

Factor Influencing Farming System Transformation Process Analysis from Small Holding Rubber-based Farming System in Songkhla Province, The Southern, Thailand

Paratta Prommee¹ and Buncha Somboonsook²

ABSTRACT

Following the economic crisis of 1997 in Thailand, rubber small holding farms were forced to adjust their farming strategies. The adjustment of rubber small holding farms involved many aspects of the bio-physical and socio-economic attributes of farms. The result indicated that trend and development of small holding rubber-fruit tree farming system (R_4) and small holding rubber-integrated farming system will be relatively well known and extensively discussed in recent years due to high opportunity interchange from other small holding types to these types and also founded that two main factors were identified influence household income of small holding rubber-based farms namely accessibility to sources of information (AIN) and small holders participation through group activity (PIG).

Key words: rubber small holding farm, rubber-based farm, farming system, farm transformation

INTRODUCTION

Following the economic crisis of 1997 in Southeast Asia, small holding rubber-based farming systems were forced to adapt and try to maintain economic viability (TRA, 1999). In Thailand solely, there are 800,000 rubber growing farms, out of which 744,000 are small holding farms (RRIT, 1999). Since

1995, Thailand has become the world's largest rubber producing country. The production continued to increase from 1.80 million tonnes in 1995 to 2.16 million tonnes, or 31. % of the world total rubber productions in 1999, with an annual increase of four to seven percent per year. Effects of economic crisis have been reflected by change in production from Ribbed Smoked Sheet (RSS) to Rubber Block in

¹ Department of Agricultural and Resources Economics, Faculty of Natural Resources, Prince of Songkla University, Hat Yai, Songkla 90112, Thailand.

² Department of Agricultural Development, Faculty of Natural Resources, Prince of Songkla University, Hat Yai, Songkla 90112, Thailand.

order to meet market requirement (Tirasarnvong, 1999).

Presently, small holding farms in Thailand have faced with the similar constraints. Many constraints have reduced productivity and income due to uneconomic size, price fluctuation, technology transfer, deficiency of capital for farm investment, shortage of farm's labor, lack of access to credit facility, inefficient market and processing system and inefficient small holders' group activity in local area (RRIT, 1999). Thus, the study on significant factors influencing on small holding farm household income is a necessary and important step in trying to suggest policies that will help improve their situation and quality of life.

OBJECTIVES

(1) To understand the demographic characteristics of small holding rubber-based farming system.

(2) To study on small holders' decision process leading to farm transformation.

(3) To find the socio-economic factors which influence farm household income.

(4) To recommend the possible strategies for increasing farm productivity.

LITERATURE REVIEW

The types and characteristics of rubber-based farms

Somboonsuke and Shivakoti (2000) classify the types of small holding rubber-based farming

systems (R) in, Songkhla province, southern Thailand, based on the criteria of individual farm's agricultural production activity (or farm household activity), socio-economic structure and agroecozone, respectively as; (1) *Small holding Rubber-Monoculture Farming System (R₁)*; rubber production is the major occupation of the farmers, in study area which comprised of 21.3% of the total small holding farms. It is indicated that rubber replanting is still an 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 labor especially during tapping period, high cost of production and off-farm employment opportunities. However, most of the small holders in this type are still interested in maintaining their rubber holding because rubber occupation has been a tradition for a long time as a cultural crop of the southern region of Thailand. (2) *Small holding Rubber-Intercrop Farming System (R₂)*; The majority of the farmers in this farm type 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% of the total small holding farms fall into this category. Normally, crops intercropped are 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 plant becomes more than 36 months old, small holders change farm's cultivation pattern to other

types of rubber-based farming for sustaining family income. (3) *Small holding Rubber-Rice Farming System* (R_3); These comprise approximately 33.69% of the total small holding farms. Normally, there are two patterns: rice is grown between immature rubber rows, as intercropping; and rice is grown in a different sector within the rubber plantation. Normally small holder's experience in rice practice is derived from their ancestor using 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. (4) *Small holding Rubber-Fruit Tree Farming System* (R_4) Intercropped fruits are economically valuable fruits of southern Thailand which includes durian, rambutan, longkong, champada, etc. Normally, the fruit trees are mixed. These represent 11.09% of the total rubber growers and can be classified in two patterns of plantations: 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 fruit trees are grown in a different section of the rubber plantation. These farmers are normally more experienced and skilled in fruit tree cultivation than those 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. (5) *Small holding Rubber-Livestock Farming System* (R_5) Very small proportion of approximately 2% 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 height 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. Small holders in this type have experience in livestock raising practice for a long the family income time. However, livestock under rubber is only supplemental occupation in enhancing income of family. (6) *Small holding Rubber-Integrated Farming System (or Rubber-Integrated Activity Farming System)* (R_6) There are approximately 5.77% of the total small holding 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 the family income due to its excelled economic performance.

METHODOLOGY

The selected study was Songkhla province in

Thailand where there are a total of 136,375 rubber small holders in the eleven systems of small holding rubber-based farms as classified earlier (Somboonsuke and Shivakoti; 2000). The study area was classified into three agroecozones based on three criteria following the methodology as suggested by Trebuit *et al.* (1983) and Conway (1985): (1) topographic characteristics (primarily land slope), (2) land use and bio-diversity of rubber cultivation, and (3) socio-economic characteristics. Three representative communities of agroecozones (Khao Phra community, Ratthaphum district (agroecozone I), Phijit community, Namon district (agroecozone II) and Klong Phea community, Cha Na district (agroecozone III)) were selected using a purposive sampling method with the following criteria: (1) the communities were included as a target area of the Provincial Rubber Development Plan under the Rubber Development Strategic Plan of 1999-2003, (2) these represented each of the 6 classifications in these areas, (3) there were a large number of small holding farms (more than 70% of

all rubber farmers) involved in rubber production, (4) there was variation in topography for comparison of farms among agroecozones, and (5) rubber-small holders had faced constraints in their production system (DOAE, 1999). The 376 small holding rubber-based farms were selected using cluster and simple random sampling methods by using questionnaires (Table 1). Data were analyzed using SPSS.

RESULT AND DISCUSSION

1. Demographic data of rubber-small holders

The demographic data of small holders in systems of rubber-based farms were shown in the table 2 as following (1) Age (*AGE*); The average age of the small holders was 45.3 years with the maximum and minimum was of 50.3 years in R_1 and 41.3 years in R_{42} . It indicated that the majorities of small holders, presently, were over 40 years of age.

Table 1 The number of sample in study.

Type of system case	Number of farm
1. Rubber-monocultured farming system(R_1)	33
2. Rubber-pine apple farming system(R_2)	44
3. Rubber-rice farming system(R_3)	44
4. Rubber-durian farming system(R_{41})	32
5. Rubber-mangosteen farming system(R_{42})	36
6. Rubber-durian-mangosteen farming system(R_{43})	22
7. Rubber-durian-mangosteen-Rambutan farming system(R_{44})	28
8. Rubber-Chicken farming system(R_{51})	42
9. Rubber-Cattle farming system(R_{52})	34
10. Rubber-Goat farming system(R_{53})	24
11. Rubber-durian-fishery farming system(R_{61})	37
Total	376

(2) *Education Experience (EDU)*; The average of education experience was 9.1 years (First secondary school) with the highest and lowest was 10.68 years (above secondary school) in R_{43} , and 7.33 years in R_1 (just literate). (3) *Farm Size (FSS)* The average farm size was 2.8 hectares per family with the highest and lowest farm size were 3.8 hectares in R_3 and 2.1 hectares in R_{44} . It indicated that rubber-rice farming system (R_3) was the highest farm size, while rubber-durian-mangosteen-rambutan farming system (R_{44}) was the lowest farm size. It indicated that small holders are, at present, hold land less than the national agricultural land holding size (2.32 ha per family)(RRIT, 1999). (4) *Farm labor (FA)* The average of farm's labor was 2.24 persons per family with the highest and the lowest were 2.72 persons in R_1 , and 1.75 persons in R_{44} . The results was indicated that there was move out of farm of family labor in the system of rubber-monocultured farm, but in the system of rubber-fruit tree farm, there was necessary to rent off-farm labor. (5) *The Accessibility to Sources of Information(AIN)*; The average of accessibility to sources of information was 2.30 in the criteria of low level of accessibility to sources of information in community. Table 2 showed that small holders in all systems have low accessibility to sources of information, especially, in R_1 , R_2 , and R_3 . Although almost of small holders have and mainly get information from TV program, they are not very interested in agricultural program. And also, the result showed that small holders in all systems are accessibility to sources of information. (6) *Small holders' information Exposure(INE)* The result showed that small holders, at present, are low information exposure with the

average of 2.05. When the comparison among systems, the system of rubber-cattle farm (R_{52}), and rubber-durian-mangosteen farm (R_{43}) were similar the highest with 2.31, while the system of rubber-rice farm (R_3) was the lowest of 1.70. And also, the result showed that all of small holders, at present/presentiy, are low level information exposure. (7) *Individual Contract (ICA)*; The small holders, present, are little level of individual contract with change agent in community with the total average of 2.26. There were many constraints faced as the sufficient change agent in community, inefficient extension program, and inefficient the ability of change agent that influent on individual contract with change agent in community. When the comparison among systems, it was found that the system of rubber-pineapple farm (R_2) was the highest individual contract with 2.59 (moderate level), while the system of rubber-chicken farm (R_{51}) was the lowest with 2.02 (little level). Normally, small holders in livestock production system have experienced in management for a long time and get it from their ancestors; thus they are not necessary to get new information. (8) *Farm Capital for Investment (CFI)*; The average of farm capital for investment was 9,895.54 baht per hectare per year. The system of rubber-durian farm (R_{41}) was the highest farm capital for investment at the average of 15,174.38 baht per hectare per year, while the system of rubber-durian-mangosteen farm (R_{43}) was the lowest farm capital for investment at 6,760.68 baht per hectare per year. (9). *Fertilizer Utilization (FUF)* The average of using fertilizer of farm was 1,624.37 kg per hectare per year. When the comparison among systems, in was found that the system of rubber-cattle

farm (R_{52}) was the highest using the quantity of fertilizer at 7,944.51 kg per hectare per year, while the system of rubber-durian farm (R_{41}) was lowest at 811.06 kg per hectare per year. Small holders, normally, use the similar fertilizer in both rubber and other crops and there were a few sources of fertilizers in community. (10) *Small holders' occupation Experience (AEF)*; The average of small holders' occupation experience was 20.18 years with the highest and lowest of 23.67 years in R_1 and 16.90 years in R_{43} . (11) *Small holders' agricultural Knowledge and Skill in Management (KUA)*; The average of small holders' agricultural knowledge and skill in management was 2.04 in the low level of small holders' agricultural knowledge and skill in management. When the comparison among systems, small holders in the system of rubber-pineapple farm (R_2) are the highest with at average of 2.52(low level), while small holders in the system of rubber-monocultured farm (R_1) are the lowest at the average of 1.82(low level) due to, small holders have experienced in rubber production for along time, thus it is difficult to change and receive new technology and also, they mainly, get information from their ancestors, thus they are not necessary to get information from out side of community. (12) *Small holders' adjustment Need for Better Productivity (SAN)*; The average of small holders' adjustment need for better productivity was 2.26 in the little need with the highest and the lowest were 2.90 (moderate level) in the system of rubber-monocultured farm (R_1), and 2.04 (little level) in the system of rubber-rice farm (R_3). Small holders in the system of rubber-monocultured farm (R_1), normally, need more

activity for supplement of rubber occupation; thus it is necessary for them to adjust their implementation strategies. (13) *Dairy Working Period(DWL)*; The average of dairy working period was 6.58 hours per day per labor. When comparison among system, it was found that dairy working period of labor in the system of rubber-cattle system (R_{52}) was the highest with 9.38 hours per day per labor, while in the system of rubber-durian farm (R_{41}) was the lowest with 4.31 hours per day per labor. (14) *Equipment, Machinery, and Building Utilization (EBM)*; Small holders were little use equipment, machinery, and building in operation with the average of 1.78. The highest was 2.18(low level) found that in the system of rubber-durian-fishery farm (R_{61}), while the lowest was 1.30 (never level) that founded the system of rubber-durian farm (R_{41}). (15) *Small holders' participatory Through Group Activity (PTG)*; The average of small holders' participatory through group activity was 2.37(little level). The highest average of 2.80(moderate level) in rubber-mangosteen (R_{42}), while small holders in the system of rubber-rice farm (R_3) were the lowest participatory through group activity with the average of 1.83 (little level). (16) *Farm Household Income (FI)*; The average of farm household income was 134,537.58 baht per hectare per year, when comparison among systems, the system of rubber-durian-fishery farm (R_{61}) was the highest farm household income with 224,464.80 baht per hectare per year, while the system of rubber-monocultured farm (R_1) was the lowest farm household income with 48,827.71 baht per hectare per year.

2. Small holders' decision making process leading to farm transformation

Table 2 Demographic data of small holding rubber-based farming systems case study in eleven systems.

Item	Small Holding Rubber-based Farming System (R)										Average	
	R ₁ (n = 33)	R ₂ (n = 44)	R ₃ (n = 44)	R ₄₁ (n = 32)	R ₄₂ (n = 36)	R ₄₃ (n = 22)	R ₄₄ (n = 28)	R ₅₁ (n = 42)	R ₅₂ (n = 34)	R ₅₃ (n = 24)	R ₆₁ (n = 37)	R ₆₁ (n = 376)
1. Average Age (AGE) (yr)	50.3	47.1	47.3	46.6	41.3	42	45.5	47.1	46.6	41.9	42.5	45.29
2. Average Education (EDU) (yr)	7.33	8.16	7.47	8.03	9.14	10.68	9.61	9.45	9.68	10.11	10.38	9.09
3. Farm Size (FSS) (hectare)	2.57	3.16	3.8	2.75	2.25	2.36	2.08	2.63	3.58	3.11	3.12	2.86
4. Farm Labor (FA) (person)	2.72	2.2	2.43	2.38	2.14	1.91	1.75	2.3	2.29	1.93	2.54	2.24
5. Accessibility to sources of Information level (AIN)	2.05	2.29	2.27	2.27	2.35	2.32	2.38	2.28	2.29	2.51	2.31	2.30
6. Information Exposure Level (INE)	1.82	1.9	1.7	2.12	2.17	2.31	1.89	2.12	2.32	2.19	2.05	2.05
7. Information Contract Level (ICA)	2.57	2.59	2.13	2.34	2.11	2.36	2.11	2.02	2.23	2.19	2.19	2.26
8. Small Holder's Occupation Experience (AEF) (yr)	23.67	20.37	20.93	21.31	17.44	16.9	19.85	23.52	22.74	18.44	16.85	20.18
9. Knowledge and Skill Level (KUA)	1.82	2.52	1.93	2	1.92	1.96	1.93	2.14	2.08	1.96	2.16	2.04
10. Adjustment's Need (SAN)	2.9	2.21	2.04	2.06	2.11	2.05	2.43	2.15	2.21	2.37	2.32	2.26
11. Diary Working Period (DWL) (hr/day)	6.15	6.82	6.91	4.31	6.11	6.86	6.82	5.93	9.38	7.04	6.08	6.58
12. Equipment and Machinery Using Level (EBM)	1.58	1.73	1.54	1.3	1.89	1.82	1.83	1.79	1.91	1.97	2.18	1.78
13. Participation Through Group (PTG)	2.13	2.29	1.83	2.39	2.79	2.53	2.51	2.48	2.43	2.22	2.51	2.37
14. Farm's capital (CFI) (Bath/ha/yr)	10,379.15	7,554.55	10,494.1	15,174.4	7,689.86	6,760.68	8,875.5	10,743.5	9,373.59	8,199.93	13,655.7	9,895.54
15. Farm's Income(SEP)(Bath/ha/yr)	48,827.71	62,930.4	61,476.6	137,145	92,251.6	122,223	254,049	182,350	187,255	106,940	224,465	134,537.58
16. Fertilization(FUF) (kg/ha/yr) ⁽¹⁾	842.12	1,547.05	1,016.84	811.06	734.72	818.63	1,375.35	814.74	7,944.1	1,036.67	926.22	1,624.37

Sources: Field Survey,2000 From 376 Small Holding Rubber-based Farms

Remark⁽¹⁾ : In R₅₁, R₅₂, R₅₃, Separate Calculation of Fertilizer for Rubber and feed for animal

: The measurements of variables: AIN, INE, ICA, AEF, KUA, SAN, EBM, and PTG are scaling movement by means Interval range $\bar{X} = 1.00-1.75$ mean never level, $\bar{X} = 1.76-2.50$ mean low level, $\bar{X} = 2.51-3.25$ mean moderate level And $\bar{X} = 2.56-4.00$ mean much level

The socio-economics and bio-physical factors affecting the changes to the agricultural production systems are shown in Figure 1;(1) Small holding rubber-monoculture farms (R_1) will be able to change to small holding rubber-fruit tree farms given sufficient water resources, farm size and available labor, and to small holding rubber-integrated farms if condition such as product price, farm size, and available labor are met. (2) Small holding rubber-intercrop farm (R_2) will be able to change to small holding rubber-fruit tree farms (R_4 including: R_{41} , R_{42} , R_{43} and R_{44}) and small holding rubber-livestock farms (R_5 Including: R_{51} , R_{52} , R_{53}) if condition of product price and available labor are met, and to small holding rubber-integrated farms (R_6) if product price, farm size and available labor are satisfied. In addition, it can change to a small holding rubber monoculture farm (R_1) under limitations of farm labor, water resources, product price, government plan and policy and technological knowledge. (3) Small holding rubber-rice farm (R_3) will be able to change to small holding rubber-fruit tree farms (R_4) if the soil is fertile; to small holding rubber-integrated farm (R_6) under suitable conditions of product price, farm size and topography; and to small holding rubber monoculture farms (R_1) if water resources are adequate. (4) Small holding rubber-fruit tree farms (R_4) will be able to change to small holding rubber-monoculture farms (R_1) if water resources are limited, or farm equipment, farm labor, product price and inconvenient communication for production transportation. (5) Small holding rubber-livestock farms (R_5) will be able to be changed to small holding rubber-fruit tree farms (R_4) or to small holding

rubber-integrated farms (R_6) under certain conditions, i.e. good marketing system, product price, capital for investment, extension policy, suitable varieties, climate, water resources and smallholders' experience and motivation; and also they can change to small holding rubber monoculture farm (R_1) under limited conditions of feed and fertilizer in the community, farm labor, capital for investment. (6) Small holding rubber-integrated farms (R_6) will be able to change to small holding rubber-fruit tree farms (R_4) under suitable conditions of farm labor and water resources; and to small holding rubber-rice farm (R_3) under suitable conditions of farm labor. Also, it can change to small holding rubber monoculture farm (R_1) under limited conditions of farm size, farm labor, water resources, farm capital, soil fertility, product price and variety.

Summary results indicated that trend and development at small holding rubber-fruit tree farming system and small holding rubber-integrated farming system will be relatively well known and extensively discussed in recent year due to high opportunity in change from other small holding types to these types, when suitable condition, meanwhile, under unsuitable conditions, all small holding types will be able to change to small holding rubber-monocultured farming system. Then, it can be said that rubber is traditional farming choice of many southern Thai farmers, and adapting to new condition is accepted as necessary from time to time, as the above explanation shows.

3. Significant variables for farm household income

To identify the significant empowerment factor for farm household income, thirteen variables

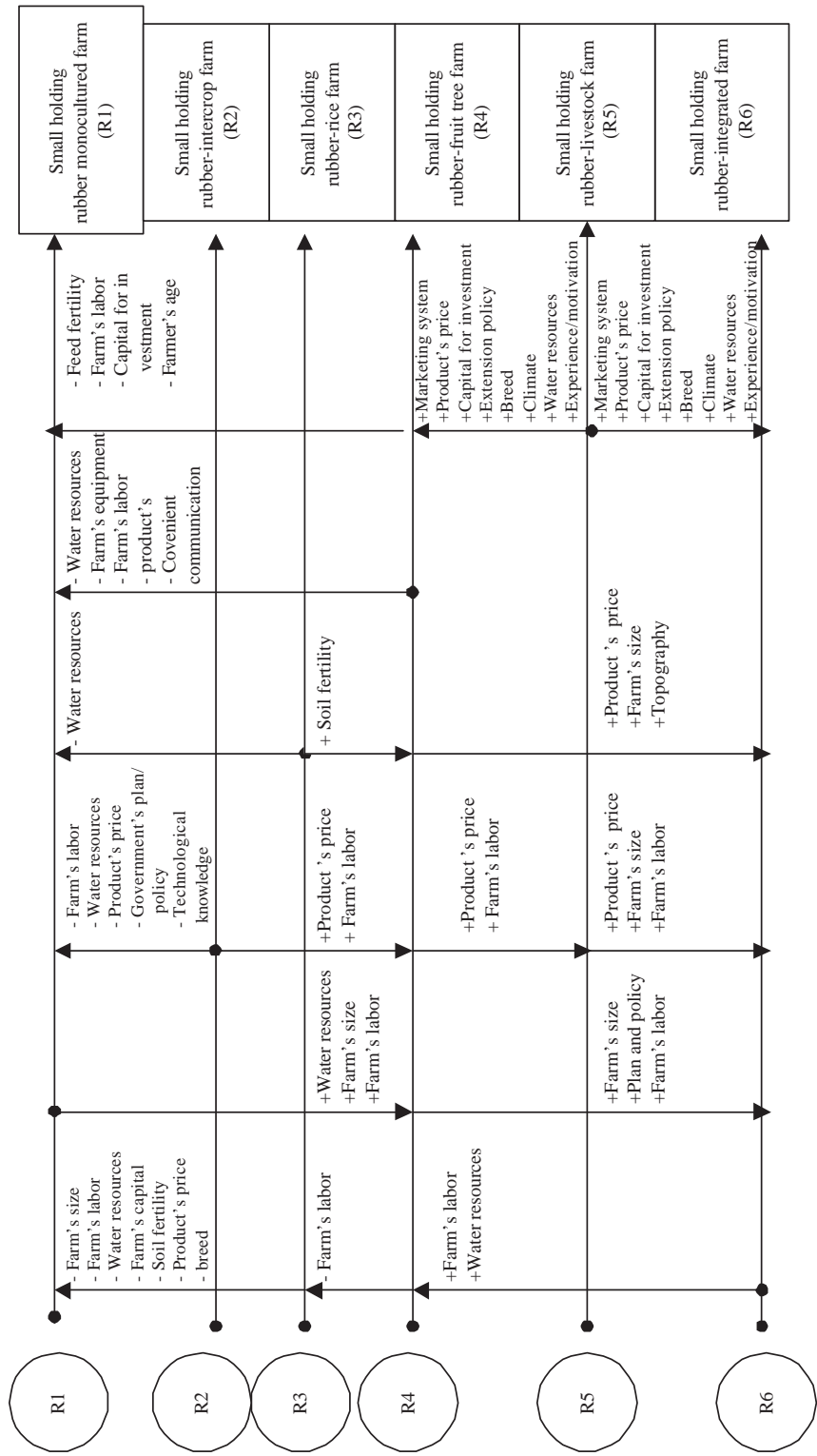


Figure 1 Small holders' decision making process
Sources: In-depth interview of PRA method and Secondary data.
Remark: -: unsuitable condition
+: suitable condition

were selected: education experience or *EDU* (X1), occupational experience or *AEF* (X2), adjustment need or *SAN* (X3), small holders' participation through group activities or *PTG* (X4), accessibility of sources of information or *AIN* (X5), individual contact 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 daily working period of total farm labor or *DWP* (X13). Stepwise forward regression estimation procedure was followed. The dependent variable (*Y*) was farm household income that was the aggregate income of all farm activities. The following regression model was used:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \epsilon$$

Where *Y* = Vector of explained indicator or dependent variable; farm household income

*X*₁....*X*₁₃ = Vectors of explanatory indicators.

β_0 = Intercept to be estimated

β_1 β_{13} = Coefficients to be estimated

ϵ = Vector of error term

The estimation equation, and standardized equation function of eleven systems in table 3 shows that every unit addition of smallholders' participation through group participation (*PTG*), accessibility to sources of information (*AIN*) are important variables. This indicates that group participation enables smallholders to organize themselves, to identify

needs, to share ideas among membership, and to evaluate farm activity to improve farm management. The accessibility to sources of information in the community and agricultural knowledge and skill in management enable smallholders to easily adjust their approach to management, to understand and evaluate situations, to set plans and implementation strategies, and also to decrease the risk of farm management. The optimum level of using fertilizer also influence the increasing of farm production toward increasing farm household income.

4. The significant explanatory correlation for farm household income

The accessibility to sources of information (*AIN*) and smallholders' participation through group (*PTG*) are the main significant explanatory correlation of small holding system for farm household income (Table 3 and 4) at the significance of 0.01 and 0.05 confident level, and they have both positive relationship with farm household income. It indicated that the government should enhance the local group and decision making process. Also, the sources and services of information in community, especially, change agent and television program should be improved.

5. Recommendation for the possible strategies to increase farm productivity

Table 4 presents the significant explanatory variables, namely accessibility to sources of information(*AIN*), small holders' participatory through group activities (*PTG*), agricultural knowledge and skill in management (*KUA*) and using fertilizer (*FUF*) have influenced farm household income. Thus, small holder should have had to adjust with policy

Table 3 Selection of significant explanatory variables from regression analysis of rubber-base farming system.

Explanatory variable	Explained variable (Y) : Farm household Income										
	Y _{R1}	Y _{R2}	Y _{R3}	Y _{R41}	Y _{R42}	Y _{R43}	Y _{R44}	Y _{R51}	Y _{R52}	Y _{R53}	Y _{R6}
AGE						-12.615 (-0.404)***					
EDU											
FSS											
AIN	1183.05*** (0.083)***	2578.118*** (1.148)***		2996.203*** (0.699)***	1842.416*** (1.137)***	2548.002*** (1.015)***	3537.360*** (0.780)***	2308.548*** (0.801)***	2202.493*** (0.827)***	978.923*** (0.634)***	2649.162*** (0.725)***
FAL											
INE											
ICA											
CFI							0.338** (0.214)**	0.468 -0.083			
FUF			2.486*** (0.594)***						0.249** (0.189)**		
AEF								91.959*** (0.217)***			
KUA											
SAN											
GTP	0.942*** (0.520)***	1.785*** (0.736)***	0.645** (0.344)**	3.079*** (0.474)***	1.813*** (0.804)***	1.767*** (1.210)***	1.445*** (0.692)***	1.441*** (0.800)***	3.119*** (1.202)***	1.508*** (1.051)***	2.241*** (1.033)***
EMB		-836.471** (-0.146)**									
DWL		-701.344** (-2.100)**		289.131** (0.106)**							
CONSTANT	-1408.369**	-2231.103**	770.543	-9871.515***	-3530.896***	-4494.689***	-7928.096***	-5635.487***	-10014.12***	-1179.614***	-9259.534***
R ²	0.65	0.884	0.347	0.936	0.929	0.898	0.889	0.824	0.825	0.582	0.777
R ² adjust	0.627	0.872	0.315	0.929	0.925	0.881	0.875	0.805	0.808	0.548	0.757
SE. of regression	108.45	127.717	269.507	172.156	392.774	94.122	235.238	186.053	170.072	148.655	211.073
F-Value	20.585***	74.174***	10.898***	136.556***	216.860***	52.724***	63.838***	57.841***	47.253***	16.742***	38.377***
Durbin-Watson	1.901	1.848	1.521	2.031	1.793	2.530	15.60	2.172	1.833	1.534	2.450

Remark: (1) The understandardized Coefficients (B) and figure in parenthesis is Standardized coefficient (Beta) with significant t-value (*)

*** significant at 1 percent level (P<0.01)

** significant at 5 percent level (P<0.05)

Table 4 The estimate and Standardized Regression Equations of the eleven smallholding rubber-based farming system.

Rubber-based farming systems	The estimated regression equation (y)	The standardized regression equation (Zy)
1. Rubber-monocultured farming system(R ₁)	$YR_1 = -1408.369 + 1183.05AIN + 0.942PTG$	$Zy_{R1} = 0.803Z_{AIN} + 0.520Z_{PTG}$
2. Rubber-pine apple farming system(R ₂)	$YR_2 = -2231.103 + 2578.118AIN + 1.785PTG - 836.471EBM-701.344DWL$	$Zy_{R2} = 1.148Z_{AIN} + 0.736Z_{PTG} - 0.146Z_{EBM} - 2.100Z_{DWL}$
3. Rubber-rice farming system(R ₃)	$YR_3 = 770.543 + 2.486FUF + 0.645PTG$	$Zy_{R3} = 0.594Z_{FUF} + 0.344Z_{PTG}$
4. Rubber-durian farming system(R ₄₁)	$YR_{41} = -9871.515 + 2996.203AIN + 3.079PTG + 289.131DWL$	$Zy_{R41} = 0.699Z_{AIN} + 0.474Z_{PTG} + 0.106Z_{DWL}$
5. Rubber-mangosteen farming system(R ₄₂)	$YR_{42} = -3530.896 + 1842.46AIN + 1.813PTG$	$Zy_{R42} = 1.137Z_{AIN} + 0.804Z_{PTG}$
6. Rubber-durian-mangosteen farming system(R ₄₃)	$YR_{43} = -4494.689 + 2548.002AIN + 1.813PTG$	$Zy_{R43} = 1.015Z_{AIN} + 1.210Z_{PTG}$
7. Rubber-durian-mangosteen-Rambutan farming system(R ₄₄)	$YR_{44} = -7928.096 + 3537.360AIN + 0.338CFI + 1.445PTG$	$Zy_{R44} = 0.780Z_{AIN} + 0.214Z_{CFI} + 0.692Z_{PTG}$
8. Rubber-Chicken farming system(R ₅₁)	$YR_{51} = -5635.487 + 2308.548AIN + 0.468CFI + 91.959AEE + 1.441PTG$	$Zy_{R51} = 0.801Z_{AIN} + 0.083Z_{CFI} + 0.217Z_{AEE} + 0.800Z_{PTG}$
9. Rubber-Cattle farming system(R ₅₂)	$YR_{52} = -10014.120 + 2202.493AIN + 0.249FUF + 3.119PTG$	$Zy_{R52} = 0.827Z_{AIN} + 0.189Z_{FUF} - 1.202Z_{PTG}$
10. Rubber-Goat farming system(R ₅₃)	$YR_{53} = -1179.614 + 978.923AIN + 1.508PTG$	$Zy_{R53} = 0.634Z_{AIN} + 1.051Z_{PTG}$
11. Rubber-durian-fishery farming system(R ₆)	$YR_6 = -9257.534 + 2649.12AIN + 2.241PTG + 1397.583EBM$	$Zy_{R6} = 0.725Z_{AIN} + 1.033Z_{PTG} + 0.201Z_{EBM}$

support through the

1. enhancement of the small holders' participation through local small holders' group activity, and also, enhancement of local small holder group activities with emphasis on participation of members,

2. provision of appropriate training course to increase knowledge, attitude and skill in practice and management and,

3. use of the optimum level of fertilization and decreased use of chemical fertilizers.

5.1 Recommendation for the strategic development of rubber small holder

5.1.1 Improvement in local information system

The possible strategies to improve local information system are proposed as follows:

5.1.1.1 Establishment of Village Information Committee (VIC) for sharing the knowledge of rubber production and marketing such as price situation, rule and regulation from government offices of ORRAF, DOAE in district level. The committee should comprise of village committee leader. The membership should comprise of small holders in villages including ORRAF official, rural officer, representative of sub-district administrative office, and Tambon agricultural extension worker.

5.1.1.2 Improvement in the sources of information in village through responsible members of VIC. The sources of accessible information, available in the village comprises the village radio tower, village newspaper place, village leader office, and meeting check point of local government officials in village such as ORRAF fertilizer point in village. These sources of information should provide small

farmers with (1) daily news about farm gate price of production,(2) the knowledge of modernized agriculture such as varieties, fertilizer, practice and management by means training system, and visiting farm (3) the accessibility to low cost of input factor. In addition, VIC should plan for coordination and cooperative with government offices and merchandise for providing and improving information in the village.

5.1.2 Increasing Education Experience

The result of this study shows that the level of education of rubber small holders is low, which affects the adoption and diffusion process of innovation in local community. Thus, the possible strategies to improve the education of rubber small holders are as follows :

5.1.2.1 Providing opportunity for education of new generation through Agricultural Program of agriculture and technology college and also, informal school program.

5.1.2.2 Establishment of Friday agricultural school for farmer in village through villages school together with extension worker. Small holder should exchange their ideas and knowledge and also hold discussion among small holders, and government officers every week.

5.1.2.3 Training during rubber production period such as tapping technique for improvement of rubber quality, Marketing strategy, price, group processing system and participation, and rubber industrial system for increasing value are necessary for small holders.

5.1.3 Improvement in Local Farmer group Formation and Participation

5.1.3.1 Encourage and strengthen Rubber

group activities such as rubber sheet making group, and rubber latex group by means of:

- Arranging training courses about group system dynamics and its benefits to the member

- Establishment of fund for members in investment. This fund should come from the small percentage contribution of members through the sale of their products.

- Enhance participation of members through group operation such as mutual decision-making process in solution the group constraint and group strategic planning.

- Improvement in the communication within group by means of improved sources of information and setting Group Information Committee (GIC) to inform relevant matters to members

- The efficient monitoring system of group operation by setting group committee of government and private officials including farmers.

- Providing agricultural knowledge through training and field trip.

5.1.3.2 Agricultural business management knowledge system

- Transfer the knowledge of small enterprise management through training system

- Establish the village agri-business administered through Village Fund Committee (VFC) together with extension worker.

CONCLUSION

Although rubber smallholders have a low level of primary schooling, they have significant occupational experience that influences their

empowerment such as decision-making process in farm management and decreasing management risk.

In addition, the adjustment needs indicate that smallholders can understand and evaluate the current situation, however, presently, they are little empowered because they are faced with many constraints involving the low level of smallholders' adjustment need, inefficient government plans and policy implementation low level of individual contact with change agents in the community, low information exposure, low knowledge and skill in practice and management, low accessibility to sources of information, low level of understanding of casual agents of their expenses and income, and low level of group participation. Altogether, these indicate that the full development of small holders' potential and ability should be the first task of agricultural development in community. It was also found that the two factors most influencing farm household income included group participation and accessibility to sources of information, The group participation is the most influential factor affecting farm household income. Thus, the enhancement of group activity and smallholders' participation therein are the first suggestions for increasing smallholders' capacity.

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