) including introduced species that have evolved over a long period (Engle and Faustino, 2007). They are offered at an affordable price and have a distinct flavor, thus contributing greatly to farmers' economy, diet and social relations.

Among ethnic groups in Indonesia, Sundanese people living in West Java prepare indigenous vegetables as raw vegetables, pickles and stir-fried vegetables; indigenous vegetables are essential ingredients for various traditional dishes such as *asinan* (salty pickles), *karedok* (salad with peanut source), *lalaban* (raw vegetables with chili paste), *pecel* (peanut sauce for vegetables, catfish and chicken, etc.). Putrasamedja (2003) identified 111 indigenous vegetables in Indonesia, some of which had a variety of medicinal properties; *katuk leaves* (*Sauropus androgynus* (L.) Merr.) is believed to stimulate breast milk production, whereas *leunca* and *takokak* (*Solanum torvum* Sw.) are effective as a contraceptive.

Although, there are no statistical data of production and demands for indigenous vegetables, *genjer* (Limnocharitaceae), *kenikir* (Compositae), *leunca* (Solanaceae) and *poh-pohan* (Urticaceae) are popular to people in big cities in Java, Sumatra, Bali and Kalimantan Islands. Those vegetables provide protein, fat, carbohydrate, fibers and minerals such as Ca and Fe (Van den Bergh, 1994a,b). *Genjer*, *kenikir* and *leunca* have high vitamin A, B₁ and C content (Van den Bergh, 1994a,b; Siemonsma and Jansen, 1994; Hassan *et al.*,

2012). *Kenikir* also contains antioxidant (Andarwulan *et al.*, 2010; Hassan *et al.*, 2012), and essential oil (Van den Bergh, 1994a) which is reported to improve appetite. According Fuzzati *et al.* (1995), *kenikir* is native to tropical regions of the Americas and has been naturalized in Java.

Our knowledge about cultural practices and utilization of indigenous vegetables is scarce. Therefore, we examined how four most familiar indigenous vegetables are grown and harvested by farmers, traded in markets by merchants, and prepared by local people in West Java.

MATERIALS AND METHODS

Research was conducted in three districts, i.e., Bogor, Cianjur and Tasikmalaya, West Java, Indonesia during the rainy season from December 2010 to April 2011. Initially, all indigenous vegetables available in 14 Bogor markets (traditional and modern markets) were surveyed and evaluated, resulted in 30 species of indigenous vegetables. Twelve out of 30 indigenous vegetables were found in all markets. Preliminary evaluation on the 12 indigenous vegetables were conducted based on the availability in markets, volumes of sales, farmers' profitability of the cultivation and consumption frequency through interviews with merchants, farmers and consumers. We concluded four species, i.e., *kenikir*, *genjer*, *leunca* and *poh-pohan* as the most common and profitable in the markets, and as special cuisine in most Sundanese restaurants.

Further assessment was carried out following the distribution channel of vegetables from consumers in the markets to farmers. Two traditional markets, i.e., Pasar Bogor and Pasar Anyar in Bogor Districts, were selected based on easiness to access, large volume of sales, and rapid turnover of the vegetables. Interview was conducted with 14 merchants and their suppliers, each 7 merchants in Pasar Bogor and Pasar Anyar regarding vegetable availability, quantity, sales and origin. Pasar Bogor (Bogor Market) was considered as one of the largest vegetable markets in West Java, except for Jakarta markets. In this market, vegetables came from surrounding districts including Bandung,

Sumedang, Sukabumi, Tasikmalaya and Cianjur Districts.

Of 10 production areas (villages) identified by interview with merchants (and suppliers) in the particular markets, we selected four villages which have been regularly supplied one or more of these indigenous vegetables, i.e., Sukaharja - Ciapus and Ciampea villages (Bogor District), Pasir Sarongge village (Cianjur District) and Citalahab village (Tasikmalaya District) located at an altitude of 300 m, 200 m, 1,200 m and 700 m above sea level, respectively. In each village, we interviewed 20 to 25 female consumers, 2 to 3 local merchants (suppliers) and 7 to 10 large farmers. Only land owner were considered in this study, therefore, the number of farmers interviewed varied among sites. Female consumers were selected as they would decide which foods to buy. The consumers' age ranged from 20 to 57 years, education background varied from elementary school to university graduates, and level of monthly income range from 0.4 to 7.0 million rupiah (average 2.3 million rupiah).

In each village, cultivation method, growing area, handling and sales amount of indigenous vegetables, were investigated. To determine the vegetables productivity, we established a plot (5 m × 5 m) in each village and requested one farmer to manage in each locations of study. *Kenikir* and *leunca* were cultivated in Ciampea (Bogor), Sukaharja - Ciapus (Bogor) and Pasir Sarongge (Cianjur), while *genjer* and *poh-pohan* were grown in Ciampea (Bogor), Pasir Sarongge (Cianjur) and Citalahab (Tasikmalaya) villages. No farmers in Citalahab village (Tasikmalaya) were familiar with *kenikir* and *leunca* and Sukaharja - Ciapus (Bogor) for *genjer* and *poh-pohan*, therefore, no agronomic data were collected from those villages. Planting density and harvesting time were conformable to local farmers' standard of cultivation, and 10 plants were monitored regularly every 2 weeks. Oxalate crystals were observed by squeezing leaf/fruit and observed under microscope of 400x magnification and categorized as "+" indicates that druses of oxalate crystals are visible and "-" as not visible or absent. Data were analyzed using ANOVA and a Student's t-test was used to assess statistical significance of differences between means.

RESULTS AND DISCUSSION

Culture Techniques and Productivity

Kenikir (*Cosmos caudatus* Kunth) is mainly intercropped with vegetables commercially-cultivated worldwide (hereafter designated 'common vegetables') such as leek, cabbage and lettuce at high altitudes, and with sweet corn and long beans at low altitudes. Many farmers plant *kenikir* as border plants along planting beds of common vegetables because they believe that it can reduce soil diseases and pests such as nematode. Van den Bergh (1994a) considered that *kenikir* improve soil structure and suppress some weeds, including *Imperata cylindrica*. Only few farmers cultivate *kenikir* on their farms as main crop. They dedicated 200 to 2 500 m² specially for growing the *kenikir*. Among research sites, the largest farm (2 500 m²) is found in a farmer in Pasir Sarongge (Cianjur District), where a local variety of *kenikir* is grown as a commercial crop. In commercial *kenikir* farms, seeds are sown in beds and raised for one to two weeks. Then seedlings are transplanted in a square pattern, e.g., 25 cm × 25 cm. Goat manures are applied at planting, while mineral fertilizers are rarely applied to *kenikir*. Some farmers apply nitrogen (urea 46% N) at a rate of 1-2 g per plant along with goat manure. When inflorescences emerge six to eight weeks after planting, edible parts of *kenikir*, i.e., leaves, young shoots and inflorescences, are harvested for the first time. Farmers usually continue to harvest new offshoots until six months after planting, although some farmers replant new seedlings after only one harvest. According to Van den Bergh (1994a), harvesting could be continued for two to three years after planting, but most farmers stop harvesting within six months after planting, possibly because plants are infested with diseases in dry season. Harvest frequency varies among research sites, i.e., once every week in Sukaharja - Ciapus (Bogor), once every month in Pasir Sarongge (Cianjur) and 5-6 times per month in Ciampea (Bogor). Average productivity is highly variable among research sites, i.e., 458, 298 and 1 214 kg ha⁻¹ per harvest in Sukaharja - Ciapus, Pasir Sarongge and Ciampea, respectively (Table 1). In Leuwiliang Subdistrict (close to Ciampea village), extension program for the

enhancement of indigenous vegetable production had been conducted by Bogor Agricultural University under the Sustainable Agriculture and Natural Resource Management (SANREM) Project in early 2000s. According farmers, they follow techniques applied by Leuwiliang farmers resulting in high yield of *kenikir* in Ciampea site.

Genjer (*Limnocharis flava* (L.) Buchenau) was introduced into Southeast Asia from tropical and subtropical America, and naturalized in Indonesia, Malaysia and Thailand (van den Bergh, 1994b). *Genjer* grows naturally in lowlands such as swampy land, paddy field, riverbank and fish ponds with water level less than 20 cm. *Genjer* plants cannot grow in ponds of which water depth is over 30-40 cm. *Genjer* plants are propagated either by seeds or vegetative through suckers. Edible parts of *genjer* are the peduncles, petioles, leaf blades and the unopened inflorescences. Farmers harvest wild *genjer* plants or semi-cultivated *genjer* plants in fields

(50, 100 and 12 m² on average in Citalahab - Tasikmalaya, Pasir Sarongge - Cianjur and Ciampea - Bogor, respectively). In fields with *genjer* plants, farmers harvest leaves and inflorescence regularly without any fertilizer application. When medium sized suckers (ca. 12 to 15 cm in height) are transplanted, first harvest is possible 5 weeks after transplanting (2 to 3 leaf stage with an inflorescence). Interviews with farmers indicate that harvesting frequency varies dependent on location and soil fertility. Harvest is conducted once a week in Pasir Sarongge - Cianjur, and twice a week in Ciampea - Bogor and Citalahab - Tasikmalaya. Generally, about 0.2-0.3 kg m⁻² of *genjer* is collected per week. In Pasir Sarongge, many farmers keep *genjer* plants along the edge of paddy fields or water convolvulus (*Ipomea aquatica*) fields, whereas farmers in Ciampea and Citalahab collect naturally-grown *genjer*. Therefore, productivity of *genjer* is higher in Pasir Sarongge - Cianjur than in other two sites (Table 1).

Table 1. Agronomic characters of four indigenous vegetables in West Java based on individual plant measurement (n= 10)

Characters	<i>Kenikir</i>			<i>Genjer</i> ^Z			<i>Poh-pohan</i>			<i>Leunca</i>		
	I	II	III	II	III	IV	I	III	IV	I	II	III
Plant density (plants m ⁻²)	16	16	16	16	16	16	16	16	4	4	2	4
First harvest (WAP ^Y)	6	6	8	5	6	5	6	6	6	6	6	7
Number of harvest per month	4	5-6	1	8	4	8	2	4	4	6	7	4
Last harvest (WAP)	24	24	28	24	24	24	24	24	24	24	26	24
Yield (kg ha ⁻¹ per harvest)	458	1214	298	1939	8924	2459	2106	2199	1427	350	1249	855
Total yield (ton ha ⁻¹ per season)	11.0	29.1	7.1	23.2	53.5	29.5	25.3	26.4	17.1	8.4	29.9	20.5
Presence of Oxalate crystals ^S	+	+	+	+	+	+	-	-	-	-	-	-

^Z Experimental plot was set up for *genjer* and *poh-pohan* in Tasikmalaya (Tasik in this table), not Ciapus (Bogor) and Ciampea (Bogor), respectively; ^YWAP-weeks after planting; ^XOxalate crystals were observed by squeezing leaf/fruit and observed under microscope of 400x magnification; + indicates that druses of oxalate crystals are visible and “-“druses are not visible. I= Ciapus (Bogor), II= Ciampea (Bogor), III= Cianjur, IV= Tasikmalaya.

Poh-pohan (*Pilea melastomoides* (Poir.) Bl.) is a succulent plant. It grows naturally in moist and shady, but well drained conditions such as areas beside gutters, fountains and fish ponds. Farmers harvest wild *poh-pohan*, but also cultivate *poh-pohan* in upland fields. In humid areas *poh-pohan* plants are less susceptible to diseases than plants grown in dry areas. It is probable that low light intensity in moist areas (ca 70-80% of full sunshine) is suitable for *poh-pohan* growth because stalk and petiole color becomes purplish under full sunshine. Ekawati *et al.* (2010) stated that productivity of *poh-pohan* growing under up to e.g. 75% of shading is five times larger than those under full sunshine. Our farmer respondents believe that *poh-pohan* growing in shady areas develop more juicy and crispy petioles than those growing under full sunshine. Most farmers cultivate *poh-pohan* on their 100-200 m² fields. The largest intensive farm is found in Bogor (Sukaharja - Ciapus), where *poh-pohan* plants are intercropped with fruit and coconut trees on about 2 500 m² field.

Poh-pohan are usually propagated by stem cutting with 2-3 nodes, and rarely propagated by seeds. As Mahyar (1994) stated, *poh-pohan* can be propagated by seeds, but small seeds like *poh-pohan* need extra attention at sowing. It takes 3 to 4 weeks for cuttings to attain the size for transplanting, e.g., 10 to 15 cm. Planting density varies among study sites ranging from 25 cm × 25 cm to 50 cm × 50 cm. The first harvest, i.e., pinching 4-5 leaves at the top of shoot, is conducted 6 weeks after transplanting, thereafter, 4 to 5 leaves are pinched every two weeks in Bogor (Sukaharja - Ciapus) and weekly in Pasir Sarongge - Cianjur and Citalahab - Tasikmalaya. After the first harvest, farmers apply fertilizers to stimulate new shoot. Total harvest per season was 25.3 t ha⁻¹, 26.4 t ha⁻¹ and 17.1 t ha⁻¹ in Bogor (Sukaharja - Ciapus), Cianjur (Pasir Sarongge) and Tasikmalaya (Citalahab), respectively (Table 1).

Leunca (*Solanum americanum* Miller) is a perennial crop which probably originates in South America (Siemonsma and Jansen, 1994). It is cultivated together with cash crops on farms and home gardens or grows wild as a weed. Plants are propagated by seed or stem cutting. Seeds were collected from mature, dark purple fruits. Seedlings are transplanted 3 weeks after sowing, while 15-20 cm stems are

planted directly into soil for stem cutting. Plants were planted in a square pattern, i.e., 50 cm × 50 cm in Sukaharja - Ciapus and Pasir Sarongge, and 75 cm × 75 cm in Ciampea. Inflorescences are harvested when fruits become dark green to tinny light purple in color. Subsequent harvest is carried out four to six times a month dependent on research sites. In intensive cultivation, which is carried out by some farmers in Bogor (Ciampea), nitrogen fertilizer is applied at a rate of 2-3 g per plant to maintain high productivity. According to the interviewees, there was variation in total yield of *leunca* fruits among locations. Harvest of *leunca* usually last 6 months after planting in rainy season and the plant die, but harvest extends on month in Bogor (Ciampea) up to 7 months after planting because available of irrigation. High yield of *leunca* was obtained in Ciampea (1 249 kg ha⁻¹ per harvest), followed by Pasir Sarongge (855 kg ha⁻¹ per harvest) and Ciapus village of Bogor (350 kg ha⁻¹ per harvest) (Table 1). According Putriantari and Santosa (2014) fruit production of *leunca* increases by increasing level of N application, application at rate of 180 kg N ha⁻¹ obtains more than 18 ton fruit ha⁻¹ during growing season equal to 2 000 kg ha⁻¹ per harvest. Therefore, low productivity of *leunca* of farmers in this study could be ascertained from low N application.

Indigenous Vegetables Market

In Bogor, there are 14 vegetable retail outlets, i.e., four large traditional vegetable markets (Pasar Bogor, Pasar Anyar, Pasar Empang, and Pasar Yasmin) and nine supermarkets (4 Giant and 5 Matahari stores). In these retail outlets, regardless of traditional markets and supermarkets, 14 to 40 species (28 on average) of vegetables are sold every day, and 25 to 58% of species are local vegetables. Some local vegetables including indigenous vegetables are young fruits, male flowers and young leaves of papaya (*Carica papaya*), *antan* (centella leaves, *Centella asiatica*), *batang talas* (taro stolon, *Colocasia esculenta*), *daun gedi* (edible hibiscus leaves, *Hibiscus manihot*), *daun jambu monyet* (young cashew leaves, *Anacardium occidentale*), *daun katuk* (leaves of *Sauropus androgynus*), *daun kacang buncis* (green beans leaves, *Phaseolus vulgaris*), *daun kacang tanah* (peanut leaves,

Arachis hypogaea), daun labu parang (winter squash leaves, *Cucurbita maxima*), daun labu siam (chayote leaves, *Sechium edule*), daun mangkokan (shield aralia leaves, *Polyscias scutellaria*), daun melinjo (gnetum leaves, *Gnetum gnemon*), daun singkong (cassava leaves, *Manihot esculenta*), daun ubi jalar (sweet potato leaves, *Ipomoea batatas*), genjer leaves and inflorescence, jantung pisang (inflorescence of banana, *Musa paradisiaca*), kemangi (basil leaves, *Ocimum americanum*), kenikir leaves, leunca fruits, poh-pohan leaves, pucuk kemang (young leaves of wild mango, *Mangifera kamanga*), selada air (watercress, *Nasturtium officinale*), terong lalap (small green fruits of eggplant, *Solanum melongena*), and triwis (sprout of cabbage offshoot, *Brassica olerace*). Mushroom was not included in this survey.

Among more than 200 retailers in Pasar Anyar market, seven retailers sell indigenous vegetables including kenikir, genjer, poh-pohan and leunca. On average, a retailer sells 10 kg of kenikir, 40 kg of genjer, 30 kg of poh-pohan, 50 kg of leunca fruits every day. Leaves of kenikir, genjer and poh-pohan are usually split into lots weighing 100 to 200 g by wholesalers, and sold at a price ranging from 500 to 2 000 rupiah per 100 g (ca. 0.05-0.2 USD kg⁻¹). A middleman distributes the vegetables to 3-5 wholesalers. There are three large wholesalers in the Pasar Bogor who take a contract with middlemen and receive indigenous vegetables from them. Most retailers in the Pasar Anyar, source indigenous vegetables from large wholesalers in Pasar Bogor, but some retailers source the vegetables directly from middlemen in Ciampea and Leuwiliang Subdistricts (Bogor). However, there are variations in the distribution channels among cities. For example, in Citalahab - Tasikmalaya, farmers in remote areas sell indigenous and common vegetables to peddlers (*pedagang keliling*) and consumers directly as well as middlemen, whereas farmers near markets sell it to middlemen, retailers, and wholesalers.

On average, it took about 20 hours from a farm to a consumer. A middleman in Ciampea buys 3 kg of kenikir, 20 kg of genjer, 20 kg of poh-pohan and 40 kg of leunca, everyday, while a middleman in Pasir Sarongge buys 80 kg of kenikir, 50 kg of genjer, 100 kg of poh-pohan and 40 kg of

leunca. Retailers stated that indigenous vegetables deteriorate faster than common vegetables, so they usually spray water frequently to keep vegetables fresh longer. It is common to place vegetables in a plastic bag with a capacity of 20 liter during transportation. Long distance transportation is usually carried out in the evening or during the night to prevent water loss via transpiration at high temperatures. Especially, kenikir and poh-pohan leaves are easily deteriorated as compared to genjer leaves and leunca fruits. Genjer is more susceptible to physical impact damage than other vegetables, thus careful handling is necessary.

Contribution of indigenous vegetables to farmers' income is the largest in Bogor (pooled Ciampea and Ciapus), followed by Pasir Sarongge - Cianjur and Citalahab - Tasikmalaya sites, i.e., 18.9%, 3.8% and 1.7%, respectively. Nevertheless, sales amount of indigenous vegetables is the largest in Tasikmalaya, followed by Cianjur and Bogor sites (Fig. 1 A), indicating that a large contribution of indigenous vegetables to farmers' income is due to high price in Bogor.

Consumer Preferences

Indigenous vegetables are generally eaten raw (*kenikir* and *poh-pohan* leaves and *leunca* fruits), slightly boiled (*kenikir* leaves) or boiled gently (*genjer* leaves and *leunca* fruits). About 78% of consumers prefers slightly boiled vegetables which are prepared as *gado-gado* (Indonesian salad served with peanut sauce), while others prefer to eat raw as salad, particularly for *kenikir* leaves and *leunca* fruits. As salad, *kenikir* and *poh-pohan* leaves are usually eaten with *sambal* (chili paste). *Leunca* fruits are sometimes stir-fried with chili and *oncom* (a kind of fermented soybean cake, alike *tempe*). In Central Java Province, there are two varieties of *leunca*, i.e., small *leunca* (*ranti* in Javanese) and large *leunca* (*ranti kebo*), but most farmers in West Java are familiar only with large *leunca*. Sizes of fruits and leaves of small *leunca* are about half of large *leunca*. Javanese people consume leaves of small and large *leunca*, while Sundanese people consume fruits of large *leunca*. Large *leunca* leaves is bitterer than those of small *leunca*, according to Javanese. Mature fruits of small *leunca* taste sweet, so

children usually consume as sweet in Central Java.

Preferences for indigenous vegetables are different among households and among family members. In general, younger families (married for less than 5 years) consume less indigenous vegetables than older ones (married for longer than 10 years). Young people believe that indigenous vegetables have harmful effect on reproduction system; therefore, they prefer common vegetables. Furthermore, young people's distaste for indigenous vegetables is related to their taste and odor. Bitter taste is dominant for *leunca* fruits and *genjer* inflorescences although taste is very soft for *genjer* leaves. On the contrary, more than 54% of households with middle-

aged and elderly wives prefer indigenous vegetables, with less than 17% in distaste.

The amount of indigenous vegetables consumed per household per day is dependent on the relative availability of indigenous vegetables and common vegetables such as amaranth, cabbage, carrot, kankoong, lettuce, and pakchoi. Daily expenditure for vegetables is 19.8, 18.8 and 12.5 thousand rupiah for households in Bogor, Pasir Sarongge - Cianjur and Citalahab - Tasikmalaya sites, respectively; those accounted for 35.4%, 13.3% and 20% of total vegetable expenditure. Average daily demand for common vegetables in study sites ranged from 0.7 to 1.5 kg per household; daily purchases of vegetables amount to 10 to 16.3 thousand rupiah (Fig. 1B).

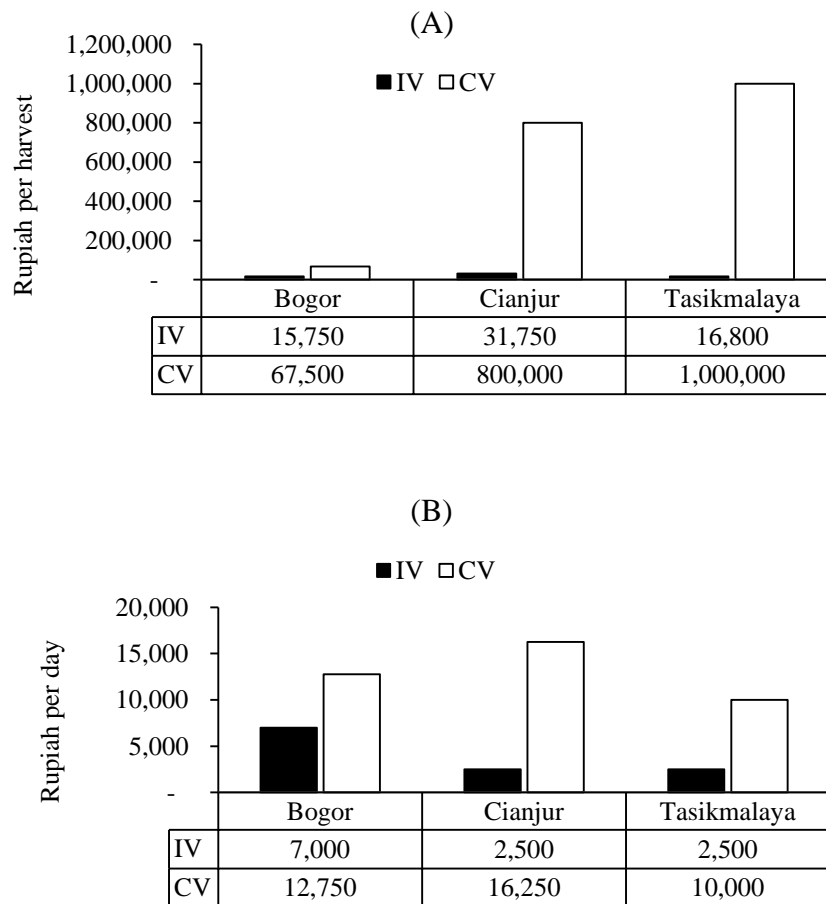


Figure 1. Average farmers' income from the sales of indigenous and common vegetables (A) and average daily expenses of a household for indigenous and common vegetables (B) in Bogor, Cianjur (Pasir Sarongge) and Tasikmalaya (Citalahab). In Bogor, data at Ciapus and Ciampea research sites were pooled. Rp 10,000 equal to 1 USD. IV = indigenous vegetables; CV = common vegetables.

Most respondents rarely use *kenikir* and *genjer* together with common vegetables in cooking, but they sometimes use *leunca* together with common vegetables. When data from all research sites were pooled, 90% of household buy less than 1 kg of indigenous vegetables at a time. Only less than 1.5% of respondents buy more than 1 kg which mainly consists of *genjer* and *kenikir*. For *poh-pohan* and *leunca*, they frequently buy about 0.2 kg and 0.1 kg, respectively. Certainly, the purchase volume of indigenous vegetables is negatively related with the purchase volume of common vegetables; when they buy relatively large amount of indigenous vegetables, they buy a small amount of common vegetables, and *vice versa* (Fig.2).

On average two thirds of the consumers ate indigenous vegetables not so often; only 10.5%, 7.8% and 5.3% of consumers ate indigenous vegetables daily, more than once a week and once a week, respectively. It appears that less frequent eating of indigenous vegetables is not related to their low availability because only about 5% of consumers replied that they could not find indigenous vegetables when they need. More than 50% of consumers acknowledged that *kenikir* and *genjer* were easily obtainable in markets in all research sites. About 70% of consumers could buy *poh-pohan* from nearby retailers, while only 15% had some difficulties

to obtain it. Regarding purchase route, 45%, 36% and 15% of consumers obtained from grocery stores (*warung*), nearby markets and peddlers (*pedagang keliling*), respectively. About 5% of consumers usually placed an order for indigenous vegetables with retailers in advance. According to retailers, sales amount of indigenous vegetables is lower than that of common vegetables (ca 30%) in medium to high-income areas. The retailers argued that indigenous vegetables are probably vegetables for low-income class.

It is likely that low price provides motive for buying indigenous vegetables. More than 65% of consumers replied that indigenous vegetables could be purchased at a lower price as compared with common vegetables such as amaranth, carrot, cucumber, cabbage, lettuce, pakcoy, etc. About 10-30% of consumers replied that indigenous vegetables were considered medium-priced. However, most consumers who buy it in supermarkets stated that indigenous vegetables are as expensive as common vegetables.

It is considered that indigenous vegetables have benefits on health, and this notion stimulating indigenous vegetable consumption. However, high-income class (monthly income > 5 million rupiah) prefers common vegetables to indigenous vegetables because they consider that the indigenous are inferior in cleanness and healthiness.

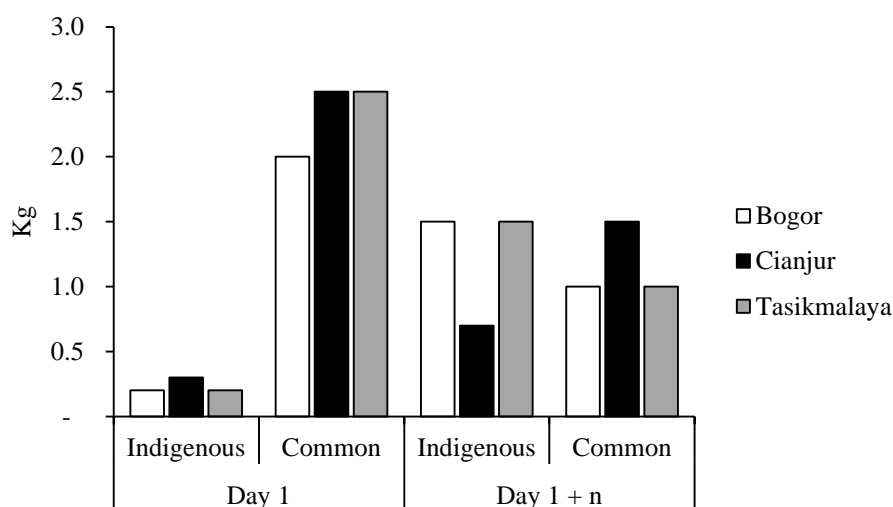


Figure 2. Average amount (kg) of indigenous and common vegetables purchased by households in Bogor (Ciampea and Sukaharja - Ciapus), Cianjur (Pasir Sarongge) and Tasikmalaya (Citalahab) on two different days (Day 1 and Day 1+n), based on interview.

In fact, about 10% of consumers complained digestion problems after consuming indigenous vegetables. Health complaint due to the ingestion of indigenous vegetables, e.g., headache and disorder of uric acid metabolism, was reported by respondents, although no specific vegetables were identified. However, 50% of consumers recognized health improvement by ingestion of indigenous vegetables, while 20% recognized no discernible effects. Mohamed *et al.* (2012) reported that consumption of *Cosmos caudatus* at 500 mg kg⁻¹ body weight has the potential to act as the therapeutic agent to restore bone damage in postmenopausal. In Sri Lanka, cooked salads of *genjer* are eaten as a cure for rheumatism (Haynes and Les, 2004). Most consumers pointed out that they did not sense intensely unpleasant smell in toilets if they ate *kenikir* and *poh-pohan*. It is probable that high content of flavoring substances in indigenous vegetables get rid of bad smell such as for *kenikir* and *poh-pohan*.

Consumers usually determined which types of vegetables to buy according to the following criteria, e.g., cooking experience, easiness of cooking, taste and appearance. Among criteria for choosing, easiness of cooking was the most important criterion; more than 60% of consumers choose a vegetable according to this criterion although less than 30% of consumers (mainly young people) in both rural and urban areas found indigenous vegetables difficult to cook. As of other criteria, 35% and 25% of consumers pointed out strong flavor and the appearance (color and freshness), respectively. On the other hand, only 15% of consumers determined which kinds of vegetables to buy according to its familiarity. Most young women never eat *leunca* fruits and *genjer* leaves because they believe *leunca* fruits have adverse effect on fertility and *genjer* leaves are non-nutritious and dirty. In most Southeast Asian countries, *genjer* is treated as a noxious weed in paddy field (Ranawakage *et al.*, 2014).

CONCLUSION

Indigenous vegetables have crucial roles in enriching the dietary life of people and generating farmers' income in West Java. Farmers also produced indigenous vegetables

as a way to ensure self-sufficiency of vegetables. Manure and chemical fertilizers are rarely applied to indigenous vegetables. From economic point of view, the vegetables were traded locally through various channels of distribution, e.g., farm-gate sales and market sales by local vegetables retailers and supermarkets. Although the sales amount of indigenous vegetables are still limited, these vegetables are promising with an increase in the number of street restaurants where indigenous vegetables are commonly used. It is probable that experience of eating indigenous vegetables at street restaurants have accustomed young people to the taste of indigenous vegetables, leading to an increase in the consumption of indigenous vegetables by younger generation.

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