Economic analysis of sengon (*Paraserianthes falcataria*) community forest plantation, a fast growing species in East Java, Indonesia

Ulfah J. Siregar[a,*], A. Rachmi[b], M.Y. Massijaya[a], N. Ishibashi[c] and K. Ando[c]

[a]Faculty of Forestry, Bogor Agricultural University, Kampus IPB Darmaga, P.O. Box 168, Bogor 16001, Indonesia
[b]Malang State Polytechnic, Jl Veteran, P.O. Box 04, Malang 65145, Indonesia
[c]Carbon Fixing Forest Management Project (CFFMP) FORDA-JICA, Jl Gunung Batu no.5, P.O. Box 165, Bogor 16001, Indonesia
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Abstract

Despite strong efforts to rehabilitate degraded forests and lands in Indonesia, successful cases of reforestation are rare. A previously identified problem was unclear land tenure in certain forest areas creating conflict between local communities and other forestry stakeholders. Although communities claim to be interested in forestry, encouraging them to conduct reforestation or establish forest plantations has proven to be very difficult because it is regarded as non-profitable. In Kediri, East Java, sengon (*Paraserianthes falcataria*) mixed plantations are usually found because they are profitable and give more routine income to communities. Sengon is mixed mostly with pineapple, and planted with a density of 800 trees/ha. Pineapple is planted only once, and then harvested every year for 4 years. Within the 8 year rotation age of sengon, a farmer can harvest pineapple 4 times before cutting the trees. To analyze whether mixed plantations give more income to communities than planting pure sengon, the Net Present Value (NPV) and Benefit–cost Ratio (BCR) of mixed plantations were calculated. Using an interest rate of 17.53% as a Minimum Acceptable Rate of Return (MARR), the result showed that mixed plantations are profitable, however community decisions were influenced by the amount of land owned, the cost of mixed plantations, the timber price and the period of gaining the income of harvesting that is difficult to cover monthly living cost. The importance of other factors in determining community interest in reforestation is discussed.

Keywords: *Paraserianthes falcataria*; Community forest; Mixed plantation; NPV; BC ratio

Article Outline

1. Introduction

Degradation of natural forest in Indonesia has rapidly increased because of increasing demand for timber due to increasing population and development of the forest product industry. The latest report by the MoF (Ministry of Forestry, Indonesia) showed that the deforestation rate has reached 1.6 million ha/year (Directorate General RLPS, MoF, 2002). This problem was actually recognized by the government in the 1980s. To overcome this problem, the government had launched a forest plantation program, namely HTI (forest plantation for industrial purpose or timber estate) in 1990. This reforestation program was conducted in degraded forest areas or degraded lands. Furthermore, this forest plantation program applied intensive silvicultural practices, and involved local communities as much as possible. Several fast growing species were recommended for this program, e.g., acacias, eucalypts, some dipterocarps, sengon (*Paraserianthes falcataria*, a leguminous tree) and others. The program's aims were to reduce pressure on natural forest, while conducting reforestation and rehabilitation of both degraded forests and lands, and at the same time providing raw material for the increasing forest industry.

Although the program seemed to be very well prepared, in fact the implementation was not successful. After 9 years of implementation Media Indonesia (18/12/1999) reported that only 20% of the projected timber supply was coming from forest plantations. The amount of area reforested was far below the targets. Iskandar et al. (2003) reported that in the year 2000 only 2.3 million ha were reforested from a 9.4 million ha target area. On average only one third of the targeted area was reforested (MoF, 1998). Meanwhile the involvement of local communities in the reforestation program was also very low.

Before the fall of the New Order Government in 1997, most natural forest in Indonesia, which is under jurisdiction of the centralized MoF, was managed by concession companies (HPH), and local access rights to the forest resources were denied (Fay and Michon, 2005). At most, the concession company was obliged to give development aid to the local communities surrounding its concession area, and to involve them in the concession activities as workers. After 1997, which is often referred as the Reform Era, the Law no. 22 in 1999 on government decentralization gave local governments authority to manage natural resources, especially forest resources in their territories. The decentralization euphoria followed by the new Forestry Law no. 41 in 1999 has caused many local community members to claim their rights to forest resources, and even forested lands. This situation had led to both extensive and intensive illegal logging (from the central government point of view), and more severe forest destruction. Some formerly established forest plantations were also destroyed.

During this time, the new government has kept encouraging reforestation, although the result was very trivial. In 1999, the government provided small soft loans to appeal to communities to plant trees (Directorate General RLPS-MoF Decision no.085, 1999) and launched a cross cutting program on social forestry in 2004 (Minister of Forestry Decree P01, 2004; Rusli, 2004). Recently, a national action program was also announced, namely the National Action Program on Forest and Land Rehabilitation (GNRHL) by the former Minister of Forestry, which aimed at accelerating forest and land rehabilitation and at the same time alleviating poverty within local communities (Rusli, 2004). Yet, despite all those strong encouragements to the community to conduct reforestation, successful cases have proven very rare. There is some evidence that some communities care more for extracting timber and obtaining other benefits from the forest than for the forest itself (Levang et al., 2005).

Some authors have reported that unclear land tenure has caused the above mentioned "negative" attitude from communities, i.e. the low involvement of communities in many reforestation programs. Unclear land tenure has also become a source of conflicts among forest stakeholders, and result in cases of forest occupancy by local communities (Fay and Michon, 2005 and Wollenberg and Kartodihardjo, 2002). The conflicts, forest occupancy, "negative" attitudes and low involvement of communities outside Java were worse than in Java. The conflicts over certain forest resources, or the occupancy of certain forest area by local communities were often interpreted as a sign that local communities were interested in and cared for the forest. However, some facts contradict this interpretation. Some lands that were already claimed were deserted. Other stakeholders even forestry officers did not dare to give assistance in reforesting the claimed land. At present, most claimed lands outside Java lay bare, without any replanting or utilization effort by the local communities who claimed them. In some areas, the condition of the land was so marginal that agricultural practices were almost impossible without a great deal of inputs or investments. Some authors (Fay and Michon, 2005) recently proposed that those claimed lands should be best put under the jurisdiction of the Agrarian authority, rather than the Ministry of Forestry. However, this proposed solution would not help the reforestation effort, because it would be directed to a different landuse, e.g., agriculture rather than forest plantations.

Amidst this generally grim picture of community forestry in Indonesia, some exceptions do exist. Several sustainable communities' forestry has been practiced for generations, either in the form of agro-forestry or pure forest tree plantations (Michon and de Foresta, 1999). The MoF defines a community forest as a forest, which grows on a minimum of 0.25 ha privately owned land, with tree crown covering more than 50% of the area, or with at least 500 trees standing in the first year. One type of community forests is composed of sengon (*P. falcataria*) trees, which are owned by communities throughout Java. Sengon community forests in Java have been estimated to supply about 22.7% of the total national timber demand (MoF, 1994). Sengon timber usually is used by community members themselves for various purposes, starting from fuel woods to many products, such as kitchen utensils, packing boxes, furniture, construction, and recently it has become a raw material for the timber industry (chips) in several parts of Java.

High hopes for reforestation and establishment of forest plantations increased with Indonesia's ratification of the Kyoto Protocol. Inclusion of afforestation and reforestation and other LULUCF activities (Land Use, Land Use Change and Forestry) in the Kyoto Protocol have

opened up possibilities for Indonesia to take part in a trading of CERs (Certified Emission Reduction) under the CDM (Clean Development Mechanism), a scheme designed to provide incentives for sustainable development in forestry. With current developments as mentioned above, likely projects proposed under CDM would be small scale, and involve local communities.

The objective of this paper is to examine sengon community forests in Kediri, East Java, using a simple economic analysis that consists of NPV and benefit–cost ratio, in order to find out some reasons for its sustainability, as opposed to the failure of most community forestry outside Java. This analysis might not be perfect, but it is logical in assessing the positive and negative views of certain choices, and it remains a powerful tool as a general rational approach to economic decision making. Wunder (2000) used NPV analysis to examine joint causality in deforestation, of which deforestation is seen as an investment in future land uses.

2. Methodology

The data used in this paper were both primary and secondary. Primary data were obtained from questionnaires given to community/farmers in Kediri District, East Java. In this district, sengon plantations are abundant in 3 sub-districts, namely Pandantoyo, Manggis and Jatirejo. At the first stage, we administered questionnaires and conducted interviews with 5 randomly selected farmers from each sub-district. Examples of questions asked were, the amount of land owned, what crops or trees were planted, the sequence of crop plantings in 8 year rotation, cultivation methods, components of cost in cultivation, income from each kind of crop, etc. Results of these first interviews were then discussed and confirmed with the Head of village, where the farmers belonged, in order to get a general pattern of cultivation, average of each component cost, prices and income. The results were once again checked with the Kediri District Field Advisor (Mandor) from Perum Perhutani, a state owned Forest Company, which manages forest areas in Java, in order to get a general pattern of silvicultural practices and the costs and prices associated with it. Since much variation was observed in community forestry practices, units and prices, the cost and revenue of a plantation was averaged from the sampled farmers and calculated for one hectare (1 ha) of land area. Meanwhile, whenever secondary data were used, the source will be indicated.

At the second stage, about 40 farmers were sampled randomly from one village in Kediri district, in order to know the factors affecting farmers' decisions to practice certain landuse. Examples of questions were, the amount of land owned, crops and trees planted on the land, income from each kind of crop, other sources of income, marketing of the harvest and timber, including prices, etc.

The mixed plantation scheme between sengon and pineapple, corn, chili or papaya is evaluated using two criteria, net present value (NPV) and benefit–cost ratio (BCR). NPV is the algebraic sum of all costs and revenues discounted at a stated rate. Discount rates are usually chosen to reflect the return on alternative investment opportunities. In Indonesia, nominal investment rate for 2002 as reported by the Bank of Indonesia was 17.53%. A project is feasible if the NPV is positive. The ratio of discounted benefits and discounted costs of a project is called the benefit–

cost ratio (BCR). The B/C ratio can be calculated by dividing the present value of benefits (total revenue per ha of plantation) by the present value of costs per ha with the formula:

$$\text{B/C ratio} = \frac{\text{PVrevenue}}{\text{PV costs}} = \frac{\sum_{y=0}^{n} \frac{R_y}{(1+r)^y}}{\sum_{y=0}^{n} \frac{C_y}{(1+r)^y}}$$

The result of the B/C ratio should be equal to or greater than 1 in order for the project to be considered acceptable or beneficial (Klemperer, 1996).

All analyses were made using the following assumptions:

1. All calculations are based on 1 ha of the agro-forestry scheme and using an 8 year rotation period for sengon. For pineapple, corn, chili and papaya, a production time rotation of 4 years is used because after 4 years it is impossible to plant any fruit or vegetables under sengon trees.

2. The interest rate used is a nominal interest rate for investment reported by the Bank of Indonesia for 2002 that is 17.53%. This nominal rate includes inflation, because values over time are always expressed in current exchange/currency, and forestry deals with long time periods over which inflation can cause current exchange values to increase greatly (Klemperer, 1996). The nominal interest rate can be considered as Minimum Acceptable Rate of Return (MARR) since the investor/owner will not use lower interest rate than the current nominal interest rate stated by the central Bank.

3. It is assumed that inflation rate is fixed for next 8 years to reflect the same current exchange of rupiahs.

4. The opportunity cost of each crop is included in the calculation of the NPVs and the B/C ratios of pure sengon plantations.

5. The data collected was qualitative and quantitative. The data assembled by questionnaire was entered and processed using Microsoft Excel.

3. Results and discussions

3.1. Community forestry practices in Kediri, East Java

The community forest in Kediri district has potentially 24,480 ha of which only around 5935 ha are well managed (Anonymous, 1998). The main tree species grown is sengon, which can be found either as pure sengon plantations or mixed with other species (agroforestry). In mixed plantations, other species planted may include annual crops (corn, chili pepper, sugarcane, cassava, etc.), fruit crops (pineapple, papaya, etc.) or other tree species (mango, coconut, banana, etc.). Silvi-agricultural practices vary greatly, especially on number of trees per ha, sequence of

species composition and harvesting age. For example, for a certain farmer, the first year might be sengon mixed with corn, then chili pepper, later corn again, meanwhile for another farmer, the mixture might be only pineapple and sengon for years, etc. The number of trees and the way they were planted was also variable. Some farmers could have only a few trees (less than 10) planted along the border of their lands compared to some other farmers who planted the trees with a regular planting distance, which also varied among farmers. Please note that the amount of land owned by farmers varies from very small (less than 0.1 ha) to fairly large (several hectares). The survey indicated that one farmer was found to possess 7.1 ha of land, while most farmers had less than 1 ha.

Most people made a minimum investment for cultivating and tending the trees; sometimes they did not spend any money at all even for buying seedlings and first land preparation. Seedlings could be obtained from the community's own plantations, or by government aid through the District Forest Service (Dinas Kehutanan) or the State Forest Company (Perum Perhutani) as part of the Government's Community Forestry Program. Occasionally farmers buy seedlings if they want to invest in forestry. The amount of money spent to buy sengon seedlings and conduct minimum land preparation was on average 178,000 rupiahs/ha. Later if farmers did some tending activities, for example applying fertilizers, this was intended for the crops, not for the trees. Previous studies (Hayono, 1996 and Nurfatriani and Puspitojati, 2002) reported some mixed plantation costs for activities, such as land preparation, transplanting, and maintenance; however, it was not clear whether the cost was for the sengon trees or for the other crop species.

Harvesting sengon trees was done at practically any age, depending on the people's need. Most farmers did not intentionally thin their plantations; they just harvested some of the trees as funds were needed. The price of harvested timber or trees varied depending on tree diameter, which ranges between 100,000 and 300,000 rupiahs per tree. Sengon timber could be used for the community's own needs, such as for fuel wood, construction, small utensils or sold for money.

3.2. NPV and benefit–cost analysis of pure and mixed plantations

In order to simplify the analysis, it was assumed that community-planted-sengon was either in monoculture, or mixed with only one crop species for the whole rotation. The farmers were also assumed to give minimum investment, i.e., for transplanting sengon seedlings only, which is on average 216.0 rupiahs per seedling, at a planting density of 800 trees/ha. Usually sengon was harvested after 10 years; however there was a tendency towards shortened age at harvest to 8 years. At the local market farmers usually sell standing trees, because they do not want to be burdened with the cost of felling, processing and transportation. The price of sengon trees at harvesting time is on average 200,000 rupiahs per tree. For other crop species cultivation was assumed to be done until the sengon reached a maximum of 4 years of age, because most crops would not tolerate the shade of sengon trees. Table 1 shows the calculation of the NPV and the B/C ratios of several sengon mixed plantations, applying a discount rate of 17.53%.

Table 1.

NPV and benefit–cost ratios of sengon mixed plantations harvested after 8 years

Mixed plantation	PV Cost (Rp.)	PV Income (Rp.)	NPV (Rp.)	B/C ratio
Sengon, pineapple	12,002,158	81,147,700	69,145,542	6.76
Sengon, papaya	10,613,082	70,389,806	59,776,724	6.63
Sengon, corn	14,993,826	66,790,938	51,797,112	4.45
Sengon, chilli	202,667,261	350,258,927	147,591,666	1.73
Mixed sengon[a]	5,960,471	21,512,025	15,551,554	3.61

[a] Data from Nurfatriani and Puspitojati (2002), re-calculated.

Table 1 showed that any type of mixed sengon plantation gave a B/C ratio of more than one, which means that planting sengon with other crops or fruit is profitable. However, mixing sengon with pineapple provided the highest value, which might explain why the community in Kediri preferred cultivating pineapple to other crops with sengon. As farmers invested almost nothing in the sengon trees, it was easy to understand that the benefit from tree planting depended on the price of sengon timber or sengon trees at harvest time. The price of sengon timber/trees varied across different locations, always increasing. In 1996 the price ranged from 7500 rupiahs to 250,000 rupiahs per tree in Wonosobo District, Central Java (Hayono, 1996) for a 15 year rotation, and then slightly changed from 40,000 rupiahs to 80,000 rupiahs in 2002 for an 8 year rotation age (Andayani, 2002). Meanwhile in Kediri the price was between 30,000 rupiahs and 50,000 rupiahs for a 7 year rotation age (Nurfatriani and Puspitojati, 2002). These different price ranges are caused by the fact that the community in Kediri, similar to other communities in other parts of Java, usually sells trees while they are still standing. This is done to avoid paying the cost for harvesting, processing and transporting (Hayono, 1996 and Nurfatriani and Puspitojati, 2002). Furthermore, they usually sell the trees at early ages (e.g., 3–5 years) due to the income problem. This situation however, has given farmers a lower bargaining position vis-à-vis the timber merchants since farmers could not offer a higher price for young trees, as the trees still have small diameter and farmers would not bear the harvesting cost. Timber merchants will leave the young trees until they are ready to be harvested (after 8 years).

Please note that the NPV value shown in Table 1 was calculated based on 1 ha of land. Most farmers, however, have very small amount of land, and therefore, the actual income is not as big as shown here. The total income from plantations is so small that most farmers have been unable to accumulate wealth (savings from past income). This is also the reason why chili is less often selected as a mixed crop compared to others, because most farmers do not have enough capital to cultivate chili.

In this paper an interest rate of 17.53% was used, and considered as a Minimum Acceptable Rate of Return (MARR). In general, the MARR is specified to reflect the *opportunity cost of capital*, the market interest rates for lending and borrowing, and the risks associated with investment

opportunities. In this case, the use of real interest rate of return for some economist does not reflect the opportunity cost (Klemperer, p. 148), that is why MARR can use nominal rates because of people's expectation about inflation. Regardless of how the MARR is determined, the MARR specified for the economic evaluation of investment is critically important in determining whether any investment is worthwhile. According to Klemperer (1996, p. 152), there are two important guidelines for computing NPV whether we used real interest rate or nominal interest: (a) If future cash flows are in constant dollars (in real terms) compute NPV with a real interest rate; (b) If future cash flows are in current dollars (nominal, or including inflation) compute NPV with a nominal interest rate. But make sure to use inflation rate in the cash flows and the interest rate. The cash flows of community forest plantation have been measured with current rupiahs since the unit cost and the selling price used are based on the current exchange of rupiah. With assumption of fixed inflation over next 8 years, there will be no fluctuation of current rupiahs. Then the use of nominal rates for MARR will be possible.

Table 2 is a calculation of the costs and revenue of pure sengon plantations with various opportunity costs coming from the same crop species as mentioned above.

Table 2.

NPV and benefit–cost ratios of pure sengon plantation with several crop opportunity costs

Opp. Cost	PV Cost (Rp.)	PV Income (Rp.)	NPV (Rp.)	B/C ratio
Pineapple	48,168,278	43,947,087	− 4,211,191	0.91
Papaya	28,200,710	43,947,087	15,746,377	1.56
Corn	12,731,797	43,947,087	31,215,290	3.45
Chili	167,336,641	43,947,087	− 123,389,554	0.26

As mentioned before, sengon monoculture should always be profitable, because the cost was minimal. However, when opportunity cost was included in the calculation, most B/C ratio values have decreased compared to Table 1. As shown in Table 2, with exception of chili and pineapple, other B/C ratios were still higher than 1, which indicated that planting sengon as a monoculture is still profitable. Since all B/C ratio values were decreased when the opportunity costs of other crops were accounted for the community members would get a higher benefit by cultivating sengon in mixed cropping or agroforestry. Similar results on the B/C ratio and NPV values were obtained in previous studies (Hayono, 1996, Andayani, 2002 and Nurfatriani and Puspitojati, 2002) in different locations in Java.

Besides being more profitable, farmers planted sengon in agroforestry complexes more often than in monoculture, because they needed immediate cashflow from their plantations. In the case of pure sengon plantations people would have to wait for 8 years before harvesting all the trees. Although in fact people harvest trees anytime they need them, the earliest reasonable/profitable harvesting time would be after sengon trees reach 4 years of age. The income obtained from such trees might not be enough for people's subsistence needs. This is not the case when people also cultivate shorter rotation crops, such as corn or chili, which can be cultivated twice a year. This situation is especially true when most farmers in our study have only a small land area.

The results of this study showed that the establishment of community forests in Java did not require expensive investment, except for food crops, especially pineapple and chili. Considering this, the government's incentive in promoting community forestry by providing small soft loan of 3.25 million (Rp)/ha to community members (Directorate General RLPS-MoF Decision no. 085, 1999) should have resulted in successful development of community forestry anywhere. That was not the case, however. The study by Donie et al. (2002) showed that the incentive, though successful in increasing the number of community forests, i.e., the area reforested, was not effective enough to produce better quality forest compared to traditionally established community forests. Observations in the field showed that the newly established forests through the small loan program, generally ,had lower growth, which resulted in lower potential harvest, compared to traditionally self-established community forests. One of the reasons stated was that the loan was given through a partnership with other stakeholders (called partners), and not directly to the farmers themselves. Although tenure was clear, this complicated arrangement has adversely affected farmers' feelings of ownership of the program, and they have become less active in tending the forest. In Indonesia farmers rarely apply for bank loan for various reasons. Some reasons as pointed out by the farmers are because farmers do not have assets for security loan charged by bank, the long and complicated procedures in applying, and high interest rates.

3.3. Factors influencing community decision

Despite high profits which could be obtained from sengon plantations, it was easy to see that not all community members were eager to do it. From our second stage survey only 40% of the sampled farmers in one village in Kediri grow sengon, while 60% do not. Among those 40% of farmers who grow sengon, 73% have land area of more than 0.25 ha. Meanwhile, among those 60% farmers who do not grow sengon, 55% have a land area of less than 0.25 ha. Apparently more farmers opt for agriculture rather than forest plantations, especially those who only have a small land area. Therefore, it was apparent that the amount of land owned by a farmer would naturally affect their decision in the type of cultivation. As the farmers need immediate cash flow, the smaller the land they have, the shorter the rotation of crops they cultivate.

Previous studies have shown that although the amount of land area owned did not significantly influence farmers' decision (Hayono, 1996 and Setyawan, 2002), the income of farmers, either from forest plantations or other sources, did significantly affect their involvement in the community forestry business. Setyawan (2002) explained that when farmers' incomes got higher, the farmers became busier and had less time to cultivate or tend their land or plantations intensively, so they would opt for plantations with less tending activities, such as forestry (as

compared to agricultural crops). Here we argued that although there was no direct correlation between the amount of land area owned and level of income, it is easy to understand that for a farmer holding a small amount of land, without other sources of income, it is difficult to choose trees over annual crops.

The income received from sengon plantations clearly depended on timber prices, as also stated by Hayono (1996). The higher the timber price, the higher the income generated, because costs are usually minimal, and communities are likely to be more attracted to planting trees. The importance of timber prices is especially true outside Java. The reason sengon is not widely planted outside Java is because sengon timber does not have much value compared to other native timber there, for example dipterocarps. Dipterocarps are the main timber species for export. However, the high price of dipterocarp timber does not result in communities outside Java planting dipterocarps, perhaps due to the remaining abundance of dipterocarp timber in natural forests outside Java.

The situation outside Java apparently is not much different than Java, or, better said, is superficially different. Outside Java the amount of land which theoretically could be claimed by community members is much greater than in densely populated Java, and in fact many communities claimed vast amounts of land during the Reform Era. However, it is also a fact that those communities have stayed out of the forestry business after claiming the land or forest. This has made us think again that perhaps it was not the land, the forest or land tenure that the community needs in order to get involved in the forestry business, and hence the reforestation program. Perhaps similar to Java, communities outside Java also need higher income in order to favor forestry or reforestation programs. The vast amount of land claimed, which might make some authors thought that community was interested in forestry, is apparently only covering the hidden truth about community needs of higher income. Recent socio-economic studies by Levang et al. (2005) on Punan hunter-gatherers in East Kalimantan showed that forest dependency was not considered as an attractive, viable option, but rather a last resort. Even though vast amounts of infertile lands were claimed, they did not generate enough income for communities to move toward the forestry business. Instead community chose other options to generate income. Therefore, in order to get the communities interested in forestry programs, community development, which could generate better income, is necessary.

Another factor, which was observed in previous studies, was the influence from extension activities or membership in farmers' groups (Hayono, 1996 and Setyawan, 2002). Apparently extension had a positive impact on farmers' knowledge and perceptions. Becoming a member of a farmers' group would also increase knowledge and farmers' participation in forestry activities.

4. Conclusion

Despite the reluctance of communities to get involved in forestry programs or establish forest plantations, this study showed that planting trees in Kediri, East Java is always profitable, because it requires only a small investment. Communities in our study obtained the highest benefit if they planted in the form of mixed cropping or agroforestry, because this type of planting gave both higher income and ensured immediate cashflow to the community.

Community decisions to get involved in the forestry business were influenced by several factors, i.e., the amount of land possessed, the timber price, and the long period before the plantation provided income. Most community members, with small land holdings, were likely to choose an agricultural option. For outside Java, where land area is not serious limitation, timber prices would likely be an influencing factor. Overall we concluded that in order to get communities interested in forestry programs, community development, which generates higher income for communities is necessary.

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Corresponding author. Department of Silviculture, Faculty of Forestry, Bogor Agricultural University, Kampus IPB Darmaga, P.O. Box 168, Bogor 16001, Indonesia. Tel.: +62 251 621677/624065; fax: +62 251 621256.