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The Conservation of Osingnese Traditional Home Garden Agroforestry in Banyuwangi, East Java, Indonesia

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ABSTRACT

Local culture and traditions have been considered as an important factor in influencing plant species diversity and composition of home garden, but their interactive effect have not yet been investigated. This research aimed to describe the plant species diversity in traditional home gardens, identify the species with important value based on ethnobotanical indices, and describe the perception of local people towards agroforestry conservation in Osingnese Villages in Banyuwangi. Data acquisition was performed at Kopen Dukuh, Buluhsari-Kopen Cungking, and Kemiren Villages. Floristic survey was implemented at 75 home gardens. An interview was implemented for each owner. Results showed that Osingnese home gardens consist of numerous plant species. Kopen Dukuh and Buluhsari-Kopen Cungking showed a complex structure which could be considered as a complex agroforestry. *Cocos nucifera*, *Coffea canephora*, *Coffea liberica*, *Garcinia mangostana*, and *Durio zibethinus* were the important species in complex agroforestry. Those species composition indicated that home gardens are able to conserve native plants of Malaysian regions, particularly Indonesian flora. Agroforestry knowledge was derived from the older generations and implemented in gardening practices. They also argued that recent agroforestry is an adaptation mechanism of land management. The government did not contribute to educate and empower local people about agroforestry practices.

INTRODUCTION

Home gardens are a sustainable agricultural practice which is widely practiced in Indonesia. The benefits of home gardens have been reported and are numerous. Home gardens have been identified to contribute to various ecological services from land conservation to global warming mitigation through carbon capture and sequestration. Recent discussions on food security have also reported that home gardens are significant plots in settlements areas to produce food. Home gardens are also potential habitats for numerous medicinal plants, which are important for community health in developing countries (Agelet, Bonet, & Vallés, 2000; Asase & Tetteh, 2010; Buck, Lassoie, & Fernandes, 1998; Finerman & Sackett, 2003).

In Indonesia, home gardens are crucial components of rural landscapes. Home gardens are found in rural areas in the Indonesian archipelago, from lowlands to mountainous rural settlements. There are Kaleka systems in Kapus (Central Kalimantan), Kebun Talun in West Java, Pekarangan in East Java, Munan in Dayak Tunjung and Lembo system in Kutainese. There are two basic aspects which contribute to the variety of home garden structures and functions. Firstly, biophysical environmental settings are crucial factors for plant richness. Climates, topography, soil, and vegetation are among the most important factors contributing to home gardens. Biophysically, Indonesia is rich in terms of biophysical settings; this situation leads to

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the diversity of home garden structures. Secondly, human culture has been reported to be important for home garden structures and plant richness (Kimber, 2004; Nair, 1985; Rahu, Hidayat, Ariyadi, & Hakim, 2013; Weersum, 1982).

Home gardens in Java are of interest for biodiversity conservation. Previous research has confirmed that home gardens in Rajegwesi Villages (0-10 m asl) in Banyuwangi harbour at least 132 plant species with numerous functions (Pamungkas, Indriyani, & Hakim, 2013). In Tengger Highland (1,050-2,300 m asl), home gardens provide habitat for at least 153 plant species. Shrubs and herbs were dominant plant groups in highlands (Hakim & Nakagoshi, 2007). The number of species confirms that home gardens are potential sites for biodiversity conservation. Home gardens are often managed with poly-culture systems, or agroforestry (Kumar & Nair, 2006). In many studies, the ethnobotanical survey has confirmed that different groups of local communities have different perspectives on plants and gardens (Padoch & de Jong, 1991; Wiersum, 2006).

Rural areas in Banyuwangi Regency (East Java) form one of the sites where home gardens are abundant, but few research studies have been conducted. Therefore, this research aimed to describe the plant species diversity in home gardens, to identify the species of importance based on ethnobotanical indices, and to describe the perception of local people towards agroforestry practices conservation in Osingnese Villages in Banyuwangi.

MATERIALS AND METHODS

This research was conducted at three villages in Banyuwangi, namely Kopen Dukuh Village, Buluhsari-Kopen Cungking Village and Kemiren Village from September 2013 to January 2014. These villages are located at 600-800 m asl on the slopes of Mt. Ijen, Banyuwangi Regency. This regency is rich in agricultural land for agribusiness development. Based on land use data, paddy fields and plantations are dominant. There are at least 27 state and private plantations in Banyuwangi regency with numerous products encompassing coffee, coconut, rubber, cacao, clove, sugarcane, and woody trees. Coffee plantations are more dominant among them. The abundance of private and state plantations was derived fromthe colonial era when Dutchman in the eighteenth century opened many areas in East Java as plantations. In East Java, the area used for plantations increased rapidly in the 1990s. Coffee plantations were opened in large numbers in Banyuwangi, particularly on dry land. The coffee cultivation as a prospective crop was introduced to local people, especially on the slopes of Mt. Raung and Mt. Ijen. Planting coffee has become a common activity among farmers. The productivity is reported to be high because of biophysical factors (BPS Kabupaten Banyuwangi, 2012). Kopen Dukuh, Buluhsari-Kopen Cungking, and Kemiren Villages are home to the Osingese, the native of Banyuwangi. Biophysically, the Osingnese are Javanese with a mixed culture in their daily lives. Balinese culture and tradition have mixed with old Javanese culture to construct the recent Osingnese culture. Recent Osingnese are farmers, whose main activity is farming in paddy fields and orchards. The settlement area is dominated by huge and large green areas. The size of villages is often large, and Osingnese houses are sparsely distributed. Paddy fields and plantations are dominant.

Data Collection

A floristic survey was implemented at 25 home gardens in Kopen Dukuh Village, Buluhsari-Kopen Cungking Village and Kemiren Village, which were randomly selected. In total, 75 home gardens were visited and studied systematically. In each garden, the direct observation of species composing home gardens was performed. An interview with the owner was implemented, and data were tabulated into observation forms. Respondents were asked to describe the useful species in their gardens. All of the useful plants were classified into nine categories, namely food, medical, culture, civil contraction, fuel biomass, ornamental, economic, animal feed and other usages. Plant species in gardens were classified based on plant habitats, namely trees, shrubs and small trees, herbs, and lianas.

Analysis

All of the data were analyzed using Microsoft Excel 2010. Plant species were classified into trees, shrubs and small trees, herbs and lianas. In this study, Relative Frequency of Citation (RFC) and Relative Importance Index (RI), as ethnobotanical indices, were calculated following Tardío & Pardo-de-Santayana (2008), and Sujarwo & Caneva (2016).

$$RFC=FC/N \quad \text{..... (1)}$$

Where:
FC = number of informants mentioning the use of the species,
N = number of informants participating in the survey.

The value of RFC varied from 0 (i.e. nobody reported or mentioned the plant species as a useful species) to 1 (i.e. all of the informants mentioned the plant species as a useful species).

RI = NUC + NT .....(2)

Where:
NUC = number of use categories of a given species divided by the total number of use categories of the most versatile species,
NT = number of types of uses divided by the total number of types of uses of the most important species.

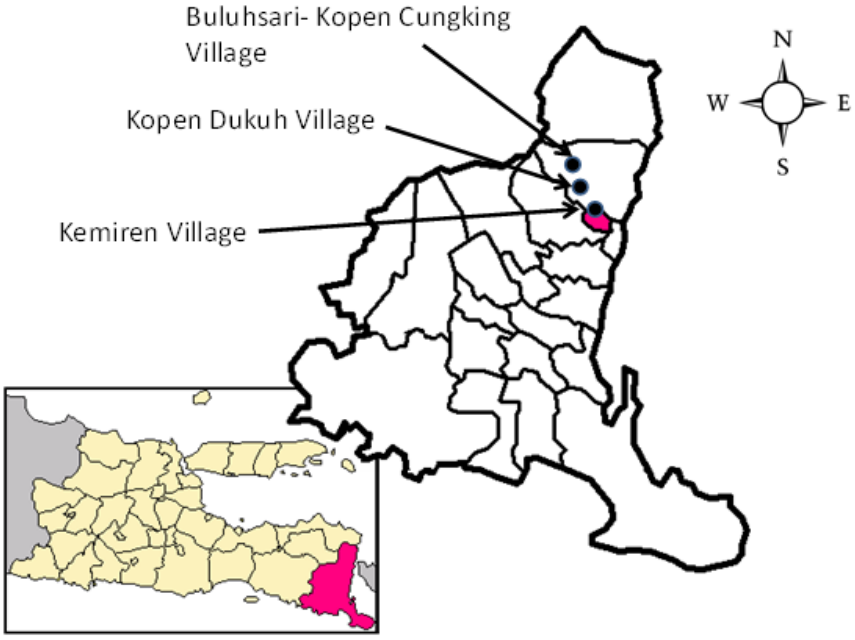

Fig. 1. The map of study sites

Fig. 2. Home gardens in Buluhsari-Kopen Cungking Village

RESULTS AND DISCUSSION

Plant species of home gardens were numerous and classified into trees, shrubs and small trees, herbs, and lianas. Home gardens of the Osingnese in Banyuwangi Regency contained a number of plant species showing the significant role of home gardens in rural biodiversity conservation. The plant species diversity and the spectrum is similar to that of other traditional home gardens in many regions in developing countries (Combe, 1982; Weersum, 1982; Rahu, Hidayat, Ariyadi, & Hakim, 2013). The diversity in terms of species, habitats, and cultural uses among home gardens in Banyuwangi represented the diverse local perceptions on plant and gardening practices. It is one of the significant forms of traditional knowledge, which has recently been considered important in biodiversity conservation (Gadgil, Berkes, & Folke, 1993).

In Kopen Dukuh and Buluhsari-Kopen Cungking, trees, shrubs and small trees, herbs, and lianas were found to be growing and forming complex agroforestry. Giant and tall trees formed the canopy and became the upper storey in the vertical structure of home garden vegetation. They encompassed *Cocos nucifera*, *Garcinia mangostana*, *Durio zibethinus* and *Lansium domesticum*. These old woody plant species, i.e. *C. nucifera*, *D. zibethinus*, and *Swietenia mahagoni*, often stood out as garden demarcation, while *G. mangostana* was often patchily distributed in home gardens. The highest number of tree species in Kopen Dukuh revealed the highest proportion of fruit tree species in home gardens in Kopen Dukuh.

The middle storey consisted of shrubs and small trees, such as *Coffea canephora*, *Coffea liberica*, *Averrhoa bilimbi*, *Averrhoa carambola*, *Leucaena leucocephala*, *Erythrina variegata*, *Syzygium aromaticum*, and *Phyllanthus acidus*. Two species, namely *L. leucocephala* and *E. variegata*, were planted ultimately as shading plant species in coffee plantations. *L. leucocephala* was also widely planted and used as animal feed. In Kemiren, the highest shrubs and small tree species number and percentage were related to the numerous ornamental shrubs and small tree species (Table 1).

The lower storey and ground covers were dominated by herbs such as *Musa paradisiaca*, *Capsicum annuum*, *Colocasia esculenta*, *Alpinia galanga*, *Solanum melongena*, *Solanum torvum*, *Zingiber officinale*, *Curcuma aeruginosa*, and *Curcuma zanthorrhiza*. Some of them grow wildly, such as *Colocasia esculenta* and *Zingiber officinale*. Herbs species were important understory species in all of the study sites. They were distributed randomly in home gardens, and there were indications of spontaneous growth in all gardens. The highest herbs in Kopen Dukuh and Buluhsari-Kopen Cungking seemed to be related to large garden areas.

All plants which in home gardens have numerous values. Among the identified plants species, the top ten highest species in RFC and RI value was given in Table 2. Species in home gardens support numerous local community daily needs, ranging from economic to cultural aspects. Principally, many species found in home gardens contain rich, active compounds which are useful in medical treatment (Joshi, 2000; Peter, 2006). These open up opportunities for future home gardens contributing to tourism in rural areas. The existence of some flora related to cultural uses represents the close relationship between local culture and plants. In Java and Bali Islands, the use of flowers and leaves for traditional rituals is common (Codron, 1999). Culture, therefore, has become an important instrument to maintain the biodiversity of home gardens. Important species from a cultural aspect were similar in Kopen Dukuh and Buluhsari-Kopen Cungking. Manihot esculenta was considered important by people in Kopen Dukuh and Buluhsari-Kopen Cungking as a food source. Local people in Kemiren Villages had different perspectives on home garden management. The density of houses in settlement areas led to the absence of tall and big tree species in community settlements and home gardens.

Table 1. Home gardens species spectrums

Plants community layer	Number of species			Percentage		
	KpD	BKc	Kem	KpD	BKc	Kem
Trees	39	24	18	0.40	0.27	0.22
Shrubs and small trees	9	24	29	0.10	0.27	0.36
Herbs	41	36	29	0.42	0.41	0.36
Lianas	8	4	5	0.08	0.05	0.06

Remarks: KpD = Kopen Dukuh; BKc = Buluhsari-Kopen Cungking; Kem = Kemiren

Table 2. Relative Frequency of Citation (RFC) and Relative Importance Index (RI) values of each species for all study sites

Plants species	Local name	Villages					
		KpD		B.Kc		Kem.	
		RFC	RI	RFC	RI	RFC	RI
Manihot esculenta	Sawi	1.00	1.53	0.70	0.55	-	-
Cocos nucifera	Kelapa	0.97	0.98	1.00	0.90	-	-
Coffea canephora	Kopi Buriah	0.90	0.65	0.93	0.86	-	-
Garcinia mangostana	Manggis	0.83	0.62	0.86	0.83	-	-
Coffea liberica	Kopi Glondok	0.80	0.66	0.66	0.73	-	-
Durio zibethinus	Durian/Duren	0.80	0.60	0.63	0.61	-	-
Syzygium aromaticum	Cengkeh	0.77	0.58	-	-	-	-
Colocasia esculenta	Bentol	0.70	0.45	-	-	-	-
Areca pumila	Jambe	0.70	0.55	-	-	-	-
Musa paradisiaca	Gedang saba	0.63	0.52	0.63	0.51	-	-
Moringa oliofera	Kelor	-	-	0.63	0.41	0.76	0.06
Senna siamea	Kayu udan	-	-	0.63	0.61	-	-
Lansium domesticum	Lansat	-	-	0.50	0.45	-	-
Nephelium lappaceum	Rambutan	-	-	0.43	0.51	0.60	0.28
Sauropus androgynus	Katuk	-	-	-	-	0.70	0.11
Cymbopogon nardus	Sereh	-	-	-	-	0.63	0.12
Lannea coromandalika	Kayu santen	-	-	-	-	0.50	0.13
Leucaena leucocephala	Lamtoro	-	-	-	-	0.47	0.07
Cordyline balmoreana	Andong	-	-	-	-	0.46	0.02
Sanseviera angustiflora	Sanseviera	-	-	-	-	0.37	0.01
Averrhoa carambola	Belimbing	-	-	-	-	0.37	0.01
Averrhoa bilimbi	Belimbing wuluh	-	-	-	-	0.37	0.03

Remarks: KpD = Kopen Dukuh; BKc = Buluhsari-Kopen Cungking; KEm = Kemiren

Plants for food were numerous and could be classified into plants as carbohydrates sources, vegetables, and fruits. Among them, *Manihot esculenta* is the ultimate starchy plant species cultivated in home gardens in Kopen Dukuh and Buluhsari-Kopen Cungking. Other starchy plants for food resources include *Colocasia esculenta* and *Dioscorea* sp. The plants which are planted to produce vegetables and fruits are numerous. Fruit species included *Durio zibethinus*, *Syzygium aromaticum*, *Musa paradisiaca*, *Lansium domesticum*, *Nephelium lappaceum*, *Averrhoa carambola*, *Garcinia mangostana*, *Averrhoa carambola*, *Averrhoa bilimbi*, *Carica papaya*, *Annona muricata* and *Artocarpus heterophylus*. Among such fruit species, only *Garcinia mangostana* and *Durio zybethinus* were considered fruit trees having economic value.

The phenology pattern of fruits in the study area showed the opportunity to involve fruits in food security programs in rural areas (Molyneux, da Cruz, Williams, Andersen, & Turner, 2012). It is especially crucial in areas with limited community health facilities. Natural sources of food that are rich in vitamins and medicinal plants are the ultimate component in community health (Alaimo, Packnett, Miles, & Kruger, 2008; Heim, Stang, & Ireland, 2009). The plant species phonology pattern in rural areas in Banyuwangi also provides opportunities for local people to continuously received cash income from home garden (Stoler, 1978; Arnold & Ruiz-Perez, 2001).

Plants for medicinal material include *Alpinia galanga*, *Boesenbergia pandurata*, *Foeniculum vulgare*, *Curcuma domestica*, *Zingiber zerumbet*, *Kaempferia rotunda*, and *Zingiber officinale*. Interestingly, their RFC and RI value was small, indicating that the medicinal values of such plants were rarely cited by local people.

Some species had important values in cultural aspects, including *Areca pumila*, *Rosa multiflora*, *Polianthes tuberosa*, *Cananga odorata*, *Codiaeum variegatum*, *Pandanus amaryllifolius*, *Jasminum officinale*, *Plumeria rubra*, and *Dracaena fragnan*. As traditional communities, Osingnese in Kopen Dukuh and Buluhsari-Kopen Cungking and Kemiren Villages practice numerous activities as part of the Osingnese culture. These species often produce flowers which are intensively used for traditional rituals.

Many tree species in home gardens were planted to provide basic materials for construction. A small part of such trees is collected as fuel biomass resources. The wood of *Cocos nucifera*, *Durio zibethinus*, and *Swietenia mahogany* are the trees with good wood for civil construction. Woody trees were used by local people to build houses. The common non-wood species for civil construction are *Gigantochloa atter* and *Gigantochloa apus*. Recently, bamboo has rarely been found in home gardens. Home gardens contained wood and non-wood trees which were important as construction materials. Bamboo is one of the most important home garden non-wood tree species among the Javanese in rural areas. In rural Javanese culture, bamboo is a multi-purpose agroforestry crop, which is commonly cultivated in agroforestry systems. Bamboo is important for making houses and fences (Soemarwoto & Conway, 1992; Christanty, Mailly, & Kimmins, 1996).

Ornamental plants were abundant on home gardens, particularly in front yards. Ornamental plants were dominated by shrubs and small trees and herbs. Plant species with beautiful flowers and foliage were often chosen as ornamental plants. They included *Rosa multiflora*, *Datura metel*, *Dieffenbachia seguine*, *Polianthes tuberose*, *Bougainvillea spectabilis*, *Allamanda cathartica*, *Codiaeum variegatum*, *Jasminum officinale*, *Begonia*, *Colocasia affinis*, *Iresine herbstii*, *Dracaena fragnan* and others.

Plants having economic aspects included *Cocos nucifera*, *Garcinia mangostana*, *Durio zibethinus*, *Syzygium aromaticum*, *Coffea liberica*, *Coffea canephora*, and *Nephelium lappaceum*. These plants were commonly cultivated in home gardens. In Banyuwangi, the productivity of fruits which were cultivated in home gardens, orchards and plantations were significant (Table 3). These plants were often planted as part of the coffee agroforestry system. Coffee is an important commodity among Osingnese villages in Banyuwangi; the abundance of coffee plantations is probably influenced by local farming culture, knowledge, market prices, and land suitability for coffee cultivation.

Local people suggested that home gardens play a significant role in their daily lives. Planting many plant species in home gardens can be an important part of local people's adaptation to life in rural areas. It is particularly important when access to markets is limited, therefore, this strategy is more effective than buying vegetables and fruit from markets. Local people, in Kopen Dukuh and Bulusari-Cungking, suggested that home gardens have an important value in monetary incomes. Home gardens provide continuous products which are available to harvest throughout the year. The phenology of species in home gardens showed the sustainability of food resource availability, thus enhancing the lives of villagers (Table 4). In Kopen Dukuh and Buluhsari-Kopen Cungking, most fruit trees start flowering from the middle until the end of the dry season. Depending on the species, flowering occurs until the early rainy season (i.e. *Garcinia mangostana* and *Durio zybethinus*). The fruit season often occurs after the dry season and in the early rainy season.

While home gardens provided numerous benefits to local people, respondents pointed out that many home gardens and agroforestry practices are under serious threat. According to respondents, threats to the sustainability of agroforestry were numerous. Firstly, the increasing population in rural areas is leading to an increase in the requirement for space and wood for building materials. Secondly, many fruit trees species are showing a decreased productivity, and people are changing fruit trees into crops (i.e. cassava, chili, corn). Thirdly, an increase in Sengon wood has led to agroforestry lands with diverse tree species changing to monoculture with a single plant, Sengon.

Table 3. The productivity of selected fruits which are planted in traditional garden in Banyuwangi regency

Fruit commodity	Productivity (Quintal ha^{-1})	Total production (t)
Durian *(Durio zibethinus)*	700.21	41,416.72
Mangosteen *(Garcinia mangostana)*	426.29	29,479.66
Rambutan *(Nephelium lappaceum)*	236.24	48,193.90
Langsat *(Lansium domesticum)*	107.27	254.23
Rose apple *(Syzygium aqueum)*	71.36	745.50
Jackfruit *(Artocarpus heterophyllus)*	486.06	26,313.34
Coconut *(Cocos nucifera)*	na	128,517.70

Table 4. Phenological aspect of some important plant species in home gardens

Species	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Cocos nucifera						Flo/Fru						
Garcinia mangostana	Fru					Veg.					Flo	
Durio zibethinus		Fru				Veg.					Flo.	
Syzygium aromaticum				Veg.						Flo		Fru
Coffea liberica					Veg-Flo						Fru	Veg
Coffea canephora				Veg-Flo				Fru			Veg	
Nephelium lappaceum		Fru					Veg.					Flo

Remarks: Flo= Flowering, Fru=Fruits, Veg.= vegetative growth

The conservation of home gardens has become important in the recently rapid rural development, especially in a spatial context. In rapid rural development, there are often rapid land use changes. Many fertile agricultural areas, plantations and agroforestry regions have been changed to other land uses (Poyatos, Latron, & Llorens, 2003; Lambin & Geist, 2006). There are ecological consequences of this land cover change, especially in the case of the decrease and loss of agroforestry systems. The ecological consequences include a decrease of biodiversity, an increase of local and regional temperatures, an increase of crop pests and diseases, and a loss of habitat for birds and small mammals. Increased runoff, flooding and landslides can also result from agroforestry system disturbances because of the loss of vegetation (Jose, 2009).

Applying agroforestry systems in home gardens can be considered as cultural approach in land management (Galluzzi, Eyzaguirre, & Negri, 2010). Challenges for agroforestry sustainability are especially related to the support of local communities. Involving local people in the future sustainability of agroforestry in Banyuwangi is important. Local people should be encouraged to sustain agricultural practices through education, economic incentives and training to increase agroforestry productivity, and should also develop new economic opportunities from agroforestry system (e.g. rural tourism, ecotourism).

CONCLUSION AND SUGGESTION

Osingnese home gardens were constructed by numerous plant species that planted for food, medical, culture, civil construction, fuel biomass, ornamental, economical, animal feeding and other usages. Kopen Dukuh and Buluhsari-Kopen Cungking showed a complex structure which could be considered a complex agroforestry form. Among the important species in complex agroforestry were *Cocos nucifera*, *Coffea canephora*, *Coffea liberica*, *Garcinia mangostana*, and *Durio zibethinus*. Based on composition of plant species, home gardens are able to conserve native plants of Malaysian regions, particularly Indonesian flora. Based on observation, agroforestry knowledge was derived from the older generations and implemented in gardening practices. In addition, people in Banyuwangi argued that agroforestry is an adaptation mechanism of land management and the government does not contribute to educate and empower local people about agroforestry practices. Involving local communities and performing education programs, providing economic incentives, providing training to increase agroforestry productivity, and developing new economic opportunities from agroforestry system (i.e. rural tourism, ecotourism) are all important to enhance the sustainability of home gardens and agroforestry practices in Banyuwangi Regency.

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