Comparative Study of Large-scale Investment in Plantation in Least Developed Countries Applying the Investment Profitability Analysis Model

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Abstract: This paper focuses on large-scale investment in natural rubber plantation in least developed countries, analyzing three types of investment in natural rubber primary processing factory, contract farming, and large-scale estate from the aspects of enterprise management, technology diffusion, and financial resource mobilization, and explains features of business management using the investment profitability analysis model.
Key words: Natural rubber; Investment profitability analysis model; Technology diffusion; Financial resource mobilization; Least developed countries

1 Introduction

Natural rubber is used to make a wide range of products, from tires, to shoe soles and medical gloves. Approximately 70% of the primary processed natural rubber is used to produce automobile tires, and consumption has been increasing due to the growth of the automobile industries. The main plantation areas of natural rubber are in Asian countries, particularly Thailand, Indonesia, and Malaysia. In 2008, these three countries accounted for 67.7% of the world's primary processed natural rubber production of 10.6 million tons.

The international market price of natural rubber has been on a continuous uptrend due to the increase in its demand. Natural rubber presents important issues both for advanced countries, securing stable supplies, and for least developed countries, expanding industry as a main export. In recent years, natural rubber planting and cultivation in least developed countries in the Mekong sub-region such as Cambodia, Myanmar, and Laos has been getting increased attention as new sources of supply [1)].

This paper focuses on large-scale investment in natural rubber plantation in least developed countries. Some studies on large-scale natural rubber plantation, such as IDE (1961)[1], Fukasawa (1968)[2] Hirashima *et.al* (1989)[3] focused on natural rubber in Thailand, Indonesia, and Malaysia in the 1980's, and mainly analyzed the enterprise behavior relative to the price fluctuation of natural rubber. This study focuses on natural rubber industries in Cambodia, Myanmar, and Laos today, and analyzes the business management of large-scale natural rubber plantation using the investment profitability analysis model.

2 Method

First, the production methods of natural rubber and primary processed products are explained. Second, business models of natural rubber industries are categorized from the view point of business types and the industrial structure is clarified. Third, comparative analysis among large-scale investment of natural rubber plantation, 1) natural rubber primary processing factory, 2) contract farming, and 3) large-scale estate is made from the viewpoints of 1) enterprise management, 2) technology diffusion, and 3) financial resource mobilization. Fourth, features of business management of large-scale plantation are analyzed using the investment profitability analysis model.

3 Results

3.1 Natural rubber primary processing typology

The production process of natural rubber in the primary processing stage is as follows. Rubber sap is harvested from a tree trunk in either liquid form "Field Latex" or solid form of "Cup Lump". The harvested natural rubber is shipped to rubber primary processing factories, either directly or after processing to un-smoked sheet (USS). A natural rubber primary processing factory fabricates three types of commodities: 1) Condensed Latex, a liquid form with high natural rubber content, fabricated by centrifuging field latex, 2) Ribbed Smoked Sheet (RSS), a sheet form fabricated by the rolling and smoking of solid natural rubber, and 3) Technically Specified Rubber (TSR), a block rubber washed, crumbed, and heat dried.

The natural rubber industries of Cambodia, Myanmar, and Laos have long histories. However, because of colonization in the 19th century and political instability in the 20th century, they have been developed along different historical paths. In Cambodia, TSR is the main product and it is manufactured by large-scale estates. In Myanmar, RSS is the main product and it is manufactured by estates and primary processing factories. In Laos, unprocessed Cup Lump is exported by small holders.

3.2 Categorizing the natural rubber business type

Table 1 categorizes the business types of natural rubber industry. Plantation sizes up to 100 acres, or approximately 40 hectors is generally categorized as a "Small holder" and over 100 acres as "Estate". An "Estate" that owns a primary processing factory is defined as "Large estate" in this table.

The table separates agricultural process and manufacturing process. Agricultural process is subdivided in terms of land as capital goods, input goods of seed and seedling, and labor force of cultivation, tapping, making un-smoked sheet (USS), and primary processing. Buildings, machinery, equipment and apparatuses as capital goods, input goods of fertilizer, and labor forces for reclamation and plantation are assumed to be procured from third parties.

3.3 Comparative study of the features of large-scale investment of natural rubber plantation

Table 2 shows the features of large-scale investment of natural rubber plantation, 1) natural rubber primary processing factory, 2) contract farming (2+3 system) [2)] , and 3) large-scale estate from the viewpoints of 1) enterprise management of investors, 2) technology diffusion to small holders, and 3) financial resource mobilization by small holders.

The investment amount for a natural rubber primary processing factory (land, factory building, machinery, and equipment) is only a few million US dollars. The primary processing factory has the advantage to save the investment amount compared with other types of investment from the viewpoints of the enterprise management of investors. In the case of Thailand, natural rubber is planted and cultivated mainly by small holders, and primary processing factories are able to procure natural rubber and sale their primary processed products at international market prices. The risk of the primary processing factories is lower than that of the other types of investment. However, this business model is not successful in the lower developed countries. For example, in Cambodia, some primary processing factories that have been established have two big problems. One is the technology diffusion to the small holders. Cup lump from the small holders includes contaminants such as stones, sands, vinyl, and metal. These contaminants are difficult to eliminate through the washing process at the primary processing factory. This leads to a higher rate of defective products. The other big problem is difficulty in terms of financial resource mobilization for natural rubber planting and cultivation by the small holders. Primary processing factories have difficulty collecting natural rubber from the small holders, so the business model is fails.

Table 1 Categories of Natural Rubber Business Types

Business type		Agricultural process				Manufacturing process	
		Capital goods	Input goods	Labor force		Labor force	
		Land	Seed/ Seedling	Cultivation	Tapping	USS	Processing
Small holder	1) Farmer (natural rubber)	Owned	Purchased	In-house	In-house	-	-
	2) Farmer (natural rubber and USS)	Owned	Purchased	In-house	In-house	In-house	-
	3) Contract farming '2+3 system'	Owned	Supplied	In-house	In-house	-	-
	4) Commissioned cultivation	Owned	Purchased	Commissioned	Commissioned	-	-
Estate	5) Estate (natural rubber)	Owned	Purchased	Commissioned	Commissioned	-	-
	6) Estate (natural rubber and USS)	Owned	Purchased	Commissioned	Commissioned	Employed	-
	7) Large estate	Owned	In-house	Employed	Employed	Employed	Employed
	8) Concession	Leased	In-house	Employed	Employed	Employed	Employed
Factory	9) Primary processing factory	-	-	-	-	Employed	Employed
	10) Consigned processing	-	-	-	-	Employed	Employed

The investment amount for a contract farming (2+3 system) investor is low composed only of that for seeds and seedlings, fertilizer, medicine, and the factory from the viewpoints of the enterprise management of the investor. This type of business is increasing in the way of strategic alliance between foreign investors and farmers in Laos. However, there are still risks for both investors and farmers. In the lower developed countries, the institution of law is not fully established. This type of contract should include detailed provisions regarding the distribution of profits, the allocation of various future costs and the sharing of risk. Such types of contracts are complicated and legal resource in case of claims of breaches is not assured. Additionally, from the viewpoint of technology diffusion to farmers, technology transfer of disembodied technology related to planting and cultivation is not so easy. For all these reasons, secure supply of high-quality natural rubber remains unsolved issues.

The investment amount for a large-scale estate is over ten million US dollars from the viewpoint of the enterprise management by the investor. The risk related to the fluctuation of the international rubber price is high because of the difficulty of the production adjustment caused by the permanent employment for natural rubber sapping. On the other hand, the technology diffusion of natural rubber planting and cultivation to employees is easy and the securing stable supplies of high-quality natural rubber would be possible compared with other business types. This business model is gradually spreading all over Cambodia.

Table 2 Features of Large-scale Investment of Natural Rubber Plantation

Viewpoint	Primary processing factory	Contract farming (2+3 system)	Large-scale estate
Enterprise management by investors	- the investment amount is a few million US dollars - the risk related to the fluctuation of the rubber price is low	- the investment amount is limited within seeds and seedlings, fertilizer, medicine and the investment in the factory	- the investment amount is over ten million US dollars - the risk related to the fluctuation of the rubber price is high
Technology diffusion to small holder	- technology diffusion is difficult	- disembodied technology diffusion is not easy	- technology diffusion is possible
Financial resource mobilization by small holder	- financial resource mobilization is difficult	- financial resource mobilization is possible	- investors pay all the costs

3.4 The investment profitability analysis model of large-scale plantation

Table 3 Assumptions of parameters

	Item	Assumption
1	Acquisition cost of land	$500/ha
2	Cost of land reclamation	$700/ha
3	Cost of seed and seedling	$300/ha
4	Cost of planting and cultivation	$2,500/ha
5	Cost of processing	$120/ton
6	Maintenance cost of project area	$500/ha /year
7	Labor cost	$1,000/person/year
8	Construction cost of factory	$3,000,000
9	Number of employees working at the factory	400
10	Number of tappers	1 person/3ha
11	Start year of tapping	8^{th} year after the project starts
12	Productivity	1.5 tons/ha/year
13	Duration of investment	25 years

This paper applies an investment profitability analysis model to analyze the features of business management of large-scale plantation. In this model, the investor engaged in planting and cultivation of natural rubber and processed sapping natural rubber to technically specified rubber is assumed. Table 3 shows assumptions of the investment analysis model. In this model, parameters are based on current market prices in Cambodia. In this model, tapping will be started in the eighth year after the project started, and natural rubber will be tapped at 1.5 tons per hectare and technically specified rubber will be produced at 15,000 tons per year in the primary processing factory.

Table 4 shows assumptions of four investment profitability analysis models of large-scale plantation. No.1 is a basic model. No.2 is in the case of downfall of the selling price at the international market to see the impact of decrease in revenue. No.3 is in the case of a bigger project than No.1 to see

the profit of scale. No.4 is in the case of a conservative project that reduce planting amount in each year to see the effect of reducing investment amount in early stage. Table 5 shows the results of simulation applying the investment profitability analysis models.

Table 4 Assumptions for 4 Investment Profitability Analysis Models of Large-scale Plantation

	Item	No.1	No.2	No.3	No.4
1	Land	10,000ha	10,000ha	20,000ha	20,000ha
2	Planting area	2,500ha/year	2,500 ha/year	2,500 ha/year	1,000 ha/year
3	Planting duration	4 years	4 years	8 years	13 years
4	Sales price	$3,000/ton	$1,500/ton	$3,000/ton	$3,000/ton

Table 5 Results of Simulation Applying the Investment Profitability Analysis Models

	Item	No.1	No.2	No.3	No.4
1	Investment amount	$43m	$43m	$86m	$86m
	(Land)	($12m)	($12m)	($24m)	($24m)
	(Planting and cultivation)	($28m)	($28m)	($56m)	($56m)
	(Factory)	($3m)	($ 3m)	($6m)	($6m)
2	Surplus earned	8th years	8th years	9th years	9th years
3	Payback period	10 years	12 years	11 years	14 years
4	Sales (20th year)	$45m	$23m	$90m	$90m
5	Profit (20th year)	$39m	$17m	$79m	$79m
6	Maximum investment amount	$40m	$40m	$78m	$46m

The main results of the investment profitability analysis of large-scale natural rubber plantation are 1) features of investment costs, 2) features of profit and loss structure, 3) impact of decrease in revenue, 4) the profit of scale, and 5) effect of conservative investment.

Firstly, features of investment costs are 1) investment amount in the early stage is high, 2) weight of planting and cultivation costs are high among all investment amounts, and 3) weight of factory constructing cost is low among all investment amounts. Secondly, features of profit and loss structure are 1) no revenue will be earned in the first seven years, 2) surplus will be earned a few years after tapping starts, 3) term after surplus earned to payback period will be short, and 4) profit ratio will be very high beyond the payback period. Thirdly, regarding the impact of a decrease in revenue, the profitability would still be high if the international market price went down 50%. Fourthly, the profit of scale is small because of the labor intensive business. Fifthly, effects of conservative investment, reducing the amount of planting in each year, are 1) extension of the payback period and the reduction of total profit will be occurred, however, 2) total investment amount will be saved because of the profit earned will be able to reinvest for the remaining planting.

4 Conclusions

This paper explains methods for producing natural rubber and primary processed products, categorizes business model of natural rubber industries, and does comparative analysis of various types of large-scale investment in natural rubber plantation, 1) natural rubber primary processing factory, 2) contract farming (2+3 system), and 3) large-scale estate from the viewpoints of 1) enterprise management of investors, 2) technology diffusion to small holders, and 3) financial resource mobilization of small holders.

As a result, firstly, in the case of the natural rubber primary processing factory, the investment amount is relatively small and the risk associated with price fluctuation is low, on the other hand, the stable procurement of material, especially high grade natural rubber, from small holders is not easy to achieve because of difficulty in technology diffusion and financial mobilization. Secondly, in the case of the contract farming system (2+3 system), there is still contract risk for both investors and farmers due to the legal system and the way it is enforced. Moreover, procurement of high grade natural rubber is unstable because of difficulty in technology diffusion to farmers, especially disembodied technology related to the planting and cultivation. Thirdly, in the case of the large-scale estate, the investment amount is big and the risk related to price fluctuation is high because of the difficulty of the production adjustment caused by the permanent employment for natural rubber sapping, on the other hand, the technology diffusion of natural rubber planting and cultivation to employees is easy and the stable procurement of high grade natural rubber in is possible.

The investment profitability analysis model reveals the following features of the structure of large-scale plantation, 1) the profitability is high and the payback period is short after tapping is started,

2) the profit of scale is small because of the labor intensive business, and 3) the conservative investment is rational, as it reduces the total investment amounts because early profits can be re-invested for the planting in later stage.

The natural rubber industries in Cambodia, Myanmar, and Laos have long chronologies, but, they are under-developed because of various historical issues. In recent years, these three countries have received increased attention because of their potential for the planting and cultivation of natural rubber. As these three countries are the lower developed countries, they have limitations in terms of raising funds, obtaining technologies, and getting supports from the governments[3]. Finance and technology diffusion by large-scale investors from foreign countries will be expected for further development.

Footnotes

1) According to the Department of Natural Rubber, Ministry of Agriculture, Forestry and Fishery in Cambodia, the planted area in 2005 was 60,400 hectares, with plans to expand to 72,000 hectares by 2010 of 450,000 hectares of available plantation area. According to the Ministry of Agriculture and Irrigation in Myanmar, planted area in 2005 was 219,000 hectares, with plans to expand to 263,000 hectares by 2010 of 600,000 hectares of available plantation area. According to the Ministry of Agriculture and Forestry in Laos, planted area in 2005 was 11,800 hectares, with plans to expand to 249,360 hectares by 2010.
2) The scheme of the "2 + 3 system" is that the farmer is responsible for farm land and the labor force, and the investor is responsible for capital, technology and selling markets.
3) 'Replanting cess system' is introduced in Thailand and Malaysia, small holders are able to get financial support from the governments funded by the export tax on natural rubber.

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