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Identifying farm risk management strategies of rubber farmers: A study in Southern Thailand

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Abstract

This study aims to identify and analyze the farm risk management strategies of rubber farmers in Southern Thailand. The study also provides efforts to examine the factors influencing risk management strategies in rubber farming in Thailand. The data were collected from a cross-sectional household survey conducted in Songkhla and Phatthalung Provinces of Thailand. A standardized and structured questionnaire was used to gather data from a total of 400 respondents. A number of statistcal tools such as descriptive statistics and multiple regression model were employed to analyze the data. The findings revealed that the rubber farmers adopted 8 (eight) main strategies to manage the risks in rubber farming, namely i) diversification in production, ii) market management, iii) labor and contract management, iv) decreasing production costs, v) production planning, vi) increasing non-farm employment, vii) debt management and viii) using high frequency tapping systems. The study also identified a number of factors including age, gender, level of education and farming experience of the farmers, number of household members, non-farm labor, off-farm labor, hired-labor, household income, debt, landholding size, participation in replanting scheme with RAOT, and membership in farmer institution that affect significantly (with the confidence level > 90%) the risk management strategies of the rubber farmers. Finally, the study recommends that the government should support and promote the research and development on risk management strategies in agriculture sector so that the farmers and farmer institutions can achieve more knowledge and efficiency to cope up successfully various risks in rubber farming in Thailand.

Keywords: Farm risk management, strategies, rubber farmers, Thailand.
Abbreviations: FAO_Food and Agriculture Organization; OECD_Organization for Economic Cooperation and Development; RMS_Risk Management Strategies; RAOT_ Rubber Authority of Thailand; PCA_Principal Component Analysis; KMO_Kaiser-Meyer-Olkin

Introduction

According to Solomon and Ruiz (2012), risk and uncertainty are two different concepts, and it is important to be clear about their contents and impacts in the agricultural sector. On the other hand, Siegel (2005) indicates that risk and uncertainty are two terms associated with losses and are often used as synonyms. However, risk can be defined as imperfect knowledge and its probabilities are known, while uncertainty exists when its probabilities are unknown. In another way, risk is the deviation between what is expected to happen and what actually happens. This deviation can be positive or negative, but from a practical point of view, negative deviations are the focus of analysis for risk management (Schaffnit-Chatterjee, 2010).

Farming is a production process that involves high risks and uncertainties which affect or damage, failure and vulnerability, or reduce the chance of farm's achievement. Decision-making on production needs to concern about the uncertainties and risks associated with production process. Jaffee et al. (2010) defines firm risk as the possibility that an uncertain event occurs and has a negative impact on the objectives of the producer or firm, which also impacts the production chain. Uncertain events that contribute highly to the risk of the business or agricultural operation can be climatic emergencies, variations in imported inputs, rise in fuel prices, variations in the exchange rate, etc. Since firm risk depends not only on local events but also on international events, farmers and local and national government authorities need to pay attention to the changes of prices of their different production items in the international market (Solomon and Ruiz, 2012).

The sources of significant farm risks can be categorized as below: (a) market and price risks which related to the changes in market and price, growth or decline in demand's and supply and incontrollable and unpredictable in input cost, (b) production risks due to the productivity in agriculture depends on biological factors, climate and geography which are affected by the climate change, pest and disease, and natural disaster, and also the tools,

equipment, production technology, (c) finance risks as for the loan for agriculture, there is no future's fixed interest, lack of capacity for continuous loan when necessary, (d) risks from government's policies, laws and institutions such as originated from unpredictable changes from government's policies and formal and informal laws relating to agriculture. (OECD 2009, 2011; Kahan, 2008; World bank, 2016).

The above-mentioned risks can negatively affect farmers' households in three aspects which are as below:

- Hazard, the risk that once happens will widely affect or damage at micro, meso, and macro level. The hazards are price crisis, natural disasters (flood, draught, or storm).
- Vulnerability from lack of capacity, readiness, and limitations in dealing with inefficiency, lack of production resources and resilience when facing the risks. Some vulnerabilities are from private conditions, micro level and the production structure depends on society's background, economy, environment and policy or organizations which could affect the living fund and choices of living strategy.
- Exposition to risk is the identification of production or possible activities that will be affected from risks, uncertainties, vulnerabilities originated from farms. This could affect the ability to expose to the risks further. Direct and indirect exposition will affect the possibility of micro-level's well-being achievement. (OECD 2009; World bank, 2016).

The World Bank opines that agriculture is undoubtedly the riskiest sector of the economy and that, moreover, it has a direct effect on rural areas of a country. If the farm risks are not managed properly, it can limit income for farmers and consequently access to basic services (education, health, among others) for human well-being. In turn, the development of businesses or entrepreneurship in agriculture would be discouraged. Therefore, the farmers should be aware of the risks and the possibility of failure or loss that will occur, and apply the proper risk management strategy which aims at risk reduction, risk mitigation, risk coping, and risk avoidance. Farm risk management begins with the decisions made by the owner or manager of the field. These decisions answer questions about what products to plant, how to distribute the land, what materials and techniques to use (Schaffnit Chatterjee, 2010). It was also reported that decisions such as diversification of farm activities (both on-farm and off-farm) usually contribute to reducing risk. In addition, the level of integration of the farmer in the production chain also contributes to reduce the farm risks (Tura et al., 2016). For example, vertical integration is one in which a product is controlled from the field to various levels of the production chain, this typically reduces the risk associated with variation in quantity and quality of inputs (backward integration) or outputs (forward integration). However, risks such as droughts, floods, or price shocks that affect a large population at the same time are more difficult to manage within the sector. There is also categorization according to the actions taken to deal with the various types of risks. Farmers can try to reduce the probability of occurrence of an adverse event. In the absence of exposure to risk or mitigation, farmers must deal with adverse events once they occur, that is to cover losses with direct payments or to have income/profits assured (Shah et al., 2022; Heimans, 2013).

Rubber cultivation is one of the significant commercial and economic activities in Thailand. It generates incomes and employment which are significant to the life and living of 1.4 million rubber farmers households in the country. In 2016, the overall area of rubber plantations in Thailand was 24.6 million Rai (1 Rai = 1,600 sq. m.). Its 17.9 million Rai was the tapping area, contributing rubber produce 4.3 million tons. The income from export of raw rubber was estimated to be 155,753 million baht and 230,660 million baht from processed rubber. Almost all rubber products are produced by the smallholder farmers (Office of Agricultural Economics, 2017). Nearly 95% of the smallholder farmers occupy, on average, 15 Rai of land area for cultivation.These smallholding farmers are experiencing the risks from various sources including climate change and natural disaster, finance, government policy, marketing, farming and households, labor, production techniques, lands, and rubber prices (Charernjiratragul & Kongmanee, 2017). The farmers are required to manage the risk in order to maintain their households' wellbeing.

During 1985 to 2000, the rubber price had decreased regularly worldwide and started to increase at the end of 2000 because of the expansion of rubber's demand in global market. Subsequently, there was a boom in rubber price between 2002 and 2012. Afterwards, the rubber industry experienced a continuous dropping in the rubber price. The year of 2018 marked the sixth year of rubber price crisis in which the farmers observed the low price of rubber (Rubber Authority of Thailand, 2016). Throughout this time, it was the farmers who had to accept the lowest price of their products without any controlling power over it. However the effect of price risk on the farmers and their responses to the risks were different (FAO, 2008; OECD, 2011). In this circumstance, the Thai government provided efforts to execute the rubber expansion policy by implementing a project to support cultivation of 1.0 million rai rubber plant during 2004 - 2013. Consequently, there was an expansion of cultivating area 1.7 times. The rubber cultivation area increased from 12.62 million Rai in 2003 to 22.48 million Rai in 2016. Most of the new rubber plants was found in the North Eastern, the North and the South Thailand accordingly. In addition, there was a significant increase in new farmers including small, middle, and large landholding. In contrast, the existing farmers expanded the rubber cultivation to replace food crop areas and flooded land which are not suitable for growing rubber trees. However, the rubber farmers face various risks and uncertainties related to rubber farming. Firstly, the farmers have to compete with the higher cost of production such as land, labor, and capital. Secondly, investing in a rubber plantation requires a high quantity capital. Thirdly, once the decision is made, there is no change in rubber production period. Fourthly, after 5-7 years of plantation, the rubber trees start yielding and remain productive for more than 25 years. During this time, the farmers have to face the risks and uncertainties which affect farm outcomes and consequently income level and well-being in livelihood. In these circumstances, the farmers need to apply risk management strategies to cope, imitate, reduce and avoid the risks at ex-ante and ex-post. However, there is no empirical study yet to focus on the risk mamagement strategies the farmers are applying in rubber farming in Thailand. Therefore, this study aims to identify and analyze the farm risk management strategies of rubber farmers in Southern Thailand. The study also provides efforts to examine the factors influencing risk management strategies in rubber farming in Thailand.

Results and Discussions

Socio-economic characteristics of rubber tree farmers

The analysis used descriptive statistics of variables illustrated in table 1. The farmers' average age was 54.9 years. Their average experience of farming was 24.5 years. 54.6 percent of all farmers had no more than elementary education. The average household's members were 3.9 people. The average land possessed was 14.9 Rai. 45.4 percent of all farmers had another job apart from the agricultural sector, on average 1.68 people. 15.3 percent of all farmers were wage-earner as a rubber-tapper. The other 20.6 percent was employing others to conduct rubber-tapping.

The risk management strategy of rubber tree farmers' households

The rubber farmers chose to use 73 sub strategies of risk management. Table 2 illustrates the first 20 sub strategies. 4 out of first 10 strategies were finance-related, which were household's expense's reduction ($\bar{x}$= 4.39), household's saving's increase ($\bar{x}$= 4.24), loan from formal loaners rather than informal loaners ($\bar{x}$= 4.18), and household's debt's reduction ($\bar{x}$= 4.13). The strategies involving production accounted for 3 out of the first 10 strategies which were temporary tapping contract ($\bar{x}$= 4.29), expansion of cultivation area ($\bar{x}$= 4.17), increase of food crops and cattle for consumption or trade ($\bar{x}$= 4.12). Furthermore, other selected strategies were funded/subsidized income strategy which was from income subsidy project ($\bar{x}$= 4.14), employment of skilled temporary tapping labor ($\bar{x}$= 4.12), and promotion for household members' employment outside agricultural sector ($\bar{x}$= 4.12).

The farmers chose to set of risk management strategies to achieve the goal of mitigating, reducing, avoiding, and handling the risks before and after the rubber price crisis during 2013-2018. The decision was made differently depending on the context and conditions of production resources, production system, living, and possible outcomes. The results of risk management, either effective or ineffective, leaded to the response and the adaptability in production system and living. Households with high resilience could adapt and have more survival capability.

Factors that affect the risk management strategies

The data has KMO statistics equals to 0.844 and Bartlett's Test of Sphericity statistics ρ <0.01. It indicates that the data is suitable for conducting components' analysis. The result of risk management strategy's principal components' analysis (PCA) was divided into 8 groups (Table 3). The error could be explained as 50.04 percent. The less weighed variables under 0.40 were omitted. The result of Cronbach's Alpha value was over 0.6 in every component (Hair, 2010). The 8 main components were named as in the components' structure (Table 3) as follows.

The Component 1 (RMS1) described the error of 19.10 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to the production management and diverse production. The component was called the "diverse production system strategy". The Component 2 (RMS2) described the error of 6.69 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to market information, member of agricultural institution, and government's policy's participation. The component was called the "market management strategy".

The Component 3 (RMS3) described the error of 5.33 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to labor contract, labor tapping, and labor contract management. The component was called the "tapping labor and contract management strategy".

The Component 4 (RMS4) described the error of 4.69 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to types of products, area expansion, tapping dates, changing rubber breeds, changing from contract labor to household labor, and grouping for production factors' purchase. The component was called the "reduction of production cost strategy". The Component 5 (RMS5) described the error of 4.19 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to rubber trees' removal, fertilizer, and pest and disease management. The component was called the "production management strategy".The Component 6 (RMS6) described the error of 3.47 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to promotion of household member's employment outside agricultural sector and urban employment. The component was called the "promotion of employment outside agricultural sector strategy".

The Component 7 (RMS7) described the error of 3.28 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to household's debt clearance planning, loan from formal loaners, and debt reduction. The component was called the "financial management strategy". The Component 8 (RMS8) described the error of 3.17 percent of all errors, showing positive correlation coefficient between risk management strategy's variables relating to tapping during no raining days and high frequency tapping method. The component was called the "high frequency tapping system strategy".

The study also employed multivariate regression model to examine the factors influencing risk management strategies adopted by the rubber farmers in Thailand. Table 4 shows the findings related to the socio-economic and other factors that influence the farmers to adopt risk management strategies in rubber farming activities in the country. The model had $\rho < 0.01$ except the model that had $\rho < 0.05$. R^2 was in the range of 0.106-0.278 and the Goodness of fit of every model was low due to the huge difference in prioritizing strategies among farmers, and the farmers chose interdisciplinary risk management strategy. (Meuwissen et al., 2001; Flaten et al., 2005; Aditto, 2011) The study found that the age had a positive relation with the market management strategy (RMS2) ($\rho < 0.05$) and had a negative relation to the financial management strategy (RMS7) (ρ<0.01). When the farmers were getting older, they prioritized the market management more and the financial management less. It was because the older farmers joined the agricultural institutions and were updated to market information but were more resilient over the debt clearance planning and changing loaners. Gender had a positive relation to the market management strategy (RMS2) (ρ<0.01). The male head of households acknowledged the importance of market management strategy more than females. That was because the males had social interaction and joined the market agricultural institutions. Hence, they acquired more opportunities to gain and exchange market information and rubber prices.

Table 1. The descriptive statistics of the respondents.

Variables	Average	S.D.
Age of the head of household (year)	54.9	11.50
Gender	0.52	0.50
Level of Education	0.45	0.49
Farming experience (year)	24.5	12.32
Number of household member (person)	3.9	1.39
Number of labor outside agricultural sector (person)	1.68	0.75
Agricultural wage labor household member	0.15	0.36
Use of tapping labor	0.21	0.41
Size of area possessed (Rai)	14.9	14.63
Household income (Baht/month)	27,382.2	23,049.47
Debt amount (Baht)	256,805.2	584,258.84
Rubber subsidy from Rubber Authority of Thailand	0.41	0.49
Joining agricultural institutions	0.47	0.49
Para rubber agricultural system	0.51	0.50

S.D. = Standard Deviation

Table 2. First 20 strategies from Para rubber farmers (from all 73 sub strategies).

Risk Management Strategies	Mean	S.D.	Rank
Household's expenses reduction	4.39	0.848	1
Household's saving increase	4.24	0.860	2
Choosing formal loaners instead of informal loaners	4.18	0.877	3
Cultivation area expansion	4.17	0.921	4
Receiving farmers' income's subsidy from income subsidy project	4.14	0.985	5
Household's debt reduction	4.13	0.909	6
Hiring skilled temporary tapping labor	4.13	0.842	7
Increase of food crops and cattle for consumption or trade	4.12	1.041	8
promotion for household members' employment outside agricultural sector (factory, company, trading)	4.12	0.920	9
Changing tapping frequency (increase or decrease)	4.09	0.809	10
Promotion of household member's employment in agricultural sector (rubber plantation)	4.05	1.070	11
Use savings in case of insufficient income	4.01	1.052	12
Use of life, health, or accident insurance	4.01	0.936	14
Tapping on no rain days during rainy season	3.99	0.925	15
Change of fertilization by producing homemade fertilizer, changing type and amount properly	3.94	0.908	16
Expansion of fruit trees plantation instead of rubber trees (durian, rambutan, banana)	3.94	0.914	17
Use of rubber-based intercropping system to promote diverse production system	3.94	0.989	18
Good connection with rubber farm's owner	3.93	1.010	19
Debt clearance planning by prolonging or refinancing	3.90	0.898	20

Remarks: In decoding the result, the score of 1.00-1.49 ranked the lowest, 1.50-2.49 low, 2.50-3.49 medium, 3.50-4.49 high, and 4.50-5.00 the highest.

Table 3. The result of component score's analysis using Varimax Orthogonal Rotation method of risk management strategies.

Risk management strategies	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8	Communality
Expansion of other commercial plantation area	0.653	0.074	0.037	0.070	0.235	0.144	0.194	0.046	0.581
Intercropping system to increase diversity	0.618	-0.043	0.163	0.126	0.125	0.098	0.202	0.046	0.490
Agriculture with low fluctuation price	0.594	0.254	0.121	0.236	0.047	0.221	-0.094	-0.008	0.643
Use of spare source of water or water management	0.555	0.092	-0.032	0.252	-0.030	-0.017	-0.101	-0.189	0.502
Farming separately to increase diversity	0.522	0.075	0.099	0.048	0.117	-0.028	0.029	0.015	0.587
Fruit trees plantation instead of rubber trees	0.508	-0.207	0.176	0.113	0.447	0.142	0.125	0.012	0.644

Increase stock of cattle or aquatic animals	0.494	0.181	0.056	0.255	0.058	0.314	0.038	-0.087	0.541
Update on market information	0.134	0.764	-0.032	-0.131	0.133	-0.023	0.022	0.000	0.696
Update on global market's change	-0.127	0.706	-0.022	0.009	-0.014	0.202	-0.005	-0.014	0.647
Joining agricultural group or cooperative to produce, process and market	0.118	0.656	0.103	0.163	0.060	-0.09	0.013	0.133	0.569
Joining and following government's rubber price support projects or measures	0.218	0.554	0.097	0.184	0.154	0.205	0.071	-0.002	0.582
Temporary tapping contract	-0.048	-0.068	0.823	0.030	0.095	0.094	0.084	0.000	0.737
Hiring experienced and skilled tapping labor	0.055	-0.003	0.820	0.001	0.103	0.200	-0.059	-0.044	0.744
Advising, monitoring and evaluating labor and contract regularly	0.298	0.127	0.714	0.078	-0.007	-0.144	-0.051	-0.083	0.655
Hiring only quality tapping labor and use low frequency tapping	0.072	0.124	0.702	0.216	0.143	0.079	0.167	-0.018	0.644
Changing Para product (raw sheet, rubber liquid, rubber piece)	0.148	0.079	0.121	0.732	0.007	0.129	0.044	-0.072	0.623
Expansion of rubber plantation area	0.383	0.007	0.022	0.667	-0.028	-0.077	0.039	-0.093	0.643
Changing tapping frequency to be more proper	-0.09	0.329	0.056	0.520	0.285	0.162	0.016	-0.023	0.590
Changing rubber breed from RRIM 600 to RRIT 251	0.272	-0.195	0.192	0.493	0.299	0.146	0.256	-0.07	0.580
Changing from wage labor to household labor	0.056	-0.028	0.037	0.472	0.132	0.097	0.089	0.100	0.480
Farmers grouping for production factor's purchase	0.243	0.397	0.063	0.471	0.087	-0.355	-0.08	0.065	0.656
Rubber trees' removal	0.198	0.094	0.190	0.097	0.637	0.090	0.162	0.038	0.614
Planning pest and disease control	0.151	0.246	0.174	0.092	0.597	0.063	-0.021	-0.034	0.590
Planning use of fertilizer's type and amount	0.087	0.263	0.113	0.097	0.536	-0.106	0.177	-0.009	0.621
Increase of household members' employment outside agricultural sector	0.113	0.103	0.019	0.063	0.058	0.750	0.074	0.010	0.625
Increase of household members' employment in urban area	0.247	-0.005	0.278	0.108	-0.014	0.689	0.043	0.002	0.651
Changing debt clearance plan	0.005	0.060	-0.022	0.116	0.135	-0.002	0.74	0.005	0.659
Applying for loans from formal loaners rather than informal loaners	0.197	-0.029	0.119	0.019	0.020	0.107	0.733	-0.062	0.680
Tapping every no rain day	0.016	0.039	-0.030	-0.071	0.078	0.003	0.011	0.829	0.713
Using high frequency tapping	-0.096	0.059	-0.132	-0.012	-0.146	0.013	-0.046	0.674	0.641
Household's debt reduction	0.35	0.221	-0.017	0.081	0.031	0.18	0.492	0.145	0.608
Using homemade fertilizer	0.105	0.025	-0.075	0.059	0.426	-0.113	-0.202	-0.034	0.517
Eigenvalues	7.875	2.746	2.185	1.924	1.716	1.422	1.346	1.301	
% Cumulative of Variance	19.208	25.906	31.235	35.929	40.115	43.584	46.867	50.04	
Cronbach's Alpha	0.77	0.706	0.809	0.704	0.641	0.59	0.561	0.505	

Table 4. Analysis of multivariate regression model on risk management strategies

Variable	RMS1	RMS2	RMS3	RMS4	RMS5	RMS6	RMS7	RMS8
constant	-0.045	-0.77**	-0.345	0.056	-0.097	-0.197	1.047***	0.223**
AGE	0.51	0.010*	-0.047	-0.082	0.052	-0.039	-0.017***	-0.068
GEN	0.032	0.203**	0.065	0.007	0.029	0.073	0.019	0.022
EDU	0.212**	0.094	-0.002	0.049	0.025	0.022	-0.398***	-0.316***
EPER	0.059	-0.275**	0.010	0.072	0.038	-0.037	-0.069	0.019
NUM	0.074	0.112***	0.024	0.020	0.046	0.041	0.056	-0.057

NONL	-0.014	0.005	0.015	0.052	-0.015	0.250**	0.058	0.037
OFFL	0.009	-0.215	0.038	-0.073	0.008	0.005	0.273**	-0.024
HIRL	-0.263**	-0.289**	1.199***	-0.458***	0.014	-0.021	-0.028	0.039
INCO	0.006	0.005	0.029	-0.007***	0.071	0.029	-0.002	-0.022
DEBT	-0.017	0.002	-0.030	0.002**	0.029	-0.009	0.002**	0.039
SIZE	0.026	-0.004	0.007**	0.012***	0.045	0.078	0.022	-0.008**
RAOT	0.050	-0.341***	0.038	0.060	-0.084	-0.001	0.081	0.318***
SOCI	0.038	0.104	-0.52	-0.004	0.213**	0.059	0.066	-0.194**
FRMT	-0.042	0.026	0.004	0.048	0.034	-0.001	-0.021	-0.029
R^2	0.145	0.190	0.278	0.160	0.106	0.226	0.255	0.254
Dubin-Watson	1.70	1.67	1.75	1.62	2.00	1.72	1.60	1.70
F	4.22***	2.703***	76.22***	6.290***	4.514**	21.251***	6.833***	8.499***

Remarks: Level of significant statistics of models and variables are * P<0.1 **P<0.05 และ ***P<0.01.

Table 5. Independent variables in the model

Variables	Meaning
AGE	Age (year)
GEN	Gender dummy variables, 1 = male 0 = female
EDU	Level of Education dummy variables, 1 = higher than the elementary level, 0 = elementary level or lower
EPER	Farming experience (year)
NUM	Number of household member (person)
NONL	Number of labor outside agricultural sector (person)
OFFL	Agricultural wage labor household member dummy variables, 1 = present 0 = absent
HIRL	Tapping labor dummy variables, 1 = present 0 = absent
SIZE	Size of area possessed (Rai)
INCO	Household income (Baht/month)
DEBT	Debt amount (Baht)
RAOT	Rubber subsidy from Rubber Authority of Thailand dummy variables 1 = receive compensation, 0 = self-funding
SOCI	Joining agricultural institutions dummy variables, 1 = join 2 = do not join
FRMT	Single Para rubber plantation dummy variables, 1 = plant only Para rubber tress 2 = use intercropping system and have other activities

Table 6. Tools for the administration of Agricultural Risk Programs

	Field/Producer/Community	Market	Government
Risk Reduction	-Choice of technology	-Training in risk management	-Macroeconomic policies -Disaster prevention (example: flood control) -Prevention of diseases in animals
Risk mitigation	-Diversification in production -Agricultural society	-Production or marketing contracts -Insurance Futures and options -Vertical integration -Annual sales planning -Diversified financial investment -Work outside the field	-Tax collection system by income level -Programs adapted to economic cycles -Measurement of impacts of disease outbreaks
Share the Risk	-Communities of Charity -Loans requested from neighbors/family	-Sale of financial assets -Savings/Loan from banks -Income from activities outside the field	-Disaster assistance -Social care -Farm relief programs

The level of education had a positive relation to the diverse production system strategy (RMS1) (ρ<0.05) and had a negative relation to the financial management strategy (RMS7) (ρ<0.01) and the high frequency tapping system strategy (RMS8) (ρ<0.01). The farmers with higher level of education that the elementary acknowledged more about the diverse production strategy than the farmers who had no education beyond elementary level. Meanwhile, the latter group gave an importance to the debt clearance strategy and high frequency tapping system more than the former. The higher education increased the adaptability and investment in the diverse production system. The experience in farming had a negative relation to the diverse production system strategy (RMS1) (ρ<0.01). The farmers with less farming experience were more interested in adapting the strategy more than the group with more experience. The younger generation of farmers had knowledge, got higher education, and chose rubber cultivation system with other activities rather than the single rubber farming.

The number of household members had a positive relation to the market management strategy (RMS2) (ρ<0.01). Households with more members acknowledged the importance of the strategy more than the households with less members. The higher number of members affect the household's expenses, resulting in the income of household depending on the market management strategy's accomplishment to gain enough income.The labor outside the agricultural sector had a positive relation to the promotion of employment outside agricultural sector strategy (RMS6) (ρ<0.05). Households whose members worked outside the sector more gave an importance to the strategy more than the households whose less members worked outside the sector. During the rubber price crisis, income from outside of agricultural sector helped maintaining the household's consumption and adjusting the well-being. Labor inside the agricultural sector had a positive relation to the financial management strategy (RMS7) (ρ<0.05). Farmers' households that worked inside the sector gave an importance to the financial management strategy than the households whose members did not work in the sector. In the study area, all employment in agricultural sector is waging from tapping for other rubber farm-owners while doing their own tapping, which was considered full-time work and to increase the wage. Insufficient income resulted in the importance of debt clearance planning and loaners among farmers.

Labor wage had a positive relation to the tapping labor and contract management strategy (RMS3) (ρ<0.01) and have a negative relation to the diverse production system strategy (RMS1) (ρ<0.05), market management strategy (RMS2) (ρ<0.05), and reduction of production cost strategy (RMS4) (ρ<0.01). Most of farming households that acquired tapping labor were the medium and large farm owners and gave an importance to the strategy because the wage of tapping labor was the main production cost and the higher efficiency of labor contract resulting in the higher profit. The farming households that did not acquire the labor were the small farm owners acknowledged the importance of diverse production system and reduction of production cost, and market management strategy.

The household's income had a negative relation to the reduction of production cost strategy (RMS4) (ρ<0.01). Households with higher income gave less importance over the strategy. Farmers' households that had less income gave an importance to production cost reduction by using household members, grouping for production factors' purchase, and changing rubber breeds to increase production. Debt had a positive relation to the financial management strategy (RMS7) (ρ<0.05) and the reduction of production cost strategy (RMS4) (ρ<0.010). Farmers with higher debts gave more importance to debt clearance's planning and debt and production cost reduction more than the group with less debts.

The size of land had a positive relation to the reduction of production cost (RMS4) (ρ<0.01), tapping labor and contract management strategy (RMS3) (ρ<0.05) and had a negative relation to the high frequency tapping system strategy (RMS8) (ρ<0.05). The large rubber cultivation area owners gave more importance to the production cost reduction and tapping labor and contract management. That was for the reason that the tapping labor was the main production cost for owners of large area and mostly they chose lower frequency system. The rubber subsidy from the Rubber Authority of Thailand had a positive relation to the high frequency tapping strategy (RMS8) (ρ<0.01) and had a negative relation to the market management strategy (RMS2) (ρ<0.01). The households that invested in growing rubber trees by themselves had more acknowledgement of market management strategy's importance than the former group, which was the owners of small farms and used the high frequency tapping system. Joining an agricultural institution had a positive relation to production management strategy (RMS5) (ρ<0.10) and had a negative relation to the high frequency tapping system (RMS8) (ρ<0.05). Farmers who joined the institution gave more importance to the production management strategy more than the group who did not join and gave more importance to the high frequency system. However, farmers that joined the institutions gained knowledge and were academically trained in production planning and cultivation area management.

Materials and Methods

Sampling and Data Collection

The study conducted a cross-sectional survey to collect primary data from the farmers who actively participate in and have sufficient experience of rubber farming. The survey was conducted in Sadao and Hatyai district under the Songkhla Province and Tamod and Pabon districts under Phathalung Province in Thailand. The purposive sampling technique was used to select samples in the study areas. An equal number of respondents were selected from each of the study areas. The sample size consisted of 400 respondents. The data was collected through interviewing the respondents using a standardized and structured survey instrument viz. questionnaire. The surveys were conducted during January to October 2019.

Statistical Analysis

The descriptive statistics was used in risk management strategy analysis. The parameter statistics match the ordinal scale in Likert scale. (Meuwissen et al., 2001). The significance of risk management strategies were divided into 5 levels, 5 was the highest and 4, 3, 2, 1 were ranked respectively to the lowest. The mid-point was used in decoding the result. The score of 1.00-1.49 ranked the lowest while the 4.50-5.00 ranked the highest.

The relation of variables of risk management strategy's acknowledgement could be examined by analyzing the multivariate regressions. (Hair et al., 2009). The analysis was divided into 2 steps. The first step is a principal component analysis to reduce the number of risk management strategies and identify their components. If any sub strategies' percentage of selection was under 20, they would be omitted, then brought into component analysis. The data's statistics has KMO over 0.50 and Berlet's test of sphericity statistics is $P < 0.05$. The correlation coefficient of selected variables is over 0.4. That factor should have an Eigen value over 1.0. The reliability analysis is required for each factor. The Cronbach's Alpha is determined to be over 0.50 (Hair et al., 2009). The results of components from each sample were recorded to analyze the multivariate regression (Flaten et al., 2005). The second step is the multivariate regression analysis to study the relation between the risk management strategy acknowledgement and socio-economic variables (Flaten et al., 2005; Hair et al., 2009; Hayran and Dul, 2015). It was acquired from the multivariate regression analysis's model as follows.

$$RS_i = \beta_0 + \beta_1 AGE + \beta_2 GEN + \beta_3 EDU + \beta_4 EPER + \beta_5 NUM + \beta_6 NONL + \beta_7 OFFL + \beta_8 HIRL + \beta_9 INCO + \beta_{10} DEPT + \beta_{11} SIZE + \beta_{12} RAOT + \beta_{13} SOCL + \beta_{14} FRMT + ui$$

Where,
RSi = the score of risk management strategy's acknowledgement
ui = the error random variables
i = score of components' analysis's results (as the independent variables were illustrated in the table 5).

Conclusion and Policy Recommendation

The study found that the farmers used 8 main strategies which were diverse production system, market management, tapping labor and contract management, production cost reduction, production management, promotion for employment outside agricultural sector, financial management and high frequency tapping system. The analyses of multivariate regression model revealed that the relation between socio-economic factors, namely age, gender, level of education, farming experience, number of household members, number of labor outside agricultural sector, labor wage in agricultural sector, tapping labor, land owning, household's income, debt, compensation from Rubber Authority of Thailand, and member of agricultural institutions affect the risk management strategies and statistically significant with the confidence level over 90 percent.

Table 6 shows the most common tools to deal with risks by type of sector and strategy. Given the interactions between types of risks, each of the tools should not be considered a single solution. In turn, these can be considered substitutes or complementary for each other.

The policy suggestions from this study are as follows:

1) The government should recognize the importance of policies which support other cultivation along with rubber trees and support the tangible diverse production system. It should promote the expansion of cultivation area along with rubber-based intercropping system and various agricultural system and regulate that the farmers that have compensation must plan of the system since the beginning and conduct the monitoring and evaluating the plan throughout its rubber plantation's life span by the Rubber Authority of Thailand. Furthermore, the government should have policies that support production factors and fund accessibility and should develop products from the rubber-based intercropping system, support for research and developments over the system. The suitable plantations for the intercropping system are Hopea odorata (Takian Thong), Orange Chempaka (Champa Thong), Eaglewood (Krisana), hairy-leafed apitong (Yangna), Shorea (Payom), Teak (Sakthong), and other fast-growing plants such as Azadirachta excelsa (Sadao Tiam) and mahogany or fruit trees such as durian, Artocarpus integer (Champada), nut (Mak), Parkia speciosa (Sator) and Riang (Charernjiratragul & Kongmanee, 2017).

2) The government should give an importance to promoting and supporting production cost reduction and production's efficiency increase measures, especially the rubber trees' removal, fertilization, increase in the use of organic fertilizer, support for labor from household instead of wage labor. Those supports should be implemented in accordance with measures that support technology in plantations following the academic guidelines of the Rubber Authority of Thai and expand the roles of monitoring, controlling, and promoting rubber trees' technology to 25 years grown plantation.

3) During the rubber price crisis, the government should implement the income stabilization policy and/or direct payment policy to households, limited for small farmers with high vulnerability in a limited frame time.

4) The government should have policies that support the financial management capability of farmers through financial stabilization program for households to give financial consultancy service, saving management, and loan service with special conditions for financially vulnerable farmers, and to strengthen a community's financial institution.

5) The government should support the investment in agricultural industry, trade, and community enterprise and agricultural tourism in countryside, with the purpose to increase employment opportunity out of agricultural sector, to increase the income and decrease the dependence on income from agriculture.

6) Market information will help the farmers make decision over risk management strategy more efficient and be updated to risk occurrence. Therefore, the government should recognize the importance of market information development and establish market information and rubber price. The purposes are to collect, follow, and analyze the data related to rubber economy both in domestic and international area, and to publicize the information efficiently and to increase the methods of data accessibility with the lowest fund to farmers, agricultural institutions and stakeholders, and also involve training and practicing analyzing the information to manage risks.

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