Crop Changes in the Rubber Plantations

-Financial and Some Environmental Aspects-

Jagath S Kularatne and Hiroyuki Takeya

(Graduate School of Bioagricultural Sciences, Nagoya University)

I Introduction

Rubber is one of the major export crops and it is cultivated in around 160,000 hectares in the plantation sector in Sri Lanka. Estates of 20 hectares or greater are considered to be large holdings. Around 36% of the total rubber cultivated area belongs to the large estates and the management of these estates were transferred to the private sector from the state-owned enterprises in 1992. After the privatization, there is an important trend i.e., shifting away from rubber to oil palm in this sector. According to the information of rubber research institute of Sri Lanka, there are some plans to convert up to 20,000 hectares of rubber lands into oil palm, and around 3,000 hectares of the rubber lands have been already converted into oil palm.

This paper attempts to analyze financial and some environmental aspects of moving away from rubber to oil palm. According to our knowledge, there is no any quantitative analysis on this movement except some qualitative overviews on the plantation sector activities in Sri Lanka (Kelagame, 1995; Sivaram, 2000; Fernando, 2001).

II Methodology and Data

Data on the farm budgets were collected by a field survey from thirty estates in the year 2003. Considering the simplicity and the easiness to interpret, the tabular analyses were employed to assess the cultivation cost and the environmental benefit of the two crops. Net Present Value (NPV) was employed as a measurement to evaluate the returns. NPV is defined as the present worth of an income stream generated by an investment (Gittinger, 1994), and the mathematical formula is given below:

\[ NPV = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1 + r)^t} \]

In the formula; \( B_t \) = benefit in year \( t \), \( C_t \) = cost in year \( t \), \( t = 1, 2, \ldots, n; n=30 \), \( r \) = interest rate

Following Gittinger (1994), a low interest rate of 3% was employed to count the long-term benefits. High interest rate of 11% was employed to count the concerns of the private entrepreneurs.

Data were divided according to the life span of the two crops. Life span of both rubber and oil palm is around 30 years and it can be divided into two major stages namely immature and mature. The mature stage could be divided into four stages based on the yield pattern; the initial low yield, high yield, stable yield, and the final low yield stages.

The immature stage of rubber is from one to five (1-5) years, and the mature stages are approximately six to nine (6-9), ten to seventeen (10-17), eighteen to twenty three (18-23), and twenty four to thirty (24-30) year periods. In the case of oil palm, immature stage is from one to three (1-3) years, and the mature stages could be...
demarcated into four to six (4-6), seven to eighteen (7-18), nineteen to twenty four (19-24), and twenty five to thirty (25-30) year periods respectively.

1 Cost Components

Labor and the material cost were considered separately in this study. The labor activities of the two crops were identified as land preparation, planting, weeding, manuring, mulching, sundrying, and harvesting.

Bark of the rubber tree cut with a specified length and depth to collect the latex. This is called tapping or harvesting. Tapping is normally done every other day by skilled laborers and it is the most labor-intensive work in the rubber plantations. Harvesting of the oil palm is carried out with the object of obtaining maximum quantity of oil. Under-ripe fruits contain less oil and therefore properly ripen fruits are selected and harvested. Due to many reasons, ripening takes place unevenly over the fruit bunch and, therefore, the harvesting cycle is varied from estate to estate. Generally, once-a-month harvesting has been practiced in the early stages with twice a month in the peak stages in many estates.

Considering the labor intensity of the harvesting, labor of harvesting was taken as a separate item and all other labor components were taken under the other field works in this study. Annual labor cost is given in man-days per hectare. Total expenditure of tools, machineries, fertilizer, pesticides, and planting materials were taken under material cost in Sri Lankan Rupees (Rs) per hectare (1US$ = 100 Rs). Total production cost and the labor utilization are given in Tables 1 and 2, respectively.

2 Prices and Wage Rate

Agricultural wage rate, and the FOB prices of rubber and oil palm were given in Table 3. Changing pattern of the wage rate and FOB prices were studied in order to understand the possible impact of these two factors on the new trend in the rubber plantations. FOB price is given in US$ per metric ton and the wage rate is given in Rs per day.
3 Returns

Average returns of the rubber and oil palm were estimated during the periods of 1995-1999, where the price has drastically decreased. Returns were estimated during the period of 1990 to 1994 for a comparison. Long-term average return (during the period of 1990 to 2000) was estimated to identify the long-term trend. Average FOB prices and the NPV estimates are given in Table 4.

Table 3 Agricultural Wage Rate and the FOB Prices of Rubber and Oil Palm

<table>
<thead>
<tr>
<th>Year</th>
<th>Wage rate Rs</th>
<th>Change (%)</th>
<th>Rubber price $/mt</th>
<th>Change (%)</th>
<th>Oil palm price $/mt</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>48</td>
<td></td>
<td>886</td>
<td></td>
<td>290</td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>52</td>
<td>8</td>
<td>836</td>
<td>(6)</td>
<td>339</td>
<td>14</td>
</tr>
<tr>
<td>1992</td>
<td>62</td>
<td>16</td>
<td>859</td>
<td>3</td>
<td>394</td>
<td>14</td>
</tr>
<tr>
<td>1993</td>
<td>72</td>
<td>14</td>
<td>919</td>
<td>7</td>
<td>378</td>
<td>(4)</td>
</tr>
<tr>
<td>1994</td>
<td>83</td>
<td>13</td>
<td>1048</td>
<td>12</td>
<td>528</td>
<td>28</td>
</tr>
<tr>
<td>1995</td>
<td>83</td>
<td>0</td>
<td>1549</td>
<td>32</td>
<td>628</td>
<td>16</td>
</tr>
<tr>
<td>1996</td>
<td>95</td>
<td>13</td>
<td>1443</td>
<td>(7)</td>
<td>531</td>
<td>(18)</td>
</tr>
<tr>
<td>1997</td>
<td>95</td>
<td>0</td>
<td>1279</td>
<td>(13)</td>
<td>546</td>
<td>3</td>
</tr>
<tr>
<td>1998</td>
<td>115</td>
<td>17</td>
<td>1048</td>
<td>(22)</td>
<td>671</td>
<td>19</td>
</tr>
<tr>
<td>1999</td>
<td>115</td>
<td>0</td>
<td>763</td>
<td>(37)</td>
<td>436</td>
<td>(54)</td>
</tr>
<tr>
<td>2000</td>
<td>115</td>
<td>0</td>
<td>883</td>
<td>14</td>
<td>310</td>
<td>(41)</td>
</tr>
</tbody>
</table>

Notes: 1) Ratio changes have compared with previous year.  
2) Values given in parentheses indicate price decrease.  

4 Environmental Benefit

There are many crop related environmental concerns like soil erosion, nutrition losses, water table depletion, and ability of carbon sequestration etc. It is difficult to focus on all concerns due to the lack of data. Carbon sequestration values of the both crops were taken as the environmental benefit of the rubber and oil palm in this study.

5 Carbon Sequestration

The concentration of carbon dioxide (CO₂) and other greenhouse gases (GHG) in the atmosphere has significantly increased over the past century and is set to rise further. The increase in CO₂ could have some negative impacts like global warming (Paustinet at. el., 2000; Albrecht and Kandji, 2003).
Significance of agro forestry in terms of carbon sequestration and other CO₂ mitigating effects is being widely recognized. Agro forestry is defined as any land-use system that involves the deliberate retention, introduction of a mixture of trees or other woody perennials with agricultural crop (Albrecht and Kandji, 2003). As the both rubber and oil palm are perennial tree crops, their role is vital in this context.

According to the website of ecosystem valuation (www.ecosystemvaluation.org/cost avoided.htm) and Kulshreshtha et al., (2000) damage cost avoided method assumes that the cost of avoiding damages provides useful estimates of the value of ecosystem or services. According to the damage-avoided method, carbon sequestration of the green plants provides an environmental benefit as this helps to avoid the cost of carbon cleaning techniques. Therefore, the environmental benefit could be defined as, (Quantity of carbon sequestration) x (monetary value of a carbon unit).

Different monetary values could be found for the carbon in the literature. According to the website of the department of energy in US (www.fe.doe.gov/coalpower/sequestration/index.shtml), the cleaning cost of carbon is in the range of US $100 to $300 under the present technology. Moreover, there is a market value for the carbon in the Global carbon market. Haites (2002) has studied about the development of the global carbon market. According to his study, Global carbon market behavior shows a price range of $2 to 9.50, and the countries like some member states of the European union, United Kingdom, Canada, Japan, and Russia are engaged in the carbon market. Considering the cleaning cost and the market value of carbon, real market value was applied as the monetary value of carbon in this study. The lowest market value of carbon, i.e., the $2/mt, was selected in order to find the significance of the environmental benefit even under the very low prices of carbon. Estimated environmental benefit of carbon sequestration and the sequestration rates of rubber and oil palm are given in Table 5.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Rubber Quantity (mt/ha/year)</th>
<th>Rubber Benefit (Rs/ha/year)</th>
<th>Oil palm Quantity (mt/ha/year)</th>
<th>Oil palm Benefit (Rs/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature</td>
<td>8.0</td>
<td>1600</td>
<td>1.1</td>
<td>220</td>
</tr>
<tr>
<td>Low yield</td>
<td>14.8</td>
<td>2950</td>
<td>4.5</td>
<td>900</td>
</tr>
<tr>
<td>High yield</td>
<td>17.6</td>
<td>3520</td>
<td>9.5</td>
<td>1900</td>
</tr>
<tr>
<td>Stable Yield</td>
<td>15.5</td>
<td>3100</td>
<td>8.3</td>
<td>1660</td>
</tr>
<tr>
<td>Low yield</td>
<td>14.1</td>
<td>2820</td>
<td>5.0</td>
<td>1000</td>
</tr>
</tbody>
</table>

Note: Monetary value of the carbon is taken as $2/mt (1$=100Rs).

Source: Hartley (1988); Webster and Baulkwill (1989).

III Discussion

Table 1 shows that the composition of the material and labor costs of rubber and oil palm are almost similar numbers in the immature stage. In the mature stages, labor cost percentage is around 80% of the total cost in the case of rubber. It is around 50% in the case of oil palm.

In the four mature stages, the average total labor requirement of rubber is higher than that of oil palm. Around 82% of total labor is required for the tapping in the case of rubber, and only 18% of labor consists of the other field works. Even in the low yield stages, this labor composition remains the same. In the case of oil palm, around 40% of the labor is required for the harvesting.
In the four mature stages, around 280 workers/ha/year are required for rubber production on average. It is around 100 workers in the case of oil palm. Therefore, the total labor requirement of rubber is relatively higher than that of oil palm. Around 230 average workers/ha/year is required for the tapping in rubber plantations. It is around 40 workers for oil palm harvesting. For the other field works, on an average around 50 workers/ha/year is required in the case of rubber and it is around 65 workers in the case of oil palm. Tapping is normally done every other day in rubber cultivations. Oil palm is normally harvested in once a month, but it is a twice a month frequency in peak yield stages. When consider the frequency of harvesting pattern, the tapping labor requirement is considerably higher in the rubber plantations than the harvesting labor requirement of oil palm.

Table 3 shows that the agricultural wage rate has gradually increased since 1990. The increase was 16% in 1992, and 17% in 1998 compared to the respective previous years. The present daily wage rate is 126 Rs, and this is around 10% increase compared to the previous year. Therefore, the labor cost has been affected by this wage rate increase. Impact of this increase on rubber is higher than that of oil palm due to the higher labor requirement of rubber.

Furthermore, Table 3 shows that there is a positive trend of the price fluctuation of rubber during the period of 1990 to 1995, except for 1991. It also shows a continuous decrease of the price during the period between 1995 and 1999. In fact, this is the period where a considerable decline in the world rubber prices was recorded because of the South East Asian financial crisis. According to Burger and Smith (2001), the economies of key players in the natural rubber market both on the demand and supply sides were severely affected due to the South East Asian crisis.

Furthermore, Table 3 shows that there was a price decrease of oil palm only in 1993 compared to the previous year during the period of 1990 and 1994. After 1995, the changes of price are (-18%) in 1996, 3% in 1997 and 19% in 1998 compared to the respective previous years. Also the table shows a huge decrease of the oil palm prices in 1999 and 2000.

During the period of 1995 and 2000, price decreases of rubber are (-7%) in 1996, (-13%), in 1997, (-22%) in 1998, and (-37%) in 1999, compared to the respective previous years. The price decrease pattern of rubber is, therefore, greater than that of oil palm between 1995 and 1998. This is the period where the changing from rubber to oil palm has taken place.

NPV estimates (Table 4) indicate that the overall long-term return of rubber is higher than that of oil palm at a low interest rate of 3% during the period of 1990 to 2000. The return of rubber is high at a low interest rate even during the period of 1995-1999, where the price has drastically decreased. However, from the private entrepreneurs point of view (measured at higher interest rate of 11%) on an average benefit of oil palm is higher than that of rubber.

The facts, therefore, emphasize that the crop changing in the rubber plantations had occurred due to the factors like higher tapping labor requirements of rubber, wage rate increase and its impact on labor cost, drastic price change and the high returns of oil palm from the view point of entrepreneurs.

According to Table 5, the average carbon sequestration of rubber is around 8 metric ton/ha/year in the immature stage. This is around 7 times higher than the amount sequestrated by oil palm in the same stage. In the first and last periods of the mature stages, the sequestration amount of rubber is almost three times higher than that of oil palm. In the periods of high and stable yield stages, this amount of rubber is almost two times higher than that of oil palm. Therefore, rubber farming has a considerable environmental advantage compared to the oil palm in terms of carbon sequestration. Hence, rubber can be considered as a more environmental friendly farming avenue.
IV Concluding Remarks

Labor cost of harvesting of rubber is higher than that of oil palm and wage rate continue to increase. A continuous decrease of the world price of rubber was observed during the period of South East Asian financial crises. Furthermore, the return of oil palm is higher than that of rubber from the entrepreneurs’ point of view. All these factors seem to have encouraged private entrepreneurs to move away from rubber to oil palm. However, overall long-term benefit and environmental contribution of rubber in terms of carbon sequestration is higher than that of oil palm. Further research on policy measures to attract entrepreneurs on rubber farming would, therefore, useful to certify the sustainability of the plantation sector in Sri Lanka.

References