Smallholder Agroforestry Fruit Production in Lampung, Indonesia: Horticultural Strategies for Smallholder Livelihood Enhancement

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Keywords: markets, tree crops, propagation, supply chain

Abstract
Smallholder farmers in Lampung Province cultivate 1-5 ha of land producing both perennial and annual crops to meet their household and income needs. Soils across the province are inherently infertile. Most smallholders are dissatisfied with annual crop production and are interested in expanding their tree farming activities. Traditionally, smallholders cultivate a large number of horticultural fruit/vegetable species as well as timber, rubber, pepper/coffee, oil palm and coconut. The production of pepper/coffee, rubber, oil palm and coconuts are strongly market oriented. In contrast, the production of horticultural species remains primarily traditional. The species involved in smallholder horticultural systems, whether indigenous or introduced, are only ‘semi-domesticated’ – the germplasm utilized is of local, unselected origin and largely propagated from seed; management practices and inputs are non-intensive. Smallholders have poor access to market knowledge, channels and opportunities. The demand for horticultural products in Lampung exceeds supply and proximity to Jakarta offers access to potentially lucrative markets. Many smallholders have the basic skills required to transform their subsistence horticultural systems into semi-commercial enterprises. To facilitate this process smallholders need assistance to: 1) identify horticultural species/cultivars appropriate for smallholder biophysical and socioeconomic conditions; 2) adapt vegetative propagation and other horticultural management practices for smallholder conditions; and 3) develop permanent market linkages. The implementation of these activities should rely on the self-interest of smallholders to improve their livelihoods, rather than project financing. The enhancement and expansion of smallholder horticultural systems will also serve public environmental goals.

INTRODUCTION
Across Southeast Asia, and especially in Indonesia, deforestation has created a scarcity of productive forest resources. The shrinking forest base, combined with a growing human population and an expanding middle class with discretionary income, result in an increased demand for forest and tree products such as timber, fruit species, medicinal plants, etc. This demand creates incentives for smallholder tree farming. In some communities, smallholder farmers have spontaneously planted or protected timber or fruit trees to provide products for home use and market sale. Farmers see tree farming as a way to diversify production and income, reduce risk, make more efficient use of their limited input (labor, time, land and capital) and built assets for the future. Smallholder tree farming is often successful because of farmer self-interest to profit from their effort.

Lampung Province represents a microcosm of modern Indonesia in several ways. The southernmost province of Sumatra, Lampung is accessible to West Java and Jakarta across the Sunda Strait and today provides labor, agricultural products and other resources to the capital. Historically migrants flowed west to Lampung, which covers 3.5 million km². In 1931 the human population was 400,00 – primarily indigenous ethnic groups. Since the 1970s the population greatly expanded as a result of government sponsored and

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spontaneous migration. In 1971 the human population was 2.8 million; in 1980 4.6 million; in 1990 6.0 million; in 2001 6.7 million (BPS, 1997, 2006) and 7.3 million currently. Primarily Javanese and Sudanese, the migrants now comprise 60% of the provincial population. Javanese and Sudanese are so prominent, a common witticism refers to Lampung as “North Java”. The influx of migrants has also drastically altered the landscape. Prior to the transmigration programs at least 70% of Lampung was forested. In 1971 forest cover had been reduced to 30% and today is only 10%.

Traditional cultivation systems of the indigenous population integrated extensive cultivation of annual and perennial plants concentrated along the river. Those extensive systems are 4-5 ha or more, plus 1-2 ha home gardens close to the house. By contrast, the Javanese and Sundanese practice intensive cultivation that evolved on their home island. Originally 2-ha allotments (1.75 ha for annual crops and 0.25 ha for home gardens) were provided through the government transmigration program, migrant households commonly cultivate 1-5 ha. Lampung soils are infertile, compared to those of Java and not able to support intensive agriculture practices for long. After 3 to 5 years of intensive annual crop production, soil fertility and crop yields usually decline, making further annual crop cultivation uneconomic. At that point migrant livelihood strategies shift towards perennial crops or to those that are less nutrient demanding, a strategy that begins to resemble the traditional system. Tree garden systems expand to meet household needs and for sale in local markets. Many farmers have cultivated sugarcane and cassava as subsistence cash crops for market sale to the corporate plantation industry. Generally, smallholders are dissatisfied with plantation crop production because: 1) crops are harvest after 9-12 months; 2) yields are low and intensive management is required; and 3) there is a lack of transparency and stability regarding the cost of the inputs provided on credit (particularly for sugarcane) and the sale price (particularly for cassava). As a result, farmers continue to look for other options to diversify their cropping systems and to increase incomes.

Smallholder tree gardens are diverse systems that include multiple fruit/vegetable species, pepper/coffee, rubber, coconut, oil palm and timber trees. The intensification of tree garden cultivation with a stronger market orientation, particularly towards the lucrative national and Jakarta markets, has been suggested as a means to enable farmers to diversify their income streams and reduce risk. Government data shows that Lampung is a major producer of fruit for sale to national markets (BPPN, 2002). However, the realities at the farmer level belie this positive macroeconomic indicator. Farmers have little access to quality germplasm, information, or professional extension services. The quantity and quality of their fruit yields are unreliable. Farmers have limited understanding of market channels and they frequently sell their fruit products to middlemen for low prices.

ICRAF and Winrock International have worked in Lampung for 15 years to improve smallholder agroforestry systems. The focus included developing an inventory of tree gardens and identification of management practices, identification of smallholder market channels, and evaluation of germplasm sources. Based on that work, this paper describes possibility strategies to enhance smallholder tree garden systems and livelihoods.

METHODOLOGY

Location and Biophysical Conditions

Lampung, located at 103°40’-05°50’ LE and 6°45’-3°45’, is categorized as tropical-humid. The dry season (<100 cm rain/month) occurs from June to October and wet season (>200 cm rain/month) from November to April. Temperature fluctuations are minimal, mainly associated with elevation; averaging 28°C (22-33°C). Elevations in the Province are general low, the highest point being Gunung Pesagi at 2200 m. Lampung soils are “yellowish red podsolic” with high aluminum content, high acidity, and low availability of nitrogen, phosphorus and potassium (Van der Heide et al., 1993).
Studies and Surveys

Studies to document tree garden components and management practices have been conducted in Pakuan Ratu, Sumber Jaya and Krui. Market surveys have been conducted for smallholder fruit and other horticultural products (Qurniati, 2002; Khairida, 2002). Additionally, a survey of 50 private timber and fruit tree nurseries was conducted to evaluate the quality, quantity and availability of tree germplasm to support land rehabilitation efforts by government agencies and small scale landowners (Yuliyanti and Roshetko, 2002). Purposive methods were used to select survey locations that were the center of smallholder fruit/horticultural or tree seedling production. Market and nursery surveys were conducted in 10 districts and 17 sub-districts (Table 1).

RESULTS AND DISCUSSION

Smallholder Tree Gardens

Smallholder tree gardens vary in different locations of Lampung, while sharing some similar characteristics. In Pakuan Ratu, many farmers cultivate 0.5-1.0 ha of commodity tree crops – rubber (Hevea brasiliensis), coffee (Coffea robusta), oil palm (Elaeis guineensis) or coconut (Cocos nucifera). They also maintain 0.75 ha home garden plots where a diverse array of annual and perennial crops are cultivated. Home garden products are primarily intended for household consumption or local sale. Studies demonstrate that 80% of home garden trees are horticultural species and 20% timber species. Coconut accounts for 11.1% of the tree component, sengon (Paraserianthes falcatoria) 9.9%, mango (Mangifera indica) 9.9%, banana (Musa paradisiaca) 9.5%, rambutan (Nephelium lappaceum) 9.2%, and petai (Parkia speciosa) 6.5%. Forty other tree species are present in home gardens; each accounts for less than 5% of the tree component (Roshetko et al., 2002).

In Sumberjaya, farmers cultivate 1-5 ha of multispecies gardens where coffee (C. robusta) is the main component and foundation of household economy. Numerous other crops are grown primarily for home use and some local market sale. Studies indicate that the following horticultural tree species are biophysically and socio-economically appropriate for the area: mango, banana, petai, avocado (Persea americana), citrus (Citrus sp.), sugar palm (Arenga pinata), jengkol (Archidendron paucifloram), candlenut (Aleurites moluccana), melinjo (Gnetum gnemon), jackfruit (Artocarpus heterophyllus), cinnamon (Cinnamomum burmannii), and sapodilla (Manikkara zapota) (Roshetko, 2002).

In Krui, farmers manage damar agroforestry – cultivated tree garden systems which resemble forests. Typically those agroforests are composed of 60-75% damar (Shorea javanica), a resin-producing tree which is the key economic component. Other key components of the system include petai, melinjo, durian (Durio zibethinus), duku (Lansium domesticum), clove (Syzygium aromaticum), and a number of indigenous fruit and timber species (Michon et al., 2005). Unlike the smallholder systems in PakuanRatu and Sumberjaya, the key fruit components of damar systems are primarily market-oriented – providing farmers with a diversified commercial tree farming system.

The key components of these smallholder systems (rubber, coffee, oil palm, damar) are strongly market oriented with farmers appropriately focusing most of their time and input on the management and production of those crops. Farmers’ second livelihood priority is often off-farm employment. The production of the fruit component of Lampung smallholder tree garden systems often remains traditional. The horticultural species, whether indigenous or introduced, are only ‘semi-domesticated’. Management is on an extractive basis, with few agricultural inputs (fertilizers, herbicides, etc.) allocated to maintain or improve the components, system or productivity. Labor is almost exclusively provided by family members and primarily focused on product harvesting. Species and cultivar selection is largely the result of chance, with farmers protecting natural regeneration or transplanting those wildlings from within or outside their tree garden. The germplasm utilized is of local, unselected origin and largely propagated from
seed. Infrequently, farmers receive tree seedlings through government, research or development programs – with species/cultivar selection controlled by the benefactor. Few farmers proactively secure (purchase, exchange, etc.) seedlings from other sources.

Tree Nurseries

As of 2002, 115 commercial and government tree nurseries operated in Lampung producing timber, fruit and commodity species; 61% of the nurseries produce timber seedlings, 21% produce seedlings of fruit and commodity species, and 18% produce seedlings of all three types (mixed nurseries). Thirteen percent of the nurseries are government nurseries and 87% are private. A survey of 50 nurseries revealed that seedlings of 52 species are produced – 22 fruit species, 17 timber species, 9 commodity species, and 4 shade/green manure species. Species that are commonly available include: teak (*Tectona grandis*), mahogany (*Swietenia macrophylla*), citrus, durian, duku, mango, rambutan, sawo, jackfruit, avocado, petai, melinjo, clove, candlenut, rubber and cacao (*Theobroma cacao*). Seedlings of the other species are available in limited quantities.

Fruit/commodity nurseries sell 60% of their seedlings to farmers or local seedling dealers and 40% to government agencies. They will produce seedlings of specific species by order. Government and mixed nurseries (associated with government agencies) generally produce seedling exclusively for government programs (Yulianti and Roshetko, 2002).

On average, fruit/commodity nurseries produce 10,000 seedlings annually, most are located in central and eastern Lampung. Generally fruit/commodity seedlings are produced through vegetative techniques with select or improved grafting material that comes from diverse sources: commercial dealers in Lampung, Java and Medan; government agencies; and selected local sources/cultivars. This material is not fully documented or certified, but does appear to be of reliable genetic and physical quality. The fruit nursery business is based on trust in the production of a quality material; operators know if they sell seedlings of substandard quality, customers will shift patronage to other fruit nurseries, which are usually in close proximity.

Marketing

The production and marketing of fruit crops by Lampung smallholders is opportunistic. The exception to this is Krui, where farmers focus commercial production on a limited number of fruit species and maintain market linkages with traders. In other locations farmers produce uncertain quantities and qualities of various fruit species, and restrict their market role to producers, seldom performing any post-harvest processing. Farmers generally wait to be approached by traders. There are multiple value chains for horticultural products in Lampung and many include multiple intermediaries separating farmers from consumers (Table 2). As a result, farmers rarely know where, to whom, and for how much their products are sold; nor are they aware of the market specifications for their products (Roshetko and Yuliyanti, 2002). Farmers have limited negotiation positions, are generally price takers, and receive low prices. Traders link farmers to customers through the market, assuming the tasks and risks associated with buying, collecting, sorting, grading and transporting fruit products. Unreliable quality, quantity and timing of smallholder products are key risks for traders. Those uncertainties, plus the time and expense required to interact with numerous smallholders, are common justifications why traders pay low prices to individual smallholders.

Strategies for Improving Smallholder Fruit Production

The non-intensive production of fruit products in most Lampung smallholder tree garden systems is not surprising. Traditionally intended for home consumption and local market sale, fruit production is not afforded the time and resources required to produce market-quality products. Conditions are changing. Population and economic growth are increasing the demand for fruit and horticultural products in Jakarta and West Java. Lampung is uniquely positioned as a gateway to West Java and those lucrative markets. Many farmers in Lampung, like elsewhere in Southeast Asia, see tree farming as a way to
diversify income, reduce risk, and build assets for the future. Many of those smallholders are interested to improve the market orientation of their tree production systems but are unsure how to focus. Experience indicates that successful strategies to improve the market-orientation of smallholder tree systems focus on: i) access to and knowledge of quality germplasm; ii) improving farmers’ tree and system management skills; and iii) developing market awareness and linkages (Roshetko et al., 2007).

Currently, fruit production in Lampung smallholder production systems is based on natural regeneration of indigenous or naturalized varieties. In Lampung, there are commercial nurseries producing quality seedlings of fruit species/cultivars appropriate for local biophysical and market conditions. However, those nurseries, concentrated in central and eastern Lampung, are not accessible to all farmers. Even when traders transport seedlings to communities for resale, few farmers opt to invest in commercial seedlings as prices are considered high. One avenue to improve access to improved quality fruit germplasm is for government land rehabilitation programs to prioritize the distribution of quality seedlings of appropriate fruit species/cultivars. This should involve giving the farmers some control over species selection – in support of bottom-up development paradigms. An option that would enhance both access and knowledge of quality germplasm would be vegetative propagation training and nursery establishment support for groups of interested farmers. Support should be participatory, practical, and operate through a minimum of one nursery cycle. A full-operating independent nursery should result from the effort. Such programs have been successful in Aceh (Roshetko et al., 2008) and West Java (Roshetko et al., 2007). The BalaiBenihInduk – Hortikultura in Metro would be an appropriate venue and partners for such activities. ICRAF and Winrock have produced a vegetative propagation manual to support smallholder farmer training (Purnomosidhi et al., 2007).

Enhancing farmers’ fruit tree management capacity can also be addressed through a farmer group extension approach developed by ICRAF and Winrock in West Java. Initial training is provided to farmer leaders to analyze existing conditions, develop priorities, and set work agendas. According to the agendas, more intensive follow-up sessions are provided to larger groups of farmers interested in enhancing their technical skills. Extension sessions are held every two weeks and planned according to farmers’ schedules. The approach is practical, impact-oriented, and dynamic; adjusting to farmers’ actual conditions and priorities (Roshetko et al., 2008). Initial sessions would likely focus on fruit tree management, including germplasm production. As farmer partners enhanced their skills and confidence the topics of sessions would expand to leadership training, marketing and even enterprise development. Session activities could include training, workshops, cross-visits, demonstration trials, market visits, internships, studies and consultancies with specialists (government officials, researchers, traders, and other technical experts).

To improve their market awareness, farmers should first learn more about product demand and specification, identify appropriate market channels and develop relationships with traders. Based on initial finds, farmers should improve the quality and quantity of products by intensifying or expanding their production systems. They could also assume sorting, grading and possible packaging activities to improve the quality of their products. Additionally, it might also be possible to transform products from raw to a semi-processed state. The intensification of smallholder production will involve the use of more agricultural inputs (improved germplasm, fertilizers, pesticides, and labor). Expanding activities to include post-harvest and value-adding processing represents new initiatives for most farmers that are within their capacity. Undertaking those new activities also requires more inputs of labor, time, capital, skills and planning. While this is a significant investment for farmers, it will be rewarded with higher incomes. These efforts to expand farmers’ market integration should be done in concert with supportive traders, who are interested in buying the better quality products for a premium. Capacity building activities implemented to help farmers produce better quality fruit products should be integrated into the farmer group extension approach described in the previous paragraph.
Marketing activities should be implemented through groups of farmers to achieve economics of scale, reducing traders’ expenses, making higher prices for farmers possible. This process should start small, gradually expanding with the capacity of farmers, interests of the traders, and accessible market segments (Roshetko et al., 2007).

CONCLUSION

Smallholder farmers in Lampung cultivate a variety of tree gardens, including monocultural systems, multispecies gardens, and agroforests – tree garden systems that resemble natural forests. The commodity tree crop component – rubber, coffee, oil palm, coconut, damar – of these systems are the basis of household economies and management is strongly market-oriented. Farmers focus their resources on the production of those commodity crops. Usually these fruit and other horticultural products from tree gardens are intended for household consumption and local market sale. Management of those crops remains traditional, with few resources allocated to their production. The quantity, quality and timing of many smallholder fruit and horticultural products are uncertain. Population and economic growth in Jakarta and West Java provide opportunities for smallholders in Lampung to produce and market fruit and other horticultural crops. Smallholders are interested in these opportunities, however, their traditional production systems leave them ill-prepared for market-orientation, and they are unsure how to focus. As a proven strategy to enhance smallholder tree systems production and market-orientation we recommend improving farmers: i) access and knowledge of quality germplasm; ii) tree and system management skills to produce products that meet market specifications; and iii) market awareness and linkages. This strategy can be implemented through a farmer group extension approach and in collaboration with a supportive trader. The implementation of these activities should rely on the self-interest of smallholders to improve their livelihoods, rather than project financing. The enhancement and expansion of smallholder horticultural systems will also serve public environmental goals.

Literature Cited


### Tables

Table 1. Location where nursery and tree garden surveys were implemented.

<table>
<thead>
<tr>
<th>No</th>
<th>Districts</th>
<th>Sub-districts nursery survey</th>
<th>Sub-districts Fruit &amp; MPTS market survey</th>
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<tbody>
<tr>
<td>1</td>
<td>Kota Bandar Lampung</td>
<td>-</td>
<td>Teluk Betung Barat, Metro Pusat</td>
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<tr>
<td>2</td>
<td>Metro</td>
<td>Gunung Betung, Panengahan</td>
<td>Padang Cermin, Katibung, Natar</td>
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<td>3</td>
<td>Lampung Selatan</td>
<td>Tegineneng</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Pasawaran</td>
<td>Kota Agung, Sukoharjo, Pardasuka</td>
<td>-</td>
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<td>5</td>
<td>Tanggamus</td>
<td>BBI Hortikultura, Community nurseries</td>
<td>Pekalongan</td>
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<td>6</td>
<td>Lampung Timur</td>
<td>BanjarAgung, Tanjung Raja</td>
<td>Muara Sungkai, Abung Barat, Abung Tengah</td>
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<tr>
<td>7</td>
<td>Tulang Bawang</td>
<td>Pakuan Ratu</td>
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<td>8</td>
<td>Lampung Utara</td>
<td>Muara Sungkai, Abung Barat, Abung Tengah</td>
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<td>9</td>
<td>Way Kanan</td>
<td>Pakuan Ratu</td>
<td></td>
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<tr>
<td>10</td>
<td>Lampung Barat</td>
<td>Pesisir Tengah, Sumberjaya, Way Tenong, Pakuan Ratu</td>
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</table>
Table 2. Value chains for fruit products in Lampung (Qurniati, 2002; Khairida, 2002).

<table>
<thead>
<tr>
<th>Channel</th>
<th>Description</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 1:</td>
<td>Farmer $\rightarrow$ consumer (banana, petai, candlenut, jackfruit, palm sugar)</td>
<td></td>
</tr>
<tr>
<td>Channel 2:</td>
<td>Farmer $\rightarrow$ collector* $\rightarrow$ retailer $\rightarrow$ consumer (banana, rambutan, mango, durian, duku, petai, candlenut, cinnamon, jackfruit, palm sugar)</td>
<td></td>
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<tr>
<td>Channel 3:</td>
<td>Farmer $\rightarrow$ local collector $\rightarrow$ local wholesaler $\rightarrow$ local retailer $\rightarrow$ consumer (banana, rambutan, mango, durian, duku, petai, candlenut, cinnamon, jackfruit, palm sugar, citrus)</td>
<td></td>
</tr>
<tr>
<td>Channel 4:</td>
<td>Farmer $\rightarrow$ local collector $\rightarrow$ wholesaler $\rightarrow$ retailer $\rightarrow$ consumer (not local) (mango, duku, petai, candlenut, cinnamon, citrus)</td>
<td></td>
</tr>
<tr>
<td>Channel 5:</td>
<td>Farmer $\rightarrow$ collector 1 $\rightarrow$ collector 2 $\rightarrow$ wholesaler $\rightarrow$ retailer $\rightarrow$ consumer (rambuttan, durian, duku, petai, citrus)</td>
<td></td>
</tr>
<tr>
<td>Channel 6:</td>
<td>Farmer $\rightarrow$ fruit industry $\rightarrow$ consumer (banana)</td>
<td></td>
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</tbody>
</table>

* In Channel 2 the collector is sometimes by-passed.