POLICY ANALYSIS OF HYBRID ACACIA PRODUCTION: CASE STUDY IN THUA THIEN HUE PROVINCE

Ho Thanh Ha and Nguyen Thi Thuong
College of Agriculture and Forestry, Hue University

Abstract. Acacia species is the main tree species grown in forest plantation in Thua Thien Hue province. This study has used Policy Analysis Matrix (PAM) as the main research framework to analyze the profitability and the effects of intervention policies on the profitability of acacia production in order to provide information, which can be used to assist in planting and expanding of acacia forest, to policy-makers and farmers. The results showed that the acacia plantation is profitable but higher-profit model of intensive cultivation was almost twice as profitable as the extensive one. Results in PAM showed that Acacia production offers both private and social efficiency. No indication of market failure was found. The policies intervention was a tariff of 6.5% on imported fertilizer. Acacia production generally has the protection of the government and efficient use of domestic resources. However, it also bore the tax burden with respect to the input (fertilizer). Acacia products are comparative products in the market. Policy-makers and other forestry development programs should support farmers in cultivating the intensive model and lowering the interest rate for planting and expanding acacia forest.

Keywords: PAM, Acacia production, profitability, Thua Thien Hue.

1 Introduction

According to the Wood Resource Quarterly report 2009, Vietnam has become a major exporter of wood chips in a short period of time. The woodchip export, of which a majority is Acacia, has steadily gone up in the past five years. In 2002, the country exported only 150,000 metric tons of wood chips and was a marginal supplier at the time. In 2008, it became the fourth largest exporter of hardwood chips in the world, with an estimated volume of two million tons being shipped, mainly to Japan and China (Wood Resources International LLC, April 16, 2009). The interest of farm households in planting trees has turned around quite dramatically within the past decade. In the 1990s and early 2000, production of rice, livestock and tea generated more profits than timber, with the consequence that farmers converted forestland to farmland. This changed when the wood chip exports took off in 2002-2003 (Department of Forestry of Thua thien Hue, 2007). Many farmers are now planting trees, especially hybrid acacia, as the
profitability is considered very good compared to many other forestry crops.

Hardly any study has been carried out to examine the impact of single policy on the profitability of reforestation or the sensibility of the policy change on farmers or the impact of government policies on economic effect of different plantation models.

This study was conducted to analyze the current profitability of Acacia production and the input use efficiency, as well as the degree of government intervention in acacia production. This will help to provide policy-makers with necessary information on making and revising policy in reforestation and give farmer guidelines for making the right decision in the expansion of Acacia forest plantation.

2 Research methodology

Research Framework

To achieve the research objectives, this study used the Policy Analysis Matrix (PAM) as a research framework. The PAM, a computational framework developed by Monke and Pearson, has been used by many researchers to measure input use efficiency, comparative advantage and degree of government intervention (Abdoukarim Esmaeili, 2008; Samarendu Mohanty, 2002; Dophu Dukpa, 2005). The PAM has proven to be one of the most suitable research tools in examining the competitiveness and efficiency of an agricultural system. It displays clearly the profitability of a crop under the current policy regime and under a system free of the influence of policy and market failures. The matrix can be easily modified to show profits given under different policy changes (Alex Winter-Nelson, 1991).

The PAM is a three by four accounting matrix designed to display the financial or (private) and economic (social) return to the activity (Monke and Pearson, 1989). The way of analysis is shown in table 1.

<table>
<thead>
<tr>
<th>Table 1. Structure of the Policy Analysis Matrix (PAM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Tradable input</td>
</tr>
<tr>
<td>Private value</td>
</tr>
<tr>
<td>Social value</td>
</tr>
<tr>
<td>Divergences</td>
</tr>
</tbody>
</table>

Notes: Profit is revenue minus cost;

Divergence effect is private price minus social price

Tradable inputs include those inputs which are traded in the world market while non-tradable inputs are mainly domestic factors that are not traded. The differences in revenues, costs and profits between their private and social prices allow PAM to
determine the extent of divergences caused by policy intervention and market failures in both the input and output markets.

The competitiveness and efficiency of the Acacia production are reflected by the private profitability (D) and the social profitability (H), respectively (Monke and Pearson 1989). Some ratio indicators for comparison are as follow:

Private cost ratio (PCR) is the ratio of factor costs (C) to value added in private prices (A-B). This ratio measures the competitiveness of a commodity system at the farm level. The system is competitive if the PCR is less than 1.

$$\text{PCR} = \frac{C}{A - B}.$$

Domestic resource cost ratio (DRC) was brought into common usage by Bruno (1972) specifically for the purpose of measuring comparative advantage. According to Bruno (1972) and Krueger (1966 and 1972), the economic efficiency in domestic resource use of a commodity system can be assessed by using this ratio. Since minimizing the DRC is equivalent to maximizing social profits, if the DRC ratio is less than 1, the system uses domestic resources efficiently. If the DRC ratio is greater than 1, then the system shows inefficiency in domestic resource use and possesses a comparative disadvantage.

$$\text{DRC} = \frac{G}{E - F}.$$

Nominal protection coefficient on tradable outputs (NPCO) shows the extent to which domestic prices for output differ from international reference prices. If NPCO is greater than 1, the domestic farm gate price is greater than the international price of output and thus the system receives protection. On the contrary, if NPCO is less than 1, the system is not protected by policy.

$$\text{NPCO} = \frac{A}{E}$$

Nominal protection coefficient on tradable inputs (NPCI) shows how much domestic prices for tradable inputs differ from their social prices. If NPCI exceeds 1, the domestic input cost is greater than the comparable world prices and thus the system is taxed by policy. If NPCI is less than 1, the system is subsidized by policy.

$$\text{NCPI} = \frac{B}{F}$$

Effective protection coefficient (EPC) is the ratio of value added in private prices (A-B) to value added in social prices (E-F). An EPC value greater than 1 suggests that government policies provide positive incentives to producers, while values less than 1 indicate that producers are not protected through policy interventions on value added.

$$\text{EPC} = \frac{A - B}{E - F}$$

To measure the profitability of Acacia production, some common economic indicators were used such as total cost, total return, net return, Net Present Value (NPV), Benefit – Cost Ratio (BCR), Internal Rate of Return (IRR).
Data collection

Information was obtained from both primary and secondary sources. The data needed for the PAM approach included input use and output per hectare, private prices of inputs and outputs, social prices of inputs and outputs, export prices for Acacia woodchip, historical data on Acacia areas and production, exchange rates and interest rates, etc.

The primary data were collected through a combination of structured surveys and focus group discussions. The structured surveys collected input-output information at farm level (from Acacia farmers). The focus group discussion was used for gathering information regarding problems and opportunities to achieve better competitiveness and efficiency of the Acacia production from selected stakeholders (involving policy makers, processors, traders, and end-users) at the communal, district, and provincial levels.

Farm level information was collected from a sample of Acacia farmers in two districts – Phu Loc and Nam Dong. Three communes were selected from each of the two districts. From each of the communes, 30 Acacia farmers were selected using a random sampling technique. A total of 180 farmers were interviewed.

The PAM framework can be used for on farm and post-farm activities. However, the analysis was only done at farm level since the main interest of the research is farmers’ profits.

3 Results and discussions

3.1 Profitability of Acacia production

3.1.1 Cost analysis

Acacia growing required a higher cost compared to agricultural crops such as rice or groundnut but it was lower than the cost of other forest species such as indigenous species by 20 million VND or rubber by at least 50 million VND in the first 7 years. The total cost per ha of Acacia was about 13 million VND (for intensive cultivation). However, the cost of acacia production could be shared in 3 years which made the amount invested in one year quite small. This amount was affordable for farmers including the poor to invest in. Furthermore, to grow acacia, it was not necessary to use any equipment or machinery. All of the activities could be done manually. Thus the cost needed at the beginning was not high because no fixed cost was needed.

Among 7 years of production, the first three years consumed 100% of cost if planters sell acacia without harvesting, in which 48% was spent in the first year. Therefore, the first year was considered the decisive year when the biggest amount was required to fulfill the technical requirements. The poor often found it difficult in the first
year because of lack of cash and labor. The remaining cost shared in the second and the third years was 28% and 24% respectively. From year 4 to year 6 no more investment was needed. In year 7, if the farmers wanted to harvest and did primary processing of acacia before selling they had to pay a considerable amount in cash or labor. In that case, the cost in the 7th year accounted for 41% of total cost. Because of a large amount needed in the last year, this stage was not often done by the poor who usually sell the whole acacia forest to the dealers as a lump-sum price.

The production cost depended much on the techniques used in acacia growing. There was a big difference in investment both in labor and material between intensive cultivation\(^1\) and extensive cultivation\(^2\) techniques. Table 2 shows the detailed differences.

In general, the extensive model cost less than the intensive one in all kinds of cost. The most remarkable difference was found in labor cost of land preparation and weeding. While intensive techniques required site clearance and weeding, the acacia in the extensive farms were planted without clearance of grass and bushes. Fertilizers were applied to the forest which met intensive technical norm whereas farmers running the extensive cultivation did not need to pay for fertilizer cost, making this cost under the extensive model close to zero. The extensive model also needed fewer saplings; compared to intensive cultivation, the saplings needed in extensive model reduce by 15%. Thus the difference in the cost of materials between the two models was considerable (Table 2).

**Table 2. Cost of acacia production of extensive (Ext.) and intensive (Int.) cultivation**

<table>
<thead>
<tr>
<th>Forest age Activities</th>
<th>Year 1</th>
<th></th>
<th>Year 2</th>
<th></th>
<th>Year 3</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation</td>
<td>1,600</td>
<td>2,080</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,600</td>
<td>2,080</td>
</tr>
<tr>
<td>Planting</td>
<td>720</td>
<td>720</td>
<td>160</td>
<td></td>
<td>720</td>
<td>880</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeding</td>
<td></td>
<td></td>
<td>240</td>
<td>960</td>
<td>0</td>
<td>640</td>
<td>240</td>
<td>1,600</td>
</tr>
<tr>
<td>Sapling</td>
<td>1,400</td>
<td>1,400</td>
<td>0</td>
<td>150</td>
<td>1,400</td>
<td>1,550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer</td>
<td>2,100</td>
<td>0</td>
<td>2,800</td>
<td>0</td>
<td>1,400</td>
<td>0</td>
<td>6,300</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>160</td>
<td>320</td>
<td>0</td>
<td>200</td>
<td>160</td>
<td>160</td>
<td>680</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,880</td>
<td>6,620</td>
<td>240</td>
<td>4,270</td>
<td>0</td>
<td>2,200</td>
<td>4,120</td>
<td>13,090</td>
</tr>
</tbody>
</table>

*Source: Calculation from interviewed household.*

\(^1\) Intensive cultivation: Cultivation model which requires careful land preparation and fertilizers in first 3 years

\(^2\) Extensive cultivation: cultivation model which requires digging hole only without applying fertilizers
3.1.2 The benefits of acacia production:

The economic indicators of acacia production under different models are shown in the Table 3. In general, it can be concluded that acacia growing yielded high economic benefit. The gross margin and NPV normally indicate the return of investment over land. The table showed that the intensive model can generate profit which was almost double that generated by the extensive model.

**Table 3. Common economic indicators for different models of acacia production**

<table>
<thead>
<tr>
<th>Economic indicators</th>
<th>Extensive model</th>
<th>Intensive model</th>
<th>Intensive model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without harvesting</td>
<td>With harvesting</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>4,120</td>
<td>13,090</td>
<td>36,090</td>
</tr>
<tr>
<td>Total Return</td>
<td>21,000</td>
<td>45,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Gross margin</td>
<td>16,880</td>
<td>31,910</td>
<td>38,910</td>
</tr>
<tr>
<td>Present Value of Return</td>
<td>14,425</td>
<td>30,911</td>
<td>51,519</td>
</tr>
<tr>
<td>Present Value of Cost</td>
<td>4,103</td>
<td>12,474</td>
<td>28,273</td>
</tr>
<tr>
<td>Net present value (NPV)</td>
<td>10,323</td>
<td>18,437</td>
<td>23,246</td>
</tr>
<tr>
<td>Benefit-cost ratio (BCR)</td>
<td>3.52</td>
<td>2.48</td>
<td>1.82</td>
</tr>
<tr>
<td>Internal rate of return (IRR)</td>
<td>29%</td>
<td>23%</td>
<td>27%</td>
</tr>
</tbody>
</table>

*Source: Calculation from interviewed household.*

The benefits gained (on 1 ha of forestland) were not the same between different models. There was a big difference in benefits between intensive model and extensive model. Under the same conditions and if the planers sold acacia on farm without harvesting, the profit generated by the intensive model was nearly double that generated by the extensive model, 45 million VND of the former compared to 21 million VND of the latter.

The discount rate was used at 7.8% (according to the bank interest). This interest rate is used for afforestation or forest plantation from the Vietnam Bank for Social and Policy. With this discount rate, the NPV of 3 models are 28,273; 18,437 and 10,323 thousand VND for intensive with harvesting, intensive without harvesting and extensive model, respectively (the production cycle is 7 years). It means that the intensive model is more profitable in term of land resources. If land resource is limited, this model is much more profitable, suitable and sustainable than the other models. Among the three models, the intensive with harvesting model is the most profitable; however, due to lack
of labor and cash to cover the cost the poor farmers could not carry out this activity. They usually sell the forest to traders for harvesting and transportation.

The BCR indicates quite high profit in financial investment in forestry production. However, compared to the intensive model, the BCR of extensive model is higher. This means that the extensive model can produce more effectively in term of capital investment. The BCR of this model is higher due to lower input cost, the benefit coming from the land and other natural resources, but this model’s productivity will be reduced due to soil degradation. This model is not sustainable and not suggested by scientists. The IRR gained is much higher than the bank deposit interest rate at the bank. It means that acacia plantation can gain more benefit than depositing the capital in the bank.

The IRR and BCR of extensive model are higher than those of intensive model because lower capital outlays are required in the extensive model but profits are much less. For most poor farmers the gross margin or NPV value is a more reasonable guide to planting decisions (in addition to the absolute value of costs). The IRR and BCR indicators are normally used for comparison among industrial investment projects and indicate the benefit that can be obtained from capital investment where the investment capital is available. However, in forestry production the capital investment of farmers is limited so they can not invest in the production therefore the benefit generated from the capital will be not much. In addition, as the land resource is limited, the intensive model should be considered by farmers and local authorities because the gross margin and NPV normally indicate the return of investment over unit of land.

The survey has revealed that the intensive cultivation is more likely to be suitable and has been the choice for the better-off households, and middle-class households. The extensive model was mostly applied by the poor who could not afford to invest as requested by technical advisers.

3.2 The PAM for acacia production in Thua Thien Hue

3.2.1 Data assumptions for social prices

The most difficult part in constructing a PAM is the estimation of social prices and the decomposition of input into their tradable and non-tradable components. The social prices of inputs and outputs are the border prices of commodities adjusted for transportation, marketing and processing cost to bring such commodities down (either buy or sell) to the operator level (Ekasingh et. all, 1999). Border price can be defined as the price at which suppliers from the exporting countries would deliver the goods to the domestic market or the price that consumers in the importing countries would be willing to pay domestic suppliers to deliver the good into their market. When the goods are imported, the prices are called social import parity price and if the goods are exported.
then the prices are called social export parity price.

The simplest way to estimate the social price is to use CIF (Cost, Insurance and Freight) or CFR (Cost and Freight) price for import commodities and FOB (Free On Board) for export commodities. In this case, the fertilizer is the tradable component and China is the main exporter to Vietnamese market so we use the CFR for social input cost. For output, China is also the main import country of acacia product from Vietnam so the FOB at Chan May seaport is used as social output cost.

The cost and revenue was calculated for 1 hectare of Acacia in year 2010

Total fertilizer used: 630 Kg/ha (tradable cost)
Private price: 10,000 VND/Kg
Social price: CFR 395 USD/Ton or 7,900 VND/Kg (exchange rate: 20,000 VND/USD)
Total productivity: 60 ton/ha
Output: 750,000 VND/ton
FOB: 110 USD/ton (dried chip) or 733,333 VND/ton

Another assumption is that there is no cost for land resources. Normally, farmer owned the land. The forestland locates in the remote area and in the steep slope so that the opportunity cost of forestland is low and too complicated to calculate in different locations.

3.2.2 The PAM for Acacia production in Thua Thien Hue

Acacia is a permanent tree crop and the production cycle is about 7 years. An analysis of competitiveness and efficiency requires that cost and revenue should be discounted to net present value. The present value at farm level of PAM for Acacia production in Thua Thien Hue province under the current policy environment is presented in table 4.

<table>
<thead>
<tr>
<th></th>
<th>Revenue</th>
<th>Costs</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tradable input</td>
<td>Domestic factor</td>
</tr>
<tr>
<td>Private value</td>
<td>45,000</td>
<td>6,300</td>
<td>6,790</td>
</tr>
<tr>
<td>Social value</td>
<td>44,000</td>
<td>4,977</td>
<td>6,790</td>
</tr>
<tr>
<td>Divergences</td>
<td>1,000</td>
<td>1,323</td>
<td>0</td>
</tr>
</tbody>
</table>

The completed Policy Analysis Matrix showed the effects of policies on the relative competitiveness of Acacia. The Acacia production was highly private and socially profitable. There was small divergence between private and social prices for revenue, tradable input and profit. The divergence probably results from either
distorting policies or market failures. No indication of market failures was found in the province. The respondents (farmers) reported that there was no difficulty in accessing either input or output market. Obtaining saplings, fertilizers, labor for plantation was relatively easy. Similarly, they found no difficulty in selling the product. Variation in input and output prices among farmers did exist but it was mainly due to variation in transportation costs and payment system. Among the current distorting policies were tariff of 6.5% on imported fertilizer and the exchange rate between USD and VND. No tariff was applied to tradable output; hence social price was lower than private price.

### 3.2.3 Ratio indicators of PAM

The Nominal Protection Coefficient on Input (NPCI) computed was 1.266; this implies that Acacia production is taxed by policy due to the tariff of 6.5% on imported fertilizer. However, The Nominal Protection Coefficient on output (NPCO) was about 1.023; this suggests that farmers received protection for Acacia production as a result of export subsidy (no tariff on exported acacia products) and exchange rate devaluation.

The Effective Protection Coefficient (EPC) value measures the net effect of subsidies, taxes, and distortion in exchange rate both for input and output market. The computed value for EPC indicated that Acacia production was encouraged through policy interventions.

The Domestic Resources Cost (DRC) value of 0.174 indicated that Acacia production had high economic efficiency in the use of domestic resources which exhibit comparative advantage and indicated that the production is potentially very beneficial to farmers in term of DRC per unit of foreign exchange earned. Moreover, the Private Cost Ratio (PCR) value was about 0.175, implying that production is much more competitive at the current level of technology and policies intervention.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Computed value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Protection Coefficient on Input (NPCI)</td>
<td>1.266</td>
</tr>
<tr>
<td>Nominal Protection Coefficient on Output (NPCO)</td>
<td>1.023</td>
</tr>
<tr>
<td>Private Cost Ratio (PCR)</td>
<td>0.175</td>
</tr>
<tr>
<td>Effective Protection Coefficient (EPC)</td>
<td>0.992</td>
</tr>
<tr>
<td>Domestic resources Cost (DRC)</td>
<td>0.174</td>
</tr>
</tbody>
</table>

### Table 5. Common ratio indicators of PAM for Acacia production

### 5 Conclusions and recommendations

### 4.1 Conclusions

Acacia production is a profitable activity. It requires lower cost compared to the
production of other forestry species and the cost invested in acacia production can be recovered in a shorter period. Acacia results in good indicators in economic assessment. The benefit of acacia production depends on the level of cultivation of which the intensive cultivation can generate profit that is approximately double that of extensive cultivation. The Acacia production is strongly competitive and efficient because it can generate very high positive private and social profits.

The existing policies on imported tax cause some losses to farmers. The tariff of 6.5% on fertilizer imported for input cost had little impact on private profit because fertilizer cost accounted for nearly 50% of the total production cost.

4.2 Recommendations

Local authorities and farmers should consider the expansion of Acacia plantation as one of the best options to improve the incomes of smallholders, particularly those who are poor and live in the mountainous area.

Local authorities and other forestry development programs, especially the agricultural and forestry extension staff should emphasize and introduce the intensive cultivation model to farmers rather than extensive model because the intensive model will lead to higher profit (net return) considering that land resource is limited in the current condition.

Government should consider removing the tariff on imported fertilizer because the fertilizer cost accounted for 50% of total production cost, thus decreasing private profit. The low fertilizer cost can encourage farmers to go with the intensive model rather than the extensive one.

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