Bulgarian Journal of Agricultural Science, 24 (No 5) 2018, 759–767

Agrobiodiversity in the rural home gardens as the food reserve for climate change adaptation (case study: Samin sub-watershed, Central Java, Indonesia)

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Abstract

Muliawati, E. S., Sri Budiastuti, M. T., Suprayogo, D. & Sutrisno, J. (2018). Agrobiodiversity in the rural home gardens as the food reserve for climate change adaptation (case study: Samin sub-watershed, Central Java, Indonesia). *Bulgarian Journal of Agricultural Science*, *24*(5), 759–767

The unpredictable yields of crops as the adverse impact of global climate change must be anticipated by growing plants of various species in rural home gardens for food reserves. The research was aimed at documenting the species diversity in the home gardens which can be used as food resources. The survey was carried out on Latosol, Mediteran, and Grumusol soil types. Each type of soil was represented by 30 units of randomly chosen home gardens, with the ranging elevation between 106 m and 272 m a.s.l. The plant diversity, type of growth, and plant utilization were observed. The results showed that the different soil types of the home gardens correspond with the diversity of the grown plant species and the existence of specific plant species can be the characteristics of each soil type. The home gardens on Mediteran soils have abundant food reserves, which the highest Shannon-Wiener index in the first and second strata are 2.87 and 2.60. Mango is the most important tree grown on all soil types, while peanut, papaya, and ginger are the most important plants in the first strata on Latosol, Mediteran, and Grumusol soils respectively.

Keywords: agrobiodiversity; edible plants; food reserve; home garden; Indonesia

Introduction

Climate change is a condition that may threaten the agricultural productivity, particularly in relation to crop production. The extreme weather that globally affects the dynamics of living beings gives cause for concern that the impact may result in crop failures. One of the methods to anticipate such condition is by cultivating various plants in the home gardens that will yield something edible.

In Indonesia, especially in rural areas, a home garden is the land around the house where the households grow diverse crops that have various benefits. In Central Java, the vernacular name of a home garden is "pekarangan". A home garden is a traditional implementation of utilizing land around the residence where some plants species are grown and the yields are mainly for household consumption (Arifin et al., 2008; Shrestha, 2015), a form of traditional resource management adaptation for mitigation of climate change impacts (Kumar and Tiwari, 2017) and lowering the risk due to the failure of existing farming systems (Singh et al., 2016).

The home garden has a huge role in the maintenance of agro-biodiversity, which is the part of natural biodiversity,

including genetic resources of plants used for food and agriculture (Negri, 2005). The plants in the home garden consist of a mix of annual and perennial plants that can be harvested at regular intervals, both daily and seasonally (Sthapit et al., 2004). In the tropics, the home garden is an optimal and sustainable land use with high productivity (Kumar and Nair, 2004; Pokhrel, 2015), which contribute directly to the fulfilment of household food needs (Trinh et al., 2003; Gautam et al., 2004; Vlkova et al., 2011).

The various plant compositions of the home garden form canopy layers that consist of trees, shrubs, herbaceous, and climbers (Amberber et al., 2014). The multilayer canopy of plants which resembles the system of agro-forestry and formed in the temporal and spatial succession with dynamic stratification shows that home garden is an elastic and sustainable ecosystem (Smith et al., 2006). The canopy of plants also covers tightly and produces litter, so that the soil will be protected from the rain blow (Hairiah et al., 2005). The soil temperature and humidity can be maintained because the litter holds the water in the soil, serves as mulch at ground level. The composition of the plants also creates structures so that the plant roots can get the nutrient from different depths of the soil, and the soil aeration can utilize efficiently (Eyzaguirre and Linares, 2004). Thus the home garden also provides services of ecosystems at the local, regional and global levels, in the ways of conserving the land and keeping the microclimates (Sthapit et al., 2004).

In the region of Samin sub-watershed, the settlements cover about 25% of the area and most of them are in the form of home gardens. There are three different types of soils namely Latosol, Mediteran, and Grumusol soils. Each soil type has different physical properties and nutrient content affecting the type of plants that grow on it. According to Junqueira et al. (2016) the texture and fertility of the soil affect the vegetation structures including the compositions of biodiversity in the home garden.

This study was aimed at documenting species diversity of the plants growing in the rural home gardens, which can function as food resources, particularly on Latosol, Mediteran, and Grumusol soil type, in the region of Samin sub-watershed.

Materials and Methods

The survey was carried out on Latosol, Mediteran and Grumusol soil type in six villages from 2013 until 2014. The locations are a flat land with a slope less than 8%, where most of the farmers cultivate paddy on the wet-land all year. On the dry-land, they cultivate some cereal crops or annual crops such as vegetables or fruits. There were 30 units of home gardens randomly chosen for each soil type, with elevation ranging between 106 m and 272 m a.s.l. The description of the sample location is presented in Table 1. Data collection involved field observations and interviews conducted with the household participants. In surveying the home gardens, the information concerning the vernacular name of each plant species was given in Javanese. The plant composition, type of growth, and plant utilization were observed. The naming and identification of the botanical species and family were done according to the Flora of Java (Backer and Van den Brink, 1980) and Heyne (1987). In the observation, the plants were divided into two strata based on the canopy height. The first strata lie within 3 m high from the ground and the second strata are above 3 m.

The density of plant individuals and plant species was obtained by counting their number per home garden. According to MaGuarran (1988), the diversity and richness of plant species in the home garden were determined based on the Shannon-Wiener Index (H') and Margalef Index (R). Importance Value Index (IVI) was used to determine the plant species on each soil type having important values for the households.

Results

The soil properties of the home gardens

Based on the content of clay, silt and sand (Table 2) the soil texture of the Latosols, Mediteran soils and Grumusols

Table 1
Sample location description of Samin Sub-watershed region

Village	Soil Type	Elevation (m a.s.l.)	Coordinates	Average home garden areas (m^2)
Tugu and Ngunut	Latosol	168-246	7°38′51″ - 7°39′27″ S 110°57′23″- 110°58′36″ E	431.9 (s= 220.5)
Jantiharjo and Bolong	Mediteran	219-272	7°37′09″ - 7°38′12″ S 110°58′30″ - 110°59′37″ E	426.9 (s = 245.2)
Bulakrejo and Pandeyan	Grumusol	106-119	7°39′11″ - 7°40′38″ S 110°49′02″ - 110°50′39″ E	507.7 (s = 300.8)

are classified as heavy clay, sandy loam and clay, respectively (Darmawijaya, 1990). The Latosols contain more clay than Grumusols, but both soil types have similar characters. These types of soil tend to easily swell and shrink dependent on the soil moisture content. In the rainy season, the water content of both soil types increases, so that the soil tends to be sticky and clumpy, while during the dry season it becomes very hard and cracked. The sandy loam soil contains sand of more than 60%, so it tends to be crumbly and porous. It has more stable structure than the other two types, either in rainy or dry season.

Generally, the households sweep the litter off the ground to make it look clean and neat, and do not add fertilizers to the soil. The available P and K content of three soil types vary. The content of available P in Mediteran soils and Grumusols is very high but in Latosols is medium, while the content of available K in Mediteran soils is only medium, yet is higher than the others.

The plant species diversity in the home gardens

In total, there were 88 plants species producing edible parts grown in the home gardens. They belong to 45 botanical families. The 53 species (30 families) were included in the first strata (Table 3) and the other 35 species (18 families) were in the second strata (Table 4).

There were 37 plants (42%) of the same species growing on all soil types, 22 of them were from the first strata while the other 15 were from the second strata. The rest 28 species (32%) grew only on certain soil types, consisting of 16 and 12 species from the first and second strata respectively.

Table 2
Result of soil properties analysis of the home gardens

Parameters	Latosol		Mediteran soil		Grumusol	
Sand (%)	9.66		69.02		6.59	
Dust (%)	15.68		11.99		38.12	
Clay (%)	74.66		18.99		55.28	
pH	6.58	N	7.74	SA	7.35	SA
SOM (%)	0.19	L	1.09	L	0.28	L
N total (%)	0.36	L	1.38	L	0.35	L
P available (ppm)	8.11	M	20.95	VH	31.48	VH
K available (mekg^{-1})	0.17	L	0.32	M	0.12	L
Description: N = neutral; SA = slightly alkaline; VH = very high; H = high; M = medium; L = low; VL = very low						

Latosols have neutral pH, while the Mediteran soils and Grumusols are slightly alkaline. In relation to soil fertility, which is based on the content of soil organic matter, the total N (Nitrogen) of these soil types are classified as low. Nitrogen is an essential macronutrient indispensable to plant growth. The plants absorb the largest quantity of N in comparison with other elements of the soil. Since the nutrient supply is low, N total of the three soil types is also low.

Table 3
Plants producing edible parts in the first strata

No	Vernacular name	Species name	Family name	Type of growth	Edible parts	Site on soil type		
1	2	3	4	5	7	8	9	0
1	Bayem	*Amarantus* spp.	Amaranthaceae	Herb	Leaf	L	M	G
2	Besusu	*Pachyrhizus erosus* (L.) Urb.	Fabaceae	Climber	Root		M	
3	Buah naga	*Hylocereus undatus* L.	Cactaceae	Climber	Fruit	L		G
4	Cempokak	*Solanum torvum* Sw.	Solanaceae	Herb	Fruit		M	
5	Camcao	*Cyclea barbata*	Menispermeae	Climber	Leaf	L		
6	Ekor kuda	*Equisetum debile* Woll.	Equisetaceae	Herb	Leaf	L		
7	Ganyong	*Canna edulis* Kerr-Gwal	Cannaceae	Herb	Root	L	M	
8	Garut	*Marantha arundinacea* L.	Marantaceae	Herb	Root	L		G
9	Gedang	*Musa paradisiaca* L.	Musaceae	Shrub	Fruit	L	M	G
10	Gembili	*Dioscorea bulbifera* L.	Dioscoreaceae	Climber	Tuber		M	
11	Ginseng jawa	*Talinum paniculatum* (Jacq.) Gaertn.	Talinaceae	Herb	Leaf		M	

Table 3
Plants producing edible parts in the first strata (continued)

1	2	3	4	5	7	8	9	0
12	Jagung	*Zea mays* L.	Poaceae	Herb	Seed		M	
13	Jahe	*Zingiber officinale* Roscoe	Zingiberaceae	Herb	Rhizome	L	M	G
14	Jeruk purut	*Citrus hystrix* D.C	Rutaceae	Shrub	Fruit		M	
15	Kacang brol	*Arachis hipogeae* L.	Fabaceae	Herb	Seed	L	M	G
16	Kacang lanjaran	*Vigna sinensis* L.	Fabaceae	Climber	Fruit	L	M	G
17	Kacang tunggak	*Vigna unguiculata* L. Walp ssp *unguiculata*	Fabaceae	Climber	Seed, leaf		M	
18	Kangkung	*Ipomoea reptans* L.	Convolvulaceae	Herb	Leaf			G
19	Kates	*Carica papaya* L.	Caricaceae	Shrub	Fruit	L	M	G
20	Katuk	*Sauropus androgynous* Merr.	Phyllanthaceae	Herb	Leaf		M	
21	Kecipir	*Psophocarpus tetragonolobus* (L.)	Fabaceae	Climber	Fruit	L		
22	Kemangi	*Ocinum cannum* Sanct. L.	Lamiaceae	Herb	Leaf		M	G
23	Kenikir	*Cosmos caudatus* Kunth	Asteraceae	Herb	Leaf	L	M	G
24	Koro pedang	*Canavalia ensiformis* (L.)	Fabaceae	Climber	Seed	L		
25	Kunir	*Curcuma domestica* L.	Zingiberaceae	Herb	Rhizome	L	M	G
26	Labu siem	*Sechium edule* (Jacq.)Sw	Cucurbitaceae	Climber	Fruit		M	
27	Laos	*Alpinia galanga* (L.) Wild	Zingiberaceae	Herb	Rhizome	L	M	
28	Lempuyang	*Zingiber aromaticum* (L.) Roscoe ex Sm	Zingiberaceae	Herb	Rhizome	L		
29	Lidah buaya	*Aloe vera* (L.) Burm.f	Xanthorhoaceae	Herb	Leaf	L	M	G
30	Lombok	*Capsicum annuum* L.	Solanaceae	Herb	Fruit	L	M	G
31	Luntas	*Pluchea indica* L.	Asteraceae	Shrub	Leaf		M	
32	Markisa	*Passiflora ligularis* A.	Passifloraceae	Climber	Fruit	L	M	
33	Mbayung	*Vigna unguiculata* walp.ssp cylindrica	Fabaceae	Climber	Leaf	L		
34	Mentimun	*Cucumis sativus* L.	Cucurbitaceae	Climber	Fruit			G
35	Nanas	*Ananas comosus* (L) Merr	Bromeliaceae	Herb	Fruit	L	M	
36	Pandan	*Pandanus amaryllifolius* Roxb.	Pandanaceae	Herb	Leaf	L	M	G
37	Pohung	*Manihot esculenta* Crantz	Euphorbiaceae	Shrub	Root	L	M	G
38	Salak	*Salacca zalacca* (Gaertn.) Voss	Arecaceae	Shrub	Fruit	L	M	
39	Semangka	*Citrullus vulgaris*(Thunb.) Matsum&Nakai	Cucurbitaceae	Herb	Fruit	L	M	G
40	Sere	*Andropogon nardus* L.	Graminae	Herb	Leaf	L	M	G
41	Suji	*Pleomela angustifolia* N.E Brown	Dracaenaceae	Herb	Leaf		M	G
42	Suruh	*Piper betle* L.	Piperaceae	Climber	Leaf	L	M	G
43	Suweg	*Amorphophallus rivieri* Durieu	Araceae	Herb	Tuber	L	M	G
44	Tales	*Colocasia esculenta* L.	Araceae	Herb	Tuber	L	M	G
45	Tapak liman	*Elephantopus scaber* L.	Asteraceae	Herb	Leaf			G
46	Tebu	*Saccharum officinarum* L.	Poaceae	Herb	Stem	L	M	G
47	Tela rambat	*Ipomoea batatas* L.	Convolvulaceae	Herb	Tuber	L	M	G
48	Temu gombyok	*Kaempferia rotunda* L.	Zingiberaceae	Herb	Rhizome		M	
49	Temu ireng	*Curcuma aeruginosa* Roxb.	Zingiberaceae	Herb	Rhizome	L	M	G
50	Temulawak	*Curcuma xanthorrhiza* Roxb.	Zingiberaceae	Herb	Rhizome	L	M	G
51	Terong	*Solanum melongena* L.	Solanaceae	Herb	Fruit	L	M	G
52	Tomat	*Lycopersicon esculentum* (L.) Mill	Solanaceae	Herb	Fruit		M	
53	Uwi	*Dioscorea alata* (L.) Lam.	Dioscoreaceae	Climber	Tuber	L		

Description: L = Latosol; M = Mediteran soil; G = Grumusol

Table 4
Plants producing edible parts in the second strata

No	Vernacular name	Species name	Family name	Type of growth	Edible parts	Site on soil type		
1	Alpukat	*Persea americana* Miller	Lauraceae	Tree	Fruit	L	M	
2	Asem	*Tamarindus indica* L.	Fabaceae	Tree	Fruit	L		G
2	Belimbing lingir	*Averrhoa carambola* L.	Oxalidaceae	Shrub	Fruit	L	M	G
4	Belimbing wuluh	*Averrhoa bilimbi* L.	Oxalidaceae	Shrub	Fruit		M	
5	Duku	*Lansium domesticum* Correa	Meliaceae	Tree	Fruit		M	
6	Duren	*Durio zibethinus* Murray	Malvaceae	Tree	Fruit	L	M	
7	Duwet	*Syzygium cumini* (L) Skeels	Myrtaceae	Tree	Fruit	L		
8	Jambu wer	*Eugenia aquea* (Burm.f) Alston	Myrtaceae	Tree	Fruit	L	M	G
9	Jambu kluthuk	*Psidium guajava* L.	Myrtaceae	Shrub	Fruit	L	M	G
10	Jambu mete	*Anaccardium occidentale* L	Anacardiaceae	Tree	Fruit, seed	L	M	G
11	Jengkol	*Pithecollobium lobatum* BENTH	Fabaceae	Tree	Seed	L	M	
12	Jeruk keprok	*Citrus sinensis* L.	Rutaceae	Shrub	Fruit		M	
13	Jeruk bali	*Citrus maxima* (Burm.) Merr.	Rutaceae	Shrub	Fruit		M	
14	Kakao	*Theobroma cacao* L.	Sterculiaceae	Shrub	Seed	L		
15	Kedondong	*Spondias dulcis* L.	Anacardiaceae	Tree	Fruit	L		G
16	Kelapa	*Cocos nucifera* L.	Palmae	Tree	Fruit	L	M	G
17	Kelengkeng	*Dimocarpus longan* Lour.	Sapindaceae	Shrub	Fruit	L	M	G
18	Kenitu	*Chrysophyllum cainito* L.	Sapotaceae	Tree	Fruit		M	
19	Kepel	*Stelechocarpus burahol* (Bl.)	Anonaceae	Tree	Fruit		M	
20	Lamtoro	*Leucaena leucocephala* (Lam.) de Wit	Fabaceae	Shrub	Seed	L	M	G
21	Matoa	*Pometia pinnata* J.R.&G. Forster	Sapindaceae	Shrub	Fruit		M	
22	Melinjo	*Gnetum gnemon* L.	Gnetaceae	Tree	Fruit, seed, leaf	L	M	G
23	Mindi	*Melia azedarach* L.	Meliaceae	Shrub	Leaf	L		
24	Nangka	*Artocarpus heterophyllus* Lamk.	Moraceae	Tree	Fruit, seed	L	M	G
25	Pace	*Morinda citrifolia* L.	Rubiaceae	Shrub	Fruit		M	G
26	Pelem	*Mangifera indica* L.	Anacardiaceae	Tree	Fruit	L	M	G
27	Pete	*Parkia speciosa* Hassk.	Fabaceae	Tree	Seed	L	M	G
28	Pring	*Bambusa* sp	Poaceae	Tree	Sucker	L	M	
29	Rambutan	*Nephelium lappaceum* L.	Sapindaceae	Shrub	Fruit	L	M	G
30	Salam	*Syzygium polyanthum* (Wight) Walp.	Myrtaceae	Shrub	Fruit, leaf		M	
31	Sawo	*Achras zapota* L.	Sapotaceae	Tree	Fruit	L	M	G
32	Sirsak	*Annona muricata* L.	Annonaceae	Shrub	Fruit	L	M	G
33	Srikaya	*Annona squamosa* L.	Annonaceae	Shrub	Fruit	L	M	G
34	Sukun	*Artocarpus communis* FORST	Moraceae	Tree	Fruit			G
35	Talok	*Muntingia calabura* L.	Muntingiaceae	Shrub	Fruit		M	G

Description: L = Latosol; M = Mediteran soil; G = Grumusol

The distribution of number of plants species in the home gardens on the three soil types is presented in Table 5. The most species, 70 of them, grow on Mediteran soils, followed by Latosols and Grumusols which grow 60 and 49 species respectively. On all soil types, the first strata contain more various species than the second. Based on the number of species in each home garden, it is shown that the quantities of species that grow in the first and second strata are proportional.

Although all the plants yield edible harvest, each species has its main benefit according to parts of plant to be used. In the first strata, the plants producing most harvest in the form of leaves on Latosols, Mediteran soils and Grumusols are 29.7%, 30.6%, and 37.9%, respectively, while in the second strata, most of the plants contribute to harvest fruits which are 64.3%, 75.0% and 73.5%, respectively (Table 6).

Based on the utilization of plants as food resources for the households, Table 7 shows that the plants in the first stra-

Table 5
Distribution of plants species number on three soil types

Parameters	First strata			Second strata		
	Latosol	Mediteran soil	Grumusol	Latosol	Mediteran soil	Grumusol
Total species	36	41	29	24	29	20
Average number of species/home garden	7.3	8.8	6.2	6.9	7.7	5.1
Minimum number of species/home garden	3	3	2	3	4	2
Maximum number of species/home garden	13	14	11	12	12	10

Table 6
Number of plant species based on their edible parts

Edible parts	The first strata			The second strata		
	Latosol	Mediteran soil	Grumusol	Latosol	Mediteran soil	Grumusol
Leaf	11	13	11	2	2	1
Fruit	11	13	8	18	25	18
Seed	2	3	1	7	6	5
Tuber/root	7	7	5	–	–	–
Rhizome	6	6	4	–	–	–
Sucker	–	–	–	1	1	–
Total	37	42	29	28	34	24

Table 7
Number of plant species based on their utilization

Utilization	The first strata			The second strata		
	Latosol	Mediteran soil	Grumusol	Latosol	Mediteran soil	Grumusol
Staple food	7	7	5	–	–	–
Vegetable	8	13	8	5	5	3
Fresh fruit	7	7	4	14	18	11
Condiment & culinary use	5	6	4	2	3	3
Medicine	9	8	8	1	2	2
Industry	–	–	–	2	1	1
Total	36	41	29	24	29	20

ta contributing to most of vegetables and medicines. Plants that produce vegetables for households on Latosols, Mediteran soil, and Grumusols are 22.2%, 31.7%, and 27.6%, respectively, while the ones produce medicines are respectively 25.0%, 19.5%, and 27.6%. The second strata dominated by plants which yield of fresh fruits was 58.3%, 55.0%, and 62.1%, respectively. The home garden also contributes to providing an alternative staple food that is 18% on average, but it still needs efforts to encourage the households to take advantage of it.

In accordance with the difference between the quantities of plant individuals and plant species in each home garden, the index of species diversity also differs from that of species richness (Fig. 1). The species diversity index (Shannon-Wiener Index) and the species richness index (Margalef Index) on Mediteran soils is the high-

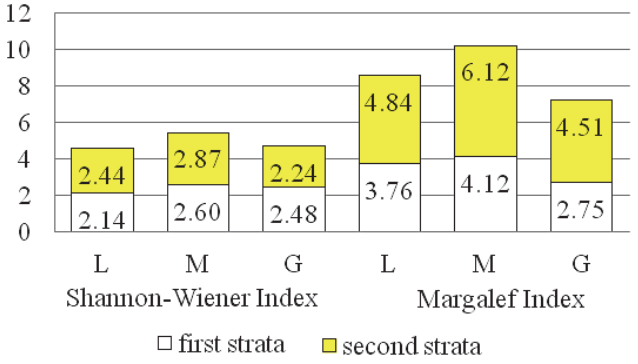

Fig. 1. The Shannon-Wiener Index and the Margalef Index on the first and second strata on Latosols (L), Mediteran soils (M) and Grumusols (G)

est, either in the first or the second strata. The lowest species diversity index in the first and second strata are on Latosols and Grumusols respectively, while the lowest species richness index in the first and second strata are on Grumusols.

The important value of plant species in the home garden

The important value index (IVI) is a quantitative parameter which can be used to express the level of mastery of the species within plant communities. The IVI is a summation of the relative density, frequency, as well as dominance. Figure 2 shows the three top plants species in the first and second strata that are important to the households.

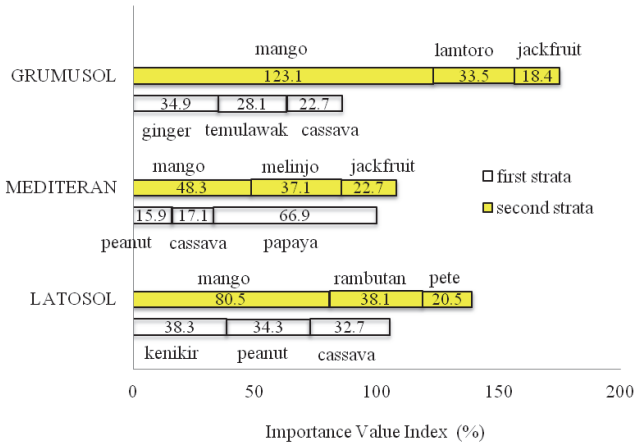

Fig. 2. The Important Value Index in the first and second strata on three soil types

The IVI of plant species describes the presence of certain species role for the households. Figure 2 shows three top species with the highest IVI which belong to the first strata: on Latosols they are kenikir (*Cosmos caudatus* Kunth.), peanut, cassava; on Mediteran soils they are papaya, cassava, peanut; and on Grumusols they are temulawak (*Curcuma xanthorrhiza* Roxb.), ginger, cassava. In the second strata, mango is the most important species on all soil types, while other plant species namely rambutan (*Nephelium lappaceum* L.) and pete (*Parkia speciosa* Hassk.) are most important species on Latosols; melinjo (*Gnetum gnemon* L.) and jackfruit – on Mediteran soils; lamtoro (*Leucaena leucocephala* Lam. de Wit) and jackfruit – on Grumusols.

Discussion

In spite of the low to moderate fertility of the three soil types, it is proved to be able to support the sustainability of the production plants in the home gardens. However, the Grumusols and Latosols that tend to easily expand and shrink are not favorable for rooting plants, particularly for types of annuals which generally have shallow rooting. In a drought, low soil moisture becomes one of the delimiters to annual plants. The physical properties of Mediteran soils, more stable and porous, are capable of supporting the sustainability of crop production with a diversity of species higher than the other two types of soil.

The total numbers of species growing on the three soil types was 88. It was less than the number of species found in other villages in Indonesia, for example, in the Teluk Naga, Citeureup and Pacet, West Java, where there were more than 100 species (Sastrapradja et al., 1985), but more than in Lampeapi, Southeast Sulawesi, where there were only 40 species (Rahayu and Prawiroatmodjo, 2005). In other countries the number of species is smaller, for examples Vietnam with 70 species (Vlkova et al., 2011) and Papum Pare District, Arunachal Pradesh, Eastern Himalayas with 85 species (Gangwar et al., 2015), while in Gajehada (Kapilvastu District - Nepal) on lowland tropical climates with an elevation ranging between 90-120 m there were 102 species (Pokhrel, 2015); in Kerala, India there were 153 species (Kumar and Nair, 2004) and in Oaxaca, Mexico there were 233 species (Aguilar-Stoen et al., 2009).

In general, the plant species that grow in the first strata are short-lived plants (annual), herbaceous plants, or climber shrubs with narrow canopies, thus many species can be cultivated in the home garden, in the same season period. In one year, the plant species can be adjusted to fit the availability of water, resulting in changes in their temporal composition with the dynamic stratification (Arifin et al., 2008). The species compositions of the second strata tend to remain unchanged throughout the year, because they mostly consist of perennial crops harvestable throughout the season, year after year. Agrobiodiversity in the home garden has been proved time after time to be capable of providing food reserves in many countries such as in Bangladesh (Trinh et al., 2003), Indonesia (Arifin et al., 2008) and Vietnam (Vlkova et al., 2011) as well as providing benefits of ecological aspects (Devi and Das, 2010; Idohou et al., 2014; Nath et al., 2015).

Each soil type has its own typical species, of which only grow on a particular soil type. In addition to the soil capability of supporting the diversity of species, the needs and interests of the owners also influence the choice of plants grown in the home gardens. On **Latosols**, in the first strata, there were found *Solanum torvum* Sw., *Equisetum debile* Woll., *Psophocarpus tetragonolobus* L., *Canavalia ensiformis* L., *Zingiber aromaticum* L., *Vigna unguiculata* Walp. ssp cylindrical, *Dioscorea alata* L., *Syzygium cumini* L. Skeels; and

in the second strata *Theobroma cacao* L. and *Melia azedarach* L. On **Mediteran soils**, in the first strata there were found *Dioscorea bulbifera* L., *Talinum paniculatum* (Jacq.) Gaertn., *Zea mays* L., *Citrus hystrix*, *Vigna unguiculata* L. Walp ssp. *unguiculata*, *Sauropus androgynous* Merr., and in the second strata *Averrhoa bilimbi* L., *Lansium domesticum* Correa, *Citrus sinensis* L., *Citrus maxima* (Burm.) Merr., *Chrysophyllum cainito* L. *Stelechocarpus burahol* (Bl.), *Pometia pinnata* J.R&G. Forster, *Syzygium polyanthum* (Wight) Walp. On **Grumusols** there were found *Ipomoea reptans* L., *Cucumis sativus* L., *Elephantopus scaber* L. in the first strata and *Artocarpus communis* Forst in the second strata. The existence of typical plant species in each soil type indicated that the kind of crops went together with the household's needs. A higher number of species, mainly found in the second strata, were grown on Mediteran soils, including the rare ones such as *Citrus maxima* (Burm.) Merr., *Lansium domesticum* Correa and *Stelechocarpus burahol* (Bl.).

Home gardens of Mediteran soil type consist of more plants and more various species than those of Latosols and Grumusols. Being more stable and crumbly as well as having higher organic substances and nutrient content than Latosols and Grumusols (Table 1), more species of plants can adapt and grow well in Mediteran soils. The plant diversity may contribute litter of leaves, twigs, branches or dead roots which will be decomposed, thus adding organic substances and nutrient to the soil. In ecosystems, the relationship among the soil, plants, nutrient, and water is part of the most dynamic (Hairiah et al., 2005).

Based on the IVI of the plant species (Figure 2), peanuts and cassava have high values in Latosols and Mediteran soils. The sample home gardens of these soil types are located on a dry land which is the central area of peanut and cassava produce. In Grumusols, the IVI of gingers and temulawak (*Curcuma xanthorrhiza* Roxb.) are also high. Having locations in the area producing the rhizomes of Zingiberaceae plants, the home gardens commodities become marketable. In addition, home gardens are also utilized to grow salable vegetables, such as kenikir (*Cosmos caudatus* Kunth). Likewise, young leaves of cassava and papaya are commonly consumed vegetables and sold in the local market. These species are of high value due to their utilization by the households, for consumption as well as for sale.

Mango is a very popular fresh fruit, especially in Java, that the tree grows in almost every home garden. There are always ready stocks of Jackfruits for sale in the local market, both ripe and unripe, to be consumed as fresh fruit as well as for culinary use. Similarly, pete and lamtoro are also favorite, as a part of the culinary delights of the households. Young leaves and fruit peels of melinjo can be utilized as vegetables, while the seeds are processed to produce several kinds of chips in home industries.

Conclusions

The different soil types of the home gardens, which differ on their supporting factors, correspond to the diversity of the grown species and the existence of specific plant species can be the characteristics of each of them. Peanut, papaya, and ginger are the most important plants in the first strata planted in Latosol, Mediteran and Grumusol soil respectively, while mango is the fresh fruit commonly grown on all soil types. The home gardens in the Mediteran soil have diverse and abundant reserves of food. Nevertheless, it shall be accompanied with the efforts of food diversification to provide the maximum benefit for the households, especially in anticipating the adverse impact of climate change.

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