Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 3, No. 3, p. 1-11, 2013
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Home gardens of the local community surrounding Lake Ayamaru, West Papua Province, and its consequences for tourism development and lake conservation

Albertho Hendrikus Solossa[1], Soemarno[2,4], Ika Rochjatun Sastrahidayat[2], Luchman Hakim[3,4*]

[1]*Office of Agriculture, Maybrat District, West Papua Province and Student of Graduate Scholl of Science and Environmental Technology, Brawijaya University, Jl. Veteran Malang, 65145, East Java, Indonesia*

[2]*Faculty of Agriculture, Brawijaya University Brawijaya University, Jl. Veteran Malang, 65145, East Java, Indonesia*

[3]*Department of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University Brawijaya University, Jl. Veteran Malang, 65145, East Java, Indonesia*

[4]*Graduate Scholl of Science and Environmental Technology, Brawijaya University Brawijaya University, Jl. Veteran Malang, 65145, East Java, Indonesia*

Article published on March 28, 2013

Key words: Biodiversity, home gardens, tourism, lake conservation, Indigenous knowledge.

Abstract

The aims of this paper are to analyze home gardens in remotes area in Maybrat district, West Papua province, Indonesia, and its potential contribution to tourism development and Lake Ayamaru conservation. The result of the study shows that principally home gardens have a high biodiversity of plants species. Within the home gardens in Maybrat, the vegetation structure is multi-strata. The plant habits range from small herbs and shrubs to tall trees with dense canopy. These plants species are used for food, medicine and ornamental plants in order to improve the visual quality of settlements. Tuber plant is commonly grown in the home gardens and swidden fields. Other commonly planted plants include medical plant, vegetables, and spices. Ornamental plants with beautiful foliage are more frequent in the home gardens. Attention should be paid to the existence of exotic plants species as these plant species are able to provide negative impacts to the native ecosystem in Maybrat, including Lake Ayamaru. The diverse flora of home gardens allows such ecosystem to support tourism development and lake conservations.

***Corresponding Author:** Luchman Hakim ✉ luchman@ub.ac.id

Introduction

In the global perspective, the biodiversity of home garden is phenomenal and remains an interesting object to study. Home garden is one of the manifestations of indigenous knowledge of local people to maintain their house environment. Home garden is ecologically a site with numerous plants species. In many parts of the world, home garden has been indisputably correlated with biodiversity conservation (Nair and Kumar 2006). It is also a manifestation of a complex relationship between human and nature. In many places, home garden has co-evolved with local culture and traditions (Galluzzi *et al*., 2010). Home garden, therefore, can be categorized as one of the world's cultural landscapes.

The value of home garden for local community development has been explored and documented in academic text. The contributions of home garden are widely equated with food security and biodiversity conservation (Perfecto and Van der Meer, 2008; Webb and Kabir, 2009; Ijinu *et al*., 2011; Bagson and Beyuo, 2012). Despite the significance of home garden as a subsistence livelihood for many rural families in developing countries, little has been written on this subject in tourism planning and development (Hakim and Nakagoshi, 2007). Integrating home garden as one of the cultural landscapes form into tourism presents unique challenges. In many cases, the cultural landscapes are attractive to tourist. For instance, Balinese rice terrace in Ubud has become one of the main attractions for tourists visiting Bali islands. Principally, indigenous knowledge forms and activities are closely linked to tourism attraction (Bolnick, 2003; Hakim *et. al*., 2009). Therefore, it is the challenges for many tourism planners in developing countries to integrate the existence of home garden into tourism planning.

The most important contribution of tourism is its benefits to local economic development. Revenues received from tourism industry in many developing countries are reported significant. In many developing countries, tourism is an important industry with regard to the alleviation of poverty. Scholars point out that economic benefits are one of the driving forces behind tourism development in many countries (Swarbroke, 2002; Bolnick, 2003; Sirivejjabhandu and Whyte, 2010). Therefore, promoting tourism as one of the development agenda is crucial in remotes and developing countries.

In particular, tourism to natural environments grows significantly. Ultimately, this was driven by an increasing tourist's awareness of the value of environment (Waller, 2001; Uriely *et al*., 2007). Recent tourist generation expects to find authentic experiences. In the context of tourism attraction management, there are two important issues to be considered in the management of destination sites (Swarbroke, 2002; Fyall *et al*., 2005). Firstly, the place should be able to invent, manage and promote a new potential attraction as a pivotal component of tourism destination. In tourism destination development theory, an attraction is the heart of the destinations. In such aspect, there are many studies urging a note of caution for the development of new attractions. Scholars point out that the conservation of biodiversity is recently considered to be one of the most important benefits of tourism. Conserving biodiversity can have a major benefit on the destination competitiveness and sustainability (Waller, 2001; Hakim *et al*., 2012). Secondly, the place should be able to protect and enhance the present tourism attractions. In fact, there are many potential threats to environmental and attraction quality. In such a case several approaches have been implemented, including the application of indigenous knowledge systems. The quality of indigenous-based attractions is becoming a more recognized component of today's Western tourist (McKercher and du Cros, 2002). In such a case, the biodiversity of home garden may have positive environmental impact to tourism destination.

Maybrat is one of the districts in West Papua province where tourism is in its initial development stage. According to the local government, promoting tourism in Maybrat seems to be the best policy option to enhance local development. Recently, the arrival of international tourists in West Papua has become a challenge for tourism development in Maybrat district. Maybrat principally has spectacular lake (i.e. Lake Ayamaru) that is potential to be promoted as a natural tourism attraction. Moreover, the diversity in biological and cultural aspects in West Papua has provided an important capital for nature-based tourism development. As mentioned above, home garden is one of the potential capitals in tourism destination. The major challenge to the tourism in Maybrat, however, is to find ways to include home gardens in the tourism planning and development. The aim of the research is to identify the diversity and roles of plants species composing the home gardens of Maybrat community in Maybrat District, West Papua.

Materials and Methods

Study area

Field survey was conducted in Maybrat district, West Papua province, Indonesia (Fig. 1). This site extents within 132° 10' - 132° 13' E longitude and 1° 14' - 1° 17' N latitude. Maybrat district is mainly hilly and undulating with most of the area being covered by tropical rain forest. The climate is tropical with an annual humidity recorded as high as 87.5%. The temperature is generally warm. Maybrat district is very rich in terrestrial and fresh water ecosystem biodiversity. The region is mainly dominated by calcareous soil which contains high amount of lime.

Within the study site, there is a huge lake, namely, Lake Ayamaru (c.a. 1,000 ha). The lake has received special concern due to rapid sedimentation and exotic plant species invasion. In 2007, it was estimated that the sedimentation area was approximately 110 ha. Lake Ayamaru provides a natural aquatic habitat for wildlife and offers spectacular views for tourism. There are several water springs flowing to the lake namely, Ella, Masoy, Framu and Rohmbi. There are also eight rivers flowing into the lake, namely, Rohmbi, Molum, Imsum, Ayamaru, Kladuk, Sraun, Kamet, and Unggas Rivers. Lake Ayamaru is a shallow water body which is recently invaded by several exotic species.

Vegetation surrounding the lake consists of medium to tall trees such as *Melaleuca leucadendron* (L.) L., *Intsia bijuga* (Colebr.) Kuntze, *Cinnamomum burmannii* (Nees & Th. Nees) Nees ex Blume, *Agathis* sp., *Araucaria* sp., *Ficus* sp., *Octomeles sumatrana* Miq. , *Alstonia scholaris* (L.) R. Br. Some open habitat is colonized by exotic shrubs such as *Lantana camara* L. In the open habitat, ferns have also been regularly found together with grasses species (LAPI-ITB, 2004; Kabupaten Sorong Selatan, 2007).

Methods

Field survey was implemented in three sub-districts, namely, Ayamaru Jaya, Ayamaru Tengah and Ayamaru Utara. In order to understand the socio-cultural background of the study area, several documents and archives related to Maybrat were collected and analyzed comprehensively. In this study, such information was considered relevant due to limited data and information available. Key informants were mostly elderly people who had lived in the study sites for many years. Mainly, interviews were conducted in the informants' homes and swidden fields. Each interview took between 10-20 minutes. Floristic survey was the main tool to describe the plant diversity of the home gardens and their function, conducted in selected houses and their respective garden. We observed systematically the kinds of useful plants species which grew in the home gardens area. The value of plants species in the home gardens were assessed through in-depth interviews and discussion among the villagers in the study area. The data were, then, analyzed descriptively.

Result and discussion

The Maybrat community

The Maybrat community probably inhabited Ayamaru area over a thousand year ago. In the past, the Maybrat lived nomadic, followed their slash-and-burn agricultural practices. Informants point out that the Maybrat people have practiced slash-and-burn agriculture for several thousand years. The consequences of nomadic lifestyle must have restricted their educational possibilities. Clearly, lack of basic education has played an important role in the status of human capacity among the Maybrat community.

Table 1. Plant species diversity in each stratum.

Category	Species	Ecological notes
Tall tree stratum	*Durio zibethinus*	Medium to large tree, typically 20-40 m tall. Tall trees provide habitat for numerous epiphytes plant species. Durian form buttress root which are beneficial for land conservation.
	Lansium domesticum	Medium tree, can reach height of 20-25 m tall. Habitat for many birds and insect.
	Mangifera indica	Evergreen trees, habitat for some birds. Species form woody taproot system which supports land conservation.
	Artocarpus communis	Medium to large tree, typically 20-25 m tall. *A. communis* is considered as fast-growing tree species and, therefore, applicable for restoration program of degraded lands.
	Cocos nucifera	Some individual may attain a height of 30 m. Very common in home gardens.
	Pometia pinnata	Medium to large tree, typically 20-30 m tall. Fruit are edible and consumed by birds and mammals.
	Canarium indicum	Large tree, typically 25-30 m tall.
Low tree stratum	*Nephelium lappaceum*	Medium size tree (15-20 m tall), but some individual may attain a height of 25 m.
	Syzygium aqueum	Medium tree, typically 10-15 m tall. Fruits are consumed by bats and birds and, therefore, *S. aqueum* plays an important role in wildlife conservation.
	Annona muricata	Evergreen tree, less than 10 m in tall. Native to tropical America and cultivated in South East. Asia.
	Artocarpus heterophyllus	Common in home gardens, individual may reach 20 m in height. *A. heterophyllus* has strong taproot system which is applicable for soil conservation.
	Morinda citrifolia	Evergreen small tree with a deep taproot.
	Phyllanthus acidus	Medium size tree (15 m tall). Native to Southern America.

	Persea americana	Medium to large tree which may attain a height of 10-15 m tall. Abundance in home gardens. Habitat for birds, honey bees, flies and wasp.
Low shrubs-herbs stratum (0.5 – 1.5)	*Coffea* sp.	*Coffea* was introduced several years ago. The species is rather uncommon in home gardens.
	Carica papaya	Herbaceous, fast-growing trees.
	Musa spp.	In home gardens, it exists in mixed with other species. There are several cultivars found.
	Pandanus conoideus Lam.	Abundance. Tolerant to moderate long drought with prop root system.
Herbaceous stratum (0 – 0,5 m tall)	*Colocasia* *Alocasia* *Xanthosoma*	These species provide a valuable food sources for local people in Maybrat district. These species grow well in sandy loam soil.
	Ananas comosus	It can grow successfully in limestone with thin soil cover.

West Papua has a long history of social and political aspects with European, especially the Dutch. This area was recognized in 1880 by Dutch Missionaries (Boelaars, 1986). In 1924, the Dutch controlled the territory of the Maybrat community surrounding Lake Ayamaru. In 1935, the first settlement was initiated and opened at Aytinyo. In 1950, many settlements were established around lake Ayamaru. The gradual settlement development in such area was stimulated by the construction of road and the development of infrastructure. In 1969, small towns and villages surrounding Lake Ayamaru were officially organized under Sorong regency, West Papua province. Lack of infrastructure and human capacity apparently limited the development of such areas. Basically, the transportation in West Papua is primarily by air. According to an UNDP report (2005), the availability of formal schools was a strongly limiting factor for human development.

According to the informants, the period of 2000-2005 represents the rise and development of area surrounding Lake Ayamaru. Political and economical issues have forced the central government in Jakarta to implement local development in West Papua. In 2009, the area surrounding Lake Ayamaru was declared as an autonomous district, called Maybrat district. Since then, issues related to the development have achieved high priority. During the past decades, Maybrat district had been opened up to development through the creation of road and kinds of infrastructure. However, there seems to be a lack of environmental concern, particularly to protect the ecosystem of the lake. Maybrat district got its name after the existence of the Maybrat people as a dominant community in the area. Maybrat district is populated by numerous indigenous clans, namely, Solossa, Bless, Kareth, Hlumbless, Naa, Sentuf, Isir, Jidmau, and Kambuaya, collectively referred to as Maybrat people (Boelaars, 1986; William and Brown, 1993).

Recently, the estimated number of population was 6,025 individuals. They live in a number of small villages. They are engaged in farming, fishing and collecting non-timber forest products (BPS Maybrat, 2012). According to the informants, forest is essential for local people in Maybrat. Local people rely heavily on the non-wood products provided by the forest. The informants point out that non-wood forest products are especially important to supply many of the local people's daily subsistence needs.

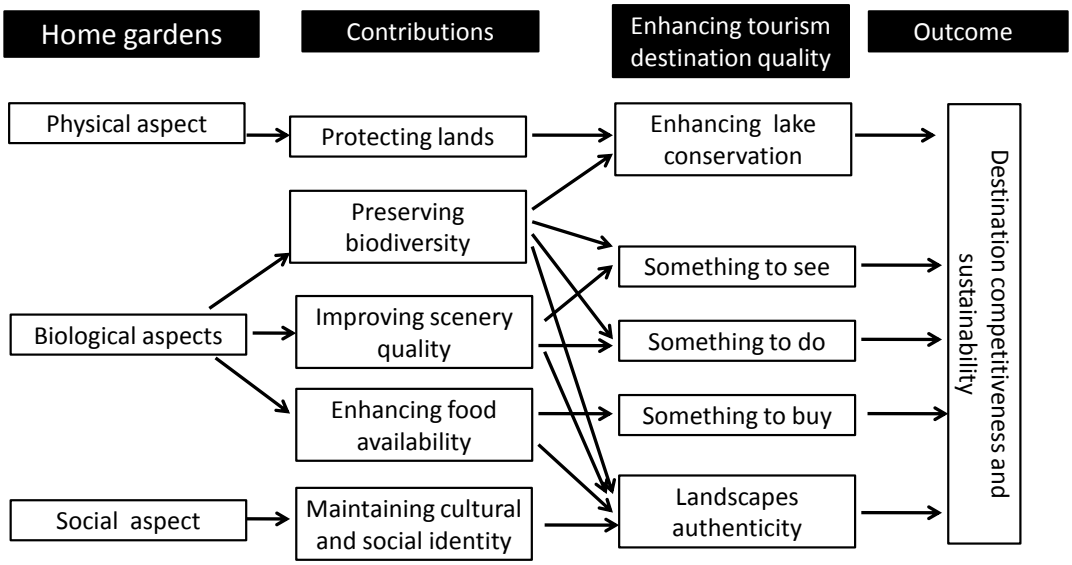

Fig. 1. Conceptual diagrams of the contribution of home gardens in tourism destination development and lake conservation.

The informants state that the lake plays a crucial role within the local people in Maybrat district. Such ecosystem fundamentally plays an important role as a site for fish-collecting, recreation and transportation. Recent observation, however, confirms that the lake has been disturbed significantly caused by human activities (LAPI-ITB, 2004; Kabupaten Sorong Selatan, 2007).

Slash-and-burn is an agricultural practice which is still applied by Maybrat people. The process begins from informal consultation and discussion between the farmers and the clan leader. After the decision is made, a small group of family starts the slash-and-burn agricultural practice. The three main stages in which slash-and-burn practices have evolved in Maybrat are: (1) selecting a place, (2) clearing and burning the selected field, and (3) planting crops. The informants point out that there were no technology and advanced tool applied at that time. The dominant crops cultivated by the slash-and-burn were *Xanthosoma sagittifolium* (L.) Schott, *Manihot esculenta* Crantz, *Ipomoea batatas* (L.) and *Arachis hypogaea* L. Other species that may be encountered in swidden field include *Saccharum officinarum* L., *Cucurbita moschata* Duchesne, *Musa* spp., and *Carica papaya* L.

Home Gardens

Structure

In Maybrat district, a family often owns a medium to small area of land for establishing houses, growing plants for food and maintaining a few pigs or cattles. The size and structure of home gardens vary from house to house. According to informants, the different size and structure can be caused by human factors such as social and economic status. Differences in economic aspect can result in large difference in the plant structure of the home gardens.

The home gardens in Maybrat district contain a large number of plants species. These plants are members of different genera and families, and they have been cultivated for many purposes. The home gardens are dominated by the existence of medium to tall trees (15-40 m). Some trees such as *Durio zibethinus* L., *Lansium domesticum* Corrêa, *Cocos nucifera* L., and *Pometia pinnata* J. R. Forst. & G. Forst. may attain a height of over 25 m. Some of them form dense canopy. The old and big trees are home to

epiphytes plants species. In such trees, numerous orchid species are found together with *Asplenium nidus* L. Mixed with such species at the lower level are low trees, shrubs and herbs. In low shrubs-herbs stratum, the dominant plant is *Pandanus conoideus* Lam. In Ayamaru Jaya, Ayamaru Tengah and Ayamaru Utara, this species is commonly found in monoculture patches in open habitat. This characteristic is similar to many home gardens in tropical regions (Perfecto and Van der Meer, 2008; Nair and Kumar, 2006). The species diversity and its ecological characteristic of some plants mentioned by the informants are summarized in Table 1.

The species composition among home gardens in Maybrat generally differs. According to the informants, the degree of distinctiveness among home gardens depends on socio-economical factors. Some people introduce many plants into their home gardens intensively, whereas others are moderate. In Maybrat, ornamental plants are among the most widely grown plants in many front yards.

Plants used by local people

According to the informants, the diverse plant species in home gardens are potential economic assets. This was expressed in a numerous function of plants species. Some species such as *Cocos nucifera* L. is considerable by its high and diverse function in daily life. The value of the species of the home gardens can be categorized into three functions.

Medical plants

Medical plants are the important plant species category of the home gardens. There are a large number of medical plants found in the home gardens. According to the informants, increasing health concern was a main reason for the cultivation of numerous medical plants. The most important medical plant species found at Maybrat home gardens are *Annona muricata* L., *Sauropus androgynus* (L.) Merr., *Persea americana* Mill., *Cordyline fruticosa* (L.) A. Chev. *Pandanus conoideus* Lam., *Morinda citrifolia* L., *Coleus hybridus* hort. ex Voss, *Codiaeum* spp. *Phaleria macrocarpa* (Scheff) Boerl., and *Dracaena* spp. These species was used as a component of numerous traditional drugs. The species diversity of medical plants recorded at Maybrat is almost identical to that of the home gardens in Manokwari (Lense, 2012).

Sources of Foods

The challenges faced by the local people in remotes area are often related to the availability of food and medical materials (UNDP, 2005; Bagson and Beyuo, 2012). A similar situation was faced by the Maybrat community in West Papua. In order to enhance food availability, cultivating edible plant food is reliable. The result of the analysis shows three main categories of plants species, that is, starchy, vegetables, and fruit plants.

Starchy food is an important element of the home gardens in Maybrat. Among the cultivated species in the home gardens, *Xanthosoma sagittifolium* (L.) Schott, *Manihot esculenta* Crantz, *Ipomoea batatas* (L.) Lam. and *Zea mays* L. belong to important starchy foods. There are also edible tubers such as *Dioscorea* spp. and *Amorphophallus* spp. cultivated in the home gardens. Tubers, particularly cassava and sweet potato, are usually sold in local market. In the past, Sagu (*Metroxylon sagu* Rottb.) was reported to be the most important carbohydrate source for local people in eastern Indonesian, including West Papua (Ehara *et al.*, 2000). In this study, however, Sagu palms are absent in the home gardens. As far, the carbohydrate consumption pattern of the Maybrat community has not been researched.

Vegetables plants are also interesting facts that need to be taken into account. The local people in Ayamaru plant a variety of vegetables within their home gardens. Leaf vegetables include *Amaranthus dubius* Mart. ex Thell., *Sauropus androgynus* (L.) Merr., and *Manihot esculenta* Crantz. There are also *Vigna sinensis* (L.) Savi ex Hassk. and *Arachis*

hypogaea L., planted in the home gardens. Spices species include *Capsicum frutescens* L., *Curcuma domestica* Valeton, *Alpinia galanga* (L.) Willd., *Cymbopogon nardus* (L.) Rendle, Leaft of *Syzygium polyanthum* (Wight) Walp., *Ocimum ×citriodorum* Vis.

In Maybrat, fruit trees have been fully incorporated into the home gardens. Through field survey, the most-frequently cultivated plants include *Nephelium lappaceum* L., *Durio zibethinus* L., *Lansium domesticum* Corrêa, *Syzygium aqueum* (Burm. f.) Alston, *Mangifera indica* L., *Citrus sinensis* (L.) Osbeck, *Citrus aurantiifolia* (Christm.) Swingle, *Artocarpus heterophyllus* Lam., *Artocarpus communis* Forst., *Persea americana* Mill. and *Annona muricata* L. There are also *Ananas comosus* (L.) Merr. and *Musa ×paradisiaca* L. cultivated in the home gardens. In Maybrat, four different banana varieties are planted. According to the informants, the fruits are mainly introduced to improve local diets. However, in some occasion they are sold in local market. Scholars point out that the home gardens in developing countries provide significant economic subsistence (Nair and Kumar, 2006; Tynsong and Tiwari, 2010)

Ornamental Plants Species

Ornamental plants seem to be significant for many home gardens. There are numerous ornamental plant species in the home gardens, ranging from herbs to shrubs. The introduction of many exotic plant species into home gardens is one of the most drastic floristic changes ever to take place in Maybrat. The botanical composition of the home gardens is determined by the owner's management. The most common reason to plant ornamental plant species is to improve the visual quality of the settlements. Common species are *Nothopanax scutellarium* Merr., *Hibiscus tiliaceus* L., *Coleus* sp., *Cordyline* spp., *Crinum asiaticum* L., and *Heliconia* spp. Some species of *Heliconia* are also found in the home gardens, including *Heliconia pendula* Wawra, *Heliconia wagneriana* Petersen and *Heliconia psittacorum* L.f.

The most abundant ornamental species is probably the Croton plant (*Codiaeum*, Euphorbiaceae). Croton, *Codiaeum variegatum* (L.) A. Juss., is a beautiful foliage plant for beautifying the front yard of the settlements. This species is native to Malesia, Autralia and western Pacific. The informants state that the local people in Maybrat plant croton as a landscape component due to its colorful foliage and its easiness to cultivate. There are more than ten varieties of croton plant in Maybrat. A number of plants species considered to exotic plants species includes *Agave americana* L. *Kalanchoe pinnata* (Lam.) Pers., *Tagetes erecta* L. and *Heliconia* spp. Many of them are ecologically adaptive exotic plants species to extreme environmental conditions (Greig, 2004).

The Promotion of Home Gardens in Tourism Development and Lake Conservation

Basically, the contribution of home gardens can be derived from its three important aspects, namely physical, biological and social aspect. Home gardens have not been crucial issues to Indonesia's tourism destination planning and management. Home gardens can be viewed as a crucial factor in the tourism development in that they offer biodiversity as tourism attraction and can enhance the conservation of lakes. These will be the potential contribution of home gardens in the tourism development (Fig. 1).

Among the plant species in the home gardens, trees have been frequently reported to be able to support the land and lakes conservation. It is relevant with the Maybrat tourism planning strategy due to the recent threats of Lake Ayamaru, as the main tourism attraction in Maybrat District, such as land degradation, water shortage and rapid sedimentation. In this study, many of the tree species have a strong lateral rooting system (*Pometia pinnata* J. R. Forst. & G. Forst.), fibrous root system

(*Cocos nucifera* L), prop root system (*Pandanus conoideus* Lam.) and woody taproot system (i.e. *Mangifera indica* L., *Artocarpus heterophyllus* Lam., *Canarium indicum* L.). The numerous and combination of roots systems in the home gardens are considered important to the land conservation (Li and Li, 2011) and, therefore, be able to protect the Lake Ayamaru ecosystem.

In biological aspect, home gardens provide crucial value in term of preserving biodiversity, improving landscapes scenery and enhancing food availability. The biodiversity of home gardens will provide crucial habitat for birds and wildlife (Nair and Kumar, 2006, Hakim and Nakagoshi, 2007; Perfecto and Van der Meer, 2008). Birds and other animals may become an interesting natural attraction for ecotourism programs (Fyall *et al.*, 2005). Reintegrating trees into the indigenous home gardens along road and riparian ecosystem of Lake Ayamaru is one of the significant strategy to protect the lake. These will also be essential to the visual improvement of the landscapes of the lake. Combining home gardens with tourism about enhancing Lake Ayamaru conservation is also powerful.

The social aspect of home gardens is important. Through home gardens, an indigenous agricultural knowledge and settlement management are often passed from generation to generation (Galluzzi *et al.*, 2010). These will produce the original landscapes forms of particular region. It is known as cultural landscapes. Through their socio-cultural background many indigenous people in the world have created cultural landscapes. The cultural landscapes are the manifestation of complex relationships between human and nature. In many cases, the cultural landscapes are attractive to tourist (Hakim *et al.*, 2009).

The existence of exotic species for ornamental plants species on home gardens is particularly interesting for two aspects: exotic plants species are commonly used to improve settlement visual quality, and they fundamentally should be reduced due to its environmental impact. Scholars point out that the impact of exotic plants species can be enormous. Exotic species may have important ecological implication (Denslow, 2002; Rouget *et al.*, 2002). Changes in home gardens structure will have a crucial impact on the future of Lake Ayamaru ecosystem.

In the perspectives of global and national tourism market, Maybrat district is still in its early development, with a large number of potential attraction sites completely unexplored. This will become the challenges of the district to develope its tourism. In such a case, home gardens potentially provide numerous advantages to support tourism development (Hakim and Nakagoshi, 2007).

Conclusion

The diversity of home gardens in Maybrat district, West Papua province, is considered high. Principally, a home garden provides potential numerous functions ranging from biological, economical and cultural aspects. Home gardens can be viewed as a crucial factor in tourism development, offering biodiversity as tourism attraction and enhancing lake conservation. It is particularly relevant since tourism and the environment has a close relationship. Attempts to integrate issues on home gardens into tourism development plans, therefore, become crucial.

Acknowledgement

We would like to thank local people in Maybrat District for their permission, cooperation and assistance during field works. We are thankful to the head of Department Biology, Brawijaya University for providing laboratorial facilities during the study.

References

Bagson E, Beyuo AL. 2012 Home gardening: The surviving food security strategy in the Nandom traditional area – upper West Region Ghana. Journal

of Sustainable Development in Africa **14 (1)**, 124-136.

Boelaars J. 1986 Manusia Irian: Dahulu, sekarang dan masa depan. Penerbit PT Gramedia Jakarta.

Bolnick S. 2003 Promoting the culture sector through job creation and small enterprise development in SADC countries: the ethno-tourism industry. SEED Working Paper No 50. Infocus Program on Boosting Employment through Small Enterprise Development Job Creation and Enterprise Department. International Labour Organization Geneva.

BPS Maybrat. 2012 Kabupaten Maybrat dalam Angka. Badan Pusat Statistik Kabupaten Maybrat Propinsi Papua Barat,Manokwari.

Denslow JS. 2002 Invasive alien woody species in Pacific island forests. Unasylva **209(53)**, 62-63.

Ehara H, Susanto S, Mizota C, Hirose S, Matsuno T. 2000 Sago Palm (*Metroxylon Sagu*, Arecaceae) production in the Eastern Archipelago of Indonesia: Variation in morphological characteristics and pith dry-matter yield. Economic Botany **54(2),** 197-206.

Fyall A, Garrod B, Leask A. 2005 Managing Visitors Attractions. New Directions. Butterworth-Heinemann.

Galluzzi G, Eyzaguirre G, Negri V. 2010 Home gardens: neglected hotspots of agro-biodiversity and cultural diversity. Biodiversity and Conservation **19(13)**, 3635-3654. DOI 10.1007/s10531-010-9919-5

Greig D. 2004 Ornamnetal Foliage Plants. Firefly Books, New York.

Hakim L, Nakagoshi N. 2007 Plant species composition in home gardens in the Tengger highland (East Java, Indonesia) and its importance for regional ecotourism planning. Hikobia **15(1)**, 23-36.

Hakim L, Kim JE, Hong SK. 2009 Cultural landscape and ecotourism in Bali Island, Indonesia. Journal of Ecology and Field Biology **32(1)**, 1-8. DOI: 10.5141/JEFB.2009.32.1.001

Hakim L, Soemarno M, Hong SK. 2012 Challenges for conserving biodiversity and developing sustainable island tourism in North Sulawesi Province, Indonesia. Journal of Ecology and Field Biology **35(2)**, 61-71. DOI : 10.5141/JEFB.2012.017

Ijinu TP, Anish N, Shiju H, George V, Pushpangadan P. 2011 Home gardens for nutritional and primary health security of rural poor of South Kerala. Indian Journal of Traditional Knowledge **10(3)**, 413-428.

Kabupaten Sorong Selatan. 2007 Study inventarisasi dampak lingkungan Danau Ayamaru. Dinas Lingkungan Hidup dan Kebersihan Kabupaten Sorong Selatan, Propinsi Papua Barat, Manokwari.

LAPI-ITB. 2004 Studi Komprehensif Danau Ayamaru, Sorong Selatan. Badan Pengendalian Dampak Lingkungan Daerah Propinsi Papua, LAPI-ITB, Bandung.

Lense O. 2012 The wild plants used as traditional medicines by indigenous people of Manokwari, West Papua. Biodiversitas **13(2)**, 98-106.

Li P, Li Z. 2011 Soil reinforcement by a root system and its effects on sediment yield in response to concentrated flow in the loess plateau. Agricultural Sciences **2(2)**, 86-93. DOI:10.4236/as.2011.22013

McKercher B, du Cros H. 2002 Cultural Tourism: The partnership between tourism and

cultural heritage management. Roudledge, New York.

Nair PKR, Kumar BM. 2006 Introduction. In Kumar and Nair (Eds). Tropical Home Gardens. Springer, P. 1-10.

Perfecto I, Van der Meer J. 2008 Biodiversity conservation in tropical agro-ecosystems: A new conservation paradigm. Annals of New York Academy of Science **1134**, 173-200. DOI: 10.1196/annals.1439.011

Sirivejjabhandu A, Whyte SJ. 2010 Poverty alleviation through community-based ecotourism in the Trans-boundary Protected Areas: The Emerald Triangle perspective. South Asian Journal of Tourism and Heritage **3(2)**, 11-18.

Rouget M, Richardson DM, Nel JL, van Wilgen BW. 2002 Commercially important trees as invasive aliens – towards spatially explicit risk assessment at a national scale. Biological Invasions **4 (4)**, 397-412. DOI: 10.1023/A:1023611713339

Swarbroke J. 2002. The Development and Management of Visitors Attractions. Butterworth-Heinemann

Tynsong H, Tiwari BK. 2010 Plant diversity in the home gardens and their significance in the livelihoods of War Khasi community of Meghalaya, North-east India. J Biodiversity **1(1)**, 1-11.

Uriely N, Reichel A, Shani A. 2007 Ecological orientation of tourists: An empirical investigation. Tourism and Hospitality Research **7(3-4)**, 161–175. DOI: 10.1057/palgrave.thr.6050045

UNDP. 2005 Human Development Report 2005: International cooperation at a crossroads: Aid, trade and security in an unequal world. UNDP, New York.

Waller, M. 2001 Biodiversity and tourism co-exist in harmony. Corporate Environmental Strategy **8(1)**, 48-54. DOI: 10.1016/S1066-7938(00)00087-7

Webb EL, Kabir MDE. 2009 Home gardening for tropical biodiversity conservation. Conservation Biology. **23(6)**, 1641-1644. DOI: 10.1111/j.1523-1739.2009.01267.x

William U, Brown E. 1993 Orang Maybrat, Irian Jaya: Penggerak dan pekerja. In Ethnografi Irian Jaya: Panduan Sosial Budaya. Kelompok Peneliti Ethnografi, Kelompok Peneliti Ethnografi Irian Jaya, Jayapura.