SMALLHOLDER TEAK SYSTEMS ON JAVA, INDONESIA, INCOME FOR FAMILIES, TIMBER FOR INDUSTRY

James M Roshetko[1], Agus Astho[2], Dede Rohadi[3], Nurin Widyani[2], Gerhard S Manurung[4], Anies Fauzi[5], and Purnomo Sumardamto[6]

[1] World Agroforestry Centre (ICRAF) and Winrock International, P O Box 161, Bogor 16001, Indonesia, *JRoshetko@cgiar.org*

[2] Balai Penelitian Teknologi Perbenihan Tanaman Hutan, PO Box 105, Bogor 16144, Indonesia *admin@bptp-bogor.go.id*

[3] FORDA, Jl. Gunung Batu No. 5 Bogor 16610, West Java, Indonesia *libforda@forda.com*

[4] World Agroforestry Centre (ICRAF), P O Box 161, Bogor 16001, Indonesia

[5] Centre for Forest Biotechnology and Tree Improvement Jl.Palagan Tentara Pelajar KM 15 Pelem, Purwobinangun, Pakem 55582 Sleman, Yogyakarta, Indonesia *breeding@biotifor.or.id*

[6] Dinas Kehutanan dan Perkebunan Kabupaten Gunung Kidul Jl. Brigjen Katamso No. 8 Wonosari, Gunung Kidul, Indonesia *mydamto@yahoo.com*)

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Abstract

Teak is among the most valuable timbers in Indonesia with international and domestic demand generally exceeds supply. Java is the center of teak production in Indonesia. As in other teak producing countries, the decline of plantation production has created opportunity for smallholder producers. Approximately 1.5 million Javanese households grow teak, managing 444,000 ha of mixed cropping systems, mainly on degraded land. Those families are independent growers providing raw material for the thriving Java teak furniture industry. The viability and profitability of smallholder teak production systems are threatened by poor silvicultural management which yield small quantities of low value timber. Smallholder producers are aware of this shortcoming, but have difficulty adapting better silvicultural management due to a lack of capital and limited ability to wait the duration of a rotation before needing returns. Additionally, most smallholders produce teak with an array of other crops to met short- and medium-term livelihood needs. Working in communities in Yogyakarta on Java, the authors conducted a number of studies to identify solutions that enable farmer producers to mitigate the threat mentioned above and improve the benefits to their families (income) and society (quality timber supply). A baseline study, teak system inventory, and management survey were conducted to identify existing conditions and practices. Participatory silvicultural trials were conducted on farms to identify management options appropriate for smallholders' conditions. Based on research findings guidelines for improved smallholder teak production were developed and evaluated with farmers. The paper provides recommendations for improving economic returns for smallholder teak producers.

Background

Teak (*Tectona grandis*) is among the most valuable tropical timber species. Its durable, strong timber is easy to work and commonly used to produce furniture, housing materials, crafts, ships and many other products. Market demand at national and international levels generally exceeds supply. Native to India, Myanmar, Laos and Thailand, teak was introduced to Indonesia by Hindu missionaries around the second century. On Java teak harvest for ship building started in the 10th century, with plantation development believed to have started during the 13th century (Simatupang, 2000). The Dutch colonial government established intensive teak plantations in the late 19th century. Following Indonesian independence, responsibility for teak plantation management passed to the state forest industry Perum Perhutani in 1963 (Simon, 2000). In the 1960's small-scale farmer plantations became widespread in Java. Java remains the center of teak production in Indonesia. In Jepara alone, a centre of the furniture industry in Central Java, more than 15 thousand small-scale teak furniture industries

operate, employing around 170 thousand people and creating products worth around Rp 12 trillion (about US$ 1.2 billion) per year (Roda *et al.*, 2007). As in other teak producing countries, declining production from natural forests and plantations has created opportunity for smallholder producers. Approximately 1.5 million Javanese households grow teak, managing 444,000 ha of mixed cropping systems, mainly on degraded land (Department Kehutanan, 2005). Independent growers, smallholder families have become an important source of raw material to the thriving Java teak industry.

However, significant barriers to profitable smallholder teak production exist; mainly poor silvicultural practices, limited market knowledge, and restrictive regulatory policies. Similar impediments to smallholder teak and timber production have been reported elsewhere (Holding and Roshetko, 2003; Tukan *et al.*, 2004; Midgley *et al.*, 2007; van Noordwijk *et al.*, 2008). Smallholder producers are aware of this shortcoming, but have difficulty adapting better silvicultural management due to a lack of capital and limited ability to wait the duration of a rotation before needing returns. Additionally, most smallholders produce teak with an array of other crops to met short- and medium-term livelihood needs. Working in communities in Yogyakarta on Java, the authors conducted a number of studies to identify solutions that enable farmer producers to mitigate the threat mentioned above and improve the benefits to their families (income) and society (quality timber supply). A baseline study, teak system inventory, and management survey were conducted to identify existing conditions and practices. Participatory silvicultural trials were conducted on farms to identify management options appropriate for smallholders' conditions. Based on research results guidelines for improved smallholder teak production were developed with farmers.

Methods and Materials

Location

The research was conducted in Gunungkidul district, one of the five districts in the Yogyakarta Province (Special Region). The district is located between 7º46'– 8º 09' latitude and 110º 21' – 110º 50' longitude (Figure 1). Gunungkidul is characterized by hilly topographic terrain, with half of the district having slopes of 15% or more. The northern zone of the district is hilly with an elevation around 200 to 700 meters above sea level (masl); the central zone is primarily flat with few hills at an elevation of 150 to 200 masl; the southern zone is characterized by the infertile, dry karst (limestone) soils at an elevation of 100 to 300 masl. Average annual rainfall is 1500 to 2500 mm.

The district population is approximately 685,000. Agriculture is the main economic engine, providing 34% of the district gross income and the most employment. Within the agriculture sector, food crops account for 64.0% of the economic value, followed by forestry (27.3%), livestock (6.3%), plantation crops (1.7%), and fisheries (0.7%). The average landholding per family is 1 ha, varying from 0.5 to 3.0 ha, and consists of multiple parcels. Common agricultural crops are rice (*Oryza sativa*), cassava (*Manihot utilissima*), peanuts (*Arachis hypogaea*), soy beans (*Glycine max*), corn (*Zea mays*), bananas (*Musa spp*) and other vegetables (Rohadi *et al.*, 2011).

Figure 1. Map of Gunungkidul Province (Special Region).

Research Methods

A baseline study of 274 teak farming families, managing1074 land parcels on a total 276.5 ha, was implemented to identify the socioeconomic conditions and farming characteristics of smallholder systems. An inventory of 227 teak farms covering 47.1 ha and a farm management survey of 275 farmers were conducted to document the current composition and management practices of smallholder teak systems. A rapid market appraisal of 295 respondents (277 farmers, 11 traders, and 7 sawmill owners) was conducted to identify smallholders' exist teak marketing practices and other opportunities. Farmer demonstration trials (Roshetko *et al.*, 2005) were designed and established collaboratively with landowners on six farms to show the advantage of silvicultural management under smallholders' conditions. The results from some of these studies have been published and are cited here.

Results

Baseline Study

Thirty-seven percent (37%) of smallholder teak growers cultivate less than 0.5 ha, 26% cultivate 0.5 to 1 ha, 25% cultivate 1 to 2 ha, and only 12% cultivate more than 2 ha. Farmers allocate 10% of their land to teak woodlots, called *kitren*. They also intercrop teak trees with in annual cropping systems and homegardens (Rohadi *et al.*, 2011). More details regarding teak systems are provided in the *smallholder teak systems* subsection.

Sixty-one percent (61%) of household income is derived from off-farm sources (casual and skilled labor, shop keeping, home industry, and services); 25% from annual crops and livestock, 12% from teak, and 3% from other timber species (Rohadi *et al.*, 2011). Teak trees serve as a living saving account. Trees are harvested when significant cash needs arise, such as weddings, school fees, medical expenses, periodic social commitments or emergencies. Farm families generally sell their teak trees as the last resort, only after other deposable assets such as motorcycles, electronic goods, jewelry or livestock have been sold (Perdana *et al.*, 2012). The practice of selling teak to meet financial needs is called *tebang butuh* (felling for needs).

Smallholder Teak Systems

Farmers grow teak in four systems: kitren, tegalan, pekarangan, and as border plantings. Kitren are woodlots dominated by teak. Tegalan are upland systems where trees and annual crops are intercropped. Pekaragan are homegardens, which are dominated by tree species, but may be intercropped with annul crops. Data from the farm inventory is summarized in Table 1. Across all systems teak accounts for 55.9% of the trees and

Table 1. Summary of smallholder teak systems.

Teak System	Percent of Teak Systems	Farm Size (ha)	Tree density (ha)	Tree species (farm)
Tegalan	50.6%	0.47	1072	8
Pekarangan	21.9%	0.24	1177	13
Kitren	21.9%	0.31	1532	5
Sawah	4.8%	0.31	138	7

Table 2. Price for farm-grown teak in Gunungkidul in 2008.

Age (year)	DBH (cm)	Price accepted by producers (USD/standing tree)	Log volume after processing by traders (m3)	Log price received by traders (USD)
10	12 – 18	3 – 6	0.045 - 0.189	3 – 25
15	13 – 31	5 – 30	0.060 - 0.515	6 – 123
20	21 – 45	10 – 265	0.307 - 1.061	57 – 284
25	29 – 49	20 – 296	0.320 - 1.321	54 – 329

Table 3. Farmer demonstration trials established by landowner, location and silviculture treatment.

No.	Landowner	Hamlet, village, sub district	Silviculture treatment
1	Subardi	Temon, Purwosari, Giripurwo	Coppice thinning (control and singling)
2	Karsukiyo	Karangduwet, Paliyan	Coppice thinning (control and singling)
3	Kardi Utomo	Karangduwet, Paliyan	Coppice thinning (control and singling)
4	Citro Widarso	Sokoliman I, Bejiharjo, Karang Mojo.	Thinning (control) Pruning (control, 50% and 60% pruned)
5	Suwarto	Sokoliman I, Bejiharjo, Karang Mojo.	Thining (control and ± 40% thinned) Pruning (control, 50% and 60% pruned)
6	Giyono/ Budiyono	Munggur, Ngawis, Karang Mojo.	Thining (control and ± 40% thinned) Pruning (control, 50% and 60% pruned)

47.2% of the regeneration, other timber species account for 18.7% of the trees and 23.4% of the regeneration (Roshetko and Manurung, 2009).

Few farmers practice proactive silvicultural management. Seventy-two percent (72%) of farmers establish teak systems with wildings, 30% use local seedlings, and 20% use coppice. Only 12% of farmers have every used improved quality seedlings, mainly provided through government reforestation programs. Most farmers (73%) practice weed control and apply fertilizer in teak systems, but mainly to benefit annual crops. Sixty-five percent (65%) of farmers prune teak to harvest fuelwood, but leave 10-15 cm branch stubs. Fifty-five percent (55%) of smallholder teak trees have been pruned. Forty-three percent (43%) of teak systems are thinned, but the practice is performed to harvest timber, poles, or fuelwood. Farmers do not practice thinning of coppice (Roshetko and Manurung, 2009).

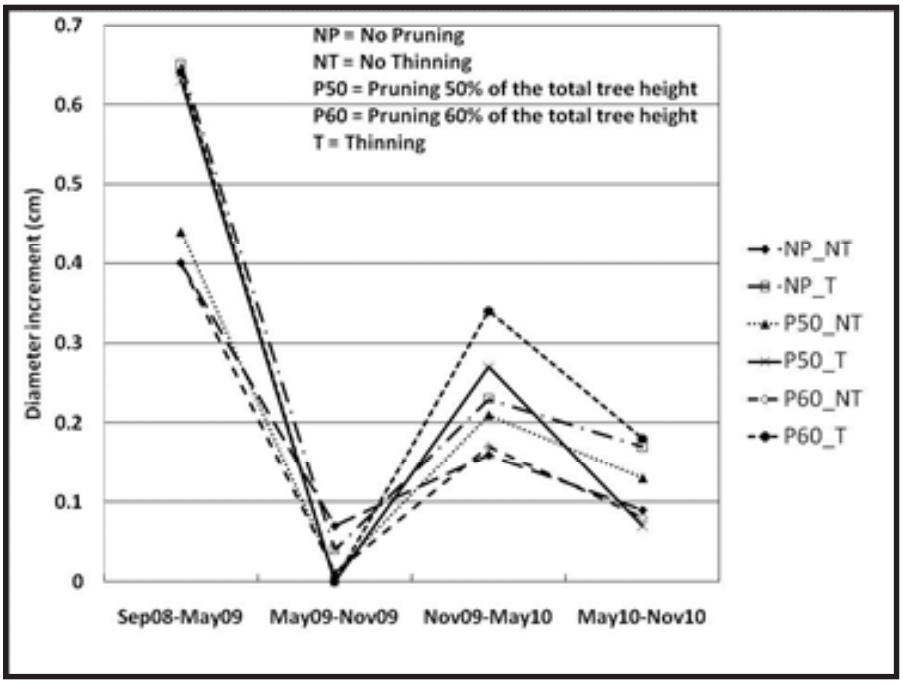

Figure 2. The effect of thinning and pruning on teak tree diameter growth.

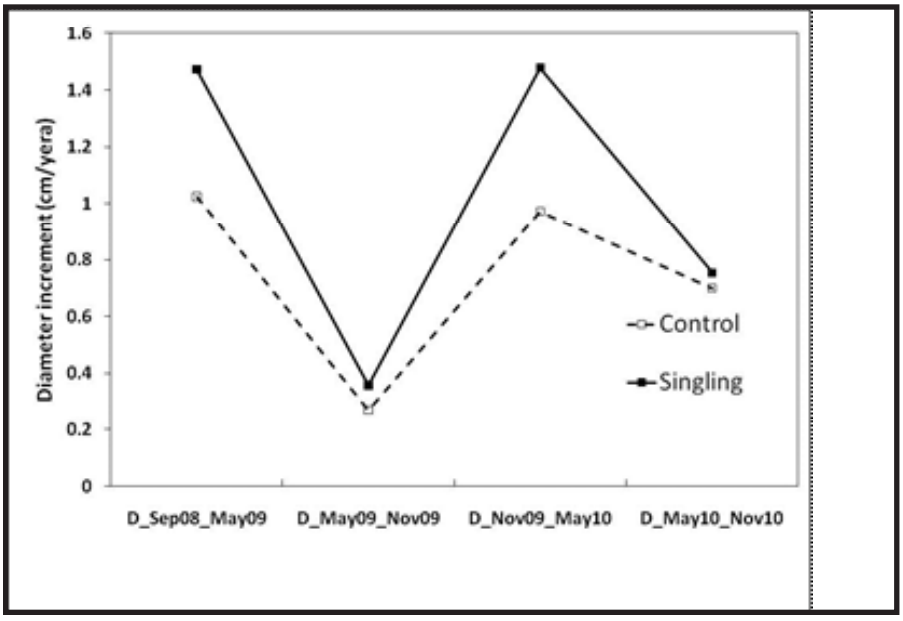

Figure 3. The effect of singling on teak tree diameter growth.

Smallholder Marketing System

Actors directly involved in the smallholder teak timber marketing chain are farmer producers, local traders, large-scale traders (wholesalers), and processors. Farmers' role is limited to producer. They engage the marketing chain through local or large-scale traders. Standing trees are the standard unit of sale for farm-grown teak. Negotiation is done without clear quality or value standards. Traders visit the farm to measure and assess the tree and negotiate the price for individual or blocks of trees. To obtain a better price, 51% of farmers collect information from other farmers who have recently sold trees. Thirty-one percent (31%) of farmers improve their negotiation position by offering the same trees to two or more buyers. The remaining farmers (18%) act as price takers. Regardless of the negotiation approach taken, farmers usually obtain prices that are well below market rates because of their limited access to market information and inability to minimize the market transaction costs, including transportation. Traders have to deal with numerous farmers, each producing small quantities of variable quality timber. This results in high transaction costs, leading to lower prices for farmer producers. The market reflects higher prices for older, larger trees (see Table 2). However, only 14% of farmers harvest trees based on economic maturity, most (80%) follow the *tebang butuh* practices (Perdana *et al.*, 2012).

Farmer Silvicultural Trials

The silvicultural practices investigated in the farmer demonstration trials were coppice thinning (control and singling); stand thinning (control and 40% thinning), and pruning (control, pruning to 50% of total height, and pruning to 60% of total height). The trials and relevant information are listed in Table 3. Results show that proper thinning and pruning treatments improve the diameter growth. The

effect of silvicultural treatments was greatest during the rainy season (September 2008 to May 2009 and November 2009 to May 2010). Average annual increment over the 2-year period shows that the thinning-60% pruning treatment increased diameter at breast height (dbh) by 60% and tree height by 124% compared to the no pruning-no thinning control (Figure 2). The singling treatment shows the benefit of managing teak coppice by thinning to a single healthiest stem, with the singling treatment demonstrating 45% greater incremental growth during the rainy seasons (Figure 3). The 2-year trials demonstrate positive impact of thinning, pruning and singling on dbh and height growth.

Discussion

The industrial demand for teak in Central Java alone is 1.8 million cubic m per year. Perhutani supplies approximately 300,000 cubic m per year. The remaining 1.5 million cubic m are sourced from smallholder producers, plantations outside of Java, foreign imports, and illegal harvest from Perhutani plantations (Ewasechko, 2005; Perdana *et al.*, 2012). Location provides Gunungkidul farmers with excellent opportunity to be strategic suppliers to the teak industry of Central Java. Currently, with limited benefit from management, teak provides 12% of smallholders' income, comparing favorably with agriculture. However, limited management results in smallholders producing small quantities of low quality teak.

Results of the farm inventory document high tree densities, equaling spacing of 2.5 x 2.5 m to 3 x 3 m, in smallholder teak systems (Table 1). Those are recommended planting densities for teak plantation, but should be followed with thinning on five-year cycles (Pramono *et al.*, 2011). Thinning is uncommon in smallholder systems. In practice, the thinning conducted by farmers is harvesting of fuelwood, poles or small diameter timbers. Smallholders do not thin to improve the growth or quality of the remaining trees and most often remove the biggest or good quality trees before the trees reach economic maturity. Similarly, pruning is conducted to harvest fuelwood. The process usually leaves 10-15 cm branch stubs, which if not removed are reduce timber quality. Their standard management practices limit smallholders' future options, resulting in smallholder teak systems being characterized as overstocked, slow growing and sub-optimal quality and production (Roshetko and Manurung, 2009). In the absence of other inputs, quality germplasm will enhance growth and productivity, particularly on degraded lands (Simons *et al.* 1994). Although germplasm was not tested in these studies, it fair to believe that quality germplasm would perform better than the undocumented wildings of unknown quality currently used to establish and regenerate most smallholder teak systems in Gunungkidul.

The farmer trials demonstrated that silvicultural management is beneficial to teak tree growth under smallholder conditions. After seeing and experiencing the trials many farmers enhanced their knowledge and adopted silvicultural practices. An assessment conducted by university students documented that 70% of the farmers in the project area increased their knowledge of silvicultural practices; 50% adopted silvicultural practices on their own farms, and 30% disseminated management practices to other farmers. In areas neighboring the project 30% of farmer increased their silvicultural knowledge as a result of project activities; with 20% adopting silvicutural practices and 15% sharing information with others (Rohadi *et al.*, 2011). The distribution of an Indonesian language teak management manual, field tested with farmers before publication, helped achieve this impact (Pramono *et al.*, 2011).

Smallholder teak systems are not industrial plantations, they yield multiple products for homeuse and market sale to support family livelihoods. The *tebang butuh* management system does not itself lead to the production of poor quality timber and given prevalent socioeconomic condition the system might be best for farmers. However, the practice should be combined with harvest restricted to trees of a minimum dbh to assure farmers receive an equitable price and the trees yield reasonable volume of timber (Table 2).

To assure hasten tree dbh growth, it is recommended that farmers adopt silvicultural practices, specifically: the use of quality germplasm, pruning to 60% of total tree height without branch stubs, and coppice should be thinned to one healthy stem. Farmers should also improving their marketing position by accessing available information and when possible engaging in group marketing to reduce transaction costs, for themselves as well as traders, and improve their negotiation position. Government and support agencies can facilitate the adoption of better silvicutureal and marketing practices by smallholder teak producers by providing training and extension services.

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