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A Comparison of Biophysical Conditions Between Sundanese Migrant and Non-Migrant *Pekarangans* in Indonesia

Muhammad Saddam Ali[1], *Hadi Susilo Arifin*[2]*, *Nurhayati Arifin*[2] *and Made Astawan*[3]

[1]Natural Resources and Environmental Management Study Program, Graduate School of IPB University, Bogor, Indonesia, [2]Department of Landscape Architecture, Division of Landscape Management, Faculty of Agriculture, IPB University, Bogor, Indonesia, [3]Department of Food Science and Technology, Faculty of Agricultural Engineering and Technology, IPB University, Bogor, Indonesia

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***Correspondence:**
Hadi Susilo Arifin
hsarifin@apps.ipb.ac.id

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Pekarangan is a typical Indonesian home garden. This article aimed to look at biophysical conditions of *pekarangan* between Sundanese migrants and non-migrants. A total of 40 *pekarangans* in Selajambe and Ciomas Rahayu villages, West Java, were chosen as representative locations for the Sundanese non-migrant population (native Sundanese), and 40 *pekarangans* in Tegal Yoso and Tanjung Kesuma villages, Lampung, were chosen as representatives of the Sundanese migrant population. Research has been carried out in the period 2019–2021. To measure the biophysical conditions of *pekarangans*, we analyzed the *pekarangan* area, *pekarangan* size, number of species and individual of *pekarangan* plants, vertical diversity and horizontal diversity of plants, and the relationship between the *pekarangan* area and number of species and individual plants. The results showed that the difference in conditions of the *pekarangan* was indicated by the difference in the area and size but not by the diversity of the plants. Both types of *pekarangans* have the same level of diversity, as indicated by the number of individual plants that are almost the same in number per 100 m^2. In addition, a strong and positive correlation (0.69–0.88) between the area of *pekarangan* and the number of individual plants indicated that the small to medium size or large *pekarangan* sizes had almost the same diversity of plants. The difference lied in the type of plant that is cultivated. Migrant *pekarangans* are dominant in cultivating food crops, while non-migrant *pekarangans* are dominant in cultivating ornamental plants. The selection of plants that have important and valuable functions can be a solution in maintaining the area of the *pekarangan*. Choosing plants with a variety of functions can be an option for a small to medium *pekarangan* size. To improve the biophysical conditions of the *pekarangan* was also inseparable from the involvement of economic, social, and cultural aspects in the *pekarangan*.

Keywords: horizontal diversity, preferences, Sundanese ethnic, transmigration program, vertical diversity

INTRODUCTION

Pekarangan is a typical Indonesian home garden associated with the house (Arifin et al., 1998; Arifin et al., 2012; Hakim, 2014). As was the case with landscapes typical of other countries such as *satoyama* in Japan (Indrawan et al., 2014), *kihamba* in Tanzania (Santoro et al., 2020), and permaculture in Australia (Mollison, 1979), the *pekarangan* had its own characteristics, that is, the vegetation structure was characterized by a combination of multilayer plants, ranging from trees to shrubs, as well as its integration with livestock and fish. (Arifin et al., 1997). The condition of the garden can describe the relationship between the owner and the ecological characteristic of their environment (Kiesling and Manning, 2010). Therefore, *pekarangan* as a landscape unit must have various functions, ecologically, economically, and socio-culturally (Irwan and Sarwadi, 2017).

The research that has succeeded in identifying the function of the home garden ecologically, such as the home garden as a reservoir of plant diversity (Caballero-Serrano et al., 2016; Chatterjee et al., 2017; Gbedomon et al., 2017), especially traditional food crops (Galluzzi et al., 2010), non-timber forest products (Mohri et al., 2013), shade plants, and ornamental plants (Abebe et al., 2010), increased food diversity and family nutrition (van der Stege et al., 2010; Caballero-Serrano et al., 2019; Thamilini et al., 2019), such as fruit crops, vegetables (Mohri et al., 2013; Ali, et al., 2021), medicinal plants (Abebe et al., 2010), spice plants, and starch-producing plants (Arifin et al., 2012).

The role of the *pekarangan* was very important for biodiversity conservation and urban planning. Diverse garden plants have directly helped plant conservation activities (Webb and Kabir, 2009; Idohou et al., 2014). The types of plants that were planted came from the components of trees, bushes, and ground cover plants. (Arifin et al., 1998; Webb and Kabir, 2009). It has indirectly provided a habitat for wildlife, such as a variety of birds and other animals (Muwav and Bekessy, 2017). For urban planning, the home garden (*pekarangan*) is a green open space that is close to the family (Coolen and Meesters, 2012). In addition, the yard also has the function of increasing food for the family (Drescher et al., 2006). Therefore, *pekarangan* plants can also ameliorate the microclimate in urban areas (Budiastuti et al., 2018).

The transmigration program has been one of the flagship programs of the Indonesian government since the new order era until the reformation era (Titus, 1992; Fearnside, 1997; Ricklefs, 2008; Prihatin, 2013). The transmigration program aimed to improve the welfare of transmigrants and their surrounding communities, increase and equalize regional development, and strengthen national unity and integrity (UURI No.15 Year 1997). Each family who got this program received 0.25 ha of land for the house and garden (*pekarangan*) and also got 2 ha of farm land. Among the ethnicities on the island of Java who received this transmigration program was Sundanese ethnic (West Java) (Nyhus and Sumianto, 1999). One of the transmigration areas that had been developed since 1952 was the Purbolinggo sub-district (previously it was part of the Central Lampung Regency, but in 1999, a new regency was formed: East Lampung Regency so that the Purbolinggo sub-district became part of it). Lampung became the first and largest transmigration destination province by the government (Titus, 1992; Nyhus and Sumianto, 1999) not only for reasons of its strategic geographical position but also in terms of demographic aspects (Khoiriyah et al., 2019).

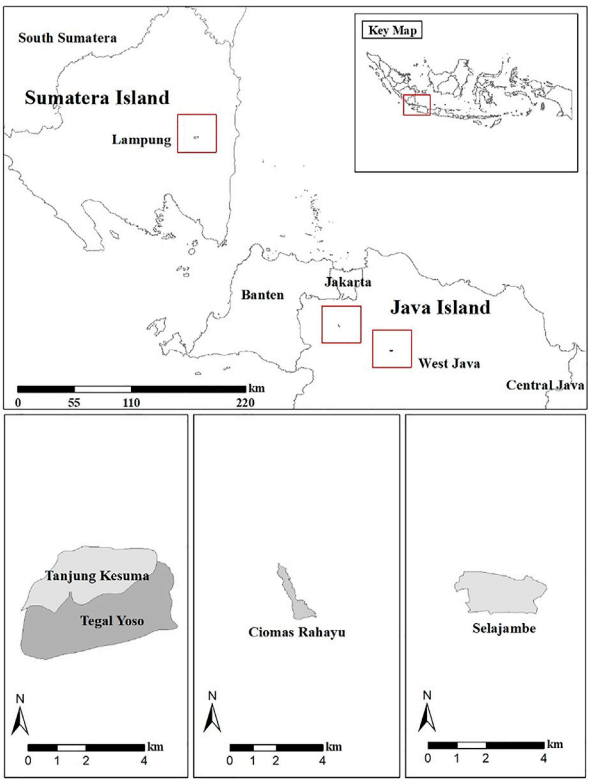


FIGURE 1 | Study site of Sundanese migrant and non-migrant *pekarangans* in Purbolinggo, Lampung, and Bogor—Cianjur, West Java Province.

Biophysical conditions of the *pekarangan* in a transmigration area are reported from various studies. The condition of *pekarangan* sustainability in the transmigration area at Central Sulawesi Province has been studied by Kehlenbeck and Maass (2006). The comparison of *pekarangan* species diversity in transmigration and non-transmigration areas has been reported by Kehlenbeck et al. (2007). Research about the *pekarangan* also reported the policy of intensification of the *pekarangan* in the transmigration settlement unit IV SP-6 Alue Peunyareng (Rananggono, 2012) and the importance of optimizing *pekarangan* as a model for developing transmigrant areas, Waplau District, Buru Regency, and Maluku Province (Nugraha et al., 2015). The use of a *pekarangan* with the agroforestry system in Sidomulyo Village, Katingan, Central Kalimantan, has been reported by Yustha (2017).

The results of research in the Sundanese *pekarangan* reported increasing the function of fruit and vegetable plants in Bogor and Cianjur (Ali et al., 2021). The ecological minimum size of the *pekarangan* was found to be 100 m^2 (Arifin et al., 1997; Arifin et al., 1998). The *pekarangan* was used as a place to increase food

TABLE 1 | Characterization of study sites.

Characterization variable	Migrant	Non-migrant
No. of sample (n)	40	40
Villages	Tegal Yoso—Tanjung Kesuma	Selajambe—Ciomas Rahayu
Sub-districts	Purbolinggo	Sukaluyu—Ciomas
Regencies/districts	East Lampung	Cianjur—Bogor
Provinces	Lampung	West Java
Kind of areas	Rural	Rural—Suburban
Year of transmigration	1952–1953	-
Distance from the nearest city (Km)	14	9–12
Elevation (m)	25–55	200–316
Rainfall/years (mm)	2,000–2,500	1,000–4,000
Average of temperature (°C)	27.8	26.5–27
People/household	4	4
Average of income/month (IDR)	1,000,000–1,505,000	1,500,000–2,700,000
Major employment	Farmer	Self-employed

diversity and nutrition for family (Azra et al., 2014) as household income (Antoh et al., 2019) and the commercialization of the *pekarangan* as a place to plant commercial crops (Prihatini et al., 2018; Abdoellah et al., 2020). The size of the non-migrant *pekarangan* was reduced due to urbanization factors (population, economic, and technological growth) (Seto, 2011; Ali et al., 2021) and the *pekarangan* land was fragmented by inheritance system, sale, and construction of new buildings (Arifin et al., 1998; Azra et al., 2014; Ali et al., 2021). Are there any differences of biophysical conditions between Sundanese migrants' and non-migrants' *pekarangan*? Therefore, the purpose of this article was to compare biophysical conditions of *pekarangan*s between Sundanese migrants' and non-migrants' *pekarangan*.

METHODS

Study Sites

The study areas of this research were located in Selajambe—Ciomas Rahayu Village, West Java, Indonesia; and in Tegal Yoso—Tanjung Kesuma Village, the transmigration area of East Lampung (**Figure 1**; **Table 1**). Research in Selajambe—Ciomas Rahayu was conducted in October–December 2019, and research in Tegal Yoso—Tanjung Kesuma was conducted in June–July 2021. Selajambe—Ciomas Rahayu village was chosen to be the representative of the Sundanese living on the island of Java, while Tegal Yoso—Tanjung Kesuma Village was chosen due to majority of the population being Sundanese who transmigrated to the East Lampung area. Selajambe—Ciomas Rahayu village was chosen due to being a rural area, and also, the average proximity of these villages to the city center (economic activities) ranges from 9 to 14 km. There were 40 *pekarangans taken* from each study area, so the total number of samples was 80 *pekarangan*s. The samples were determined by the purposive sampling technique (Sundanese). The number of samples was determined according to the sample determination by Arifin et al. (1998) and Ali et al. (2021). In total, 10 samples in Ciomas Rahayu Village and 30 samples in Selajambe Village were based on the representation of the number of *pekarangan* in the research location, respectively. Therefore, the villages of Tegal Yoso and Tanjung Kesuma followed these provisions to make comparisons easier. By collecting the data during the COVID-19 pandemic, we conducted research by implementing strict health protocols. We also collected some respondent data by an online survey.

Biophysical Conditions of a *Pekarangan*

To analyze the biophysical conditions of a *pekarangan*, there were four minimal variables of a *pekarangan*, that is, measuring the area and size, *pekarangan* zoning, number of species and individual plants per *pekarangan*, and the vertical diversity and horizontal diversity of plants. In this article, some of the *pekarangan* conditions of the *pekarangan* are measured such as the *pekarangan* area (m^2), size of the *pekarangan* (small to extra larges), the zone of the *pekarangan,* the number of species and individual plants per *pekarangan*, and the vertical and horizontal diversity of plants. In addition, this study also calculated the effect of the *pekarangan* area on the number of individual plants per *pekarangan*. These measurements were carried out to show the differences of biophysical conditions of the *pekarangan* between Sundanese migrants and non-migrants.

The area of the *pekarangan* (m^2) and the size of *pekarangan* are the important things in ecological value because the owner can use it to plant various plants, especially tree species. This can provide natural shade, provide fresh air, and also benefit from the fruit. In addition, the area of the *pekarangan* can also be a water catchment area when it rains, so that it becomes a source of water reserves that can be used for plants. Loss of yard area due to conversion to other uses will cause impacts such as the increase in temperature around the house because of the unavailability of land to plant trees, making the air feel hotter, causing large run-off when it rains, and causing puddles. Although currently small *pekarangans* are widely used with vertical garden patterns and potted plants, shade functions, fresh air, and water absorption cannot be provided well by a small *pekarangan*.

The *pekarangan* sizes (Arifin et al., 1998) were determined by data-centered descriptive statistics (Kaur et al., 2018), such as the mean, median, minimum value, maximum value, and standard deviation.

TABLE 2 | Criteria of vertical and horizontal diversities of plants.

Diversity	Information
Vertical	Plant height
V	Tree > 10 m
IV	5 m < large shrub, small tree ≤ 10 m
III	2 m < bush height, small shrub ≤ 5 m
II	1 m < herb, bush ≤ 2 m
I	Grass and shrubs ≤ 1 m
Horizontal	Plant function
1	Ornamental plants
2	Fruit plant
3	Vegetable plant
4	Spice plant
5	Medicinal plants
6	Starch-producing plants
7	Industrial raw material plant
8	Other crops (producing feed, firewood, shade, etc.)

Sources: Arifin et al. (1998); Arifin et al. (2010); Arifin et al. (2012).

$$u = \text{Land Area } (m^2) - \text{Building Area } (m^2), \quad (1)$$

$$\hat{u} = \frac{1}{n}\sum_{i=1}^{n} ui. \quad (2)$$

u = *pekarangan* area. $\hat{u}$ = average *pekarangan* area. ui = area of the i-th *pekarangan*. n = number of sample *pekarangan*s

The *pekarangan* sizes were then grouped into Small ≤ 120 m^2, 120 m^2 < Medium ≤ 400 m^2, 400 m^2 < Large ≤ 1,000 m^2, and Extra Large > 1,000 m^2 (Arifin et al., 2012). The zoning of the *pekarangan* divided the *pekarangan* into four zones, that is, the front *yard*, left yard, right yard, and backyard (Arifin et al., 1998; Arifin et al., 2010). The number of species and individual plants per *pekarangan* was determined per 100 m^2. The same unit area was needed to compare (Peng et al., 2018) the number of plant species and individuals in migrants' and non-migrants' *pekarangans*. Vertical diversity was the grouping of plants based on the plant height, and horizontal diversity was the grouping of plants based on the plant function (**Table 2**) (Arifin et al., 1998; Arifin et al., 2010; Arifin et al., 2012).

Simple linear regression analysis was largely used to analyze between two biophysical conditions (Nelson, 2009) and also was conducted to see the effect of the *pekarangan* area on the number of individual plants in each location. Calculations and data processing were carried out in Microsoft Excel 2016. Shorting data was carried out to discard data with a high error value.

Knowing the biophysical condition of the *pekarangan* based on the type of migrants and non-migrants from the same ethnicity (Sundanese) provides evidence that whether different *pekarangan* areas and sizes of the *pekarangan* will have an impact on different plant diversities, both in species and number of individuals.

RESULTS AND DISCUSSION

Characterization of Study Sites

As a comparison area for the native Sundanese ethnic, Selajambe and Ciomas Rahayu villages were chosen. They are located in the West Java Province. The population of two villages consisted of 80% of the original residents (Sundanese Bogor and Cianjur), and 20% were immigrants (Sundanese from another area). These two villages were characterized by rural areas that have been heavily affected by urbanization. There were fewer people working as farmers. Many residents switched to work as entrepreneurs or Indonesian migrant workers (TKI) in foreign countries (Kertawibawa and Harun, 2012). The average income of the population was 1.5–2.7 million rupiahs/person/month. The increasingly expensive prices of basic necessities have forced residents to switch jobs to more promising sectors. In the Selajambe Village, there were still irrigated rice fields, but their existence continued to be eroded by the construction of garment factories. This development occurred because this village was traversed by the highway that connected Cianjur and Bandung. This definitely affected the biophysical conditions of the area including the *pekarangan*.

Lampung province has been known as a transmigration area since the Dutch colonial era. The transmigration program in Lampung province, specifically in East Lampung Regency, occurred in the period 1952–1953. Most of the people who transmigrated came from the island of Java (Sundanese and Javanese ethnics). Purbolinggo, as one of the sub-districts in the East Lampung Regency, consisted of Sundanese transmigrants. Tegal Yoso and Tanjung Kesuma villages were villages where the majority of them were Sundanese ethnic. The population of the two villages was 45% from Bandung, 40% from Sumedang, 13% from Tasikmalaya, and 3% from Majalengka, West Java Province. The annual rainfall and temperature in the Purbolinggo sub-district were suitable for people to carry out agricultural activities. Both villages were characterized by rural areas with the main commodities, such as rice and corn. The agricultural land system was based on the irrigation system. In December, usually farmers planted rice, and in June, farmers planted corn. The distance between two villages and Sukadana (the capital city of East Lampung Regency) was about 14 km. The two villages were also close to the Sumatran East Coast National Road. The average monthly income of residents who work as farmers was 1–1.5 million rupiahs/person/month. This number was higher than the Lampung poverty line, which was IDR 457,495/person/month.

Pekarangan: Performance, Area, Size, and Zone

The dynamics of changes that occurred especially in non-migrant *pekarangan*s were strongly influenced by urbanization factors. In Arifin et al. (1998), when the first research of a *pekarangan* had been conducted in those locations, the average area of the *pekarangan* in Selajambe—Ciomas Rahayu was 364.7 m^2. In 2019, the average area of the *pekarangan* was 150.7 m^2 (Ali et al., 2021), it was from the medium size in 1998 to be the small size in 2019. The reason of decrease was due to urbanization during 2 decades (1998–2019). The four urbanization factors that mostly influenced changes in the *pekarangan* were the increasing level of education, the use of technology, the increase in the average income of the community, and the increase in the built-up area (Ali et al., 2021). It happened because the economic development of the

TABLE 3 | Area of Sundanese migrant and non-migrant *pekarangans*.

Variable	Migrant	Non-migrant
Mean (m^2)	733.1[a]	150.7[a]
Median (m^2)	689.0[a]	85.8[a]
Minimum (m^2)	215.0	5.0
Maximum (m^2)	1994.0	748.0
Standard deviation	371.8	184.1

[a]*Means and medians in a row are significantly different at* p *0.05.*

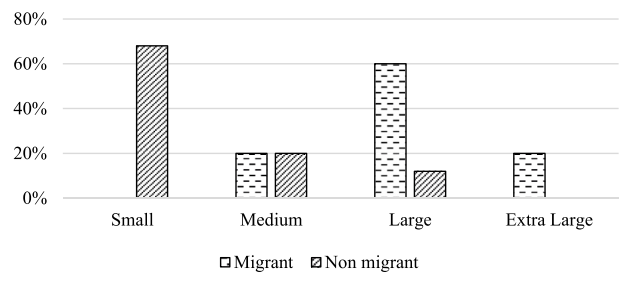


FIGURE 2 | Size of Sundanese migrant and non-migrant *pekarangans*.

TABLE 4 | Average number of species and individual plants of migrant and non-migrant *pekarangans* per 100 m^2.

Pekarangan	Number of plants	
	Species	Individual
Migrant	4	50
Non-migrant	19	53

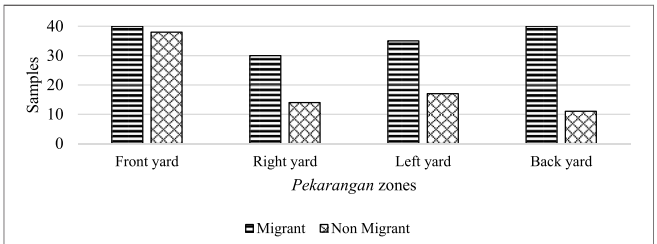


FIGURE 3 | Zones of Sundanese migrant and non-migrant *pekarangans*.

island of Java was much higher than the island of Sumatra. The level of education and ease of access to technology made the development of rural areas into suburban and even urban areas faster. The need for a place to live or a place to sell was also an important reason so that the *pekarangan* land became the first land to be converted into the new building. For the Sundanese themselves, the *pekarangan* became one of the inheritances that were divided among the children, thus making the *pekarangan* land fragmented and its size from medium to small. It was also happening in the migrant *pekarangan*. The *pekarangan* land that used to be large was handed down to children as a land to build a place to live (house). Although the decrease in the *pekarangan* area was still small, it was proven that the current *pekarangan* size was 80% large and extra-large. Does the difference in the size of the *pekarangan* between a migrant and non-migrant one affect the diversity of species and individual plants? This will be explained in the species and individual plants of *pekarangan* sections.

The performance of the migrant *pekarangan* is not much different from the non-migrant one. They still brought Sundanese habits and culture to the transmigration area. The difference was showed by the different sizes of the *pekarangan*. Migrant *pekarangans* were wider because the transmigration program provided land to build houses and *pekarangan*s on average of 0.25 ha. Currently, the average land area has been only 1,200 m^2. Since 1952 until now, the average *pekarangan* area of his/her house is 733.1 m^2 (large size), and 80% of the migrant *pekarangan* size is still in large and extra-large sizes (**Table 3**; **Figure 2**). The median value indicated that the size of the migrant *pekarangan* was ecologically well. Its size was above the minimum size of 100 m^2, while the non-migrant *pekarangan* was already below 100 m^2 (Arifin et al., 1998).

The front yard zone was almost found in migrant and nonmigrant *pekarangans* (**Figure 3**). The existence of a right and left yard in migrant *pekarangans* was higher than that of the non-migrant one and also the existence of a backyard. The front yard is still predominant because it is an important part of the house and can be used as a welcoming area. By that reason, the front yard was planted with many ornamental plants and other decoration stuff. Furthermore, the front yard was a characteristic sign of a house. It was shown by the Sundanese *pekarangans*. The other three zones began to decline due to the widening of houses or the construction of new buildings, for example, store, garage, etc. (Azra et al., 2014; Ali et al., 2020). Another reason for their decline in existence was due to being sold (Ali et al., 2021). The front yard zone was expected to be the most durable zone in a *pekarangan* because it had an important role and function for householders, especially the small *pekarangan* in urban areas. Nowadays, the front yard is not only being planted with the ornamental plants but also planted with vegetables, fruits, medicine, and spice plants. In particular, during this COVID 19 pandemic, many householders used their *pekarangan* while at home (work from home) for gardening, exercising, and other activities (Arifin et al., 2021; Montefrio, 2020; Sofo and Sofo 2020). However, in Arifin et al. (1998), the potential zone to be the most durable zone was the backyard. It was considered to be a potential space for biodiversity conservation such as food and medicinal plants, livestock, and fish ponds. The front yard was prone to change because it had a huge potential of being used for the construction of new buildings such as stall, workshop, and garage. (Arifin et al., 1998). Those activities were believed to have a positive influence in maintaining and increasing the immunity of the human body both physically and psychologically (Clatworthy et al., 2013; Buck, 2016; Soga et al., 2017; Corley et al., 2021). Because of that, the *pekarangan*, as the closest landscape unit in the house, was considered to be the best choice for doing those activities. This

FIGURE 4 | Conditions of the Sundanese migrant **(A)** and non-migrant **(B)** *pekarangans*.

phenomenon was occurring in urban, suburban, and rural areas (Sofo and Sofo, 2020).

Sundanese migrants and non-migrants lived close to their families. It has been proven by the position of their house. There was a place to dry agricultural products (rice or corn) in the front yard of Sundanese migrants' *pekarangan* (**Figure 4A**). The front yard, called *buruan* in Sundanese, was not only planted with ornamental plants such as in non-migrant *pekarangans* but also planted with food crops, for example, fruits, vegetables, spices, medicine, etc. (**Figure 4A**). The characteristics of the front yard of the Sundanese non-migrants were dominated by ornamental plants (**Figure 4B**). The majority of the front yards of non-migrants have been paved with concrete, asphalt, or cone blocks, while for non-migrants, the front yard was still left with soil. In migrant *pekarangans,* almost all the vegetations were directly planted on the ground, without the use of pots or planter boxes, while in non-migrant *pekarangans*, they planted them in pots or planter boxes.

Plant Species and Plant Individuals of the *Pekarangan*

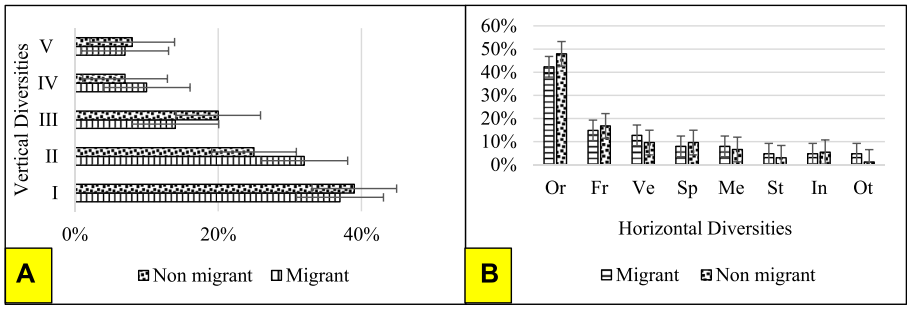
The difference in the average number of species planted in *pekarangan* migrants and non-migrants was different, but the number of individual plants was almost the same. This indicated that per 100 m^2 of the *pekarangan* area had almost the same number of individual plants, although the number of species was different (**Table 4**). The difference in the number of species occurs because the average area of the *pekarangan* was different. The average area of 150 m^2 in non-migrant *pekarangan* was used to plant various types of plant species as much as possible, both for ornamental and food functions. This also indicated that both migrant and non-migrant *pekarangans* were being used well by their owners. This can be seen in the number of individual plants which are almost the same in every 100 m^2 of the *pekarangan* area. The differences in the number of species depend on the type of plant (ground cover plants to high trees). In the migrant *pekarangan*, it was proven by three plant species with a large number of individuals, such as kale, leek (vegetable), and cassava (starch). In non-migrant *pekarangans*, it was also proven by 19 plant species with 53 individual plants. The plant species consisted of *Pleomele*, wild tea, euphorbia, *Sansevieria*, aloe vera, cordyline, asplenium (ornamental), banana, rambutan, mango, papaya, jackfruit (fruit), tree spinach, *Polyscias* (vegetable), turmeric, cayenne pepper, galangal (spice), sweet potato, and cassava (starch).

Vertical and Horizontal Diversity of Plants in a *Pekarangan*

The vertical diversity of plants in the *pekarangan* showed plant strata ranging from ground cover to high trees because the *pekarangan* looked like a forest which had layers of plants. In addition, there was also horizontal diversity which groups plants according to the functions mentioned by the owner of the *pekarangan*. Therefore, the use of plants in each ethnic was different. It was influenced by culture, mainly culinary and belief systems. The differences in the vertical diversity and horizontal diversity of plants between migrant and non-migrant *pekarangans* were not much different.

The total species of plants in migrant and non-migrant *pekarangans* were 189 and 167 species, respectively. From that number, it was clearly divided into the vertical diversity and horizontal diversity. In vertical diversity of plants in the *pekarangan*, there were 14 species in stratum V in both migrant and non-migrant *pekarangans*. There were 19 and 12 species of stratum IV in migrant and non-migrant *pekarangans*. There were 26 and 34 species of stratum III in migrant and non-migrant *pekarangans*. There were 61 and 42 species of stratum II in migrant and non-migrant *pekarangans*. Therefore, there were 69 and 65 species of stratum I in migrant and non-migrant *pekarangans*. The total ornamental (Or) and fruit (Fr) plants in migrant and non-migrant *pekarangans* were 80 and 28 species, respectively. The total vegetable (Ve), spice (Sp), medicine (Me), and starch (St) plants in migrant and non-migrant *pekarangans* were 24 and 16, 15 and 16, 15 and 11, and 9 and 5 species, respectively. The total industrial (In) plants in both migrant and non-migrant *pekarangan* were 9 species, respectively, and the last one, other (Ot) uses of plants were 9 and 2 species, respectively.

In **Figure 5A**, it can be seen that the condition of the vertical diversity of *pekarangan*s in migrants showed the presence of stratum I (height of plant under 1 m), which was higher than the other four strata. The interesting one was that the percentage of strata IV (height of trees 5–10 m) and V (height of tree > 10 m) was almost the same between the two research sites. It indicated



Ornamental (or), Fruit (Fr), Vegetable (Ve), Spices (Sp), Medicine (Me), Starch (St), Industrial (In), and Other (Ot) use of plant.

FIGURE 5 | Vertical diversity **(A)** and horizontal diversity **(B)** of plants in migrant and non-migrant *pekarangans*. Ornamental (or), fruit (Fr), vegetable (Ve), spices (Sp), medicine (Me), starch (St), industrial (In), and other (Ot) uses of plants.

that plants with a height of more than 5 m were still present in non-migrant *pekarangan*s, even though the size of the *pekarangan*s has declined. The tree plants that were maintained a lot must have had more functions for the owner. These trees usually had ecological functions such as climate amelioration (shelters) and food functions (fruit trees). The existence of shady trees, especially in sub-urban *pekarangan* areas such as Ciomas Rahayu Village, was still widely maintained.

In **Figure 5B**, the horizontal diversity of *pekarangan*s in the two research locations was also not too different. Ornamental plants still dominated among the eight functions of *pekarangan* plants. It was in accordance with the results of research Ortiz-Sanchez et al. (2015) and Irwan and Sarwadi, (2017) which stated that the home garden was dominated by ornamental plants. Ornamental plants in non-migrant *pekarangan*s were higher than migrants due to urbanization. The urbanized *pekarangan*s were dominated by ornamental plant species (Ali et al., 2021). *Acalypha siamensis* (wild tea) as an ornamental plant and *Musa paradisiaca* (banana) as a fruit plant were most commonly found in migrant and non-migrant *pekarangans*. This was in accordance with the conditions of rural *pekarangans* which were widely planted with ornamental and fruit plants (Mathewos et al., 2018; ElfridaMubarak and Suwardi, 2020) *Curcuma longa* Linn. (curcuma) as a spice plant was most commonly found in migrant and non-migrant *pekarangans* as well. In rural areas, there are still many people who grow plants for spices and seasoning in the *pekarangan* (Zuberi et al., 2014; Villa and García, 2017). Plants with other functions were more commonly found in migrant *pekarangans*. Plants with other functions are plants that function other than for food (Arifin et al., 1998), such as land boundary marker plants (*Cordyline fruticose* L. and *Dracaena fragrans* L.) (Werdiningsih, 2007) and fodder plants (*Pennisetum purpureum*), which were often found in rural *pekarangans* Schumach (Ivanova et al., 2021).

Correlation Between *Pekarangan* Size and the Number of Individual Plants

The effect of the *pekarangan* area was analyzed by simple linear regression and resulted in the effect of *pekarangan* area on the number of individual plants. In the migrant *pekarangan* (**Figure 6**), it can be seen that the regression graph showed a positive linear line, where upon the addition of 0.3905 m of the *pekarangan* area, the number of individual plants will be added. However, the concerned variable in this analysis is the x-value (increase in the area of the *pekarangan*). The r value (0.69) of the migrant *pekarangan* was in the category of strong correlation (Ridwan Aldila Melania Care et al., 2018), with a significant value = 0.000 < 0.05. The 48.02% of the number of plants can be explained by the influence of the *pekarangan* area and the other influences came from outside variables of the analysis.

In the non-migrant *pekarangan* (**Figure 6**), it can be seen that the regression graph also showed a positive linear line, where upon the addition of every 1 m^2 of the *pekarangan* area, the individual plants will increase by 0.4205. The r value (0.88) of non-migrant *pekarangan*s was in the category of strong correlation (Ridwan Aldila Melania Care et al., 2018) with a significant value = 0.00 < 0.05. There are 77.77% of the number of plants that can be explained by the influence of the *pekarangan* area and the other influences also came from outside variables of the analysis. From the regression graph, it was found that the area of the non-migrant *pekarangan* was very strongly correlated with the number of plants in the *pekarangan*.

It can be seen that the area of the *pekarangan* had strong to very strong correlations (0.69–0.88) with the number of individual plants. Although migrant and non-migrant *pekarangans* have different areas, they have a strong relationship with plant diversity. The larger the *pekarangan*, the greater is the diversity of the plants. It was different from the findings of Antoh et al. (2019) on their *pekarangan* research in Arguni Bawah, West Papua Province, where they found a large *pekarangan* with low diversity of plants (the correlation was positive, but weak). It was proven by the comparison of plant diversity (number of individual plants) per 100 m^2 of the *pekarangan* area. Adjustments were made to the area of the *pekarangan* owned. The large *pekarangan* was planted with a large number of individuals, although the variety of species was little. The small *pekarangan* was being planted with a large variety of species but the number of individuals/species was the same as the large *pekarangan* as well per 100 m^2. Wherever the Sundanese

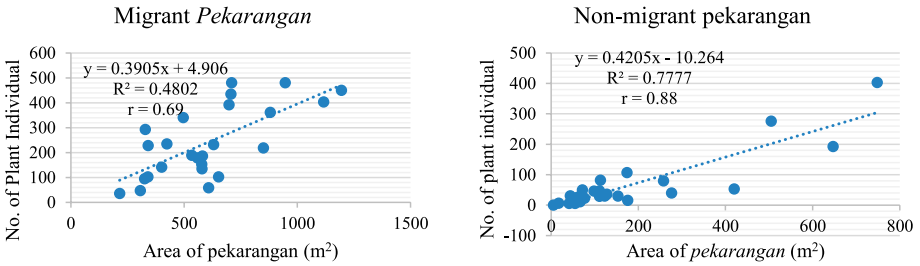


FIGURE 6 | Influence of the *pekarangan* size and the number of individual plants of migrant and non-migrant *pekarangans*.

lived, whether the size of *pekarangan* was large or small, the plant diversity of the *pekarangan* was high. It was due to their habit and culture. Mazumdar and Mazumdar (2012) stated that there was a functional value between the garden (plant diversity) and the family and culture.

Differences in conditions of migrant and Sundanese non-migrant *pekarangans* can be seen from the different types of plants planted. In migrants' *pekarangan*, plants from food types dominated, while in non-migrants' *pekarangan*, plants with ornamental functions dominated. This could be due to urbanization factors that are more influential on the Island of Java so that the dominant types of plants planted were also different. It must be improved so that the use of food plants also dominated in addition to the ornamental plants in small-medium sizes of the *pekarangan*.

Improving *Pekarangan* Conditions

All types of *pekarangan* sizes can display plant diversity. However, in non-migrants' *pekarangan*, the use of plants for food was still less when compared to migrants' *pekarangan*, so that the selection of multifunctional vegetation types can be suggested. In migrants' *pekarangan*, the potential for the loss of *pekarangan* area in the future was quite high due to development and urbanizations. Therefore, steps are needed in the utilization *pekarangan* so that the area can be maintained. So we made some considerations that can be applied to improve the condition of the *pekarangan*, both for migrant and non-migrant and other types of *pekarangans*.

First: a large *pekarangan* can be planted with various types of plant species in various functions. These can fulfill the criteria for the existence of vertical and horizontal diversities of plants. The valuable and important plants can be planted in the *pekarangan*, such as commercial crops (Abdoellah et al., 2020). Based on experience, the area of the *pekarangan* can exist if there was something valuable in it.

Second: for non-migrant *pekarangans*, a small *pekarangan* area was not a problem to display a shady and green *pekarangan*. Currently, there are many farming systems that do not require a lot of land for gardening, such as vertical gardens (do Valle Santos et al., 2019), hydroponic systems (Lal et al., 2020; Solis-Topanta et al., 2020), fish farming in buckets, hanging gardens, rooftop gardens, and planter boxes (Lal et al., 2020). These systems can be applied in the *pekarangan* to grow mainly vegetables, medicine, herbs, fruits, starch-producing shrubs, or herbs (Azra et al., 2014; Jesica et al., 2019), and wherever possible annual plants are chosen to be more sustainable. Although the area of the *pekarangan* was small, the diversity of species and individual plants remains high. Sundanese, who were attached to the culture of eating *lalap* (raw or boiled vegetables) should maintain this habit (way) (Septiani et al., 2020). They can grow various types of vegetables, apart from shrubs or herbs, but also from tree species, for example, *petai* (*Parkia speciosa* Hassk.), *jengkol* (*Pithecellobium jiringa* (Jack) Prain), *melinjo* leaf (*Gnetum gnemon* L.), *moringa* leaf (*Moringa oleifera* lamk.), and cashew leaf (*Anacardium occidental* L.). Therefore, the vertical diversity function existed too. In addition, high trees can also be a shelter, climate amelioration, windbreak (Turner-Skoff and Cavender, 2019), carbon sequestration (Mattsson et al., 2015), and as a place to live for wild animals (Turner-Skoff and Cavender, 2019). This would very well be applied on a regional scale where the owners of the *pekarangan* can form a community. It was widely evident in urban and sub-urban areas where the *pekarangan* size was small, and it gave a positive perception for urban communities (Grebitus et al., 2020; Wood et al., 2020). There were many related government programs from the Ministry of Agriculture *via* National Food Agency (BPN) that could be a way out in funding for *pekarangan* revitalization.

Third: to achieve a good condition, sustainability of the *pekarangan* did not only depend on improving the biophysical condition (*pekarangan* area, plant diversity) but also the positive role of economic, social, and cultural aspects (Mazumdar and Mazumdar, 2012; Antoh et al., 2019). As long as the *pekarangan* had these roles for its owner, its existence and biophysical condition will be good and sustainable. Therefore, the owner's preference in managing and utilizing *pekarangan* was an important factor to be considered because these three aspects were highly dependent on it. Therefore, campaigns on the need to maintain and improve biophysical conditions must continue to be carried out by the government and non-governmental organizations (NGOs) to create higher public awareness. Environmental awareness can be effectively carried out by social media, and it made a positive impact for the environment (Ragusa and Crampton, 2017; Kuppuswamy, 2018). Several activities and programs by both the government and NGOs continued to grow, especially those related to the use of *pekarangans*. The existing government programs are "Sustainable Food from *Pekarangan*" (P2L), Family Farming (PK), Creative Village Development, and Local Food Diversification (Asmoro et al., 2020; Food Security Agency,

2020). The examples from NGOs are Community of Indonesian *Pekarangan* and Productive Garden (KPKPID), Bogor Gardening, and other relevant communities. The main principle of these programs was how the *pekarangan* can be used as productively as possible. Group members can exchange ideas and experiences in utilizing the *pekarangan*. In addition, community members can also share their seeds, seedlings, and crops. In the future, the *pekarangan* can be one of the potential tourism destinations that will be diverse and interesting.

CONCLUSION

Biophysical conditions of migrant and non-migrant *pekarangans* differed in area and size but not so much in terms of plant diversity. Both have good plant diversity but differ in the dominant types of vegetation planted in each type of the *pekarangan*. In migrants' *pekarangan*, the dominant individual plants came from food plants, while in non-migrants' *pekarangan*, ornamental plants were dominated. The criteria for correlation between the *pekarangan* area and its plant diversity in migrant and non-migrant *pekarangans* are strong and positive. It indicated that even though the area of *pekarangan* was different, it still had the same high diversity of plants. Planting important and valuable crops was an option to maintain the *pekarangan* area to still exist, especially in migrants' *pekarangan*. The selection of plant species that had a variety of functions can be an option for small and medium size in non-migrants' *pekarangan*. The improvement of biophysical conditions of the *pekarangan* must also be accompanied by the improvement of the economic, social, and cultural aspects with awareness actions on the importance of using the *pekarangan*.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MSA developed ideas and wrote down the contents of the manuscript. HSA contributed as the supervisor, corrected the content along with corresponding authors. NA contributed as the supervisor and corrector. MA contributed as the supervisor and corrector.

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