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# The impacts of traditional homegarden conversion into the commercial one: A case study in Sukapura Village of the Upstream Citarum Watershed, West Java, Indonesia

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**Abstract.** *Prihatini J, Iskandar J, Partasasmita R, Nurjaman D. 2018. The impacts of traditional homegarden conversion into the commercial one: A case study in Sukapura Village of the Upstream Citarum Watershed, West Java, Indonesia. Biodiversitas 19: 1926-1940.* In the past, rural homegardens in West Java were planted with various annual and perennial crops. As a result, the vegetation structure of traditional homegardens in rural areas of West Java, Indonesia was very complex, similar to that of forest vegetation. Nowadays, however, due to rapid development of market economic system in rural areas, many traditional homegardens in West Java have been converted into the commercial ones. Consequently, the structure and functions of the homegardens have drastically changed. For example, the vegetation structure has become simpler and dominated by commercial crops, and the gardens serve mostly economic function instead of providing various ecological, socio-economic and cultural functions. The aim of this study was to elucidate: (i) the ecological history of traditional homegardens, (ii) the changes of structure and functions of the homegardens converted from the traditional into the commercial one, and (iii) the positive and negative impacts of conversion of the traditional homegardens into the commercial ones in the Village of Sukapura, the Subdistrict of Kertasari, the District of Bandung, Upstream Citarum Watershed, West Java. The combination of qualitative and quantitative methods were used, while some techniques, including observations, and in-depth interviews with competent informants were applied in this study. The results of study showed that initially the traditional homegardens in Kertasari Village had been predominantly cropped with various annual and perennial crops. However, due to market economic development, the homegardens have been drastically changed. For example, the commercial vegetable crops, including Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L) and cabbage (*Brassica oleracea* var *capitata*) have been predominantly cultivated in the commercial homegardens. Consequently, the household income of the village people who own the commercial homegardens increased, however, some ecological and socio-cultural functions of the commercial homegardens drastically decreased. In addition, some negative impacts of the commercialization of the homegardens have occurred. We suggest that to develop the sustainable village homegardens for the future, the diversity of plants must be maintained to provide ecological function or ecosystem services and the economic production must be improved to increase the income of the rural people.

**Keywords**: Changes of homegarden, commercial homegarden, traditional homegarden, Upper Citarum Watershed

## INTRODUCTION

Homegarden is one of the traditional agroforestry systems which may be defined as "a piece of land with a definite boundary surrounding a home, cultivated with a diverse combination of perennial and annual plant species, having a multilayered vertical structure, and it is often used as a place for raising livestock, and managed mainly by household members for subsistence production." (Karyono 1990; Iskandar and Iskandar 2011; Iskandar et al. 2018).

According to environmental history, the rural homegarden of West Java has evolutionally devolved from forest ecosystem and culturally developed into the homagarden (*pekarangan*), the perennial mixed garden (*kebun campuran* or *talun*), the garden (*kebun*), and the rice field (*sawah)* (Iskandar and Iskandar 2011). The homegarden as one of traditional agroforestry systems has both subsistence and commercial functions. The subsistence production functions have been recognized as providing the household needs, including starchy or carbohydrate foods, spices, vegetables, ornaments, medicines, handicraft, and traditional materials for rituals, while the commercial production functions is providing cash income from the trade of production surpluses, including fruits (Iskandar and Iskandar 2016a; Iskandar 2017).

Initially the rural homegardens in West Java had been managed using the traditional ecological knowledge (TEK) and had been strongly embedded in local culture (cf. Toledo 2002; Iskandar 2010). In addition, it had been managed mainly for subsistence and not for commercial function (cf. Warton 1970). In the past, the homegardens were planted with high diversity of annual and perennial plants. Since homegarden is a man-made ecosystem, various plants planted in the homegardens have been determined by ecological factors, including altitude, water availability, soil condition, and climate, and by socioeconomic-cultural factors, including land size, education level, income, distance from market, and market development (Iskandar and Iskandar 2016a). The size of a

homegarden varies between less than 100 $m^2$ and more than 200 $m^2$ (Arifin 2013). There is a positive correlation between the size of a homegarden and the diversity and the number of individual plants in the homegarden (Karyono 1990; Iskandar and Iskandar 2016a). The results of inventory of the Indonesian homegarden plants of the framework of the consortium of genetic resources of conducted by the Agricultural Technology Research Centers in 2013, showed that the food, horticultural, spice and medicinal plants in the homegardens contributed of 17, 57, and 26%, respectively. The genetic resources of food crops in the homegardens which have been planted for a long time were considered as the ones adapted to the local environment and can be used for plant breeder programs (cf. Surat and Yaman 2017). As a result, the homegardens have played an important role in conserving genetic sources and in supporting food security referred to in the Act No. 18 of 2012 (cf. Saliem 2011). According to the reports of case studies in East Kalimantan and Bengkulu Provinces, the utilization of homegardens cultivated with high diversity of plants can support food self-sufficiency of the traditional people and village communities (Afrilia and Rizal 2015; Wiryono et al. 2016). However, unlike the village homegardens, the urban homegardens are usually small in size and have low diversity of plants, except for ornamental plants which are relatively high (Iskandar and Iskandar 2016a).

In the past, the homegardens got low external inputs, including seeds, inorganic fertilizers, and pesticides. However, since the homegardens have high diversity of plants, they have high stability, equitability, and resilience (cf. Soemarwoto and Conwey 1992; Kehlenbeck and Maass 2004; Arifin 2013; Iskandar and Iskandar 2016a).

The people in Sukapura Village initially owned traditional homegardens. However, in the last several decades, a lot of traditional homegardens in Sukapura Village have been converted into the modern ones, including by intensification of monoculture vegetable crops, due to many factors, particularly intensive market economic penetration. Consequently, several positive and negative impacts on ecological, socio-economic and cultural aspects have been inevitable. Some studies on changes of the homegarden were undertaken by some scholars, including Hadikusmah (2003), Kubota et al. (2003), Prihartini (2004) that were focused on vegetation structures and economic aspects. However, the study on changes of the homegardens in ecological and socio-economic-cultural aspects as in integrated systems has rarely been undertaken.

This paper elucidates: (i) the ecological history of traditional homegardens, (ii) the changes of structure and functions of the homegardens converted from the traditional into the commercial one, and (iii) the positive and negative impacts of conversion of the traditional homegardens into the commercial ones in the Village of Sukapura, Upstream Citarum Watershed, the Subdistrict of Kertasari, the District of Bandung, the Province of West Java, Indonesia conducted in 2004 (Prihatini 2004) and 2018.

## MATERIALS AND METHODS

### Study area

This research was conducted in 2004 in Sukapura Village, upper Citarum watershed, Kartasari Sub-district, Bandung District, West Java, Indonesia (Figure 1), and the results were used as baseline data (Prihartini 2004), while the updated data were collected in the same location in April 2018.

### Data collection

This study used a combination of quantitative and qualitative methods. The quantitative methods were applied to record species of plants in both the traditional and commercial homegardens. Total samples of 40 homegardens, consisting of 20 traditional homegardens and 20 commercial homegardens, were selected. Each unit of homegarden was considered as a plot. The species of every plant and number of individuals of each species in every plot were recorded.

The qualitative data were applied to collect social-economic aspects, including ecological history of land use types, particularly the homegarden ecosystems, homegarden functions, changes of farming practices of the homegardens. Some techniques including observation and interview were applied to collect primary data in the field. Observations were conducted to observe general local environmental conditions, such as that of settlement and homegarden, and homegarden vegetation. In-depth interviews with competent informants or local experts who were purposively selected were conducted (cf. Martin 1995; Iskandar 2012). The informants consisted of formal village leaders, hamlet leaders, informal/religion leaders, old farmers, vegetable farmers, village vegetable traders, village market traders, and village middlemen.

### Data analyses

The structure and floristic composition of homegardens were analyzed using some indexes, including Summed Dominance Ratio (SDR), Index of Similarity, and Index of Diversity. The qualitative data of social-economic aspects of the homegardens were analyzed by cross-checking to get valid data collected by observations.

*Summed Dominance Ratio (SDR)*

SDR index was used to analyze the plant species dominance and frequency of both the traditional and commercial homegardens. SDR was calculated using the formula below (Numata 1974; Iskandar and Iskandar 2016a):

$$SDR = (FR + DR) /2$$

Where;
SDR : Summed dominance ratio;
F : Absolute frequency;
FR : Relative frequency;
Di : Absolute dominance of species -i;
DR : Relative dominance

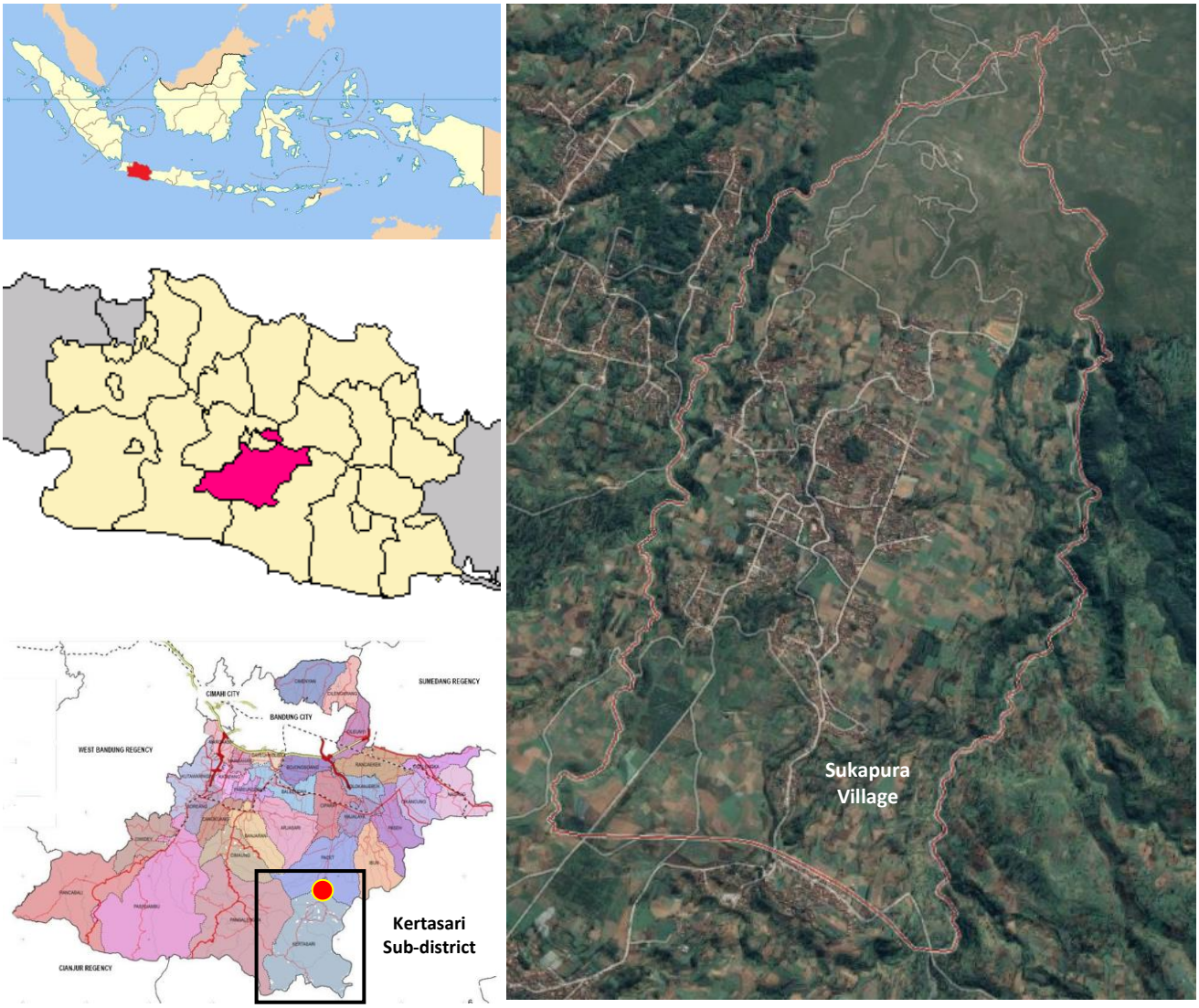


**Figure 1.** Map of location of study area in Sukapura Village (●), Kertasari Sub-district, Bandung District, West Java, Indonesia

These parameters were computed as follows:

$$F = \frac{Number\ of\ home\ gardens\ in\ which\ a\ particular\ species\ occurs}{Total\ homegarden\ samples} X100\%$$

$$FR = \frac{Frequency\ of\ species\ -\ i}{Sum\ frequency\ of\ all\ species}\ x\ 100\ \%$$

$$Di = \frac{Individual\ number\ of\ species\ -\ i}{ndividual\ number\ of\ all\ species} X100\%$$

$$DR = \frac{Dominance\ of\ species\ -\ i}{Dominance\ of\ all\ species}$$

The plant species which are found in many samples and have many individuals have a high-value index of SDR.

*Diversity index*

Diversity index is based on the relationship between the total number of individuals of plant present and the number of individuals per species of plant of the homegarden samples. In other words, diversity index integrates species richness and evenness into a single value. A measure diversity is useful when investigating the interactions of physical and biotic factors in an ecosystem, including human factors, particularly in the homegarden ecosystem (cf. Williams 1987; Magurran 1988; Iskandar and Kotanegara 1995).

The formula of diversity index of Shannon-Wiener is:

$$H' = -\sum_{i-1}^{n}\left[\frac{n_i}{N}\ ln\ \frac{n_i}{N}\right]$$

Where:

H' : The diversity index of Shannon-Wiener

ni : Total number of individuals of the i-th species in the samples

N : The total number of individuals of all species in samples

The diversity index can be used in analyzing the quality of communities, particularly in natural ecosystems, including forest ecosystem. The community, including homegarden, that has high diversity index has a good quality (Iskandar and Iskandar 2016a).

*Similarity index*

To compare the floristic communities of homegarden plants in different times, namely in 2004 and 2018, similarity index of Sørensen was used (cf. Mueller-Dombois and Ellenberg 1974; Iskandar and Iskandar 2016a):

$$ISs = \frac{2\,C}{A + B} \times 100\ \%$$

Where:

ISs : Index of similarity of Sørensen

A : Total number of plant species recorded in 2004

B : Total number of plant species recorded in 2018

C : Number of plant species common in both 2004 and 2008

IDS : Dissimilarity index is 100 %-ISS

High similarity index means that the homegardens in 2004 and 2018 have similar species composition.

*Analyses of social data*

The qualitative data of social aspects were analyzed by cross-checking, summarizing, synthesizing, and narrating (Newing et al. 2011). Cross-checking was carried out to check the validity of information based on the information obtained from different techniques, namely observation and in-depth interviews, and information from different informants. Moreover, the data were summarized, synthesized and made into systematic descriptions with descriptive and evaluative analyses.

## RESULTS AND DISCUSSION

### Study site

Administratively, Sukapura is one of the villages of Kertasari Sub-district, Bandung District of West Java, Indonesia (Figure 1). Sukapura Village has located about 52 km from Bandung city, the capital city of West Java, and has distance of approximately 39 km from Soreang, the capital of Bandung District.

Sukapura is bordered by other neighboring villages. To the north, it is bordered by Resmitingal Village of Kertasari, to the south by Cibeureum Village of Kertasari Sub-district, to the east by Cihawuk Village and Forest area of Kertasari Sub-district, and to the west by Girimulya Village of Pacet Sub-district (Sukapura 2016).

The agricultural land use types of Sukapura are homegarden (*pekarangan*), vegetable garden (*kebun sayur*), mixed-perennial crop garden (*kebon tatangkalan* or *talun*), bamboo talun (*kebon awi*), and rice field (*sawah*). Almost all households in Sukapura Village have homegardens. They obtained the homegardens by various means, mainly heritage, buying, and heritage and buying.

Sukapura Village is categorized as a village of highland located at an altitude of 1,300 m. The daily air temperature is between 20 and 24 degrees Celsius and the average rainfall is between 600-700 mm/month. Its high altitude makes Sukapura Village appropriate for vegetable farming. In recent changes of development, the commercial vegetable crops, including the Welsh onion (*Allium fistulosom* L), carrot (*Daucus carota* L) and cabbage (*Brassica oleracea* var *capitata*) were not only planted in the vegetable gardens but also in homegardens. As a result, Sukapura Village has been known as one of vegetable center areas of Bandung District, West Java.

According to the village statistical data, the total area of Sukapura Village is 596.7 Ha. The population of Sukapura in 2016 was 8,636, consisting of 4,415 males and 4,221 females with a total of 2,844 households (Sukapura 2016).

The main occupations of people are farmers (547 persons) and farmer labors (1,230 persons).In addition, various off-farm occupations, such as merchants of village stalls, peddlers, and carpenters are also found (Table 1).

### Ecological history and changes of the homegarden

According to ecological history, in the past, the upper Citarum watershed of West Java was predominantly forest. Like other upland areas of West Java, the forest of the upper Citarum watershed was traditionally used by local villagers for practicing the swidden cultivation (*ngahuma*) (cf. Iskandar and Iskandar 2011; Iskandar et al. 2017). The forest of the upper Citarum drastically changed due to the introduction of cultivation system (*cultuur stelsel* or *tanam paksa)* in Java between 1830 and 1870. The forests were predominantly planted with quinine/*kina* (*Cinchona pahudiana* Howard) and tea (*Camellia sinensis* (L.) Kuntze). In 1870, the cultivation system was abolished and the land was taken by private commercial plantation.

**Table 1.** Composition of people occupations in Sukapura Village, Kertasari Sub-district, Bandung District, West Java, Indonesia

| People occupations | Number of people (persons) |
|---|---|
| Free detailer | 2120 |
| Labor farmer | 1230 |
| Farmer | 547 |
| Merchant of village stall | 199 |
| Civil servant | 59 |
| Micro/Middle craftsmen | 42 |
| Livestock farmer | 30 |
| Peddler | 28 |
| Carpenter | 26 |
| Soil digger | 10 |
| Retired civil servant | 10 |
| Trained village healer | 9 |
| Mechanic | 8 |
| Businessmen | 6 |
| Servant of Army/Police of Republic of Indonesia | 6 |
| Army/Police of Republic of Indonesia | 4 |
| Barber | 3 |
| Midwife/Nurse | 3 |
| Total | 4,340 |

Note: Sukapura (2016)

Then, after the Indonesian Independence, the quinine and tea plantation were managed by Perkebunan Nusantara (PTPN) VIII based on '*Hak Guna Usaha'* (*HGU*-Plantation concession permit) and the permit expired at the end of 1997 (Kurniawan et al. 2011). Afterward, since the beginning of the Reform Order, some abandoned the quinine, and the plantation areas were illegally cultivated with commercial vegetable crops by farmers. At the same time with forest conversion to plantation, some rural people continuously practiced swidden farming. Furthermore, they established the settlement by converting the secondary forest to a farmhouse and developing into semi-permanent houses in a cluster called *catihan* and new hamlet (*babakan*) and more permanent hamlet (*kampung* or *ampian*). Then the forest areas decreased and the population increased, so the shifting cultivation was formally prohibited by the government. As a result, the traditional swidden farming was gradually changed to several agroecosystem types, including homegarden (*pekarangan*), wet rice field (*sawah*), perennial mixed-garden (*kebun campuran* or *kebon tatangkalan*) and *bamboo talun* (*talun bambu*). However, with the introduction of commercial vegetable crops, some traditional agroforestry systems, including the perennial mixed-garden and bamboo talun have been gradually converted into the commercial vegetable garden. Indeed, the effect of intensive farming of commercial vegetable crops in the gardens has caused the conversion of the traditional homegarden into commercial one.

According to the informants, in the period between 1900s and 1980s the homegardens in Sukapura Village were predominantly managed by traditional system which provided very low or zero inputs from outside or markets. The homegardens were planted with a variety of annual crops, including corn (*Zea mays* L), cassava (*Manihot esculenta* Crantz), banana (*Musa x paradisiaca* L), tomato (*Solanum lycopersicum* L), ginger (*Zingiber officinale* Roscoe), sand ginger/*kencur* (*Kaempferia galanga* L), tumeric/*koneng* (*Curcuma domestica* Valeton), sweet potato/ *hui boled* (*Ipomoea batatas* L), peanut (*Arachis hypogaea* L), and lemongrass (*Cymbopogon citratus* (DC) Stapf). In addition, some perennial crops, including fruit plants, such as common guava (*Psidium guajava* L), soursop/*sirsak* (*Annona muricata* L), jackfruit (*Artocarpus heterophyllus* Lam) and mango (*Mangifera indica* (L) Pulp) were also planted in combination with annual crops in the homegardens. Most production of the homegardens was mainly used for home consumption instead of being sold to obtain cash income. In the 1980s some traditional homegardens drastically changed into the commercial ones. At that time, potato (*Solanum tuberosum* L), cabbage (*Brassica oleracea* var *capitata*) and carrot (*Daucus carota* L) were first introduced and planted in the traditional homegardens in Sukapura Village. The seeds of those plants were brought from Cisarua, Lembang. As a result, between 1990 and 2004, 65% of respondents of the villagers of Sukapura adopted the commercial vegetable crops and drastically changed the traditional homegardens into the commercial ones (Prihartini 2004).

Moreover, since 2000s a lot of people of Sukapura Village have planted Welsh onion (*Allium fistulosum* L) in their homegardens. As mentioned by Hadikusumah (2003), the homegardens in Sukapura had been drastically changed from the traditional into the commercial one as indicated by the cultivation of mostly commercial vegetable crops, particularly Welsh onion (*Allium fistulosum* L) (see Figure 2). The villagers have perceived that farming the vegetable crops instead of other crops in the homegardens can provide benefits because the vegetable crops have relatively shorter harvest age and the produce can be sold at a high price. Generally, the produce of traditional homegarden crops is mainly for daily household home consumption, while that of the commercial homegarden crops is predominantly sold to middlemen or village market (Hadikusumah 2003). The external inputs, including seeds, chemical fertilizers, and pesticides of the commercial homegardens are high, while the external inputs of the traditional homegardens are very low, even zero. In addition, the diversity of plant species in the commercial homegardens is very low because the vegetation is dominated by only commercial vegetable crops. Conversely, the diversity of plant species of traditional homegardens is high. For example, staple food, spice, vegetables, and ornamental plants have traditionally been planted in the traditional homegardens.

**The traditional homegardens versus the commercial ones**

Initially, the homegardens in the villages of upper Citarum watershed of West Java, including Sukapura Village were managed by the traditional ecological knowledge embedded in the local culture (cf. Toledo 2002; Iskandar 2012). In other words, the characteristics of homegardens in Sukapura village depend on local environment, local natural resources, local knowledge, and local institutions. The homegarden farming systems continued to develop in constant interaction with local culture and local ecology. As conditions for farming changed, e.g., because of the village's population growth and intensive penetration of market economy systems into the village ecosystems, including introduction of commercial crops, the homegardens of local people of Sukapura also changed. Some people had adopted the commercial homegardens, including adoption of commercial vegetable crops, use of external inputs, such as vegetable seeds, chemical fertilizer, and synthetic pesticides. In addition, most yielde of the commercial homegardens is sold to middlemen instead of being used for daily household consumptions. However, at the same time some people also still maintain the traditional homegardens, including application of internal inputs, such as various local annual and perennial crops, and organic fertilizers. In addition, most produce of the homegardens is used for fulfilling the household needs instead of being sold to middlemen (cf. Wharton 1970; Reinjntjes et al. 1992).

According to the respondents, from 1970s to 1990, some traditional homegardens in Sukapura were gradually changed into the commercial ones (Table 2). As a result,

the commercial homegardens have been predominantly planted with commercial vegetable crops as both monoculture and polyculture instead of planting of various annual and perennial plants, namely vegetable, spice, starchy or additional staple food, fruit, , and ornamental plants. However, some people still maintain the traditional homegardens for the following reasons, namely tradition (45,0 %) and concern with subsistence needs (55 %) (Table 3).

**Plant species of the homegardens recorded in 2004 and 2018**

The direct survey of plant diversity of both traditional and commercial homegardens in Sukapura Village in 2018 found 171 plant species belonging to 74 families. The total number of plant species of the homegardens increased from that recorded in 2004 survey by Prihatini (2004). In 2004, the total number of plant species of both traditional and commercial homegardens was 134, belonging to 63 families (Prihatini 2004). The complete list of plant species recorded in 2004 and 2018 are presented in Table 4.

It can be seen in Table 4 that some plant species, namely *handeuleum, wortel, jinteun, alamanda, taleus hias, gelombang cinta, salada bokor, kembang tai ayam, begonia* and *lobak* which are mainly vegetable and ornamental crops were recorded in 2018 but not in 2004. These results are similar to that of study undertaken by Kubota et al. (2003) regarding the changes of plant structure of the homegardens in Cibakung, Cianjur, and West Java. According to Kubota et al. (2003), the number of ornamental, vegetable, and fruit, spice plants was larger in the survey of 1999 than in 1980, and especially the number of ornamental plant species was more than twice of that in 1980. Similarly, study on changes of the plant structure of homegardens in Rancakalong, Sumedang for 10 years showed that the total number of ornamental plants increased, but the size of homegarden decreased due to population increase (Suryana et al. 2014). This fact indicates that the number of ornamental plant species increases because of socioeconomic changes of the farmers, including the increase of standard of living of the farmers in the village (Kubota et al. 2003). In other words, the increase of plant species of vegetables and ornament in Sukapura Village between the survey of 2018 and 2004 indicated that standard of living of the farmers of Sukapura has increased, because with the increasing the living standard, in general, the people become more interested in planting more ornamental plants (cf. Iskandar and Iskandar 2016a).

**Index of similarity of the homegarden floristic composition**

The species composition of homegardens in Sukapura Village in 2004 (Prihartini 2004) was highly similar with that in 2018, with a similarity index of 72.13%, higher than the similarity index between traditional and commercial homegardens in 2018, which was only 56.22%. The lower similarity index between the traditional and commercial homergadens is due to the introduction of commercial crops in the commercial homegardens.

**Plant species diversity of the traditional and commercial homegardens in 2018**

The study undertaken in 2018 found that the total plant species in the traditional homegardens in Sukapura Village was 156 belonging to 67 families, while that in the commercial homegardens was 61 from 47 families (Figure 3).

The commercial homegardens had lower number of plant species because they were predominantly planted with commercial vegetable plants only. Conversely, the traditional homegardens were planted with various crops, including spice, vegetable, ornamental, and fruit crops. Because the traditional homegardens have high diversity of plants, they provide some ecological and socioeconomic and cultural benefits, including conservation of local plant diversity, soil erosion protection, soil fertility maintenance, production of oxygen, production of subsistence economy and carbon sequestration, and serve as wildlife habitats, particularly for birds and insects (Soemarwoto 1989; Iskandar and Iskandar 216a). Conversely, because the commercial homegardens were dominated only by commercial vegetable plants, the economic function was very high, but the ecological functions, including soil erosion protection, soil fertility maintenance, and wildlife conservation were very low. In other words, because the traditional homegardens have a high diversity of plants, they play important roles for ecological functions and economic subsistence of village farmers, but their commercial economic function is low. Conversely, the commercial homegardens, due to their low diversity of plants; have low ecological function, but high commercial economic function (Soemarwoto 1989).

**Vegetation structure of traditional and commercial homegardens**

The life forms of plants of the homegardens in Sukapura Village can be divided into 5 categories mainly herb, bush, tree, liana, and succulent. In terms of life forms, the traditional and the commercial homegardens in Sukapura were dissimilar in that the traditional homegardens had a much higher number of species in all life forms than the commercial ones (Figure 4).

**Table 2.** Time period of changes of the traditional homegardens into the commercial one in Sukapura Village, Kertasari Sub-district, Bandung District, West Java, Indonesia (Prihatini 2004)

| Time period | Number of households | Percentage of the total |
|---|---|---|
| Before 1970s | 2 | 10 |
| Between 1970s and 1979s | 2 | 10 |
| Between 1980s-1989 | 3 | 15 |
| Between 1990s-2004s | 13 | 65 |
| Total | 20 | 100 |

**Table 3.** The reasons of respondents for maintaining the traditional homegardens in Sukapura Village, Kertasari Sub-district, Bandung District, West Java, Indonesia (Prihatini 2004)

| Reasons of the respondents | Number of households | Percentage of total |
|---|---|---|
| Tradition | 9 | 45 |
| Concern for subsistence needs | 11 | 55 |
| Total | 20 | 100 |

**Table 4.** Comparison of species composition of homegardens of Sukapura Village, West Java, Indonesia recorded in 2004 and 2018

| Family | Plant name | | Year | |
|---|---|---|---|---|
| | Local name | Scientific name | 2004*) | 2018 |
| Acanthaceae | Lolipop | *Pachystachys lutea* Nees | √ | √ |
| | Handeuleum | *Graptophyllum pictum* (L.) Griff. | | √ |
| | Suplir | *Adiantum venustum* D. Don | √ | √ |
| Amaranthaceae | Iresine | *Iresine herbstii* Hook. | √ | √ |
| | Jawer kotok | *Celosia cristata* L. | √ | √ |
| Amaryllidaceae | Bakung | *Hippeastrum reginae* (L.) Herb | √ | √ |
| | Bawang daun | *Allium fistulosum* L. | √ | √ |
| Anacardiaceae | Buah/Mangga | *Mangifera indica* L. | √ | √ |
| | Kedondong | *Spondias dulcis* Parkinson | √ | √ |
| Annonaceae | Sirsak | *Annona muricata* L. | √ | √ |
| | Sarikaya | *Annona squamosa* L. | √ | √ |
| Apiacea | Wortel | *Daucus carota* L. | | √ |
| | Saledri | *Apium graveolens L.* | √ | √ |
| | Adas | *Foeniculum vulgare* Mill. | √ | √ |
| | Jinteun | *T. roxburghianum* L. | | √ |
| Apocynaceae | Tapak dara | *Catharanthus roseus* (L.) G.Don | √ | √ |
| | Alamanda | *Allamanda cathartica* L. | | √ |
| Araceae | Taleus hias | *Caladium bicolor* (Aiton) Vent. | | √ |
| | Gelombang cinta | *Anthurium plowmanii* Croat | | √ |
| | Kuping gajah | *Anthurium andraeanum* Linden ex Andre | √ | √ |
| | Taleus | *Colocasia esculenta* (L.) Schott | √ | √ |
| | Srirejeki | *Aglaonema* sp. | √ | |
| | Kasintu | *Dieffenbachia fournieri* N.E.Br. | √ | |
| | Taleus | *Xanthosoma sagittifolium* (L.) Schott | √ | √ |
| Araliaceae | Daun kedondong | *Nothopanax fruticosum* (L.) Miq | √ | √ |
| | Waregu | *Rhapis humilis* Blume | | √ |
| | Kelapa | *Cocos nucifera* L. | √ | √ |
| | Palem beureum | *Cyrtostachys lakka* Burret | √ | √ |
| | Palem koneng | *Chrysalidocarpus lutescens* H.Wendl. | √ | √ |
| | Palem raja | *Roystonea* sp | √ | √ |
| | Buntut kala | *Euphorbia tithymaloides* L. | √ | √ |
| Asparagaceae | Hanjuang | *Cordylin fruticosa* (L.) A.Chev. | √ | √ |
| | Ganas sabrang | *Agave sisalana* Perrine | √ | |
| Asteraceae | Salada bokor | *Lactuca sativa* L. | | √ |
| | Kembang tai hayam | *Tagetes erecta* L. | | √ |
| | Randa midang | *Cosmos caudatus* Kunth | | √ |
| | Krisan | *Chrysanthemum indicum* (Kovalevsk.) | √ | √ |
| | Dahlia | *Dahlia x hybrida* Huber | √ | √ |
| Balsaminaceae | Pacar air | *Impatiens balsamina* L. | | √ |
| Bambusaceae | Haur | *Bambusa vulgaris* Schrad. | √ | |
| Basellaceae | Binahong | *Anredera cordifolia* (Ten.) Steenis | | √ |
| Begoniaceae | Begonia | *Begonia rex pan* (Putz.) Seem. | √ | √ |
| | Begonia | *Begonia maculata argentea* (Klotzsch) Voss | | √ |
| Brassicaceae | Sosin | *Brassica chinensis* L. | √ | √ |
| | Lobak | *Raphanus sativus* L. | | √ |
| | Kol | *Brassica oleracea* L | | √ |
| Bromeliaceae | Ganas | *Ananas comosus* (L.) Merr | √ | |
| | Adam eva | *Rhoeo discolor* (L'Hér.) Hance | | √ |
| Cactaceae | Kaktus | *Opuntia ficus-indica* (L.) Mill. | √ | √ |
| | Wijayakusumah | *Epiphyllum anguliger* (Lem.) G.Don | √ | √ |
| | Buah naga | *Hylocereus undatus*(Haworth) | | √ |
| Cannaceae | Bunga Kana | *Canna indica* L. | √ | √ |
| | Ganyong | *Canna edulis* Ker Gawl. | | √ |
| | Gedang | *Carica papaya* L. | √ | √ |
| Caryophyllaceae | Anyelir | *Dianthus caryophyllus* L. | √ | √ |
| Compositae | Hebras | *Gerbera jamesonii* Bolus ex Hook.f. | √ | √ |
| | Krisan | *Chrysanthemum indicum* L. | √ | √ |
| Convolvulaceae | Boled | *Ipomea batatas* L. | √ | √ |
| Costaceae | Pacing | *Costus spicatus (*Jacq.) Sw. | | √ |
| Crassulaceae | Buntiris | *Kalanchoe pinnata* (Lam.) Pers. | √ | √ |
| Cucurbitaceae | Waluh gede | *Cucurbita pepo* L. | √ | √ |
| | Paria | *Momordica charantia* L. | √ | √ |

| | | | | |
|---|---|---|---|---|
| | Waluh sieum | *Sechium edule (Jacq.)* Sw. | √ | √ |
| Dracaenaceae | Drasaena | *Dracaena* sp | | √ |
| Equisetaceae | Paku ekor kuda | *Equisetum hyemale* L | | √ |
| Ericaceae | Azalia | *Rhododendron ledifolium* G. Don | √ | √ |
| Euphorbiaceae | Puring | *Codiaeum variegatum* (L.) Rumph. ex A.Juss. | √ | √ |
| | Pakis giurang | *Euphorbia milii* Des Moul. | √ | √ |
| | Kastuba | *Euphorbia pulcherrima* Balf.f. | | √ |
| | Jarak pager | *Jatropha curcas* L. | | √ |
| | Sampeu | *Manihot esculenta* Crantz | √ | √ |
| | Dawolong | *Acalypha hispida* Burm.f. | √ | |
| | Puring | *Coidaeum variegatum* (L.) Rumph. ex A.Juss. | √ | |
| | Pakis giwang | *Euphorbia milii* Des Moul. | √ | |
| | Sampeu | *Manihot esculenta* Crantz | √ | √ |
| | Buntut kala | *Euphorbia tithymaloides* L. | √ | |
| Fabaceae | Hiris | *Cajanus cajan* (L.) Millsp. | √ | √ |
| | Kacang jepun | *Glycine max* (L.) Merr. | | √ |
| | Dadap | *Erythrina variegata* L. | √ | √ |
| | Albasiah | *Albizia chinensis* (Osbeck) Merr. | | √ |
| | Roay | *Dolichos* sp | √ | √ |
| | Buncis | *Phaseolus vulgaris* L. | | √ |
| | Kacang beureum | *Vigna angularis* (Willd.) Ohwi & H.Ohashi | | √ |
| | Kacang panjang | *V. unguiculata* L. | | √ |
| Ferbenaceae | Widara | *Duranta erecta* L. | √ | √ |
| Heliconiacea | Pisang hias | *Heliconia bihai* (L.) L. | √ | |
| Hydrangeaceae | Borondong | *Hydrangea macrophylla* (Thunb.) Ser. | √ | √ |
| Iridaceae | Gladiul | *Gladiolus* sp. | √ | |
| Lamiaceae | Pagoda | *Clerodendron paniculatum* L. | √ | √ |
| | Surawung | *Ocimum ×citriodorum* Lour. | √ | √ |
| | Kumis kucing | *Orthosiphon aristatus* (Blume) Miq. | √ | √ |
| | Lapender | *Lavandula angustifolia* Mill. | | √ |
| | Nona makan sirih | *Clerodendrum thomsoniae* Balf.f. | | √ |
| | Jati putih | *Gmelina arborea* Roxb. | | √ |
| | Seuseureuhan | *Clerodendron paniculatum* L. | √ | |
| | Daun min | *Mentha cordifolia* Opiz ex Fresen | | √ |
| | Jawer Kotok | *Plectrannthus scutellarioides* (L.) R.Br. | √ | √ |
| | Cingcau | *Premna corymbosa* Rottler & Willd. | √ | √ |
| Lauraceae | Kayu manis | *Cinnamomum verum* J.Presl | | √ |
| | Alpuket | *Persea americana* Mill. | √ | √ |
| Laxmanniaceae | Hanjuang | *Cordyline banksii* Hook.f. | √ | √ |
| Leguminosae | Kacang suuk | *Arachis hypogaea* L. | √ | √ |
| | Buncis | *Phaseolus vulgaris* L. | √ | √ |
| | Kapri | *Pisum sativum* L | √ | √ |
| Lytheraceae | Dalima | *Punica granatum* L. | √ | √ |
| Malvaceae | Kembang wera | *Hibiscus rosa-sinensis* L. | √ | √ |
| | Daun edi | *Abelmoschus manihot* (L.) Medik. | √ | √ |
| | Duren | *Durio zibethinus* L. | | √ |
| Manisperceae | Batrawali | *Tinospora crispa* (L.) Hook. f. & Thomson | √ | √ |
| Maranthaceae | Kalatea batik | *Maranta lietzei* E.Morren | √ | √ |
| Maranthaceae | Sagu | *Maranta arundinacea* L | √ | √ |
| Meliaceae | Mahoni | *Swietenia macrophylla* King | | √ |
| Meliaceae | Suren | *Toona sureni* (Blume) Merr. | √ | √ |
| Menispermaceae | Cingcau | *Cylea barbata* Miers | √ | √ |
| Moraceae | Murbai | *Morus alba* L. | √ | √ |
| | Nangka | *Artocarpus heterophyllus* Lam. | √ | √ |
| | Karet kebo | *Ficus elastica* Roxb. ex Hornem. | | √ |
| | Sukun | *Artocarpus altilis*(Parkinson ex F.A.Zorn) | | √ |
| | Caringin | *Ficus benjamina* L | √ | |
| Muntingiaceae | Kersen | *Muntingia calabura* L. | | √ |
| Musaceae | Cau | *Musa ×paradisiaca* L. | √ | √ |
| Myrtaceae | Kayu putih | *Melaleuca leucadendron* F.Muell. | √ | √ |
| | Pucuk merah | *Syzygium oleina* Merr. | | √ |
| | Jambu batu | *Psidium guajava* L. | √ | √ |
| | Jambu air | *Syzygium aqueum* (Burm.f.) Alston | √ | √ |
| | Cengkeh | *Syzygium aromaticum* (L.) Merr. & L.M.Perry | √ | √ |
| | Jambu kupa | *Vaccinium vitis* L. | √ | √ |
| | Jambu bol | *Syzygium malaccense* (L.) Merr. & L.M.Perry | √ | √ |
| | Jambu lokat | *Eriobotrya japonica* (Thunb.) Lindl. | √ | √ |

| | | | | |
|---|---|---|---|---|
| Nyctaginaceae | Kembang kertas | *Bougenvillea spectabilis* Willd. | √ | √ |
| Orchidaceae | Anggrek Kala | *Arachnis hookeriana* (L) Rchb.f. | √ | √ |
| | Anggrek bulan | *Phalaenopsis amabilis* Blume. | | √ |
| | Anggrek japati | *Dendrobium crumenatum* SW. | | √ |
| Oxalidaceae | Calincing | *Averrhoa bilimbi* L. | √ | √ |
| Pandanaceae | Pandan | *Pandanus amaryllifolius* Roxb | √ | √ |
| Passifloraceae | Konyal | *Passiflora ligularis* Juss. | √ | √ |
| | Markisa | *Passiflora edulis* Sims | √ | √ |
| Phyllanthaceae | Katuk | *Sauropus androgynus* (L.) Merr. | √ | √ |
| | Cermai bogor | *Phyllanthus acidus* (L.) Skeels | √ | √ |
| Phytolaccaceae | Gegetihan | *Rivina humilis* L. | | √ |
| Pinaceae | Pinus | *Pinus merkusii* Jungh. & de Vriese | √ | √ |
| Piperaceae | Seureuh | *Piper betle* L. | | √ |
| Poaceae | Jagong | *Zea mays* L | √ | √ |
| | Sereh | *Cymbopogon citratus* (DC.) Stapf | √ | √ |
| | Tiwu | *Saccharum bengalense* Retz | | √ |
| Polypodiaceae | Paku tanduk rusa | *Platycerium superbum* de Jonch. & Hennipman | | √ |
| Portulacaceae | Gingseng jawa | *Talinum paniculatum* (Jacq.) Gaertn. | √ | √ |
| | Kriminil | *Portulaca amilis* Speg. | √ | √ |
| Rhamnaceae | Widara | *Ziziphus mauritiana* Lam. | √ | √ |
| Rosaceae | Eros | *Rosa hibrida* Wolley-Dod | √ | √ |
| | Arben | *Rubus rosaefolius* S.Vidal | √ | √ |
| | Stroberi | *Fragaria* × *ananassa* (Duchesne ex Weston) | | √ |
| | Jambu lokat | *Eriobotrya japonica* (Thunb.) Lindl. | √ | √ |
| Rubiaceae | Kaca piring | *Gardenia augusta* Merr. | √ | √ |
| | Soka | *Ixora javanica* (Blume) DC. | √ | √ |
| | Kopi | *Coffea arabica* L. | √ | √ |
| | Jabon | *Neolamarckia cadamba* (Roxb.) Bosser | √ | √ |
| Ruscaceae | Kasintu | *Sansevieria trifasciata* Prain | √ | √ |
| | Suji | *Dracaena angustifolia* (Medik.) Roxb. | | √ |
| | Kibeusi | *Dracaena* sp | √ | √ |
| Rutaceae | Jeruk | *Citrus aurantifolia* (Christm.) Swingle | √ | √ |
| | Jeruk lemon | *Citrus limon* (L.) Osbeck | √ | |
| | Jeruk mangse | *Citrus* × *sinensis* L. | √ | |
| | Jeruk papaya | *Citrus medica* L. | | √ |
| | Jeruk purut | *Citrus* × *hystrix* Pers. | √ | √ |
| | Kemuning | *Murraya paniculata* (L.) Jack | | √ |
| | Jeruk Bali | *Citrus grandis* (L.) Osbeck | √ | √ |
| Solanaceae | Leunca | *Solanum nigrum* L. | √ | √ |
| | Tomat | *Solanum lycopersicum* L. | √ | √ |
| | Cabe | *Capsicum annum* L. | √ | √ |
| | Cengek | *Capsicum frutescen* L. | √ | √ |
| | Terong kori | *Solanum betaceum* Cav | √ | √ |
| | Terung | *Solanum* sp. | √ | √ |
| | Terung roti | *Solanum melongena* L. | | √ |
| | Kentang | *Solanum tuberosum* L. | | √ |
| | Melati gunung | *Brunfelsia uniflora (*Pohl) D.Don | | √ |
| | Kecubung gunung | *Datura metel* L | | √ |
| Spindaceae | Lengkeng | *Dimocarpus longan* Lour. | √ | √ |
| Theaceae | Teh- | *Camellia sinensis* (L.) Kuntze | √ | |
| Verbenaceae | Kinakal | *Duranta erecta* L. | | √ |
| | Ganas sabrang | *Agave sisalana* Perrine | √ | |
| Xanthorrhoeaceae | Lidah buaya | *Aloe vera* (L.) Burm.f. | √ | √ |
| Zingiberaceae | Combrang | *Etlingera elatior (Jack)* R.M Smith | √ | √ |
| | Jahe | *Zingiber officinale* Roscoe | √ | √ |
| | Koneng | *Curcuma longa* L. | √ | √ |
| | Laja | *Alpinia galanga* (L.) Willd. | √ | √ |
| | Panglay | *Zingiber cassumunar* Valeton | √ | √ |
| | Temu lawak | *Curcuma xanthorrhiza* Roxb. | √ | √ |

Note: *) Prihatini (2004)


**Figure 2.**A. The traditional homegarden in Sukapura Village, West Java, Indonesia is predominantly planted with various crops, including jackfruit (Artocarpus heterophllus), banana (*Musa x paradisiaca*), coffee (*Coffea arabica*), orange (*Citrus* sp), and laja (*Languas galanga*). B. The commercial homegarden in Sukapura Village is predominantly planted with a single species of Welsh onion (*Allium fistulosum*). C. The nursery of cabbage (*Brasica oleracea* ) in the commercial homegarden in Sukapura Village. D. The carrot (*Daucus carota*) is planted in the commercial homegarden in Sukapua Village

Herb was the predominant life form recorded in the both the traditional and the commercial homegardens, i.e. 51 species in the traditional homegardens and 33 species in the commercial ones.

**SDR (Summed Dominance Ratio) of plant species in the traditional and commercial homegardens**

On the basis of SDR analysis, it can be seen that three species of plants which had high value of SDR in the traditional homegardens were Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L), and carnation (*Dianthus caryophyllus* L) (Table 4), while in the commercial homegarden systems were Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L) and cabbage (*Brassica oleracea* var *capitata*) (Table 5).

Table 6 shows that the vegetable crops had a high value of SDR in both the traditional and the commercial homegadens in Sukapura Village because the village is located in the mountainous upland of upper Citarum watershed of West Java which is appropriate for growing vegetables and the vegetables have high economic value (cf. Iskandar et al. 2017).

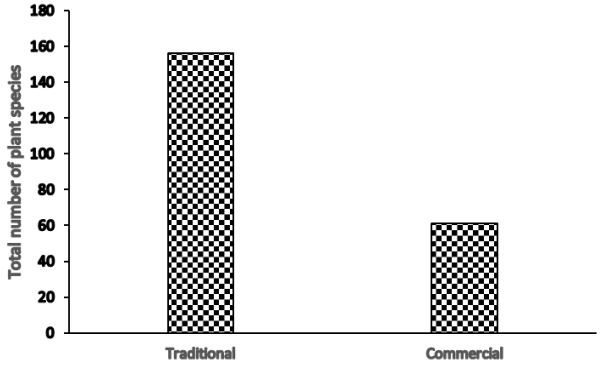


**Figure 3.** The number of plant species in the traditional and commercial homegardens of Sukapura Village, West Java, Indonesia

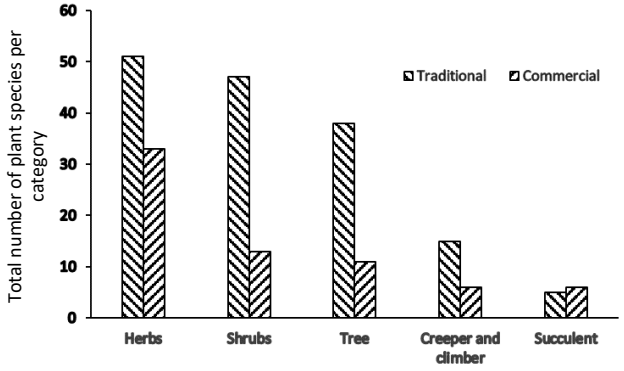


**Figure 4.** Comparison of total number plant species in the traditional homegarden and that in the commercial homegarden of Sukapura Village, West Java, Indonesia based on category of the living plant forms

The SDR values of plant species of both traditional and commercial homegardens in Sukapura Village in 2018 were generally similar to the results of earlier studies conducted by Hadikusumah (2003) and Prihartini (2004), showing that vegetable crops were the dominant species. In conclusion, it can be said that the commercial crops have been predominantly planted in Sukapura Village for the last several decades because they have high economic value, but the cultivation of commercial crops has caused local environmental problems, including soil erosion and pesticide pollution (cf. Iskandar et al. 2017).

**Index of plant species diversity of the homegardens**

The traditional homegardens had species diversity index (**H'**) of 4.16, much higher than that of the commercial homegardens, i.e., 1.71, which is considered low (Shannon-Wiener 1949 cited by Krebs 1985). The low diversity index in the commercial homegardens was caused by the high dominance of commercial crops, including Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L) and cabbage (*Brassica oleracea var capitata*). Although they provide some economic benefits for the farmers, having low species diversity, the commercial homegardens need high external inputs, including seeds, inorganic fertilizers, and synthetic pesticides and are subject to vulnerable market economic factors, including drastically changes of both the inputs and output prices. In addition, ecologically they are less resistant to environmental changes, including pest attack and climatic changes (cf. Iskandar 2017).

**The positive and negative impacts of the conversion of the traditional homegardens into the modern ones**

The conversion of traditional homegardens into the commercial ones has caused positive and negative impacts. According to perception of informants, the traditional homegardens provide some benefits, including protection of local plant varieties, maintenance of soil fertility, and provision of healthy food production. In addition, because the traditional homegardens have been predominantly planted with various perennial plants, including trees, they may provide appropriate wildlife habitats, particularly for species of birds.

**Table 5.** Species composition similarity between homegardens of Sukapura Village, West Java, Indonesia in 2004 and 2018 and between commercial and traditional homegardens in 2018

| Communities being compared | Sørensen similarity index (%) |
|---|---|
| Homegardens in 2004 and 2018 | 72.13 |
| Commercial and traditional homegardens in 2018 | 56.22 |

**Table 6.** Plant species having high SDR value in traditional and commercial homegardens of Sukapura Village, West Java, Indonesia

| Traditional gardens | | | Commercial gardens | | |
|---|---|---|---|---|---|
| **Local names** | **Species** | **SDR** | **Local names** | **Species** | **SDR** |
| *Bawang daun* | *Allium fistulosum* L | 9.12 | *Bawang daun* | *Allium fistulosum* L | 33.59 |
| *Wortel* | *Daucus carota* L | 4.40 | *Wortel* | *Daucus carota* L | 8.30 |
| *Anyelir* | *Dianthus caryophyllus* L. | 1.88 | *Kol* | *Brassica oleracea* var. *capitata* | 6.25 |

**Table 10.** Net income from the traditional homegardens in Sukapura Village, West Java, Indonesia in a year in 2004 (Prihatini 2004)

| Fruits | Vegetables | Starchy/additional staple food | Another crop | Total net income (Rp.) |
|---|---|---|---|---|
| Banana (16 $m^2$) | Pumpkin (112 $m^2$) | Cassava (7 $m^2$) | Coffee (158 $m^2$) | 81,710 |
| Orange (113 $m^2$) | Welsh onion (14 $m^2$) | Corn (14 $m^2$) | | |
| Pomegranate (3 $m^2$) | | Sweet potato (20 $m^2$) | | |
| Net income = Rp 22,170 | Net income = Rp 22,600 | Net income = Rp 23,780 | Net income = Rp 13,160 | |

**Table 11.** Gross income from the commercial homegardens in Sukapura Village, West Java, Indonesia in a year in 2004 (Prihatini 2004)

| Planting season | Main crops and area of planting ($m^2$) | Production (kg) | Price of selling (Rp.) | Gross income (Rp.) |
|---|---|---|---|---|
| I | Welsh onion (62) | 90 | 950 | 85,500 |
| | Carrot (108) | 120 | 750 | 90,000 |
| | Potato (56) | 50 | 1,500 | 75.000 |
| | Pumpkin (63) | 130 items | 250 | 32.500 |
| Gross income (I) | | | | 283,000 |
| II | Welsh onion (117) | 150 | 800 | 120,000 |
| | Carrot (91) | 175 | 550 | 96,250 |
| | Potato (81) | 50 | 1,600 | 80,000 |
| Gross income (II) | | | | 296,250 |
| III | Welsh onion (118) | 130 | 900 | 117,000 |
| | Carrot (69) | 85 | 900 | 76,500 |
| | Potato (52) | 30 | 2,500 | 75,000 |
| | Pea (50) | 13 | 7,000 | 91,000 |
| Gross income (III) | | | | 359,500 |
| Total gross income (I +II+III) | | | | 938,750 |

The traditional homegardens also provide some socio-economic benefits for the owners. The traditional homegardens function as the living barn, particularly during 'the famine season' (*musim paceklik*) when rice as staple food is lacking, so some produce, including starchy food, spices, and fruits may be provided by the homegardens. Because the traditional homegardens have been commonly planted by a variety of food crops, they provide daily needs of the households, including spices and vegetables, for fulfilling the subsistence of the villagers, so the farmers do not have to buy food produce from village food stalls. As a result, the traditional homegardens have also been popularly known as the life barns (*lumbung hidup*) or life shops *(warung hidup*). In addition, the traditional homegardens also provide medicinal plants, including lemon (*Citrus aurantifolia* Swing), turmeric (*Curcuma longa* L), sand ginger/*kencur* (*Kaempferia galanga* L), ginger (*Zingiber officinale* Roscoe), and round cardamon/*kapulaga* (*Amomum compactum* Soland), so they are also called "living pharmacies" (*apotek hidup*).

The traditional homegardens also have social-cultural functions. For example, the front yard of a house (*buruan*) has traditionally been used for playing for children, performing traditional ceremonies, and chatting for the parents. Because villagers need some plants for traditional rituals, some traditional ritual plants have been traditionally planted in the traditional homegardens. In addition, since the traditional homegardens have been planted with ornamental plants, including jasmin (*Gardenia augusta* Merr), evergreen maidenhair (*Adiantum venustum* D.Don), and dahlia (*Dahlia x hybrida* Huber), the traditional gardens also have esthetical function.

It can be inferred that because the traditional gardens have been planted with a high diversity of plants, they provide various ecological, socio-economic and cultural benefits, including genepool conservation, subsistence, and commercial produce, and esthetical benefits (Arifin 2003; Suhartini et al. 2013; Hidrawati et al. 2017).

The conversion of homegardens from the traditional into the modern ones in Sukapura Village has caused changes of structure and functions of the village homegardens. Because of the homogenization of commercial vegetable plants and the high external inputs, including seeds, an-organic fertilizers, and pesticides, the commercial homegardens have lower number of individual plants of vegetables and the plant species diversity than the traditional ones (Hadikusumah 2003).

Beside causing negative impacts, the commercialization and the homogenization of the homegardens in Sukapura Village have provided advantages too, including the increase of economic production. However, although the total gross income of the commercial homegarden system in Sukapura is high, the cost of inputs, including vegetable seeds, organic fertilizer, inorganic fertilizer, fungicide, and

pesticides is also high. Conversely, the production of the traditional homegarden system in Sukapura Village is low, but it also needs low or zero inputs. For example, based on the homegarden research conducted in 2004 on analysis of inputs and outputs or crop production of the traditional homegardens in Sukapura Village planted by various plants, including banana (*Musa x paradisiaca* L), orange (*Citrus* sp), pomegranate (*Punica granatum* L), pumpkin (*Cucurbita pepo* L), Welsh onion (*Allium fistulosum* L), cassava (*Manihot esculenta* Crantz), corn (*Zea mays* L), sweet potato (*Ipomoea batatas* L), and coffee (*Coffea arabica* L), the net income was Rp 81,710 per year, without any costs (Table 7). While the commercial homegardens in Sukapura Village planted with commercial vegetable plants, including Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L), potato (*Solanum tuberosum* L), and pea (*Vigna* sp.) resulted in the gross income of Rp 938,750 per year (Table 10) (Prihatini 2004).

Tables 10 and 11 show that the net income from the traditional homegardens (Rp 81,710) is lower than that of the commercial one (Rp 938,750); however, the input of the traditional homegardens is very low or zero, while inputs of the commercial homegardens are very high. The field research in 2018 showed that total input costs of farming Welsh onion and carrot in the commercial homegardens in Sukapura Village approximately 78% and 35% (Tables 12).

In addition, the monoculture of commercial vegetable crops in Sukapura Village has a high risk of drastic changes of input and output prices (Jalurdi et al. 2011). For instance, according to informants, many farmers of Sukapura Village who planted commercial vegetable crops in the homegardens in the main planting season of 2018 suffered financial loss due to the low selling price of vegetables. For example, the selling price of Welsh onion in early 2018 was Rp 25,000/kg, but a couple months later drastically dropped to Rp 2,000/kg because the supply of the Welsh onion increased.

**Table 12.** The gross income of Welsh onion (*Allium fistulosum* L.) cultivation in the commercial homegardens in Sukapura Village, West Java, Indonesia in 2018

The size of the homegarden is 400 $m^2$ (1 *patok*)

**Welsh onion (*Allium fistulosum* L.)**

**Inputs**:
Seeds: 150 kg x Rp 3,000 = Rp 450.000
Organic fertilizer: animal dung 10 sack (*karung*) = 10 x Rp 10,000 = Rp 100,000
Inorganic fertilizer: NPK Phonnska = Rp 160,000
Fungicide (*Kanon*) = Rp 40,000
Pesticide (*Roke*r , *Bitan*, and *Dakotil*) = Rp 180,000 + Rp 85,000 + Rp 90,000
Total inputs = Rp 450,000 + Rp 100,000 + Rp 160,000 + Rp 40,000 + Rp 180,000 + Rp 85,000 + Rp 90,000 = Rp 1,105,000

**Outputs:**
After 4 months of planting, the production of Welsh onion in 3 times of harvesting = 3 x 700 kg x Rp 2,000 = Rp 1,400,000

**Gross income**:
Cultivation of Welsh onion for one season (4 months) = Rp 1,400,000 – Rp 1,105,000 = Rp 295,000, not included labor costs, including land preparation, planting, and harvesting.
Percentage of total input costs to total outputs is approximately 78 %.

**Carrot (*Daucus carota* L)**

**Inputs:**
Seed of carrot 1 liter = Rp 50,000
Organic fertilizer of animal dung = 10 sacks x Rp 10,000 = Rp 100,000
Inorganic fertilizer (NPK Phonska) = Rp 160,000
Fungicide (Kanon) = Rp 40,000
Inputs for 3 times of planting season = 3 x (Rp 50,000 + Rp 100,000 + Rp 160,000 + Rp 40,000) = Rp 1,050,000

**Output:**
Farming carrot of 400 $m^2$ per year (3 season of 4 times of harvesting)
Production of carrot for 4 times of harvesting = 4 x 500 kg = 4 x (Rp. 1.500,00 x 500 kg) per 400 m2 per year = Rp 3.000.000

**Gross income:**
Farming of carrot in 400 m2 of three planting seasons in one year = Rp 3,000,000-Rp 1,050,000 = Rp1,950,000, without labor costs
Percentage of total input costs to total outputs is approximately 35%.

According to the informants, although the commercial homegardens provided some advantages, including the increase of gross income and household income increased, and job opportunity in the commercial vegetable crop farming, they also brought some disadvantages, including the disappearance of local species and varieties of plants, and higher input dependence from market or outside (cf. Iskandar et al. 2018). In addition, according to informants, it also had negative effects on local environment. For example, the soil fertility decreased and a lot of fertilizers must be added to the soil, and the soil has been intensively contaminated with poison of pesticides and fungicides. The soil erosion has also occurred due to the simplification of vegetation structure, including the loss of trees, and intensive weeding of terrestrial weeds. The simplification of vegetation stratification has drastically changed the habitat of wild animals, particularly terrestrial birds. Indeed, intensive use of pesticides has brought negative effects on wild birds in the village ecosystems due to pollution.

In conclusion, initially the traditional homegardens in Sukapura Village have been predominantly cropped with various annual and perennial crops. However, due to market economic development, the traditional homegarden systems have drastically changed. For example, the commercial vegetable crops, including Welsh onion (*Allium fistulosum* L), carrot (*Daucus carota* L) and cabbage (*Brassica oleracea* var *capitata*) have been predominantly cultivated in the commercial homegardens. Consequently, the economic production of the commercial homegardens has increased. However, some disadvantages of the commercial homegardens have occurred, including disappearance of local species and varieties of plants, and higher dependence of inputs from market or outside. This study showed that the rural homegardens have not been static but dynamically changing caused by ecological and socioeconomic and cultural factors, including intensive market economic penetration to village ecosystems. We suggest that to develop the sustainable village homegardens for the future, the diversity of plants must be maintained to provide ecological function or ecosystem services and the economic production must be improved to improve income for the rural people.

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