論　文

The Profitability of Eucalyptus Farm Forest in Northeast Thailand

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タイ東北部におけるユーカリ農家林経営の収益性

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The Profitability of Eucalyptus Farm Forest in Northeast Thailand: Recently Eucalyptus farm forest has rapidly expanded in Thailand, especially in eastern and northeastern regions. This research analyzed the recent change in profitability between Eucalyptus planting and cassava cultivation, by focusing on changes in production prices, factor prices and factor costs. Two sources, a 1994 reference survey on the profitability of Eucalyptus and cassava in the northeast region, and a field survey on farm forest management conducted in 1996, were analyzed. First, it was found that Eucalyptus farm forest provided labor savings for farmers. Second, the decreasing trend in the cassava farm gate price from the mid 1980s to early 1990s improved the relative profitability of Eucalyptus planting.
Key words: Northeast Thailand, Eucalyptus, Farm Forest, Profitability

近年タイでは農家によるユーカリ林業経営（農家林経営）が東部や東北部を中心に急速に広まっている。本研究では、東北部における1994年のユーカリ・キャッサバの費用・収益に関する文献資料と、1996年に行った農家林経営に関する聞き取り調査をもとに、要素費用と生産物価格の変化に着目して、近年のユーカリ農家林経営とキャッサバ耕作との収益性の比較を行った。ユーカリ農家林経営は農家にとって労働節約的な経営であること、80年代後半から90年代前半にかけてのキャッサバ庭先価格の相対的下落が、ユーカリの収益性を相対的に改善したことが明らかとなった。
キーワード：タイ東北部、ユーカリ、農家林、収益性

1 Introduction: Expansion of Eucalyptus farm forest in Thailand

Recently the area under farm forest has rapidly expanded in Thailand, even though Thailand has experienced serious deforestation since 1960s. The expansion in northeast region is one of the most recent and drastic examples. NAGATA and KONO (1996) estimated that approximately 550,000 rai (1 rai = 0.16ha) of Eucalyptus private forest, of which farm forest is considered the largest part, was established between 1991 and 1996 in northeast. This figure; 110,000 rai per year, is more than the annual forest depletion in this region during 1991 and 1993.

Eucalyptus (*Eucalyptus camaldulensis*) is mainly used for pulp, construction poles, furniture and wood chips in Thailand. It has been in the spotlight since the late 1980s, in accordance with the price hike of pulp product in both domestic and international markets. The government has also promoted Eucalyptus planting to replace various agricultural crops, which have been facing marketing problem (such as cassava), for structural adjustment in the agricultural sector.

From the farmer's point of view, it is quite natural to say that a change in terms of profitability may affect a change in agricultural crops. Some researches analyzed profitability of Eucalyptus plantation and that of cassava, the most competitive crop with Eucalyptus.

First, based on a field survey in eastern region,

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MAKARABHIROM (1994) suggested that Eucalyptus was more profitable than cassava under the 12% discount rate. However, whether a research in eastern region is adaptable to the northeastern region remains in question. In addition, detailed data (especially factor costs) on cassava production were not presented in the analysis.

Taking a theoretical approach, a Finnish group pointed out that profitability of Eucalyptus was higher than that of cassava under the 12% interest rate, although the market interest rate (18%) changed in order (NISKANEN, et.al., 1993). However, because of lack of field survey, the research of Finnish group used estimated data in calculation, some part of which did not reflect field data. For instance, it used optimum rotation period (8 and 10 years for pulpwood and sawlog production in farm forest, respectively), while the most farmers cut and sold the trees within 5 years. Besides, the reason why farmers in northeast region eagerly planted Eucalyptus, especially during the early 1990s, was not analyzed since the old data (basically during 1980s) was used.

To date, few researchers analyzed the factors affecting the change of the relative profitability between Eucalyptus planting and cassava cultivation in northeast Thailand. In addition, factor cost efficiency and recent trends in factor costs, that took further account of farmer's decision-making behavior, were not calculated in the previous research. Therefore, to provide explanations for recent expansion of Eucalyptus farm forest management in northeast region, this research aims to discuss the factors affecting recent change in profitability between Eucalyptus farm forest and cassava cultivation, by focusing on changes in production prices, factor prices and factor costs.

2 Methodology and Data Source

2-1 Methodology

First, based on references and interviews, the farmer's management of Eucalyptus farm forest is described, and the production costs of Eucalyptus planting are compared with that of cassava cultivation.

Second, financial analysis is presented to measure profitability. The following indices are calculated.

Net Profit (NP) and Net Present Value (NPV)

Production costs here are defined as variable costs, which are basically categorized into three parts; labor, material and others. This includes non-cash costs (e.g. unpaid family labor, materials not purchased). For cassava cultivation, revenue is calculated by multiplying farm gate price (Baht/kg; 1 Baht = US$0.4, in 1996) by the amount of production (kg/rai). Then based on production cost and benefit, Net Profit (NP) is calculated by revenue minus costs. Since Eucalyptus is a perennial crop, Net Present Value (NPV) is used to determine the discounted profit by time. It is calculated by the following formula.

$$NPV = \sum_{i=1}^{n} \frac{NP_i}{(1+r)^i}$$

Where,

NP_i = NP in year i, i = 1, 2, 3,..., n

r = interest rate

Annual Net Profit (ANP)

Since cassava is generally regarded as an annual crop in Thailand, NPV of Eucalyptus should be modified into annual terms so that it can be compared with the NP of cassava cultivation. Regarding Revenue in each year as constant, Annual Net Profit (ANP) of Eucalyptus planting is calculated by the following formula.

$$ANP = \frac{NPV}{\sum_{i=1}^{n} (1+r)^{-i}}$$

Benefit cost ratio (B/C-R)

Benefit cost ratio (B/C-R) is used to analyze the cost efficiency of the investment. It is calculated by dividing the discounted cost into discounted revenue (benefit). For cassava cultivation, cost and revenue are not discounted by time. In the same manner, "benefit per labor cost" (B/LC) and "benefit per material cost" (B/MAC) are defined to see the efficiency in terms of labor cost (LC) and material cost (MAC).

Internal Rate of Return (IRR)

Choosing a discount rate is one of the problems in profitability analysis of investment. Using the Internal rate of return (IRR) can avoid it. This gives the rate that NPV of the investment is equal to zero. However, it is not zero value of money but net profit of cassava that profit from Eucalyptus planting should be compared with. Thus "the discounting rate that offers equivalent return with net profit of cassava" (IRRe = c) is defined and calculated.

Sensitivity analysis

In analysis, Four discount rates are used; 0%, 5%, 10%, and 15%. The latter three discount rates represent recent saving rate, 12 months deposit rate, and lending rate in recent Thailand, respectively (Asian Development Bank, 1996). Each result is compared with that of cassava cultivation.

As shown in Figure 1, farm gate price of cassava (real value) has fluctuated, while mill gate price of Eucalyptus (real value) has been rather constant. Some forms of time series analysis are necessary to analyze its impact on Eucalyptus planting behavior. However, lack of data source does not allow such analysis. Thus we calculated the real farm gate price of cassava that offers equivalent net profit to Eucalyptus planting ($P_{e=c}$), provided that cost and production are constant across time (Calculated by the following formula).

$$P_{e=c} = \frac{ANP_e + C_c}{X_c}$$

Where,

ANP_e = Annual Net Profit of Eucalyptus

C_c = Production cost of cassava (variable cost is used)

X_c = Amount of cassava production per rai

Results are compared with average farm gate price of cassava (real value). If this index is higher than the average farm gate price, Eucalyptus offers better profits in the longer term.

Changes in the factor prices

Change in the factor prices such as wage and material prices also plays an important role in profitability change. Recent changes in factor prices, such as agricultural wage and seedling price for Eucalyptus farm forest, are described and discussed

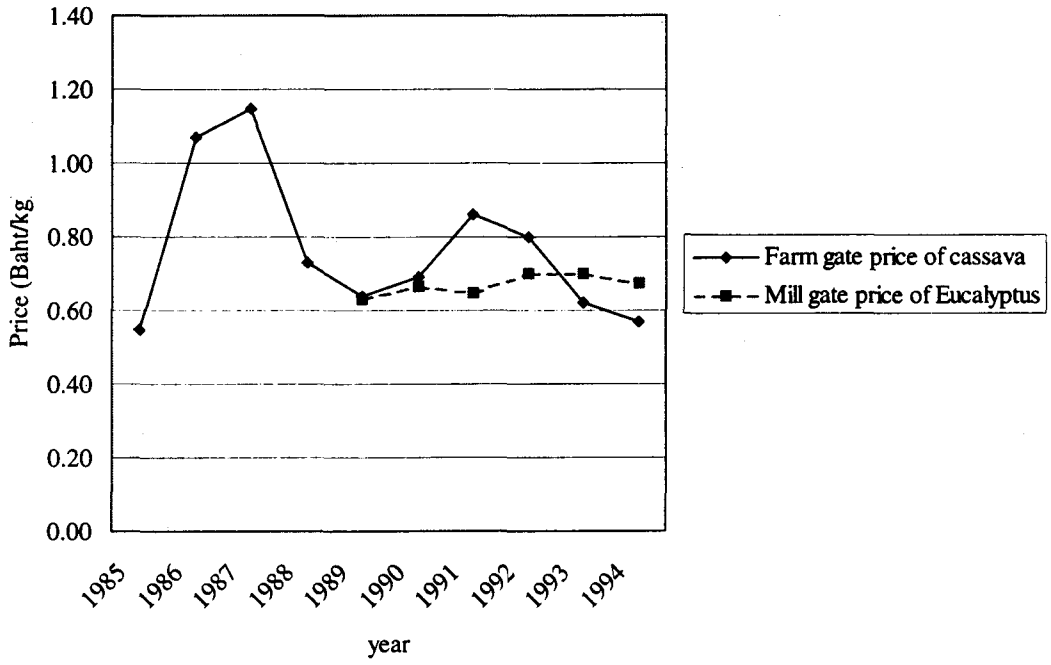

Figure 1: The Price Trend of Eucalyptus and Cassava (Base year: 1994)
Note: Standardized by WPI. Source: Agricultural Statistics of Thailand Crop Year 1994/95, SONGANOK, 1994,
Asian Development Bank, 1996.

on the basis of field interviews.

2-2 Data Source

Data was collected from two sources, references on profitability of Eucalyptus and cassava in the northeast region, and a field survey in Kosum Pisai district, Mahasarakham province.

From reference, information on cost and revenue of both Eucalyptus planting and cassava cultivation was obtained. On Eucalyptus farm forest, SONGANOK's survey in 1994 was used, since it is currently the most reliable data that can be compared with that of cassava (SONGANOK, 1994). For cassava cultivation, data concerning production costs in the northeast region in the crop year 1993/1994, from office of agricultural economics was used (Office of Agricultural Economics, 1994).

Field survey was conducted in the southern part of Kosum Pisai district, Mahasarakham province in 1996. This district is located in the southeast of Khon Kaen city, which is one of the central cities in this region (Fig. 2). Since there are accessible markets around this area; construction pole and raw materials for a pulp mill, Eucalyptus farm forest has rapidly expanded in this area. Socio-economic conditions were mainly surveyed in Ban Hua Na Kham village, while farmer's management on Eucalyptus farm forest was surveyed complementarily in several villages

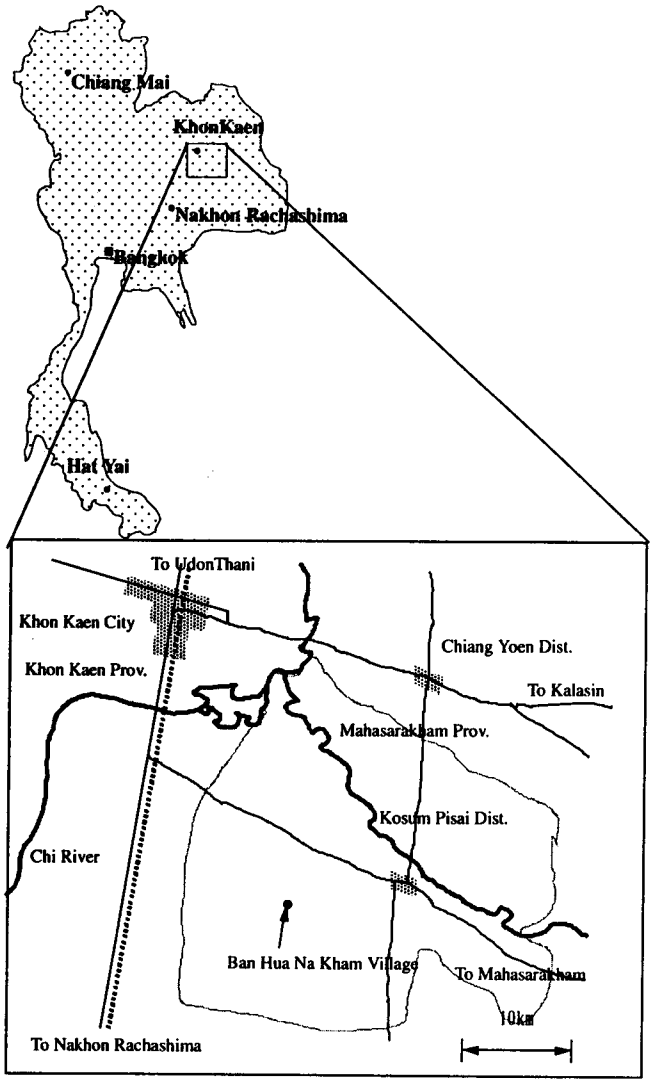

Figure 2: Kosum Pisai District, Mahasarakham Province
Note: Thin gray lines, thick doted lines, thin lines and shadowed area represent border of the district, railway, main roads and urban area, respectively.

including Ban Hua Na Kham village.

3 Result and discussion

3-1 Management and cost of Eucalyptus farm forest

First, interviews give the following insight into the management of Eucalyptus farm forest.

Ploughing and planting is operated during the rainy season. After a certain amount of rainfall, ploughing is operated by using water buffaloes or power tillers. Planting immediately follows after ploughing. Spacing is varied among farmers, while 2 × 2m (400 seedlings per rai) is generally recognized.

Operations after planting recommended by Royal

Table 1: The Production Cost of Eucalyptus and Cassava (Baht/rai, %)

Items		Eucalyptus 13 years		Cassava 1 year	
Factor Costs		Cost	Share(%)	Cost	Share(%)
Labor Cost	Ploughing	135.61	12.57 (28.59)	248.87	21.93 (26.85)
	Planting	129.32	11.99 (27.26)	114.99	10.13 (12.40)
	Maintenance before Harvest	112.98	10.47 (23.82)	278.30	24.52 (30.02)
	Harvest (Felling)	0.00	0.00 (0.00)	248.78	21.92 (26.84)
	Maintenance after Harvest	96.42	8.94 (20.33)	36.08	3.18 (3.89)
Labor Cost in Total		474.33	43.97 (100.00)	927.02	81.69 (100.00)
Material Cost	Seed (Seedling)	438.24	40.62 (83. 55)	57.15	5.04 (54.25)
	Fertilizer	51.60	4.78 (9.84)	42.36	3.73 (40.21)
	Pesticide and Weed Killer	4.52	0.42 (0.86)	0.00	0.00 (0.00)
	Agricultural Tools, etc.	30.18	2.80 (5.75)	5.84	0.51 (5.54)
Material Cost in Total		524.54	48.62 (100.00)	105.35	9.28 (100.00)
Others	Maintenance of Agricultural Tools	0.00	0.00 (0.00)	2.51	0.22 (2.45)
	Interest etc.	79.91	7.41 (100.00)	99.97	8.81 (97.55)
Others in Total		79.91	7.41 (100.00)	102.48	9.03 (100.00)
Total Cost		1078.78	100.00	1134.85	100.00

Notes

1: Data in 1994. Source: SONGANOK, 1994 and Office of Agricultural Economics, 1994.

2: The production cost of Eucalyptus is an average for the northeast region. SONGANOK's data on Eucalyptus is based on field survey of 40 households in the northeast region (total cost for 13 years).

3: For Eucalyptus, cost on maintenance before harvest is the total in the 1st and 2nd years (93.21, 19.77 Baht, respectively). Cost on maintenance after harvest is the total in the 5th, 8th and 11th years (43.98, 38.36, 14.08 Baht, respectively).

4: Cost share means cost share in total cost (%), while cost share in parentheses means cost share in factor costs (%).

Forest Department include annual weeding and fertilizing. However, interviews showed that 11 out of 20 farmers used fertilizer only during planting. 5 farmers did not use fertilizer at all. For weeding, 5 out of 10 farmers said that they did not weed after planting. They perceived that weeding was not necessary on the Eucalyptus farm forest.

The rotation period of 3-5 years is shorter than the recommended 5 years. Then the stand is sold to a middleman through negotiation. As price per stand is generally recognized, felling is operated by a middleman. Regeneration is based on coppice regeneration, 4-5 shoots per stump are left, while other shoots are cut.

These results highlight the labor-saving aspect of Eucalyptus farm forest management. This hypothesis is checked in Table 1 by comparing Eucalyptus and cassava in terms of production cost per rai. The amount and the share of the cost are presented.

First, even though production cost of Eucalyptus considers 13 years of operation (4 years for 1st rotation, 3 years thereafter), it is lower than annual production cost of cassava. Second, cassava cultivation requires higher labor costs, both in terms of share and amount, than Eucalyptus planting, while the order changes in terms of material cost. Provided that wage rate is 50-60 Baht per day, the amount of labor that cassava cultivation requires is 15.5-18.5 man-days, while 7.9-9.5 man-days are required for Eucalyptus. Thus we can conclude that Eucalyptus planting has cost-saving and labor-saving aspects for farmers.

3-2 Profitability of Eucalyptus farm forest in northeast region

Table 2 shows profitability of Eucalyptus planting and cassava cultivation in the northeast region in 1994. All results on ANP, B/C-R, and B/LC indicate that Eucalyptus is higher and more profitable. IRR and $IRR_{e=c}$ also indicate better profitability for Eucalyptus planting. However, for B/MAC, Eucalyptus is higher only under the 0% and 5% discount rate. The remarkable differences between B/LC and B/MAC indicate the labor-saving nature of Eucalyptus planting.

Results on $P_{e=c}$ are compared with average farm gate price of cassava (real value). Average farm gate price during 1985-1989, 1990-1994 is 0.83, 0.71 Baht/kg, respectively. Under the 0%, 5% and 10% discount rate, $P_{e=c}$ became higher than 0.71, the average farm gate price of cassava during 1990-1994, because of fall in cassava price. Even under the 15% discount rate, the difference dramatically narrowed to only 0.02 Baht/kg. This indicates that Eucalyptus gained its competitiveness against cassava during this period because of the relative fall in cassava farm gate price.

3-3 Recent changes in the factor prices in Kosum Pisai District

Factor prices, as well as production prices, are important signals affecting farmer's decision-making behavior. Considering the difference in factor costs between Eucalyptus planting and cassava cultivation, (see Table 1), recent trends of wage and material costs are clearly important.

According to the interviews in Kosum Pisai district, many people of the younger generation had moved to work in the urban sector, especially during the early 1990s. Wage hikes also started in this period. Agricultural wages increased from 50 baht/day in 1993 to 100 baht /day in 1996. It is likely that the combined effects of the wage increase and the labor shortage, contributed to an increase in Eucalyptus as it is regarded as a labor-saving crop.

In contrast, seedling price was around 1 baht/seedling during 1990s. Assuming that the farmers did not change the tree spacing, seedling costs, which are the highest portion of the material costs for Eucalyptus planting, remained stable. Or if we consider the inflation rate (annual rate is around 4-5% during 1990 to 1995), seedling costs decreased around 20% within 5 years. In addition, one of the forest extension projects was initiated in 1992 near the study area. Some farmers could get certain numbers of seedlings from the project free of charge. Figure 3 shows that 29% of respondents had received Eucalyptus seedlings from the government agencies. Although this figure needs to be considered cautiously due to the small sample size, it suggests that relatively large number of farmers may benefit from government agencies in this area. Thus the constant (or decreasing

Table 2: The Profitability of Eucalyptus and Cassava (Baht/rai, 1994)

	Cassava (r= 0%)	Eucalyptus (r = 0%)	Eucalyptus (r = 5%)	Eucalyptus (r = 10%)	Eucalyptus (r = 15%)
Revenue	1218.66	9745.73	6478.65	4502.31	3251.20
Cost	1034.88	998.87	927.23	868.91	819.93
NP	183.78	8746.86	5551.42	3633.40	2431.27
ANP	183.78	672.84	590.98	511.50	435.47
B/C-R	1.18	9.76	6.99	5.18	3.97
B/LC	1.31	20.55	15.15	11.48	8.94
B/MAC	11.57	18.58	12.97	9.44	7.13
Pe=c (Baht/kg)	n.a.	0.80	0.76	0.72	0.69
IRR (%)	n.a.	53.26	53.26	53.26	53.26
IRRe=c (%)	n.a.	34.30	34.30	34.30	34.30

Notes

1: Calculation is based on data in Table 1 and note 2 in Table 2. In cost calculation, cost on "interest etc." is excluded. Revenues and costs are also discounted by the discount rate. As cassava is usually harvested within a year (around 7-12 months), no discount rate is used for it.

r = Discount rate, n.a. = Not available

2: The farm gate price of cassava in Thailand, and the amount of production per rai in the northeast region are, 0.57 Baht/kg (Agricultural Statistics of Thailand Crop Year 1994/95), and 2138 kg/rai (Office of Agricultural Economics, 1994), respectively in 1994. The revenues of Eucalyptus are, 2374.23, 2331.4, 2340.1, and 2700 Baht/rai, for the 4th, 7th, 10th and 13th years, respectively (SONGANOK, 1994).

3: The results are different from SONGANOK's analysis, although the data sources described in SONGANOK's article are used. For example, under the 10% interest rate, NP, ANP, B/C-R, and IRR of Eucalyptus is 3636.91, 512.80 Baht, 5.20 and 53.42%, respectively in SONGANOK's analysis. Although Such differences may reflect slight differences in definitions of calculation, they are almost negligible.

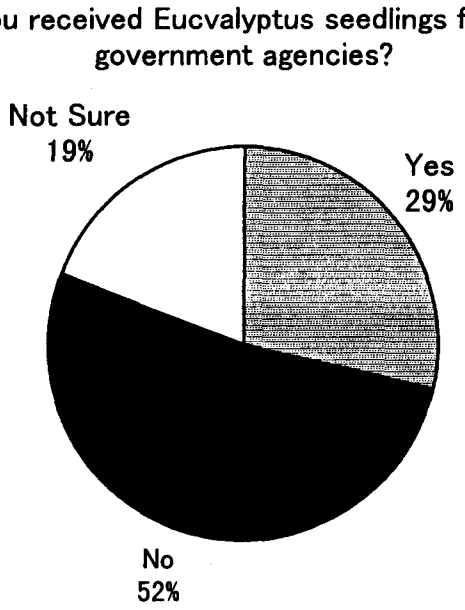

Figure 3: The farmers who received Eucalyptus seedlings from the government agencies
Note: Based on interviews from 21 farmers in Kosum Pisai District, Mahasarakham Province.

in real value) trend of seedling costs, and the extension project might also contribute to reduce material costs of Eucalyptus planting in this area.

Clearly, the changes in the factor prices and costs during the early 1990's were favorable for Eucalyptus planting in Kosum Pisai district.

4 Conclusion

First, it was found that Eucalyptus farm forest management had labor-saving aspects for farmers. Its labor productivity was much higher than that of cassava. This might help to improve profitability of Eucalyptus in some area where the labor wage increased and material price decreased. Second, it was found that the decreasing trend in cassava prices from the mid 1980s to early 1990s had improved the relative profitability of Eucalyptus planting when compared to cassava.

Field interviews provided useful information that imply a relationship between Eucalyptus planting and rural socio-economic change. Nevertheless profitability alone does not account for this relationship. In addition, new trends of rural socio-economic change may occur as a consequence of the 1997 economic crisis. More detailed field surveys would extend the current analysis, provide insight into the effects of recent economic crisis, and provide baseline information for future studies.

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