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Indigenous agroforestry practices by *Orang Asli* in peninsular Malaysia: Management, sustainability and contribution to household economy

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The *Orang Asli* communities in Malaysia have been practicing indigenous agroforestry for generations, but little is known about the specifics of their practices. This study examined the indigenous management and sustainability of agroforestry practices, constraints experienced and contribution to household income. Data were collected from two *Orang Asli* villages practicing forest-garden agroforestry (FAF) and homegarden agroforestry (HAF). Tools of participatory rural appraisal namely semi-structured household interviews, group discussion and personal observation were used to collect data. In both types of agroforestry practices villagers planted commercially important local fruit species of which *durian* was the most common and more profitable. Locally available planting materials, use of household labour, market demand of agroforestry products, and usage of mulching and litter to maintain soil fertility were the principal attributes of sustainable agroforestry. A majority of the respondents reported that agroforestry was their principal source of income, self-employment, and safe and healthy food. Income from per unit area of HAF was significantly higher (21 %) than that of FAF. Land tenure and wildlife disturbances were two major constraints among others. Recommendations were made to resolve land tenure issue in light of government policy for agroforestry promotion.

Keyword: Agroforestry, *Orang Asli*, Indigenous management, Sustainability, Household income, Land tenure

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Rainforests worldwide have a long history of human inhabitation, mainly of indigenous people who have very close livelihood connection with forests[1,2]. In Malaysia, indigenous people are often collectively called *Orang Asli* that consists of 18 different ethnic groups under three main categories namely *Senois* (55 % population), *Proto-Malays* (42 %) and *Negrito* (3 %)[3,4]. Forests are essential for their culture, livelihood, and identity[5,6]. Traditionally, they are often linked with various agroforestry practices including home gardening, forest garden, shifting cultivation, gathering and trading of forest products including non-timber forest products (NTFPs), fishing and hunting activities to maintain their subsistence based livelihood[7,8].

Indigenous communities in the South-east Asian countries commonly practice HAF and FAF[9-12]. Home gardens in Malaysia have received great attention in recent years due to their role in the conservation of genetic resources and household livelihood and economy[10]. Forest gardens, on the other hand, are modified forest system where villagers purposively grow economically important plants by opening the canopy of wild forest for their subsistence and cash incomes, as well as a means for capital accumulation, risk spreading, labour saving, and possible demonstration of ownership[9].

In Malaysia, agroforestry is practiced for centuries and considered as an integrated productive-protective ecosystem of land use[13]. Commodity crop based agroforestry was first introduced in Malaysia in the 1920s, when coffee plantations were incorporated with rubber trees[14]. Research on agroforestry in Malaysia is limited. Some available studies reported that agroforestry projects at community levels in Sarawak helped people to build capacity to overcome poverty and from being marginalized[13,15]. Milow and his colleagues extensively studied composition, diversity and uses of plants in the home gardens of *Orang Asli* and Malay villages in several states[10-12].

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These studies, however, have not discussed management, sustainability and contribution of home gardens to household income.

Based on above agroforestry research background in Malaysia, this study was designed with the following objectives:

- To explore the indigenous management and sustainability of agroforestry being practiced by *Orang Asli* communities,
- To identify the important agroforestry produces, their marketing system and impact on household economy, and
- To determine the constraints towards sustainable agroforestry

Methodology

The study area

This study was conducted in two villages selected deliberately from Perak and Selangor states. The reasons for deliberate selection were easy access to villages and villagers' dependence on agroforestry for their livelihood. These two villages have divergent contexts in terms of closeness to town and agroforestry practices. The first village, *Kg* (*Kg* means *kampung* or village) *Chang Lama* (4°07'16.0"N 101°19'16.7"E), is situated in Bidor, Perak. The topography of the site is mostly hilly forested areas. As per village headman's estimate the village has an area of approximately 2 km^2 and surrounded by oil palm plantations and rubber gardens. The villagers were mostly of *Semai* ethnic group belongs to *Senios* and lived in compactly assemblage houses. Most inhabitants are subsistence farmers and suffer from poor social and infrastructure conditions. The village consists of 80 households. Main roads, markets, medical facilities are situated at the nearest town of Bidor approximately 4 Km away.

The second village was *Kg Genting Paras* (3°07'20.8"N 101°57'02.5"E) situated in Hulu Langat, Selangor. The topography of the village is steep hilly forested areas and approximately 1 Km^2 village area having sparsely assemblage houses. The villagers were dominated by *Temuan* ethnic group belonging to *Proto-Malays*. The village consists of 36 households. Access to the main road is about 500 m away and the nearest markets or medical facilities are 20 Km away at the nearest town.

Research approach

Before conducting the study, the researcher visited selected villages to observe the general conditions and practices of agroforestry and also to obtain the village heads' consent. A list of all villagers was made in both villages with the help of village heads. From the list 48 households in *Kg Chang Lama* and 22 households in *Kg Genting Peras* were selected using a simple random sampling for field data collection.

Three participatory rural appraisal tools were used to collect field data during September – October 2016:

Semi-structured interviews

A pre-tested semi-structured questionnaire was used for each household to collect data on socio-demographic, household economic status and the biophysical characteristics of their farms. Socio-demographic and economic information were related to household size, education, profession, landholding, mean monthly income range, income source, and contribution of agroforestry. Respondents were asked about agroforestry composition (e.g., plant species, planting pattern). They were asked about sustainability of agroforestry by using the sustainability attributes of agroforestry adopted by Nath & Inoue[16].They were also asked about marketable agroforestry products, harvesting time and quantity, sale values, benefits and income from agroforestry.

Group discussion

Two group discussions, one in each sampled village, were held with 5-6 elderly respondents and issues like indigenous management techniques, constraints experienced in agroforestry, marketing of agroforestry products, impacts on household economy and government support were discussed.

Field observation

Observational data such as agroforestry species assemblage, and crop arrangements were gathered during village walk to different households and visit to agroforestry plots.

Survey development and implementation

The survey questionnaires were first developed in English and then translated into *Bahasa Melayu* because the respondents were comfortable with *Bahasa Melayu*. After field procedure data were transcribed into English. Ethical approval for participants' survey was obtained from the research ethics committee of Faculty of Science, University of Nottingham Malaysia Campus. Participants were anonymous, remained unidentified and verbal consent was taken to participate in the survey. As a token of

appreciation each sampled household was given a packet (1 Kg) of sugar for their time in the study.

Data handling and analysis

Field data were compiled, summarized, tabulated and frequency distribution for some variables was obtained. A descriptive analysis was adopted to describe the findings. An unpaired t-test was conducted for household agroforestry income per unit land area to see any significant difference between two villages. In order to see the association between weekly income (sale values) and income sources (fruits sell) Pearson correlation test was carried out for both villages.

Results and discussion

Basic demography and socioeconomy of respondents

Both male (77 %) and female (33 %) members participated in the households' interviews and average age of the respondents was 46 yrs indicating that they had ample knowledge about agroforestry practices and could provide reliable information. The average household size in both villages was five and only 20 % respondents had up to secondary education. More than 80 % households had their own land for residence and farming practices. Agroforestry was the principal (81 % respondents) earning activity followed by off-farm works including petty business, contractor, bus driver and wage labourer in rubber and oil palm plantations. Being near the town and having rubber and oil palm plantations around the village, some villagers (21 %) of *Kg Chang Lama* were involved in salaried off-farm jobs like driver, contractor, labourer in oil palm and rubber plantations. The range of mean monthly income was US$ 244-732, and majority of the respondents (69 % in *Kg Chang Lama* and 59 % in *Kg Genting Peras*) had a mean monthly income of US$ 244-488.

In group discussion villagers reported that they collect most of their food materials from forest resources other than rice which is their staple food item. They grow and collect cassava, yam, wild leafy vegetables, fruits, catch fishes and, sometimes hunt and trap game animals in the forest around the village for their subsistence. In most cases they purchase rice, sugar, oil, and salt from nearby markets. Other than these food items the villagers were seem to be self-sufficient in their food needs.

A description of prevailing agroforestry practices and indigenous management

Two types of agroforestry practices were observed in studied villages: homegarden agroforestry and forest-garden agroforestry. The HAF was found only in *Kg Genting Peras* whereas, FAF was found in *Kg Chang Lama* and upto small extent in *Kg Genting Peras*. During group discussion at *Kg Chang Lama,* villagers said that their village is surrounded by rubber and oil palm plantations and they have no spaces in the village to develop HAF. The HAF involves cultivating trees and other crops on the land surrounding the houses and the average area of HAF plots was about 1.3 ha. The village and the HAF plots were located at the bottom of Hulu Langat forest reserve. Respondents reported that their ancestors had developed these HAF on deforested land adjacent to natural forest soon after building their houses. They reported that suitable and available forest areas were first cleared off and left fallow for six months before plantings were established. The selection of plant species for HAF was highly randomized and considering four broad factors: (a) market returns, i.e., profitability and market demand; (b) essential techniques, i.e., management capacity and product processing requirements; (c) social aspects, i.e., indigenous knowledge about products and plants, income generation; (d) ecological aspects, i.e., sustainability, harvest period, usages and resource availability. Researchers[7,17] reported that farmers select crops for their agroforestry farms based on profitability, availability of input and experience on cultivation of these crops. Following the tradition, competing plant material (small undesired trees, grasses and fallen leaves) is cleared and used as mulch around crops which ultimately adds nutrients when decomposed.

In HAF plots, it was observed that farmers cultivated a variety of trees and other crops of which 11 fruit tree species were mentioned economically more important (Table 1). Additionally, three important vegetable crops/trees namely cassava, yam and papaya were found along with several naturally growing wild vegetables. Whenever there were available spaces due to natural disturbances farmers filled the gap with important plant species. The respondents commented that in HAF the plant components are75% big tree crops, 20% understory crops (e.g. cassava, yam, etc.) and 5 % vegetables (e.g. *pucukpaku*) and medicinal plants. This type of combination of tree crops in home-garden agroforestry has also been reported by Noor *et al*.[18].

Table 1 — Commonly grown important economic plants in agroforestry plots in the study villages, fruits harvesting period, sale values and income

Plants' name (Local)	Scientific name	Plant form	Products	Respondents (%) having this plant		Fruits harvesting period (month)	Price (US$/Kg)	Mean harvest amount and sale value			
								FAF		HAF	
				Kg Chang Lama	Kg Genting Peras			Amount (Kg/week)	Sale value (US$/week)	Amount (Kg/week)	Sale value (US$/week)
Durian	*Durio zibethinus* Murr.	Tree	Fruit, Timber	84	95	6-8, 11-1	1.04	122.5	127.4	100	104.00
Rambutan	*Nephelium lappaceum* L.	Tree	Fruit	1	42	6-8	0.46	60	27.6	37	17.00
Langsat	*Lansium domesticum* L.	Tree	Fruit	32	63	7-8, 11-1	0.44	56	24.64	26	11.40
Petai	*Parkia speciosa* Hassk.	Tree	Fruit, Timber	73	90	8-10, 11-2	8.17/ bunch	6 bunch	49.02	5 bunch	40.85
Banana	*Musa malaccensis* Ridely	Tree	Fruit	11	47	1-12	0.37	20	7.4	32	11.85
Mangosteen	*Garcinia mangostana* L.	Tree	Fruit	24	21	6-8, 12-1	0.83	50	41.5	18	14.95
Cempedak	*Artocarpus integer* (Thunb.) Merr.	Tree	Fruit	54	37	5-7, 11-2	0.46	300	138.0	94	43.25
BuahRambai	*Baccaurea motleyana* (Mull.Arg.)	Tree	Fruit	35	32	6-8	0.85	125	106.25	87.5	74.40
Jering	*Archidendronpauciflorum* (Benth.) I.C.Nielsen	Tree	Fruit	22	-	6-8	0.31	60	18.6	-	-
Kelidang	*Artocarpus anisophyllus* Miq.	Tree	Fruit	-	16	6-8	0.98	-	-	40	39.20
Tampoi	*Baccaurea macrocarpa* Mull.Arg.	Tree	Fruit	-	32	6-8	0.85	-	-	100	85.00
Mean income/week (RM) = A									534.10		440.40
Mean income/month (RM) B= 4xA									2136.46		1761.70
Mean income/year/household (RM) C= 3xB [3 months harvesting period]									6409.40		5285.04
Mean income/ha/year/household (RM) D= C/Agroforestry plot area									3204.70		4065.30

The FAF plots, on the other hand, were located in hilly areas in the dense natural forests. The respondents claimed that these are customarily owned land and have no clear boundary. Each family had an average of 2 ha of FAF plot consisting of naturally growing forest trees and planted commercial fruit trees. Scholar[9] reported that forest-garden systems are designed to produce commercially valuable products representing the main or only cash income to producers. Respondents commented that their ancestors had planted a number of perennial fruits trees (e.g. *Durian*, *Petai*, etc.) at about 3m x 6m spacing to avoid canopy competition. Whenever there was an opening due to disturbance or mortality of trees they filled the gap with fruit trees. They often cleared the small unwanted plants to provide space for desired trees. However, they encourage desirable understory plants like banana and wild vegetables for their own consumption. They usually use mulches from weeding and pruning which help to maintain soil fertility. Mulyoutami *et al*.[19] in their study in Indonesia stated that *Dayak* community cultivate a number of commercially important multipurpose crops in the forest gardens and maintain tree productivity through weeding, pruning and mulching. A list of economically important plants growing in FAF is mentioned in Table 1.

In both types of agroforestry practices farmers (100 %) learned the techniques of planting, soil fertility management, harvesting and marketing of products from their parents. They (100 %) reported that they received no training from government

or other agencies on agroforestry management. Respondents (100 %) commented that they pass indigenous cultivation techniques on to the next generation. Indigenous knowledge passed down is not just for the conservation of their livelihood but also crucial for the establishment of environmental and biodiversity conservation measures[20].

Agroforestry products and marketing

Even though some trees have timber values, farmers collect only fruits for selling in the markets. They harvest fruits in different fruiting seasons, but primarily during June – August (Table 1). Most of the harvested products (about 75 %) are sold to traders or middlemen outside or within the village. Respondents as well as participants in group discussions reported that they do not receive a fair price when products were sold to middlemen. Wyn & Anak[21] reported that *Orang Asli* is situated at the lowest level in the source-to-market chain which resulted in less profit. However, middlemen perform important roles in linking farmers to other agents; take significant risks in purchasing products with unreliable quality in local villages and transporting them to central locations for sale[22].

These traders then supply these products to the retailers in cities like Kuala Lumpur from where consumers purchase these products for consumption. Harvest products which are partially rotten or cosmetically unappealing (5-10 %) are consumed by the farmers themselves. A small portion of products (10-15 %) are sold directly to the consumers in nearby markets and roadside stalls for which they receive higher profits.

Sustainability of agroforestry

All respondents claimed that both types of agroforestry support a variety of crops including trees, shrubs and herbs. Even though they obtain income from selected crops only, they allow other crops to grow for household uses. The diverse crops cultivated in agroforestry farm yield products of various kinds, in particular, fruits and vegetables that contribute to dietary needs and allow revenue streams to spread out throughout the year, reducing the risk associated with crop failures[23]. Researchers reported that the enhancement of fruit availability within farms attracted mammals from surrounding forest to forage, expedites dispersal, broadening animal species diversity and contribute positively to the *Orang Asli*[24]. Due to regular rainfall and continuous addition of litter and other plant materials soil remains productive and so application of chemical fertilizer is not necessary. There were no serious plant diseases in either type of agroforestry, but wilting and mortality of annual crops occur during prolonged drought.

According to respondents, the trend of productivity was unpredictable. In some years they noticed bumper production of fruits and in some years it declined. Sometimes they experienced no fruiting in some species in a year, but had fruiting in other species. It is in fact a natural cycle with many forest and domestic fruit species having no fruiting in some years which is known as periodicity in botanical terms. However, they claimed that on an average they had a stable production of fruits. They usually do not hire labour and family members are enough to manage agroforestry plots. They collect planting materials from natural sources and need no investment for irrigating and fertilizing the areas. Both income and market demand of products depend on productivity. Some fruits like *durian* and *petai* always fetch higher price as these are popular among consumers. These agroforestry practices require minimum input and all are locally available. Respondents said that they have been practicing agroforestry generation after generation and so these are well adapted to their culture and tradition. Individual land ownership on HAF and traditional rights to practice FAF on natural forests were conducive for the sustainability of agroforestry practices.

Respondents' perception on agroforestry benefits and impact on their household economy

Both household interviews and group discussions revealed that the villagers obtain several benefits from their agroforestry system. They reported six major benefits (Fig. 1). In both studied villages almost all respondents commented that agroforestry was the main source of their income (70-90 % of

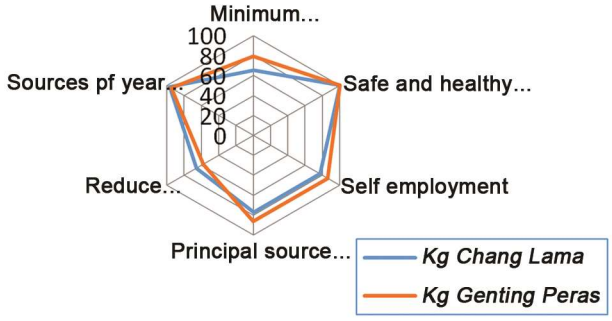

Fig. 1 — Respondents' opinion on benefits of agroforestry. Axis values indicate percentage of response.

household income), provided safe and healthy food and ensured self-employment (Fig. 1). More than 70 % respondents reported that agroforestry required minimum maintenance and so less capital investment. Being the main sources of household income and availability of fruits round the year (65 % respondents), agroforestry helped to reduce dependency of *Orang Asli* people on forest resources (65 % respondents).

Among agroforestry products, fruits were the principal source of household income. Out of 11 fruits *durian* was most profitable (contribute 24 % of mean weekly agroforestry income) as its market prices were higher than other fruits (Table 1). In both villages more than 80 % respondents cultivated this species. Researchers reported that as a fruit, *durian* is a large source of farming income in forest dependent communities[25]. Respondents said that hybrid *durian* seedlings were being cultivated for its high market value. *Petai* pods (beans) were sold in a bunch, each bunch containing 30-40 pods that consists of about 350 seeds. Villagers said that bigger size of seeds from older trees usually fetch higher price. *Petai* is a timber species and its fruits (pods) can be readily harvested and sold, fetching higher prices, and is a proper choice for smallholders that support household economy[26]. During harvesting season villagers sold their products on a weekly basis. Even though geographical location of studied villages was little different, but the selling price of agroforestry products in two villages varied just slightly. While the productivity varied from year to year they recalled an average weekly harvest and market values.

Considering an average of 3 months harvesting period in a year the household income from selling agroforestry products was estimated. As such the weekly income per household from FAF and HAF was estimated US$534.10 and US$ 440.4, respectively (Table 1). The Pearson correlation test shows that income from *langsat* ($r = 0.88$, $p < 0.01$, 2-tailed) was highly correlated to household agroforestry income from HAF followed by *durian* ($r = 0.864$, $p < 0.01$, 2-tailed) and banana ($r = 0.823$, $p < 0.01$, 2-tailed). On the other hand, in FAF only *durian* ($r = 0.561$, $p < 0.01$, 2-tailed) significantly contributed to household agroforestry income. The household income per year from agroforestry products was US$ 6409.40 and US$ 5285.04, respectively for villagers having FAF and HAF, respectively (Table 1). Household income per year per unit area was significantly ($t = 3.246$, $df = 51$, $p < 0.002$) higher (by 21 %) for HAF owners. This might be due the facts that HAF were close to houses, owners could take care regularly and fruits were not much damaged by wild animals. In case of FAF, the agroforestry plots were a bit away (5-7 Km) from owners' residence and incidence of fruits damage by wild animals was higher.

Apart from marketable fruits, villagers (100 %) also reported that they collected wild vegetables, cassava, papaya and other products from agroforestry plots for their own consumption and for selling also. These products contributed to fulfilling families' food demand. Income from agroforestry products enables households to afford food from markets and use gas cylinders, positively impacting the lives of females. Furthermore, vegetable and fruit products from agroforests were shared with neighbours thus strengthening social cohesion and providing direct benefit to the community as a whole.

Constraints towards sustainable agroforestry

Villagers reported several constraints that impose challenges towards the sustainability of agroforestry. The major one was wildlife disturbances. Villagers (85 %) said that as compared to the past, sightings and footprints of giant predators (e.g., tigers and bears) have reduced, but the occurrences of annoying wildlife mainly monkey and wild-boar, squirrel and birds have risen. These wild animals most often damage agroforestry produces especially fruits. Measures, for examples-building makeshift huts or tents in agroforestry plots, stand guarding from wildlife foraging their crops and also traps, have been taken to deter wildlife from foraging in their farms, but with little results. The villagers of *Kg Chang Lama* commented that land tenure was a constraint for sustainability of FAF. For decades they have been practicing FAF on forest lands where customary rights have been recognized and passed on generations without any legal ownership. They (80 % of *Kg Chang Lama*) suspect that the government may reclaim the land because in Malaysia, lands allocated to *Orang Asli* are occasionally reclaimed by state government officials, especially when the land has rich resources and can be sold at premium[27].

To villagers (50-60 %) other constraints were lack of government technical assistance, lack of high yielding quality seedlings, no guarantee on actual market price and lack of market information. Secure tenure, supportive policies, and access to quality seedlings, technical training and market information

are important for the development of productive agroforestry systems[28].

Conclusion and policy implications

Orang Asli communities have long been living in forest areas and earn their livelihood from forest resources. In order to ensure sustainable livelihood, they have manipulated forest environment following their traditional culture. Results showed that both HAF and FAF are sustainable and have proven to reinforce villagers' farm income, provide a source of food to supplement their daily needs, conserve agrobiodiversity, and increased food security. Results confirm that the income generated from selling of agroforestry produces helps villagers to maintain their living, create jobs in the fruits' supply chain and enhance local biodiversity.

This study has potential policy implications. Even though agroforestry is the principal source of *Orang Asli'*s livelihoods, due to some constraints they could not obtain the full benefits. In order to solve land tenure issue, the government may allocate a small plot of degraded forest land (e.g. 1 ha) to each family permanently or as a long-term lease with the condition that they would practice sustainable agroforestry on the granted land. The government agencies may also provide extension services in order to supply quality seedlings, access to market information and encourage cooperative marketing of agroforestry products for better market price.

This study, conducted only in two villages, looked at indigenous practices of agroforestry, sustainability and contribution to household economy. Further extensive research is needed to explore the role of agroforestry on biodiversity conservation, climate change mitigation and on overall livelihoods of villagers.

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References

1 Kareiva P, Watts S, McDonald R & Boucher T, Domesticated Nature: Shaping Landscapes and Ecosystems for Human Welfare, *Science,* 316 (5833) (2007) 1866-1869.

2 Hunt C & Rabett R, Holocene landscape intervention and plant food production strategies in island and mainland Southeast Asia, *J Archaeo Sci,* 51 (2013) 22-33.

3 Indriatmoko Y, Orang Asli, land security and response to the dominant society: a case study of the Tanjung Rambai Temuan, In: *Power, Purpose, Process, and Practice in Asia*. The Work of the 2003/2004 API Fellows, The Nippon Foundation, Asian Public Intellectuals Program, Tokyo, 2006, 52-67.

4 Noora M, Advancing the *Orang Asli* through Malaysia's clusters of excellence policy, *J Int Comp Edu,* 1(2) (2012) 2232-1802.

5 Aziz S, Clements G, Rayan D & Sankar P, Why conservationists should be concerned about natural resource legislation affecting indigenous peoples' rights: lessons from Peninsular Malaysia, *Biodiv Cons,* 22 (3) (2013) 639-656.

6 Kardooni R, Kari B, Yahaya B &Yusup H, Traditional knowledge of *orang asli* on forests in peninsular Malaysia, *Indian J Tradit Knowle, 13* (2) (2014) 283–291.

7 Saifullah M, Kari F& Othman A, Income Dependency on non-timber forest products: An empirical evidence of the indigenous people in Peninsular Malaysia, *Social Indic Res,* (2016) DOI 10.1007/s11205-016-1480-5. Available from: https://umexpert.um.edu.my/file/publication/00001583_143321.pdf

8 Kari F, Masud M, Yahaya S & Saifullah M, Poverty within watershed and environmentally protected areas: the case of the indigenous community in Peninsular Malaysia, *Env Monitor Assess,*188 (3) (2016) Article 173. doi:10.1007/s10661-016-5162-1.

9 Belcher B, Michon G, Angelsen A, Ruizpe´rez M & Asbjornsen H, The socioeconomic conditions determining the development, persistence, and decline of forest garden systems, *Econ Bot,* 59 (3) (2005) 245–253.

10 Milow P, Ramli MR & Ong HC, Preliminary Survey on Plants in Home Gardens in Pahang, Malaysia, *J Biodiver,* 1 (1) (2010) 19-25.

11 Milow P, Ghazali NH, Mohammad NS & Ong HC, Characterization of plant resource at Kampung Parit TokNgah, Perak, Malaysia, *Sci Res Essays,* 6 (13) (2011) 2606-2618.

12 Milow P, Malek S, Mohammad NS & Ong HC, Diversity of Plants Tended or Cultivated in Orang Asli Homegardens in Negeri Sembilan, Peninsular Malaysia, *Hum Ecol,* 41 (2013) 325–331.

13 Noor N, Koter R, Othman R, Hai E & Yahya Z, Generation of high income through compatible combinations of forest trees and agricultural crops under agroforestry ecosystem, Paper presented at 3rd Apicex 2012, 5-7 November 2012, Kota Kinabalu, Sabah, 2012.

14 Ahmad F, September. Sustainable agriculture system in Malaysia, In: *Regional Workshop on Integrated Plant Nutrition System (IPNS), Development in Rural Poverty Alleviation*, United Nations Conference Complex, Bangkok, Thailand, 2001,18-20.

15 Jaafar A, Kasiran N, Muhammed S & Ismail W, Agroforestry practices in Malaysia--Integrating plantations crops with timber species, 2009, Available from http://www.iipm.com.my/ipicex2014/docs/posters/Ahmed%20Azhar%20et%20al.pdf

16 Nath TK & Inoue M, Sustainability attributes of a small-scale *Betel* leaf agroforestry system: A case study in North-eastern Hill Forests of Bangladesh, *Small-scale For,* 8 (3) (2009) 289-304.

17 Nath TK, Jashimuddin M, Hasan KM, Shahjahan M & Pretty J, The sustainable intensification of agroforestry in shifting cultivation areas of Bangladesh, *Agrofor Syst,* 90 (3) (2016) 405-416.

18 Noor M, Hazim M & Syafinie M, Strategic forest plantation establishment in Malaysia for future product development and utilization, *Intl J Agri For Plant*, 1(2015) 14-24.

19 Mulyoutami E, Rismawan R & Joshi L, Local knowledge and management of simpukng (forest gardens) among the Dayak people in East Kalimantan, Indonesia, *For Ecol Manage,* 257 (2009) 2054–2061.

20 Halim A, Othman N, Ismail S, Jawan J & Ibrahim N, Indigenous Knowledge and Biodiversity Conservation in Sabah, Malaysia, *Int J Soc Sci Hum*, 2 (2) (2012)159-163.

21 Wyn T & Anak AN, Wood for the trees: A review of the agarwood (Gaharu) trade in Malaysia: TRAFFIC Southeast Asia, Malaysia, 2010. Available from http://www.trafficj.org/publication/10_Wood_for_the_trees.pdf

22 Roshetko JM & Yuliyanti, Pemasaranuntukhasil-hasilwanatani di tingkatpetani (Marketing small holder farmers agroforestry products), In: Roshetko JM, Mulawarman WJ, Santoso IN, Oka. Wanatani di Nusa Tenggara. Prosiding LokakaryaWanatani Se-Nusa Tenggara (*Agroforestry in Nusa Tenggara, Proceedings of a Workshop*), 11-14 November 2001. Denpasar, Bali, International Centre for Research in Agroforestry (ICRAF) and Winrock International, 2002.

23 Sharma N, Bohra B, Pragya N, Ciannella R, Dobie P & Lehmann S, Bioenergy from agroforestry can lead to improved food security, climate change, soil quality, and rural development, *Food Energy Sec*, 5 (3) (2016) 165-183.

24 Moore J, Sittimongkol S, Campos-Arceiz A, Sumpah T & Eichhorn M, Fruit gardens enhance mammal diversity and biomass in a Southeast Asian rainforest, *Biolog Conserv*, 194 (2016) 132-138.

25 Rahman S, Jacobsen J, Healey J, Roshetko JM & Sunderland T, Finding alternatives to swidden agriculture: does agroforestry improve livelihood options and reduce pressure on existing forest?, *Agrofor Syst,* 91(1) (2017) 185-199.

26 Roshetko JM, Rahayu S, Wiyono & Prastowo N, Evaluating indigenous practices for *Petai* (*Parkia speciosa* Hassk.) seed germination: The effect of seed shelling and seed cutting on germination, growth, and survival, *Small-scale For,* 7 (3-4) (2008a) 285-293.

27 Prosterman R, Zhu K, Ye J, Riedinger J, Li P & Yadav V, Secure land rights as a foundation for broad-based rural development in china, NBR Special Report 18, NBR, 2009.

28 Roshetko JM, Snelder DJ, Lasco RD & van Noordwijk M, Future Challenge: A Paradigm Shift in the Forestry Sector, In: Snelder DJ, Lasco R (eds) *Smallholder Tree Growing for Rural Develop and Env Serv*, (2008b) 453-485.