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Socio-Economic Adjustment of Smallholding Rubber-Based Farming System: Case Study in Southern Region Thailand

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ABSTRACT

Following the economic crisis of 1997 in Thailand, rubber-based small holding farms were forced to take various steps to remain economically viable. These steps were taken with the objective of increasing the farm's productivity and farm income of the six main types of rubber-based farming systems. The four systems of rubber-based farms: rubber-pineapple farm (R2), rubber-durian-mangosteen farm (R43), rubber-durian-mangosteen-rambutan farm (R44), and rubber-durian-fishery farm (R61) achieved greater in economic performance respectively, net farm income and gross margin, than any other farm types. And also, four significant explanatory variables: accessibility to sources of information (AIN), smallholders' participation through group activity (PTG). Agricultural knowledge and skill in management (KUA), and Using fertilizer and feed (FUF) have influence on farm household income with the coefficient of multiple adjust (R2) of 0.460 explained at least 46%. However, smallholders face many constraints in trying to maintain a profitable farming operation, including fluctuating prices, low capital for investment, disease and pests, insufficient water and poor water management systems. To encourage and help farmers to change farm modernization implementation strategies are suggested including providing improved credit systems, modern tapping methods, provision of soil and leaf analysis, provision of infrastructure and financial incentives, provision of information on high-yield varieties, and new water resources infrastructure development. To help increase farm income directly, it is suggested to implement government programs which focus on the needs of smallholders, encourage agents of technology transfer to be more supportive of smallholders, improve rubber-processing technology, encourage the establishment of value-added businesses in local communities and optimize land use.

Key word : rubber, farming system, smallholding rubber-based farm, farm's evolution

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INTRODUCTION

Rubber is the world economic crop which has helped substantially in the development of quality of life and increase family income of rubber small holders in many parts of the world because it is widely grown in all continents: Asia, Africa and America. In Asia, especially in the Southeast Asia region, over the last four decades global trends in rubber cultivation continue to be dominated by three major producing countries, Thailand, Malaysia and Indonesia. In 1999, more than70% of the world 's total rubber production or 4.80 million tones came from Southeast Asian rubber producing countries with the total rubber productions of Thailand 2.04 million tons, Indonesia 1.74 million tons, Malaysia 0.88 million tons, Vietnam 0.12 million tons, Philippine 0.07 million tons and the other Southeast Asian rubber producing countries 0.02 million tons, respectively. The annual growth rate of rubber production is approximately seven percentages, while the annual rubber consumption rate is only four percentages. Of all the total rubber productions in Southeast Asia region, more than 70 % of total rubber productions or 3.36 million tons have been produced by the smallholding sector with Thailand, Malaysia and Indonesia 72%, 74% and 76%, respectively. It is indicated that the smallholding sector is an important sector to be aware of rubber development in Southeast Asian countries. Although the rubber development projects have been applied for small holding sector in the Southeast Asian rubber producing countries such as production projects, marketing and processing projects, contract agreement, associated organizations and rubber industrial projects, respectively, smallholding sector is still to face with many constraints that effect the decreasing of farm productivity and farm income (RRIT, 1999).

Following the economic crisis of 1997 in Southeast Asia, small holding rubber-based farming systems were forced to adapt in trying to maintain economic viability. In Thailand alone there are 800,000 rubber-growing farms out of which 744,000 are small holding farms. Since 1995, Thailand has become world's largest rubber producing country. The production continued to increase from 1.80 million tones in 1995 to 2.16 million tones or 31. % of the world total rubber productions in 1999 with an annual increase of four to seven percent per year. Effect of economic crisis has been reflected by change in production from Ribbed Smoked Sheet (RSS) to Rubber Block in order to meet market requirement. However, smallholding farms in Thailand have faced many constraints which have reduced productivity and income due to uneconomic size, price fluctuation, technology transfer, capital inefficiency, shortage of labor, lack of access to credit facility, inefficient market system and inefficient smallholders' group in local area. Thus, there is a need for small holding farms to adjust their implementation strategy for increasing production efficiency (Tirasarnvong, 1999).

The summary above indicates that rubber smallholders in Thailand, acting on their own are apparently unable to improve their income and productivity toward improving their quality of life. From the economic crisis of 1997 to present, smallholders have to spend more income to meet the

increasing cost of living. Understanding what smallholders have done to try to adjust to this new condition is a necessary and important step in trying to suggest policies that will help improve their situation and quality of life. Thus, this research was undertaken to(1)examine the current major rubber-production systems and their agricultural production systems,(2)examine the economic performances of small holding rubber-based farming systems,(3)find what socio-economic factors influencing on farm household income,(4)determine the main constraints to smallholders farm improvement, (5)examine the possible solutions for the smallholders to adapt better growing methods.

LITERATURE REVIEW

Current situation of smallholding rubber-based farming system in Thailand

Area and production

Natural Rubber first introduced into Thailand from Malaysia through Trang province, Southern Thailand in 1900. It was later spreaded to Chantaburi province, Eastern Thailand, and the price of rubber was fairly high compared to that of other crops, Rubber growing area, therefore, increased rapidly from time to time (Thainugul and Nganthavee, 1996). Based on the 2000's survey of rubber area in Thailand, the estimated rubber area for 1999 was 12.2 million hectares that are mainly situated in the fourteen provinces in Southern Thailand. This area accounts for approximately 88.2% of total rubber holding. The balance being located in five provinces in Eastern (9.7%) and Northeastern region (2.1%) (Table 1). The average holding size is estimated between two and three hectares (Promdej, 1987) and the total number is as high as 800,000 holding farms. About 93.1% of smallholding farms (744,800 farms) own an area of less than forty hectares (RRIT, 2000) and only 6.9% of estate (a holding of more than forty hectares). In 1999, the total rubber productions increased to 1.96 million tons (Table 2). Of which country's total rubber production, about 72% or 1.56 million tons come from small holding sector in using various cultivation patterns.

The majority of rubber production is Ribbed Smoked Sheet (RSS), Standard Thai Rubber (STR) and Latex Concentrate (LC), which accounting for 1.23, 0.56, and 0.37 million tons, respectively (Table 3). After economic crisis which starting in mid-1997, there are some change in rubber production from Rubber Sheet to Rubber Block to meet the rubber industrial requirement, causing rubber smallholders to adjust their rubber production from Rubber Sheet to Latex. In addition, the demand for rubber sheet in the immediate future seems uncertain due to lower natural rubber consumption, shortage of labor, fluctuated rubber price and low technology use that has been the major factor on the shift of rubber production in Thailand.

According to the rubber development strategic plan (1999-2003), Thailand concentrates on rubber production of STR and Latex. The plan will support an increase in STR production while RSS production will be maintained but reducing the growth. (Suthisong, 2000). In the future, Thailand has to step up the expansion of STR and Latex, which are small

Table 1 Rubber plantation area by region of Thailand, 1999.

Region	Area[1]	Percentage
Southern	1.73	88.2
Northeastern	0.04	2.1
Eastern	0.19	9.7
Total	1.96	100.0

Source: RRIT, 1999

Table 2 Rubber area plantation and production in Thailand 1900-1999.

Item	Before 1960	1960s	1970s	1980s	1990-94	1995	1996	1997	1998	1999
Area[1]	1.13.	1.26	1.44	1.78	1.95	1.95	1.96	1.97	1.96	1.97
Produc-tion[2]	N/A.	0.17	0.29	0.50	1.26	1.81	1.97	2.02	2.04	2.16
Small holding production share	N/A.	0.12	0.21	0.41	0.95	1.21	1.30	1.42	1.42	1.56
Estate production share	NIA.	0.05	0.08	0.09	0.32	0.60	0.67	0.60	0.62	0.60

Source: RRIT, 2000 and Thai Rubber Association, 1996

[1] Unit: million hectares and [2] Unit: million tons

quantities of production. The degree of success in the expansion of the rubber block depended chiefly on the basic structure of production, structure of processing facilities, competitive cost of production and personal resources in the country (Jampasut, 1999). Table 3 shows the information of Thai Rubber Production during 1995-1999.

The Classification of smallholding rubber-based farming system

The classification of the rubber farmers in Thailand is based on the ratio of agricultural land to the household labor and other activities (Thungwa, 1998); (1) The farmer who has more labors than agricultural land; (2) The farmer whose agricultural land and labors are in relatively equal supply; (3) The farmer who has more agricultural land available than labor to utilize the land and (4) The rubber farmer who hires the labor of others working own farms. Of the four types of rubber farmers, those in the fourth group showed the highest possibility of using crop associations with their farming method. Those farmers in group 1 and 2 showed a moderate likelihood of changing, and those in group 3 the least likelihood of changing.And also he classified three types of smallholding rubber-based farming systems in Thailand based on the number of associated crop with rubber as follows: (1)Rubber plantation with one associated cash-producing crop; (2)Rubber plantation associated with two other cash-producing crops

Table 3 Thai rubber production 1995-1999.

Item	1995	1996	1997	1998	1999
General data					
1. Area (million hectares).	1.95	1.96	1.97	1.96	1.96
2. Production (million tons)	1.81	1.97	2.02	2.04	2.16
3. Rate of increase (%)	+5.06	+9.27	+2.69	+7.11	+5.38
4. Rubber export (million tons)	1.60	1.76	1.83	1.90	2.00
5. Rubber consumption (million tons)	0.15	0.17	0.18	0.19	0.19
Rubber products (miilion tons)					
1. Ribbed Smoked Sheet (RSS)	1.14	1.25	1.23	1.16	1.17
2. Standard Thai Rubber (STR)	0.37	0.39	0.51	0.53	0.62
3. Latex	0.21	0.24	0.25	0.27	0.29
4. Other forms	0.09	0.08	0.05	0.07	0.08
Farmgate price (baht/kg.)					
1. Unsmoked Sheet (USS) at Local market (Grade 3)	32.61	28.36	23.55	23.10	17.52
2. Latex at local market	33.29	29.41	24.24	24.80	17.48

Source:RRIT. 1999

grown in a fixed pattern between the trunks and/or row of the rubber trees; and (3)Rubber plantation with 3 or more other cash-producing crops grown in various patterns between the truck and/or rows. The patterns are non-intensive crops. The plots were evaluated and observed attentively by farmers and the researcher, and 55.9% were found to have given a good growth rate and indicated good future possibilities, although some associated crops were not very productive in the rubber plantation. However, over 88% of the smallholders would cut down the rubber trees and continue only with the associated crops in the future.

Kgonchaikun(1995) indicated four types of small holding rubber-based farming system in Thailand that are useful crops to be the supplement income of small holding farm as follows; (1) Rubber intercropping system such as pineapple, sweet corn, and cassava in northeastern region, pineapple and corn in eastern region and pineapple, corn, and rice in southern region, (2) Rubber-cover crop system for soil improvement and increasing family income (3) Rubber-orchid system (4) Rubber-multicropping system such as fruit crop, Rattan and etc.

Nissapa *et al.* (1994) classify the type of small holding rubber-based farming system in southern region Thailand into four types: (1) the jungle rubber community is normally located in the creek boundary near jungle. The characteristic of this type has been varieties of plants that grow with the rubber trees. The rubber trees may be high breed or traditional breed (2) traditional jungle rubber: the varieties of plants have been grown with traditional breed of rubber trees which is normally located near homestead and

produced for only consumption. It uses a few of labors and input factors. (Fertilizer, chemical for used control.) (3) economic rubber system: normally, this type has been used for both commercial and consumption. Rubber intercrop farming system and Rubber multicrop farming system are the example of this type. This type, usually, has many labors, input factors (fertilizer, chemical for used control) and has good irrigation (4) rubber monocultural system: The rubber trees have been grown in the total area. This type uses input factor according to agricultural knowledge, high technology and high breed Rubber trees such as RRIM 600, GT1, BPM24 and etc. Normally, this type has faced with farm labor, especially, tapping labor.

Laosuwan (1987) classify the type of rubber-based farming system as follows: (1) farm investment such as commercial and consumption rubber-based farming system (2) rubber farmer potential in management such as family labor, fertilizer, capital and (3) rubber farm activity such as rubber monoculture system, rubber with crops (intercrop, multicrop or mixedcrop) and rubber-livestock systems.

Klongsripun (1994) induced the principle of integrated farming system to the rubber-based farming system, there can be divided the rubber-based farming system into three main rubber-based farming systems in Thailand as: (1) rubber intercropping system: this system is supplement rubber system that in the production technology for increase product and income of smallholder during the first 1-3 years of rubber planting or during the immature of the rubber trees. The smallholder can manage the land between rubber row by planting the pineapple, rice, banana, mungbean, soybean and other vegetables. The decision on selection the intercrop depends on the topography, need of community, marketing system (local market), environment factor and the potential of ecological system. The products from this system are, normally, in both sale at market and family consumption, (2) rubber multicropping system; The potential improvement of crops that are grown with rubber trees for long-time (normally more than 3 years) Such as fruit crop, ((durian, mango and mangosteen) and etc.) rattan, orchid and etc. This system can increase family income for long time and improve, also, ecological environment of the farm, (3) rubber-livestock farming system: the rubber with bee keeping, poultry in rubber tree. Rubber tree with cattle and rubber tree with sheep and etc.

The current economics and policy implication

The process and marketing

The processing and marketing of rubber smallholders in Thailand are presently complicated and difficult for smallholders to comprehend and individual smallholders are unable to cope with it. The rubber farmgate price and marketing structure are complementary to each other in determining the final price paid to smallholders, who are the original producers of the raw material. The price paid to smallholder in local markets is a residue of the FOB price after deduction for export and other taxes and marketing margins. The complexity of the marketing structure and its numerous levels of intermediaries also raise the question of competition. Under the traditional Thai rubber marketing chain, there are

four levels of dealers, namely, mobile dealer, village dealer, town dealers and processor/exporters, respectively.

In traditional Thai rubber marketing chain, there are two types of rubber marketing chains, namely, Rubber Sheet marketing chain and Rubber Latex marketing chain depending on form of production. The Rubber Sheet marketing chain, there are five dealers, namely, village dealer, local rubber smallholder group, such as Rubber Sheet making group and Rubber latex group etc., town dealer, regional dealer and processor/exporters, respectively, while the rubber latex marketing chain are founded the three dealers, namely, local rubber smallholders group, village dealers and processors/exporter. respectively(RRIT, 1999).

The Current plan and policy implication

The government set the Rubber Development Strategic Plan (1999-2003) for rubber small holdings in both short-term and long-term strategy. In the short-term strategy, there are four activities: (1) enhancement of inputs and providing credit to increase production efficiency and decrease cost of production; (2) the development of farm labor skills and knowledge, especially for tapping; (3) enhancement of other rubber products, i.e. rubber block; and (4) improving the quality of current rubber products to meet market requirements.In the long-term strategy. there are seven activities: (1) helping smallholders access new technology to reduce the time interval between planting and harvesting from 7 to 5 or 6 years; (2) strengthening rubber farmers' organizations to at least 80% of rubber smallholders are fairly represented in market bargaining; (3) enhancing the opportunities for rubber smallholders to augment their income during non-productive rubber periods; (4) operation in the registration of rubber holder and farmer's organization according to rubber zoning ; (5) adjusting rubber smallholder's production by decreasing the area planted rubber by 48,000 tons and replanting with high potential crops such as oil palm instead. (6) enhancement of education and research such as breed, fertilizer and improved tapping methods to increase rubber production; and (7) establishing a rubber pilot project for environmental management according to ISO 14000, of approximately 8,000-16.000 hectares (RRIT, 1999).

METHODOLOGY

The study area is Songkhla province in southern Thailand where there are a total of 136,375 rubber smallholders. The smallholders are those farmers who have under 8 hectares of rubber, in both upland and lowland areas. Songkhla is the most important province for industrial rubber development in southern Thailand due to large number of smallholders large rubber planting area and the greatest number of approved rubber projects with the investment fund of 3.875 million baht in 1999 (RRIT 1999). All types of rubber-based farming systems in varied topography are found in the province, making it an ideal representative study area. The study area has been classified into three Agroecozones based on three criteria as suggested by Trebuit et al. And Conway: (1) topographic characteristics (primarily land slope); (2) land use and biodiversity, and (3)

socio-economic characteristics (farm size) (Trebuil *et al.*, 1983; Conway, 1985). Three representative communities of Agroecozones (Khao Phra Community, Ratthaphum District (Agroecozone I), Phijit Community, Namom District (Agroecozone II), and Khlong Phea Community, Cha Na District (Agroecozone III) were selected using a purposive sampling method according to the following criteria: (1) all communities are included in a target area of the provincial rubber development plan according to the Rubber Development Strategic Plan of 1999-2003; (2) these communities have at least several rubber-based farm types; (3) each community has a large number of Small holding farms and more than 70% of all farmers in the community where involved in rubber production; (4) there is variation in topography for comparison of farms among Agroecozones; and (5) smallholders have faced the constraints in production system.

Twenty-six representative farms from three communities were selected by using the purposive sampling method for the qualitative study: Secondary data, and Participatory Rural Appraisal (PRA). Three hundred seventy-nine representative farms from three communities were selected by using the cluster sampling method for quantitative method; field survey with the questionnaire. All quantitative data were analyzed using SPSS, Version 10.0, and computer software.

RESULTS AND DISCUSSIONS

1. The current main types of smallholding rubber-based farming systems

It was found the six types of small holding rubber-based farming systems (R), in Songkhla province, based on the criteria of individual farm's agricultural production activity (or farm household activity), socio-economic structure and agroecozone, respectively (Table 4).

Type R_1: Smallholding rubber-monoculture farming system

Rubber production is the major occupation of the farmers, approximately 21.3% of the total of the studied 807 farm households. It is indicated that Rubber Replanting is still the emphasized activity of the government. These crops usually use high technology. High yielding varieties of rubber grown used RRIM600, BPM24 and Songkhla 36.There is low efficiency due to the diversity in management. The constraints for low efficiency include lack of labors especially during tapping period, high cost of production and off-farm employment opportunities. However, the most of the smallholders in this type are still interested to maintain their rubber holding because rubber occupation has been a tradition for long time as a cultural crop of Southern region of Thailand.

Type (R_2): Smallholding rubber-intercrop farming system

The majority of the farmers in this farm type include those who have participated in The Office of Rubber Replanting Aid Funds (ORRAF), replanting program. The support is provided during the initial unproductive period (0-36 months). Approximately 26.36% (1,007 farms) fall into this category. Normally, intercropped crops are pineapple, rice, corn, vegetables, and other annual crops . The decision to intercrop

Table 4 The number and percentage of small holding rubber-based farms in three communities.

Farming System type	Agroecozone I Khao Phra community		Agroecozone II Phijit community		AgroecozoneIII Khong Phea community		Total No. of farms	Percentage
	No. of farms	Percentage	No. of farms	Percentage	No.of farms	Percentage		
1.Rubber-monoculture farms (R1)	434	22.60	149	16.3	224	24.40	807	21.30
2.Rubber-intercrop farms (R2)	578	30.00	196	21.40	233	23.20	1,007	26.36
3.Rubber-rice farms (R3)	374	19.40	466	50.90	447	44.60	1,287	33.69
4.Rubber-fruit tree farms (R4)	376	19.70	16	1.70	32	3.30	424	11.09
5.Rubber-livestock farms (R5)	31	1.60	14	1.50	30	3.00	753	1.96
6.Rubber-integated farms (R6)	130	12.70	75	8.2	15	1.50	220	5.77

Sources: Secondary data collection and PRA technique

depends on a number of factors such as soil and terrain condition, marketing and labor availability. When rubber plant becomes more than 36 months old smallholders change farm's cultivation pattern to other types of rubber-based farming for sustaining family income.

Type R_3: Small holding rubber-rice farming system

These comprise approximately 33.69% (1,287 farms) of the total small holding farms. Normally, there are two patterns: (1) rice is grown between immature rubber rows, as intercroping; and,(2) rice is grown in a different sector within the rubber plantation. Normally smallholder's experience in rice practice is derived from their ancestor and use both high-yield and indigenous rice strains. The rice production is used for family consumption only. In the future, this type may decline due to many constraints such as shortage of family labor, high cost of input factor and uncertain price.

Type R_4: Smallholding rubber-fruit tree farming system

Intercropped fruits are economically valuable fruits of southern Thailand including durian, rambutan, longkong, champada, etc. Normally, the fruit trees are mixed. These represent 11.09% (424 farms) of the total rubber growers and can be classified into two patterns of plantations: (1) Fruit trees are cultivated in the same plot of rubber, that is, grown between rubber rows called rubber multi crop. The objective is to get fruit production at the same time as rubber production, however, farmers tend to postpone the rubber collection if the price of fruit is higher than rubber; and (2) Fruit trees are grown in the different section of the rubber plantation. These farmers are normally more experienced and skilled in fruit tree cultivation than farmers in the previous pattern and this pattern is more like a normal business. This type requires higher capital investment and family labor. The constraints of this type include the shortage of water and its management and deficiency of capital investment. However, this type has yielded the highest economic performance due to greater farm income than other farm types.

Type R_5: Smallholding rubber-livestock farming system

Very small proportion of approximately 2% (75 farms) of the total rubber farmers practice this type. Livestock is normally reared within both immature and mature rubber areas. Types of livestock include cows, poultry, swine, goat and sheep. The main constraints are the high cost of production and a deficiency of farm labor and feed. In immature rubber, the rubber plant normally has to be above 2-meter high and at least 18 months old for livestock raising. Usually, the average number of livestock was rearing in rubber area, range between 6-8 bodies per hectare. Smallholders in this type have an experience in livestock raising practice for along time. However, livestock under rubber is only supplemental occupation in enhancing income of family.

Type R_6: Smallholding rubber-integrated farming system (or rubber-integrated activity farming system)

There are approximately 5.77%, or 220 farms in this type of rubber farming system. There are four patterns: Rubber-Fruit Tree-Livestock, Rubber-Rice-Livestock, Rubber-Rice-Fruit Tree and Rubber-Fruit Tree-Fish. The main constraints facing this type are the shortage of family labor, fluctuated price deficiency of capital for investment and lack of management skills. However, this is one of the better alternatives for increasing family income due to its excelled economic performance.

2. The functioning of smallholding rubber-based farm agricultural production systems (APS)

The comparison of smallholding APS between the six identified types of small holding rubber-based farming systems (Somboonsuke, and Shivakoti, 2000) was undertaken in terms of farm objectives, farm implementation strategies, and farm constraints (summarized in Table 5).

Farm objectives

All smallholdings have the main objective to increasing productivity. Increased yield and biodiversity are also important in rubber-fruit operations. Such

Table 5 Comparison of small holding rubber-based farms' APS.

Rubber farming system	Farm purposes	Farm implementation strategies	Farm constraints
R_1 Small holding rubber-monoculture farming system	• Increase farm income and maximize farm production	• The fertilizer is formula of 15-15-15 two times/year • the membership of farmer's group for bargaining price in local market • Use chemicals for weed control	• Low product price (rubber) • Insufficient capital for farm investment • Disease and pests (non-resistant rubber species such as RRIM600 GT1)
R_2 Small holding rubber-intercrop farming system	• Increase farm income and maximize use of farm area	• The fertilizer is formula of 15-15-15 and also, use manure • Use chemical control • Crop as intercrop: pineapple, corn, rice, vegetable and mung bean • Use natural water resource, rainwater	• Insufficient capital for Investment • Disease and pest • Deficient input factor • Low production price and quality • Deficient production knowledge
R_3 Small holding rubber-rice farming system	• Increase farm income and maximize farm product toward sufficient standard of living	• The fertilizer is fomular of 15-15-15 for rubber and 16-20-0 for rice • Two parterres of rice plantation; transplanting of paddy seedling and paddy is sown without transplanting • Fertilization: two times/year of rice plantation • No use chemical • Use indigenous breed such as rice	• Disease and weed • The shortage of family labor • High cost of input factor • Low product price • Deficient water resource and non appropriate soil (low soil fertility)

Rubber farming system	Farm purposes	Farm implementation strategies	Farm constraints
R_4 Small holding rubber-fruit tree farming System	• Increase farm income/use high technology in implementation. strategy/enlarge farm size toward more activity/increase product and yield	• Mixed fruit tree crop for decreasing of risk and disease • Use similar fertilization 15-15-15 for both rubber and fruit tree • Have pond in fruit tree area • Use equipment and method in harvest	• The shortage of water resources • The deficiency of capital for input factor • The efficient extensional system and management • Inconvenient communication • Low quality of product and price • Much disease and natural harm • Little agricultural knowledge • Deficient family Labor
R_5 Small holding rubber-livestock farm	• Insufficient farm product/increase farm income toward increased standard of living	• Plan for livestock production: • Sell at least 8 cows/year average • Use indigenous breeds that are resistant to environment and more appropriate than high breed • Contract local livestock officer for support of input factors such as vaccine, additional feed toward decreasing the cost of production • Manage working time for farm activity	• Insufficient feed resource (grass for animal feed) and vaccine • Disease and pest • Low product and price (rubber)

Rubber farming system	Farm purposes	Farm implementation strategies	Farm constraints
R_6 Small holding Rubber integrated farm	• Increase farm income/improve existing farm implementation strategies/ improve farmer's ability/increase farm savings, improve the efficiency of farm management/decrease e farm debt.	• Land use efficiency by means try to increase biodiversity and there are founded four farms types such as -Rubber with fruit tree and livestock -Rubber with rice and fruit tree -Rubber with rice, fruit tree and livestock and -Rubber with fruit tree and fishery • use fertilizer in similar form (15-15-15 in both rubber and fruit tree) • Fertilizer for rice 16-20-0 • Use chemical for weed control • try to use family's labor for decreasing the cost of production	• Low quality of product and price • Disease and Pest • Insufficient capital investment • Pattern less in practice • Inefficient extensional system • Little knowledge in management • Shortage of water resources • Shortage of family's labor • Use indigenous breed

Sources: Secondary data and Participatory Rural Appraisal (PRA) Techniques

objectives are aided by the use of new farming practices and technology. Sustainability is also a concern of most.

Farm implementation strategy

All of small holding farms use the similar fertilizer for rubber in formula 15-15-15 due to the fact that it is widely found in the local area. And also there use this formula in fruit tree. For crop breed, all of smallholding farms have been used high-yielding breed of rubber. However, there has been used indigenous breed of rice because it is appropriate for local area (resistant to disease in local area). Smallholding rubber-livestock farming system, it was found that smallholding farm has been used in both high yielding breed and indigenous breed. Majority of systems used chemical treatment with especially, cattle, goat and poultry. The result showed that the more farm's biodiversity is, the more chemical is used especially in smallholding rubber-fruit tree

farming system and smallholding rubber-integrated farming system because they have to get more management practice than other systems. All smallholdings use natural sources of water such as rain or underground pools since irrigation is not available in their area. In smallholding rubber-fruit tree farming system, the mixed fruit tree crop is most widely found in the study area, since small holders can harvest them all year, and this system is more profitable than other systems (Somboonsuke and Shivakoti, 2000). In the small holding rubber-rice farming systems, especially in different plots of the rubber area, there are two patterns of planting - transplanting of paddy seedlings and broadcasting of seed. For small holding rubber-integrated farming system (which some call a small holding rubber-integrated activity farming system). Four main types of farming system have founded:(1) rubber-fruit tree-livestock, (2) rubber-rice-fruit-livestock, (3) rubber-fruit tree-fishery and (4) rubber-rice-fruit tree, respectively.

Farm constraints faced

All small holding farms were faced with the main constraints of low production and price, disease and pests due to the use of vulnerable breeds (i.e. RRIM 600), and insufficient capital for farm investment. In addition, the result showed that the smallholding rubber-fruit tree farming system and the smallholding rubber-integrated farming system faced more constraints than other smallholding farms did.

3. Economic performance of smallholding rubber-based farming system

From the table 5, it showed the results of economic performances of the eleven case studies of smallholding rubber-based farming systems involving total cost, total variable cost; cash cost and non-cash cost (family labor), total fixed cost and total gross output. The cost and output, we identify Gross margin(GM), Net Farm Income (NFI), Return to fixed cost(RFC), and Return to Variable Cost(RVC).

In gross Margin (GM), it was found that the highest value of GM was found in R6 system (Rubber-Durian-fishery farming system) with 174,183.35 baht per hectare per year. And also, the result was indicated that rubber with associated other activities influent on the increasing of cash cost, and gross output The rate of increasing gross output was more increasing rate than the rate of increasing cash cost, thus Gross margin was increased. It was confirmed in-R1 system (Rubber-monocultured farming system, it showed the lowest value of gross margin with27, 829.24 baht per hectare per year compare with other systems (Table 5).

In the net farm income, it was found that R6 system (Rubber-Durian-fishery farming system) showed the highest value of NFI with 114,829.26 baht per hectare per year, while R3 system (Rubber-rice farming system) showed the lowest value of NFI with 1,677.29 baht per hectare per year. I was indicated that gross margin and net farm income were shown in the same direction of value. And also, It was found that NFI of R4 systems(Rubber-fruit tree farms) (R41, R42, R43, and R44) were higher than R5 systems(Rubber-livestock farms) (R51, R52, and R53). Smallholders in R4 systems, normally, have not necessary to invest in the fixed cost because there

Table 5 Economic performance of small holding rubber-based farming systems.

Measurement	R1	R2	R3	R41	R42	R43	R44	R51	R52	R53	R6
1. Total cost (Baht/ha/yr)	26,513.74	37,503.58	38,464.15	51,117.79	53,009.21	57,610.56	62,136.89	86,736.89	112,406.53	95,186.53	169,872.00
2. Total Variable cost (Baht/ha/yr.)	20,064.27	30,076.91	35,409.93	42,383.85	43,773.60	47,722.78	52,341.56	60,683.20	101,383.20	77,433.20	151,793.15
2.1 Cash	13,471.27	22,781.91	31,333.26	35,160.31	36,184.51	37,847.70	40,883.15	3,4078.21	68,928.22	53,128.65	110,517.91
2.2 Non-cash	6,593.00	7,295.00	4,076.67	7,223.54	7,589.09	9,875.08	11,458.41	26,604.99	32,454.98	24,304.55	41,275.24
3. Total Fixed Cost (Baht/ha/yr.)	6,449.47	7,426.67	3,054.22	8,733.94	9,235.61	9,887.78	9,795.33	26,053.33	11,023.33	17,753.33	18,078.85
4. Total Gross output (Baht/ha/yr.)	41,300.51	117,256.25	40,141.44	86,211.76	75,606.37	122,211.76	131,011.76	107,286.39	132,286.39	109,286.39	284,701.26
5. Gross Margin (GM) (Baht/ha/yr.)	27,829.24	94,474.34	8,808.18	51,051.45	39,421.86	84,364.06	90,128.61	73,208.18	63,358.17	56,157.74	174,183.35
6. Net Farm Income (Baht/ha/yr.)	14,786.77	79,752.67	1,677.29	35,093.97	22,597.16	64,601.20	68,874.87	20,549.50	19,879.86	14,099.86	114,829.26
7. Return to Fixed Cost (RFC)	6.40	15.79	13.14	9.87	8.19	12.36	13.37	4.12	12.00	6.16	15.75
8. Return to Variable Cost (RVC)	2.06	3.90	1.13	2.03	1.73	2.56	2.50	1.77	1.30	1.41	1.88

Source : Field Survey, 1999

Remark: R1:Rubber-monocultured farm, R2: Rubber-pineapple farm, R3: Rubber-rice farm, R41: Rubber-durian farm, R42: Rubber-mangosteen farm, R43: Rubber-durian-mangosteen farm, R44: Rubber-durian-mangosteen-rambutan farm, R51: Rubber-cow farm, R52: Rubber-chicken farm, R53: Rubber-goat farm, and R6: Rubber-Durian-fishery farm.

are the same activity with rubber activity, while smallholders in R5 system are investment with the high cost of input factor, because the farms' activity are different from rubber activity.

In the return to fixed cost (RFC), and the return to variable cost (RVC), it was found that eight rubber systems: R2, R3 R41, R42, R43, R44, R52, and R61 are high of return to fixed cost, while, R1, R51 and R53 are low of return to fixed cost. The increasing of efficiency of using fixed input is given by enlargement production system that effects on increasing farm household income. When we consider on the efficiency of using variable input, it was found that R2 system (rubber-pineapple system) is the highest efficiency of using variable cost with the value of return to variable cost (RVC) 3.90. It was indicated that one unit of increasing variable input increases the farm income 3.90 units.

4. Socio-Economic factors influencing on farm household income

To identify the significant socio-economic factors for farms' household income of six systems of small holding rubber-based farms, thirteen variables are selected as follows: Education or EDU (X1), Occupation experience or AEF (X2), Adjustment need or SAN (X3) Small holders' participation through group activity or PTG (X4), Accessibility sources of information or AIN (X5) Individual contract with change agent or ICA (X6), Information exposure or INE (X7), Agricultural knowledge and skill in management or KUA(X8), Capital for farm investment or CAI(X9), Using farm equipment and machinery or EBM(X10), Using fertilizer and Feed or FUF(X11), Actual agricultural labor or FAL(X12), and Dairy working period of total farm labors or DWP(X13),respectively. Stepwise forward regression estimation procedure was aggregate. The dependent Variable (Y) was farm household income that was aggregate income of all farm activities.

It was found that four significant explanatory variables : smallholders' participatory through group activity(PTG), accessibility sources of information(AIN), agricultural knowledge and skill in management(KUA), and using fertilizer and feed(FUF) are influencing on farm household income. The following the estimation equation therefore explains the contributing variables to proportion of farm household income;

$$Y = 295.677 + 0.630\ X4 + 0.305X5 + 0.143X8 + 0.141X11$$

The coefficient of multiple determination (R^2) of 0.466 and adjusted R^2 of 0.460 explained at least 46 percent (Table 6). The Durbin-Watson (1.576) confirms the criteria of multiple regression. The high F-Value and its significant at 0.01 level confirm the appropriateness of model. All the significant explanatory variables have positive relationship with the dependent variable. The constant value of 295.677 shows the theoretical estimate of farm household income.

5. Main constraints faced of smallholding farms

Low product price is the most serious constraint faced by all types of farmers. In addition, deficient production knowledge, disease and pests, insufficient capital for farm investment, and the poor market system are also important constraints on all

Table 6 The significant explanatory variables for smallholding farm household income.

Dependent variable	Explanatory variable			R^2	Adjust ED R^2	Sd. erroe of regression	F-Tatistic
	Variable	Coefficient	t-ratio				F-Value
Y	β_0	5,437.455	10.076***				
	x_4	0.560	13.144***	0.313	0.311	39.280	171.983***
Y	β_0	1,143.400	2.786***				
	x_4	0.648	16.044***				
	x_5	0.348	8.612***	0.426	0.423	35.945	139.762***
Y	β_0	554.518	1.276				
	x_4	0.643	16.193***				
	x_5	0.327	8.163***				
	x_8	0.142	3.662***	0.446	0.442	35.368	100.720***
Y	β_0	295.677	0.682				
	x_4	0.630	16.034***				
	x_5	0.305	7.625***				
	x_8	0.143	3.737***				
	x_{11}	0.141	3.678***	0.466	0.460	34.791	81.447***

Note *** = Significant at 1 percent level ($p<01$)

** = Significant at 5 percent level ($p<0.05$)

Durbin-Watson = 1.576

types of farms and farmers (Table 7). Like other primary commodities, rubber price fluctuation depends on both supply and demand factors in the market and from external events. During the last twenty years, the rubber price fluctuated greatly, and affected small holding farms in Thailand. For example, in 1995, the world's rubber production was in excess of consumption and the rubber price dropped. This had bad effects on the small holder and was a major reason for small farmers to leave their farms to search for off-farm employment . Inevitably, this led to less utilization of land and productivity further declined in Thailand, and also in Malaysia, and Indonesia. The low level of education and lack of accessibility make the creditability worse and low adoption of new agricultural practice and innovations. The market constraints, which include the low type and grade (normally 80% of USS grade 3 and 4), reflect the inefficiency, complexity and constraints of industry. Also, smallholders get an unfair price in the local market, and marketing becomes difficult and complicated for these small holders to comprehend and moreover individual small holders are unable to cope with it. The market structure and rubber prices are complementary to each other in determining the final price paid to small holders, who are the original producers of raw material. The price paid to the producer in local market is the residue of the FOB

Table 7 The main constraints of smallholding rubber-based farming systems.

Constraint	Percentage
1. Low production price and quality	25.4
2. Deficient capital for farm investment	13.8
3. Disease and Pests	11.2
4. Deficient input factors and high cost of inputs	10.9
5. Inefficient local marketing system	10.2
6. Deficient agricultural knowledge	6.8
7. Shortage of water resources	6.8
8. Low soil fertility	6.1
9. Shortage of family labor	5.1
10. Inefficient local extension system	3.7

Source: Field survey, 1999

price, after deductions for export and other taxes and marketing margins. The constraints caused by the high cost of production and input such as fertilizer, seed and chemicals for weed control and also low farm-gate price lead to insufficient capital for investment(Somboonsuke and Rattanachai, 1997).

6. The suggestion of plan and implementation strategies for the development of smallholding farm

The constraints analyzed for setting can be the strategic plan and policy for development of small holding rubber-based farming system and suggestion of possible solution.

6.1 Strategies for improving farm's productivity.

The strategies for improving farm productivity are: (1) providing a credit system to meet the cost of cultivation, including a subsistence incentive, (2) encouraging the establishment of community capital funds for investment, (3) providing soil and leaf analysis and fertilizer recommendation, as well as disease and pest control information, (4) providing infrastructures and financial incentives based on the socio-economic position of the small holders in general, or in specific areas such as land acquisition schemes, (5) providing information on high-yield varieties and other modern planting techniques, (6) strengthening research and development and dissemination of this information to small holders through exchange agents and local community groups, (7) improving access to water through water resource infrastructure assistance and management, (8) encouraging exchange agents of technology transfer to be more supportive of smallholders, (9) improving the rubber-processing technology available to smallholders so they can provide a better grade of rubber sheet, and (10) encouraging the establishment of value-added businesses in local communities to process some of the rubber there, and thus increase overall community prosperity.

6.2 Strategies for improving smallholders' ability and potential

The strategies for improving small holders' ability and potential include (1) emphasizing the needs of small holders and encouraging the improvement of small holders' ability, aspiration, skill and knowledge by providing appropriate training courses such as breeding technique, harvesting techniques like tapping, marketing and processing, and (2) motivating small holders' to become more self-reliance.

CONCLUSION

Following the economic crisis of 1997, smallholders along with many other sectors of the economy have had to adjust their attitudes towards their traditional ways of farming and doing business to become more efficient. The six types of rubber small holdings described in this article are all important for rubber development in Thailand, but many of them should be considered changing to the more profitable rubber-intercropping and rubber-fruit systems as described where they have that opportunity and are not hindered by the constraints on changes as described. Various suggestions are offered to overcome these constraints in certain cases, and public policy options are also suggested in helping farmers to make the change. What is certain is that rubber will remain an important commodity in the world, and Thailand is an important world supplier of this commodity, so with a positive attitude and willingness to work and to adapt, the rubber industry can remain an economic strength of southern Thailand.

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