Diversification of Smallholding Rubber Agroforestry System (SRAS) Thailand

Buncha Somboonsuke[1], Prawat Wetayaprasit[1], Parinya Chernchom[2] and Kanokporn Pacheerat[2]

ABSTRACT

The rubber agroforestry system is an alternative agriculture practice for rubber smallholders to enhance the ecological integrity and crop diversity. The data collection for the study of diversification of smallholding rubber agroforestry system (SRAS) included 300 rubber farms of 21 systems in the south, east, and northeast of Thailand. The project results revealed that there are a multitude of 21 rubber farming systems in Thailand. These systems can be classified into three main types: (1) the intercropping rubber-food crop system, growing short-lived plants, for example, pineapple, chili, banana, rice, sweet potato, long bean and corn, for a rubber period, no longer than 36 months; (2) the rubber-fruit crop system, growing multicrop within the rubber area during the rubber productive period. The most common fruit crops that have been grown in Thailand are guava, gnetum, long kong, salacca, mangosteen, durian, and levistona, etc., and (3) the rubber-timber species system, normally yielding higher income to rubber smallholders since the sales of both rubber and wood products are at the same time and this is coupled with the presently high value of wood. The important timber varieties in the rubber area are neem and teak. As for profitability of Smallholding Rubber Agro forestry System (SRAS), it was noted that pineapple, chili, salacca, and gnetum are highly profitable. However, in the rubber-pineapple system which yields the highest income, the cost of investment is the highest too, when compared to the rubber-gnetum system which requires minimal input and low cost of production and management. The main conditions for decision-making in the rubber intercropping system are as follows: (1) farm household labor requirement, (2) knowledge and experience, (3) extension and policy implication, (4) marketing opportunity, (5) consistent capability of local communities, and (6) land topography and sustainability. For SRAS development strategy in the southern Thailand, improvement should be made on pricing and marketing of agroforestry products, appropriate technology for higher productivity, greater farm efficiency and risk reduction at farm level, and more synchronized co-ordination among stakeholder agencies at the regional level.

Keywords: rubber farming system, rubber diversification, rubber agroforestry

[1] Department of Agricultural Development, Faculty of Natural Resources, Prince of Songkla University, Songkhla 90112, Thailand.

[2] Department of Agricultural Economics, Faculty of Economics, Prince of Songkla University, Songkhla 90112, Thailand.

บทคัดย่อ

ระบบบวนเกษตรยางพาราถือเป็นอีกทางเลือกหนึ่งของเกษตรกรชาวสวนยางพาราขนาดเล็ก เพื่อเพิ่มความสมบูรณ์ให้แก่ระบบนิเวศ และเพิ่มความหลากหลายของพืชในสวนยางพารา การศึกษาเรื่องความหลากหลายของระบบเกษตรยางพาราขนาดเล็กได้ทำการศึกษาจากการสัมภาษณ์เก็บข้อมูลจากฟาร์มสวนยางจำนวน 300 แห่ง ที่มีความหลากหลาย จำนวน 21 ระบบ จากพื้นที่ภาคใต้ ภาคตะวันออก และภาคตะวันออกเฉียงเหนือ จากผลการวิจัย พบว่า มีระบบการทำฟาร์มสวนยางพาราในประเทศไทยทั้งสิ้นจำนวน 21 ระบบ สามารถจำแนกเป็น 3 ประเภท คือ (1) ระบบการทำสวนยางพารากับพืชอาหารแซม โดยมักจะเป็นพืชที่มีอายุสั้น เช่น สับปะรด พริก กล้วย ข้าว มันเทศ ถั่วฝักยาว และข้าวโพด ทั้งนี้จะปลูกแซมยางพาราที่มีอายุไม่เกิน 36 เดือน (2) ระบบการทำสวนยางพาราร่วมกับไม้ผล ที่มีการเจริญเติบโตในพื้นที่สวนยางพาราระหว่างช่วงที่ยางพาราให้ผลผลิต ชนิดไม้ผลที่มีการปลูกมากในประเทศไทย ได้แก่ ฝรั่ง ผักเหลียง ลองกอง สละ มังคุด ทุเรียน และสิเหรง เป็นต้น และ (3) ระบบการทำสวนยางพาราร่วมกับไม้ยืนต้น ซึ่งพบว่า รูปแบบดังกล่าวเกษตรกรจะได้รับผลตอบแทนสุทธิที่สูงกว่าโดยเปรียบเทียบ เนื่องจากเกษตรกรชาวสวนยางพาราสามารถขายผลผลิตยางพาราและผลผลิตจากไม้พร้อมกัน ตลอดจนมูลค่าของไม้ยืนต้นค่อนข้างสูง โดยไม้ยืนต้นส่วนใหญ่ที่พบในสวนยางพารา คือ ต้นสะเดา และต้นสัก สำหรับความสามารถในการทำกำไรของระบบบวนเกษตรยางพาราขนาดเล็ก (SRAS) พบว่า สับปะรด พริก สละ และผักเหลียง ให้ผลกำไรสุทธิโดยเปรียบเทียบสูงที่สุด อย่างไรก็ตาม แม้ว่าสับปะรดจะให้รายได้สูงสุด แต่ค่าใช้จ่ายในการลงทุนก็สูงที่สุดเช่นกัน เมื่อเปรียบเทียบกับระบบการทำสวนยางพาราที่ปลูกผักเหลียงร่วม ซึ่งเป็นระบบที่ต้องการค่าใช้จ่ายด้านการจัดการที่ต่ำ เนื่องจากใช้ปัจจัยการผลิตในอัตราส่วนที่น้อยที่สุดโดยเปรียบเทียบ สำหรับเงื่อนไขตัดสินใจปลูกพืชร่วม คือ(1) จำนวนแรงงานที่ใช้ในครัวเรือน (2) ความรู้และประสบการณ์ (3) การส่งเสริมและนโยบาย (4) โอกาสทางการตลาด (5) ความเข้มแข็งของชุมชนท้องถิ่น และ(6) ลักษณะภูมิประเทศและความยั่งยืน สำหรับกลยุทธ์การพัฒนาระบบบวนเกษตรยางพาราขนาดเล็กในภาคใต้ ประเทศไทย คือ ปรับปรุง แก้ไขปัญหาด้านราคา และการตลาดของผลผลิตจากระบบบวนเกษตร ด้านเทคโนโลยีที่เหมาะสมเพื่อเพิ่มผลิตภาพและลดความเสี่ยงในระดับฟาร์ม รวมถึงความร่วมมือของตัวแทนที่มีส่วนเกี่ยวข้องในระดับภูมิภาค

คำสำคัญ: ระบบการทำฟาร์มสวนยางพารา ความหลากหลายของสวนยางพารา วนเกษตรยางพารา

INTRODUCTION

The improvement of productivity of rubber farming system is crucially important, especially for smallholding rubber farms in Thailand for an increase in farm household income since more than 72 percent of the world's natural rubber production comes from smallholding sectors (Somboonsuke and Shivakoti, 2001a). In the three major rubber producing countries, Thailand, Malaysia and Indonesia, 72 percent, 74 percent and 76 percent respectively of total rubber production come from the smallholding sector using various cultivation patterns. In Thailand, there are some 1,080,000 rubber plantations, of which some 864,000 are small farms with a variety of smallholding rubber-based farming systems (Somboonsuke and Shivakoti, 2002b). Thus, this paper attempts to (1) describe the demographic data, main current agricultural production system, and the major constraints of three rubber-based farming systems: rubber-food crops, rubber-fruit tree and rubber timber species, (2) examine the current economic performance of the three rubber-based farming systems, (3) examine profitability simulation of some rubber diversification system such as

income and expenditure, (4) a case study of economic analysis of SRAS through a model of analysis, and (5) suggest appropriate strategic development of the three farming systems toward sustainability.

Agroforestry system

Agroforestry is the production of trees and a variety of crops or animals on the same area The crops can be grown together at the same time, in rotation, or can even be grown in separate plots when materials from one are used to benefit another. In addition, the definition of agroforestry is the integration of trees, plants and animals in a conservative, long-term, productive system. Agro forestry system makes maximum use of land. Every part of the land is considered suitable for plants that are useful. Focus is placed on perennial, multipurpose crops that are planted once but yield benefits over a long period of time. And also, agroforestry system represents association of a small number of components, usually no more than five tree species and an annual species. Agroforestry system may be considered as a principal part of the system itself, which contains many other sub-systems that together define a way of life: (1) alley cropping: growing annual crops between rows of trees, (2) beautification: planting trees for ornamental purposes, (3) boundary fencing: planting trees along the boundary or property for demarcation, (4) dispersed trees: trees planted alone or in a small number on pasture or otherwise fallow areas, (5) earthworks: streetwise made of earth, usually to conserve or control drainage (Kheowvongsri, 1994).

Model of diversification in smallholding rubber agroforestry system (SRAS)

Rubber agroforestry as a rubber farming system is one of the cropping patterns. There exist two factors that affect the production system, i.e., endogenous and exogenous factors (Somboonsuke and Kunlayanee, 2002). The endogenous or controllable factors are constituted by biological and some physical components that have a direct impact on smallholding farm layout and implementation strategies such as rubber breed, decision making process, empowerment (skills, knowledge, attitude), soil fertility and farm management practice (capital investment, labor, and fertilizer). The exogenous factors imply some physical and socio-economic components that have an indirect impact on farm operation and implementation strategies such as climate, temperature, rainfall, resource profile, marketing system, current plan and policy implication, and group dynamics. This framework outlines what rubber planters in the agroforestry system have and what they have to do, identify the rubber farmers' decision making process, and analyze how rubber farmers control and manage their farms (Figure 1). Practically in Thailand situation, rubber farmers employ different agricultural activities as appropriate technology, local environmental resources, materials, financial sources and management practice to operate their farm economically on a sustainable basis.

METHODOLOGY

A total of 300 rubber agroforestry farms operated under 21 systems of rubber diversification are targeted for data collection, 150 farms in the southern, 60 in the eastern, and 90 in the northeastern regions of Thailand (Table 1). The structured interview form was used to collect data. The analysis was emphasized on (1) socio-economic characteristics that describe general demographic data, opinions of smallholders for the assessment of their farm situation and profitability, (2) current agriculture production system (APS) and, (3) economics and profitability of SRAS (Cherdchom *et al.*, 2002).

RESULTS AND DISCUSSION

1. SRAS typology

There are four main types of SRAS in the southern Thailand, based on the criteria of individual farm's agricultural production activity, socio-economic structure and agro-ecozone.

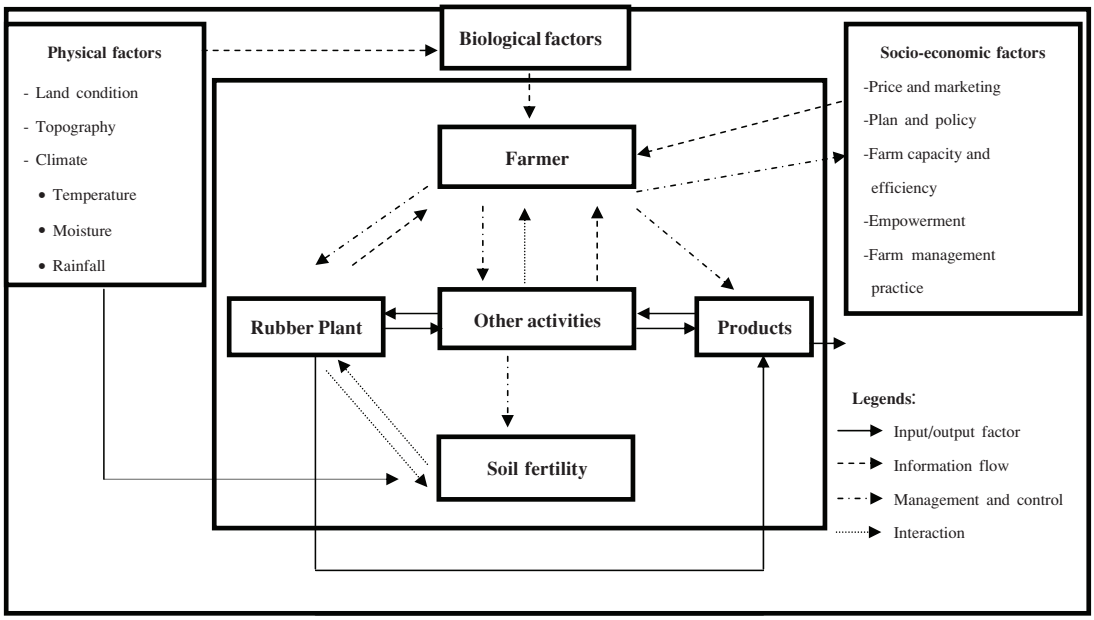

Figure 1 A model of the diversification in smallholding rubber agro forestry system
Source: (Somboonsuke, 2002a)

Table 1 Twenty-one systems of rubber smallholding operation in Thailand

No.	SRAS combination	Frequency
1	Rubber-banana system	10
2	Rubber-cassava system	22
3	Rubber-custard apple system	11
4	Rubber-cashew system	12
5	Rubber-grass system	6
6	Rubber-rice system	10
7	Rubber-mangosteen system	25
8	Rubber-cotton system	8
9	Rubber-jack fruit system	4
10	Rubber-salacca system	4
11	Rubber-vegetable(chili) system	22
12	Rubber monoculture system	31
13	Rubber-rattle system	8
14	Rubber-mango system	7
15	Rubber-papaya system	10
16	Rubber-sumac system	4
17	Rubber-cape marigold system	18
18	Rubber-durian system	12
19	Rubber-corn system	16
20	Rubber-cattle system	18
21	Rubber-pineapple system	42
	Total	300

Source: (Somboonsuke and Kheowvongsri, 2007)

Rubber-food crop system

The majority of the farmers practicing this farming include those who have participated in the Office of Rubber Replanting Aid Fund's (ORRAF) replanting program. The support is provided during the initial unproductive period (0-36 months). Approximately, 26.36 percent (1,007 farms) fall into this category. Normally, intercropped varieties include pineapple, rice, corn, vegetables, and other annual crops. The decision to intercrop depends on a number of factors such as soil and terrain condition, marketing and labor availability. When rubber trees are more than 36 months old, small holders change their farm cultivation patterns to other types of rubber-based farming to sustain their family income (Figure 2).

Rubber-fruit tree system

Intercropped fruits which include durian, rambutan, long kong, champada, etc. are economically valuable in the southern Thailand. Normally, the fruit trees are mixed and cultivated in the same plot of rubber. These trees are grown between rubber rows called rubber multi crop. The objective is to benefit from fruit production at the same time as rubber production. However, farmers tend to postpone the rubber harvest if the price of fruit is higher than that of rubber. These farmers are normally more experienced and skilled in fruit tree cultivation than farmers in the previous pattern and this pattern is becoming a common practice. This type requires higher capital investment and family labor. The constraints of this type include the shortage of water and its management, as well as, the shortage of capital investment. However, this type yields the highest economic return due to its greater farm income than other farm types (Figure 3).

Timber species mixed system

Normally, the income of rubber smallholders who operate this type of farming is high because the income is from both rubber and wood products at the same time and also, wood price is presently high. The most common timber species grown are neem, and teak. When asked for their opinions, smallholding farmers practicing mixed farming were generally satisfied with the various input-output characteristics aspects. Many farmers, however, were less satisfied with family income and savings (Figure 4).

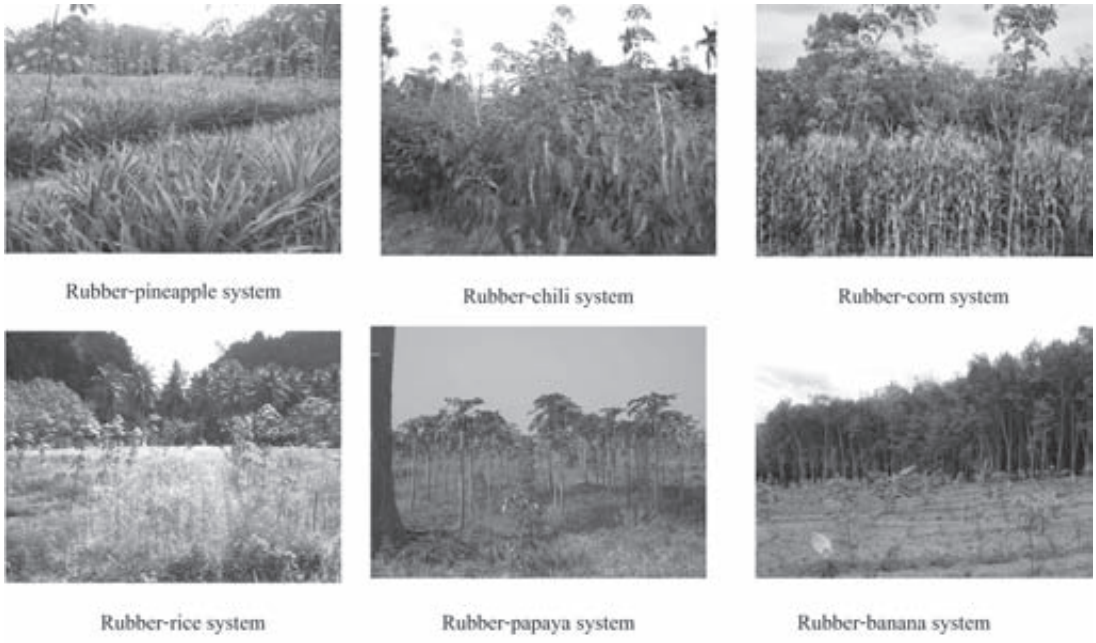

Figure 2 Different combinations commonly practiced in rubber-based farming in Thailand

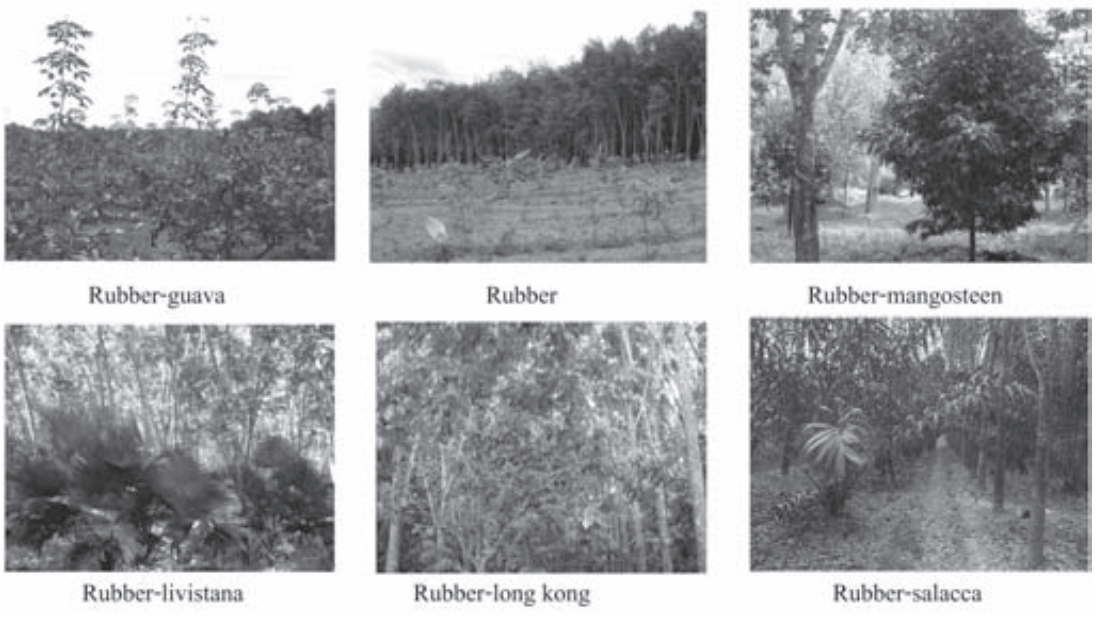

Figure 3 Rubber-fruit tree mixed system in Thailand

Figure 4 Timber varieties in mixed farming system of Thailand

Smallholding rubber livestock farming system

A very small proportion of approximately 2 percent (75 farms) of the total rubber farmers practices 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 in farm labor and feed. In immature rubber, the rubber plant normally has to be above 2 meters high and at least 18 months old for livestock raising. Usually, the average number of livestock rearing per hectare in rubber areas ranges from 6 to 8. Smallholders in this type have long experience in livestock raising practice for a long time. However, livestock under rubber area is only supplemental occupation in enhancing family income (RRIT, 1999).

2. Demographics data of SRAS

Table 2 presents the demographic data of 21 combinations of SRAS. The average age of rubber smallholders in SRAS is 47.54 years and the average number of years in education is 6.65 years. The majority of rubber smallholders have had experience in their present farming system for 19.47 years on

Figure 5 Rubber livestock farming system

average. The average number of family labor is 3.13 persons/family with the average number of agricultural labor of 2.11 persons/family and the average number of non-agricultural labor of 0.57 person/family. Regarding hired labor, it was noted that the average number of hired labor is 1.10 persons/family and average wage of 81.53 baht/day. The average total area is 24.25 rais/family with the agricultural area of 15.47 rais/family. The result indicates that the rubber smallholders normally have knowledge and skills in rubber production. However, they need the government to transfer rubber production technology and biodiversity in the rubber area due to low education. As for the labor issue, it is now enough to manage labor in the family; however, in the future, region hired labor may be necessary due to the shortage of young labor in the community which is likely to become critical owing to the migration, and the migration of labor from rural to urban areas. In the future, the shortage of agricultural labor will affect the wipes encouraging the employment of cheaper labor from Myanmar and Cambodia, the trend that the rubber family structure will change in the future, with a smaller proportion of young generations. Thus, farmers will sell out their lands or hand the land to their children. The farm size, therefore, will be smaller than the present.

3. Current constraints faced by SRAS

Under the current situation of rubber planting, we have recognized the following constraints faced by smallholders in enhancing diversity in their plantations:

(1) Labor shortage is the important factor that determines the increase percentage of rubber agroforestry system in specific areas, in both existing and developed rubber areas.

(2) Lack of knowledge and skills in selection of rubber varieties buds, production management, environment, and experience in biodiversity production, the intention and attitude of farmers on diversification. However, low education is one of the key factors that impact the adoption process for agricultural action innovation.

(3) Discontinuous extension service and inefficient extension plan and policy implication about biodiversity. The gradual recruitment of extrusion workers in some rubber cultivation areas has contributed to a more efficient dissemination of biodiversity concept to the rubber planters.

(4) Lack of integrity among rubber planters. The rubber planters were generally offered unfair price for the product due to lack of bargaining process.

(5) Inefficient plan and policy implication, uncertain government plan and policy implication, while concentration is on commercial (monoculture) rubber plantation. This seems more profitable to the smallholders who have little consideration for the diversified planting system.

(6) Inefficient marketing system for the products from mixed farming practices and hence prices of such products do not increase and they are sold only in local markets which discourage the adoption of biodiversity principles.

Table 2 Demographic data of rubber smallholders in SRAS

Socio-economic variable	Rubber Agroforestry System (RAS)									
	RAS 1 (10 farms)	RAS 2 (22 farms)	RAS 3 (11 farms)	RAS 4 (12 farms)	RAS 5 (6 farms)	RAS 6 (10 farms)	RAS 7 (25 farms)	RAS 8 (8 farms)	RAS 9 (4 farms)	RAS 10 (4 farms)
1. Age (years)	41.60	51.17	33.00	36.00	49.00	57.00	47.72	50.00	55.00	56.00
2. Sex (%)										
Male	70.30	69.30	90.00	100.00	100.00	65.00	57.00	100.00	100.00	100.00
Female	29.70	30.70	10.00	0.00	0.00	35.00	42.50	0.00	0.00	0.00
3. Education (years)	4.83	1.33	4.00	2.00	7.00	1.00	2.36	7.00	7.00	7.00
4. Farming system experience (years)	18.67	27.50	15.00	10.00	5.00	21.00	23.36	15.00	10.00	30.00
5. No. of farm labor (persons/family)	2.33	3.17	7.00	2.00	2.00	2.50	2.12	5.00	2.00	3.00
No. of agricultural labor (persons/family)	2.00	2.50	7.00	2.00	2.00	1.50	1.56	2.00	1.00	3.00
No. of non-agricultural labor (persons/family)	1.00	0.00	0.00	0.00	0.00	0.00	0.24	3.00	1.00	0.00
6. No. of hired labor (persons/family)	1.00	1.67	0.00	0.00	0.00	0.00	0.68	0.00	0.00	1.00
7. Labor wage (baht/day)	120.00	216.70	0.00	0.00	0.00	0.00	164.80	0.00	0.00	100.00
8. Total area (rais)	16.00	40.17	30.00	14.00	35.00	10.50	29.04	38.00	3.50	40.00
Agricultural area (rais)	14.83	25.50	21.00	7.00	30.00	2.00	20.00	30.00	3.00	19.00
9. Approximate farm size (rais)	3.83	3.83	4.00	4.00	4.00	3.00	2.88	3.00	2.00	3.00

Note: RAS1: Rubber-banana system; RAS2: Rubber-cassava system; RAS3: Rubber-custard apple system; RAS4: Rubber-cashew system; RAS5: Rubber-grass system; RAS6: Rubber-rice system; RAS7: Rubber-mangosteen system; RAS8: Rubber-cotton system; RAS9: Rubber-jack fruit system; RAS10: Rubber-salacca system.

Table 2 (cont'd)

Socio-economic variable	Rubber Agroforestry System (RAS)											
	RAS 11 (22farms)	RAS 12 (31 farms)	RAS 13 (8 farms)	RAS 14 (7 farms)	RAS 15 (10 farms)	RAS 16 (4 farms)	RAS 17 (18 farms)	RAS 18 (12 farms)	RAS 19 (16 farms)	RAS 20 (18 farms)	RAS 21 (42 farms)	Total 300 farms
1. Age (years)	48.05	50.39	53.00	55.00	37.00	40.00	42.25	52.50	42.00	55.00	46.69	47.54
2. Sex (%)												
Male	60.00	74.50	70.20	100.00	100.00	50.00	70.20	100.00	62.80	87.30	65.00	80.55
Female	40.00	25.50	29.80	0.00	0.00	50.00	29.80	0.00	37.20	12.70	35.00	19.42
3. Education	7.71	7.46	7.50	7.00	8.00	11.00	9.75	10.00	9.33	8.00	10.31	6.65
4. Farming system experience(years)	24.57	24.21	35.00	45.00	25.00	20.00	5.00	17.50	12.33	2.50	22.31	19.47
5. No. of farm labor (person/family)	2.57	3.11	4.00	2.00	7.00	2.00	2.75	2.50	3.00	3.00	2.63	3.13
No. of agricultural labor (persons/family)	1.67	2.50	4.00	0.00	2.00	2.00	1.50	2.00	1.33	1.00	1.81	2.11
No. of non-agricultural labor (persons/family)	0.14	0.43	0.00	0.00	5.00	0.00	0.00	0.00	1.00	0.00	0.13	0.57
6. No. of hired labor (persons/family)	1.00	0.64	0.00	5.00	0.00	0.00	1.75	0.00	3.33	5.00	2.13	1.10
7. Labor wage (baht/day)	102.40	147.80	0.00	100.00	0.00	0.00	157.50	0.00	150.00	175.00	278.00	81.53
8. Total area (rais)	25.70	19.10	19.00	37.00	10.00	10.00	22.50	11.50	31.67	31.67	35.00	24.25
Agricultural area (rais)	10.00	12.50	19.00	10.00	10.00	4.00	10.00	18.00	18.00	11.00	30.00	15.47
9. Approximate farm size (rais)	3.29	2.96	4.50	4.00	4.00	4.00	2.50	3.00	3.33	3.50	3.31	3.43

Note: RAS11: Rubber-vegetable (chili) system, RAS12: Rubber monoculture, RAS13: Rubber-rattle system, RAS14: Rubber-mango system, RAS15: Rubber-papaya system, RAS16: Rubber+sumac system, RAS17: Rubber-cape marigold system, RAS18: Rubber-durian system, RAS19: Rubber-corn system, RAS20: Rubber-cattle system, RAS21: Rubber-pineapple system

(7) Community leaders are less concerned with the drainage of biodiversity. They should have a broader view regarding the biodiversity that it can improve the quality of life domestically.

(8) Education for young generation in primary school lacks of the enhancement of wisdom and insight habits. Better education of family members is necessary for upgrading the labor quality in association with rubber production.

4. Case Studies of economic performance of SRAS

To analyze the economic efficiency of SRAS case studies, the farming systems were classified into four types according to the kinds of rubber intercrops. It was found that only two systems--rubber-food crop system and rubber-fruit tree system--yielded higher net incomes of the farms, compared to the rubber monoculture system. (Table3-6)

Table 3 shows that, in the rubber-food crop system, the crops that yielded a net income increase were cassava, banana, rice, corn and pineapple, and farmers earned the highest income, 500,000 baht/year, from growing rubber and pineapples.

Table 4 shows that, in the rubber-fruit tree system, zalacca and custard apples yielded a net income increase, 220,000 and 250,000 baht/year respectively, when compared to the rubber monoculture system.

Table 5 and 6 show that neither the rubber-fiber or inedible crop system nor the rubber-livestock system yielded a higher net income than the rubber monoculture system.

CONCLUSION AND RECOMMENDATIONS

1. Conclusion

The three main types of rubber intercropping systems have been practiced in both traditional

Table 3 Rubber-food crop system

RAS No.	SRAS combination	Net farm income (baht/year/rai or household)
12	Rubber monoculture system	83,428.57
11	Rubber-vegetable (chili) system	8,000.00
16	Rubber-sumac system	50,000.00
15	Rubber-papaya system	75,000.00
2	Rubber-cassava system	111,666.67
1	Rubber-banana system	116,106.67
6	Rubber-rice system	163,200.00
19	Rubber-corn system	280,000.00
21	Rubber-pineapple system	500,000.00

Table 4 Rubber-fruit tree system

RAS No.	SRAS combination	Net farm income (baht/year/rai or household)
12	Rubber monoculture system	83,428.57
9	Rubber-jack fruit system	6,000.00
14	Rubber-mango system	29,000.00
18	Rubber-durian system	50,000.00
4	Rubber-cashew system	80,000.00
7	Rubber-mangosteen system	81,668.00
10	Rubber-salacca system	220,000.00
3	Rubber-custard apple system	250,000.00

plantations and non-traditional rubber areas. Food crop mixed systems, normally, are pineapple, rice, maize and vegetables grown during the initial unproductive period of rubber, i.e., up to *3* years. The decision to intercrop depends on soil, topography, labor availability and market access. Fruits in the intercropping system are guava, durian, salacca, gnetum, and mangosteen that should be actually extended to farms. Timber species in mixed systems are neem and teak, normally used for construction

Table 5 Rubber-fiber or inedible crop system

RAS No.	SRAS combination	Net farm income (baht/year/rai or household)
12	Rubber monoculture system	83,428.57
17	Rubber-cape marigold system	30,250.00
8	Rubber-cotton system	39,000.00
5	Rubber-grass system	40,000.00

Table 6 Rubber-livestock system

RAS No.	SRAS combination	Net farm income (baht/year/ rai or household)
12	Rubber monoculture system	83,428.57
20	Rubber-cattle system	30,000.00

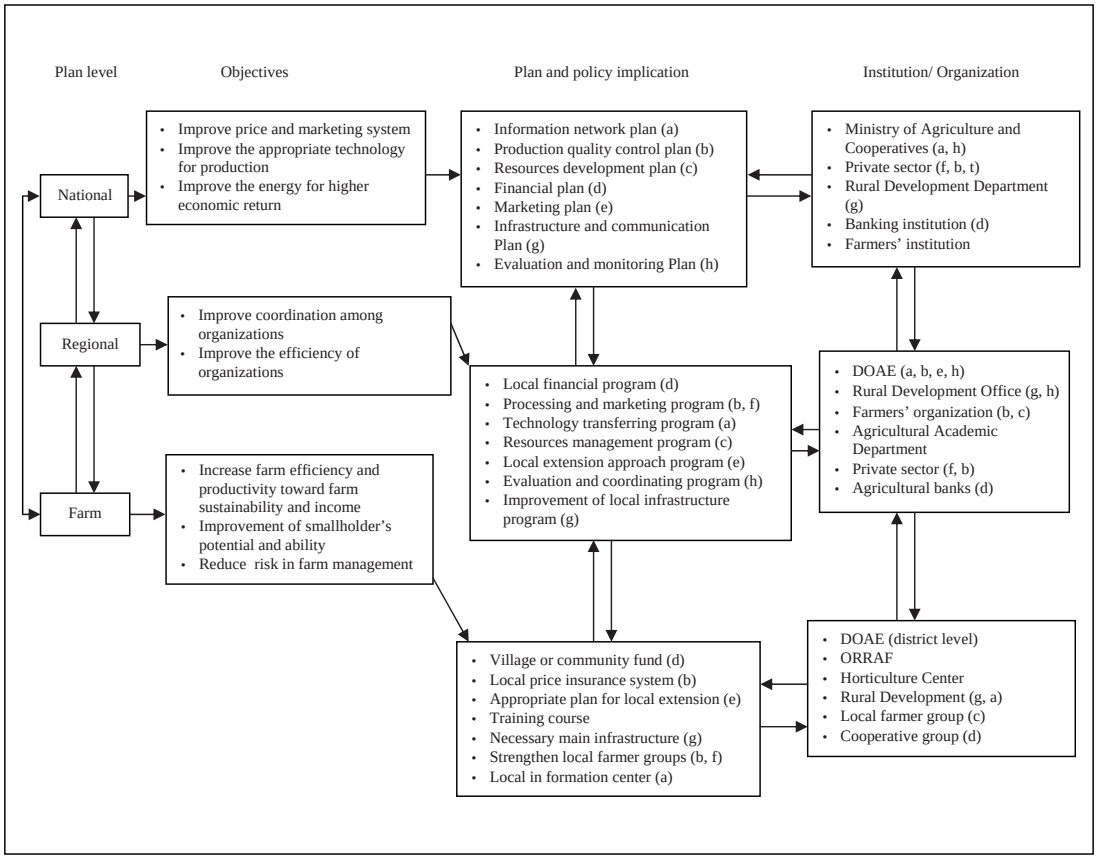

Figure 8 SRAS development strategy for southern Thailand

and furniture. As for the profitability of SRAS, the system of rubber with pineapple has the highest economic return but requires more farm resources and input. The rubber-banana mixture is also very profitable. The rubber-chili combination is less lucrative due to diseases and intensive management. Among rubber-fruit combinations, rubber-salacca shows the highest net income it but requires more farm input. The Guava and gnetum mixtures are also profitable since the cost of production and management is low smallholding farmers practicing mixed farming are generally satisfied with various input-output net profit. Many farmers are less satisfied with family income and savings. For the sustainable profit from SRAS, Thai government should concern with (1) availability of local capital (credit) and price insurance, (2) training and technology for diseases and pest control, as well as management skills, (3) improving transportation systems, (4) labor sharing systems to alleviate labor shortage problems, and (5) strengthening farmer institutions for price negotiation and decreasing cost of input. In SRAS development strategies for the southern Thailand, there should be (1) at the national level improvement in price and marketing of agroforestry products, (2) at the farm level, appropriate technology for higher productivity, better farm efficiency and reduction risk, and (3) at the regional level, improvement in co-ordination between stakeholder agencies.

2. Recommendations

Regarding the development strategies for SRAS in Thailand, the authors suggest three levels of development, i.e. national, regional and farm levels. At the national level, there should be improvement in price and marketing of agro forestry products. At the farm level, the government should transfer the appropriate technology for higher productivity, better farm efficiency and risks reduction. At the regional level, there should be improvement in co-ordination between stakeholder agencies in the region.

According to the results of this study, the following recommendations for the improvement of productivity of SRAS in Thailand are proposed**.**

Improvement in local information system

The possible strategies for improving the local information system are proposed as follows: establishment of village information committee (VIC) for information about the benefits and importance of rubber intercropping, knowledge in production and marketing such as price fluctuation, rules and regulations concerning biodiversity from government offices e.g. ORRAF, DOAE at the district level.

Increasing education level

The result of this study shows that the level of education of rubber smallholders is low which affects the adoption and diffusion process of biodiversity. Thus, the possible strategies for improvement of education of rubber smallholders are (1) providing education opportunities for young generation through Agricultural Program in Agriculture and Technology College and also, information cuter program, (2) establishing Friday Agricultural School for farmer in villages through local school together with extension workers. Smallholders should exchange their ideas and knowledge and also hold discussion among themselves and with government officers on a regular basis, and (3) during the rubber production period, organizing a training course in tapping techniques for the improvement of latex quality, marketing strategies, price, as well as, group processing system for increasing value.

Initiative in local farmer group formation and participation

Encourage and strengthen local group activities such as sheet making group, and rubber latex group by (1) arranging training courses on group system dynamics and its benefit to the members, (2) establishing fund for members in investment. This fund should come from a small percentage contribution of members through the sale of their products, (3) enhancing participation of members through group operation such as interactive decision-making process in solving the group constraints and group strategic

planning, (4) improving communication within groups by means of improved sources of information and setting up Group Information Committee (GIC) to inform relevant matters to members, (5) organizing an efficient monitoring system of group operation by setting up a group committee of government and private officials, including farmers, and (6) providing agricultural knowledge through training and field trips. For agricultural business management skills, (1) transfer of the knowledge of small enterprise management through training systems, and (2) establishing the village agri-business capital administered by Village Fund Committee (VFC) together with extension workers.

Promoting bio-fertilizer use and optimizing chemical fertilizer use

Rubber smallholders in RAS should minimize chemical control and promote bio-fertilizer instill by (1) providing a training course on advantages of using bio-fertilizer and bio-fertilizer making process and (2) training and exploring local availability and manipulation of materials for making bio-fertilizer within the community.

LITERATURE CITED

Cherdchom, P., P. Promme and B. Somboonsuke. 2002. "Economic performances of Smallholding Rubber-Based Farms in Southern Region Thailand: Case Study in Khao Phra, Phijit and Khlong Phea Communities Songkhla Province." *Kasetsart Journal: Social Sciences,* 23: 151–165.

Kheowvongsri, P. 1994. *Analyse de quelques systmes agroforestiers traditionnels de Thalande.* Biologie des populations et ecologie, Thèse Université de Montpellier II, France.

Somboonsuke, B. 2002a. *Farming System Adjustment of Small holding Rubber-Based Farms in Thailand.* Asian Institute of Technology. Bangkok, Thailand.

Somboonsuke, B. 2002b. "Recent Revolution of Rubber-Based Farming System in Southern Thailand." *Kasetsart Journal: Social Sciences,* 23: 61–74.

Somboonsuke, B and P. Kunlayanee. 2002. "Factor Influencing on Cattle Farming System in the Southern Thailand." *Kasetsart Journal: Social Sciences,* 22: 65–89.

Somboonsuke, B. and G. Shivakoti. 2001a. "Agricultural Sustainability Through Empowerment of Rubber Smallholders in Thailand." *Asia-Pacific Journal of Rural Development,* 11: 65–89.

Somboonsuke, B. and G. Shivakoti. 2001b. "Smallholders of Rubber-Based Farming Systems in Thailand: Problems, Potential, Solutions and Constraints." *Journal of Rural development,* 21: 85–114.

Rubber Research Institute of Thailand (RRIT). 1999. *The Annual Report of Rubber Research Institute of Thailand 1988.* Ministry of Agricultural and Coorperative. Bangkok, Thailand.

Somboonsuke, B. and P. Kheowvongsri. 2007. Socio-economic Characteristics Data of Smallholding Rubber Agroforestry System in Thailand. *CFC/TRSG/II. World Agroforestry Center, Bogor Indonesia*