We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,800
Open access books available

122,000
International authors and editors

135M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

CLARIVATE ANALYTICS BOOK CITATION INDEX INDEXED

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Chapter 20

Sources of Risk and Risk Management Strategies: The Case of Smallholder Farmers in a Developing Economy

Satit Aditto, Christopher Gan and Gilbert V. Nartea

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/50392

1. Introduction

Risk in agriculture is pervasive and complex, especially in agricultural production.[1, 2] Farmers confront a variety of yields, unstable output and input prices and radical changes in production technology as inherent in their farming operations. These affect the fluctuation in farm profitability from season to season and from one year to another.[3, 4] The sources of risk and level of its severity can vary according to the farming systems, geographic location, weather conditions, supporting government policies and farm types. Risk is a major concern in developing countries where farmers have imperfect information to forecast things such as farm input prices, product prices, and weather conditions, that might impact the farms in the future.[2, 5, 6] The types and severity of risks that farmers face differ from place to place. Incorporating and understanding the effects of risk at the farm level will benefit policy makers who develop appropriate strategies that can help farmers survive the numerous risks they confront.

Sources of risk in agriculture are classified into *business risk* and *financial risk*.[1, 7] Business risks can be classified further into a) production or yield risk, b) marketing or price risk, c) institution, policy, and legal risk, d) human or personal risk, and e) technological risk. On the other hand, financial risk occurs when farmers borrow to finance farm activities as farmers often face variations in interest rates on borrowed funds, inadequacy of cash flow for debt payments and changes in credit terms and conditions.[8, 9]

For several decades, agricultural production in Thailand has faced many risks such as variability in yields, product-prices and cost of inputs.[10-12] Thai farmers typically grow their crops in rain-fed conditions due to poor irrigation systems.[13] The annual rainfall fluctuates widely each year, and pests, diseases and poor soil fertility affect the yields of cash crops in

Thailand. In addition, agricultural commodity prices rise and fall annually depending on the demand and supply in both local and international markets, which are out of the farmer's control. Similarly, the costs of farm inputs also vary each year and may negatively affect farm production costs.

Agriculture contributes approximately 7.86 per cent to Thailand's GDP and 8.98 per cent to exports in 2008.[14, 15] However, large numbers of farmers in rural Thailand still live below the poverty line. In 2007, Thai farm households earned an average income of 129,236 baht/year (US$ 3,692) but only 39 per cent or 50,370 baht/year (US$ 1,439) is from farm activities.[16] Thai farmers are basically smallholders and the national farm size is approximately 7.72 acres.[17] Most farmers have limited diversification potential, face resource problems, environmental variability, lack of soil fertility and water shortages especially smallholder farmers in the north-east region.[18] In addition, smallholder farmers in Thailand also face various sources of risk that vary both seasonally and annually.

Knowledge of the characteristics of risks that influence smallholder farmers is the key to developing appropriate strategies to deal with risks. However, empirical studies on farmers' responses to risks and how risk affects farmers' income, especially in rural Thailand are limited. The aim of this chapter is to examine the sources of risk for smallholder farmers in the central and northeast regions of Thailand and their risk management strategies. We will also relate the farmers' socioeconomic characteristics to their perceived sources of risk and their favoured risk management strategies to gain a deeper understanding of their choices.

2. Sources of risk and risk management strategies on farm

There is much literature on risk sources that impact farming operations and their risk management strategies. Flaten et al. argued that the assessment of farmers' perceptions and how they respond to risk are very important because this can describe the decision making behaviour of farmers when faced with risky situations.[19] Similarly, Hardaker et al. states that *"the welfare of the farm family and the survival of farm business may depend on how well farming risks are managed"*.[1]

The lack of relevant information on farmers' risk perceptions and their risk behaviour present a challenging task for policy makers and researchers who want to create a proper risk management system to help farmers.[19, 20] Extant literature shows that there is no agreement about the most appropriate methods to describe sources of risk and risk responses on farms. However, the Likert-scale rating method has been regularly applied in previous research. In most of those studies, the respondents were asked to rate the sources of risk that affected their farm and the risk management strategies they used on a five-point scale (where 1 is not particularly important and 5 is highly important).

Boggess, Anaman, and Hanson examined farmers' awareness of risk in crop and livestock production in northern Florida and southern Alabama.[21] The respondents were asked to define risk and then to rank the sources of risk and risk management strategies based on how important each risk was to their farm. The results showed that most respondents

defined risk as the probability of a negative outcome. The respondents ranked rainfall variability, pests and diseases, and crop price variability as the primary sources of risk for crop production. Livestock price and weather variability and livestock diseases were perceived as important sources of risk for livestock production.

Patrick, Wilson, Barry, Boggess and Young studied farmer attitudes towards risk and risk management among mixed crop and livestock farmers in the US.[22] A total of 149 farmers in 12 states were interviewed. The respondents were grouped into five types of farm; mixed farming; cotton; corn, soybean and hogs; small grain and ranch. The results showed that changes in weather, output price and input costs were rated as the three most important sources of risk in both crop and livestock production.

A nationwide mail survey was used to examine the sources of risk and the risk management strategies of New Zealand farmers by Martin[23]. The survey covered eight types of farm including sheep and beef, dairy, deer, pip fruit, kiwifruit, cropping, vegetables and flowers. The results showed that marketing risk (such as change in product prices and change in input costs) was ranked as a very important source of risk by all farmers. Conversely, production risks (such as rainfall variability, weather, and pests and diseases) were regarded differently depending on geographical location, farm type and product.

Pellegrino studied rice farmers' perceptions of the sources of risk and risk management responses in Argentina.[9] Using size of the respondents' farms as large, medium, and small farms, the author argued that a farmer's awareness of the sources of risk varied depending on farm size. The small size farm group tended to have a higher awareness of production risks than the other two groups.

Meuwissen, Huirne, and Hardaker identified price and production risks as the most important sources of risk for livestock farmers in the Netherlands.[24] An insurance scheme was rated as the appropriate strategy to manage risk. Flaten et al. compared risk perception and the risk responses of conventional and organic dairy farmers in Norway.[19] The results revealed that the institutional (such as government support policies) and marketing risks were classified as the principal sources of risk for the organic dairy farmers. The authors ranked production cost variability and animal welfare policy as the greatest worries for conventional dairy farmers.

Hall, Knight, Coble, Baquet and Patrick found severe drought and meat price variability as the primary sources of risk perceived amongst cattle farmers in Texas and Nebraska.[25] In a recent study, large-scale South African sugarcane farmers perceived land reform regulations, labour legislation and crop price variability as the three most important risk factors.[20]

In terms of risk management strategies, Boggess et al. and Patrick et al. reported that 'placing of investments', 'obtaining market information' and 'enterprise diversification' were the most important strategies that the sampled crop and livestock farmers use to handle risk in the US.[21, 22] Meuwissen et al. found that 'cost of production' and 'insurance schemes' were regarded as important risk strategies among livestock farmers in the Netherlands.[24] Similarly, Flaten et al. noted that organic and conventional dairy farmers in

Norway perceived 'increasing farm liquidity', 'disease prevention', 'buying farm insurance' and 'cost of production' as the most important strategies used to deal with risk on their farms.[19] On the other hand, New Zealand farmers used a mix of risk management strategies to reduce risk. The strategies varied among the groups of farmers depending on the nature of the product, market structure and conditions, farmer characteristics, dynamic risk adjustment considerations and the regulatory situation.[23]

Despite the fact that the evaluation of farmers' risk perceptions and risk management responses are essential to better understand their risk behaviour and managerial decisions, few studies have explicitly investigated awareness of risk among Thai farmers. Akasinha, Ngamsomsuk, Thongngam, Sinchaikul and Ngamsomsuk examined risk perceptions among rice farmers in Payao and Lampang provinces in the northern region.[26] In their study, the Participatory Risk Mapping (PRM) technique was used to elicit sources of risk. The authors' results showed that rice farmers in Payao faced five major sources of risk including 'outbreak of rice disease', 'insects causing damage to rice', 'high input costs', 'flooding', and 'shortage of water supply'. Farmers in Lampang typically faced 'drought', 'insects causing damage to rice', 'low output prices', 'pests', and 'high input costs'.

3. Data and methodology

The sources of risk and their preferred risk management strategies are obtained from face-to-face interviews of 800 farmers, 400 each in the central and northeast regions of Thailand. The central and north-east regions differ in terms of resources, economic development and income distribution. The central region has a farming area of 8.61 million acres or 19.2 per cent of the total farming area. In 2007, the average monthly income per farm in this region is 15,271 baht.[16] The central region is known as the 'rice bowl of Thailand' and more than half of the country's irrigation systems are located in this region known for wet-rice cultivation.[27] In contrast, the north-east region is defined as the 'poorest region' with a long dry season and an annual rainfall that fluctuates widely each year.[13, 18] Approximately 45 per cent of the total farming area in Thailand is located in this region. In 2007, the average monthly income per farm in this region is 8,344 baht.[16]

A smallholder farmer is defined as a farmer who has a farming area less than 30 rai (4.8 ha). Purposive random sampling was employed to classify a particular group of respondents from a certain portion of the population. The sample selection process is as follows. First, the provinces in each region were separated into two main groups: (a) the provinces with large and medium irrigation systems and (b) the provinces in the rain-fed area. Second, purposive sampling was employed to select smallholder farmers in each group. This procedure ensured that the sample covered smallholder farmers of both the irrigated and rain-fed areas in the central and north-east regions.

The information on the sources of risk and risk management strategies perceptions obtained from the respondents using a five-point Likert scale were analyzed in two steps. First, exploratory factor analysis (EFA) was used to capture the information on the interrelationships among the set of variables. This technique enabled the researcher to manage and reduce the

number of original variables into a smaller group of new correlation dimensions (factors), which are linear combinations of the original variables.[28, 29] The Kaiser-Meyer-Oklin (KMO) method measured the appropriateness for factor analysis of both data sets. The KMO index varies from 0 to 1, with results of 0.6 or greater suitable for factor analysis. The latent root criterion (eigenvalue > 1) was estimated to identify how many factors in each data set to extract. After the number of factors had been identified, the orthogonal (varimax) rotational method was performed in order to minimize the number of variables that have high loadings on each factor. A factor loading of ± 0.4 was employed as a cut off criterion to determine the inter correlation among the original variables. In addition, Cronbach Alpha was employed to evaluate the internal consistency of each factor.[28]

The relationships between the socioeconomic variables and the perception of risk sources and risk management strategies of the smallholder farmers were also analyzed. Multiple regression was employed to evaluate the influence of farm and farmer characteristics on the smallholder farmers' risk perception and risk management responses. Diagnostic tests were carried out to verify that there was no violation of the multiple regression assumptions. The model specification for the farmer's perception of risk source with socioeconomic variables is postulated as follows:

$$S_i = b_0 + b_1 AGE + b_2 GEN + b_3 EDU + b_4 EXP + b_5 OFFW + b_6 FSIZ + b_7 INCM + b_8 LOC + b_9 FINC + b_{10} AHIN + b_{11} HSIZ + e \quad (1)$$

The model for risk management responses with socioeconomic variables is given as follows:

$$R_i = b_0 + b_1 AGE + b_2 GEN + b_3 EDU + b_4 EXP + b_5 OFFW + b_6 FSIZ + b_7 INCM + b_8 LOC + b_9 FINC + b_{10} AHIN + b_{11} HSIZ + e \quad (2)$$

where:
Si is source of risk i (from factor analysis); Ri is risk management strategy *i* (from factor analysis); *AGE*= 1, if the respondent's age is over 40 years old, 0 otherwise; *GEN*= 1, if the respondent is male, 0 if female;*EDU* = 1, if the highest education of the respondent is high school and higher, 0 if primary school education or less; *EXP*= 1, if the farming experience is over 30 years, 0 otherwise; *OFFW*= 1, if the respondent has off-farm work, 0 if no off-farm work; *FSIZ* is farm size; *INCM* is net farm income; *LOC*= 1, if the respondent's farm is located in central region, 0 if a farm located in north-east region; *FINC*= 1, if farm has a loan, 0 if farm without a loan; *AHIN*= 1, if the annual household income greater than 90,001 baht, 0 otherwise; *HSIZ* is household size; and e is error term.

4. Results and discussion

4.1. Socioeconomic characteristics of the farmers

The household and farm characteristics of the central and north-east region farmers are presented in Table 1. Table 1 shows that except for gender, household size and finance used for the farm business, central and north-east region farmers generally differ in terms of personal

and farm characteristics, and income distribution. The age group distribution indicates that the majority of the farmers in both regions were over 40 years old. Around 40 per cent of the north-east region farmers were over 60 years old, whereas 42 per cent of the central region farmers were between 41-50 years old. The age distribution between the farmers in both regions was significantly different with the north-east region farmers more likely to be older than the central region farmers. Nearly half of the farmers in the north-east had been involved in agricultural work for over 40 years which implies that younger farmers are rare especially in the north-east. This may be a result of the rural-to-urban migration problems in Thailand.

Around 75 per cent of the farmers in both regions graduated with a primary education and about three per cent were illiterate. The result indicates that the central region farmers had higher levels of education than the north-east farmers ($P<0.01$). Mustafa argued that the educational level of farmers affected their decision making capacity.[30] A higher educated farmer was expected to perform better than an uneducated farmer in terms of management skills and farm resource allocation to maximize farm profitability.

The average farm size of the farmers in the central region was 21.40 rai (3.42 ha) of which 30 per cent was self-lease operated. In contrast, farmers in the north-east had an average farm size of 14.80 rai (2.37 ha) of which 90 per cent was self owned. This result indicates that the central region farmers hold average farm sizes larger than north-east farmers ($P<0.01$). This is consistent with the Office of Agricultural Economics who reported that farmers in the central region usually had an average farm size larger than the north-east farmers.[16]

The results for the average net farm income between the farmers in the central and north-east regions were statistically significant at the one per cent level. This result indicated that the average net farm income of the central farmers was larger than for the north-east farmers. In 2008, the central farmers had an average net farm income of 166,445.05 baht/household, whereas the average net farm income of the north-east farmers was only 42,632.80 baht/household.

In addition, approximately 63 per cent of the central region farmers worked off-farm, which was significantly more than for the north-east farmers ($P<0.01$). The results also showed that central farmers had significantly higher annual household incomes than north-east farmers.

In terms of farmer access to credit, nearly 70 per cent of the farmers in the central and north-east regions had loans and nearly half of them borrowed from the Bank of Agriculture and Agricultural Cooperatives. In addition, eight per cent of the farmers used their own savings to operate their farm business. Only about four per cent had loans from commercial banks. The majority of the farmers obtained short-term loans (see Table 2). This finding supports Limsombunchai, who argued that smallholder farmers in rural Thailand lacked investment funds due to a credit accessibility barrier.[31]

Nearly 50 per cent of the farmers had small debts. Further, 30 per cent of the farmers in the north-east had outstanding debts of less than 30,000 baht during the 2008 crop year. Similarly, 27 per cent of the farmers in the central region had debts between 31,000-50,000 baht. An average of 72.6 per cent of the loans were used in operating the farm business, such

as purchasing farm equipment, seeds and fertilizers, but the balance was spent on the farmer's personal and household consumption, for example, food and clothing.

Item	*Unit*	*Region*		*Overall (n=800)*	*Test of differrence* [a]
		Central (n=400)	*North-east (n=400)*		
Gender	%				0.66
Male		73.3	75.8	74.5	
Female		26.8	24.3	25.5	
Age group	%				67.14***
Less than 30 years old		1.5	0.5	1.0	
31-40 years old		10.3	7.3	8.8	
41-50 years old		42.0	22.3	32.1	
51-60 years old		30.0	30.5	30.3	
Over 60 years old		16.3	39.5	27.9	
Marital status	%				12.52***
Single/Never married		4.0	2.0	3.0	
Married		87.5	86.3	86.9	
De factor relationship		0.8	4.3	2.5	
Divorced/separated		7.8	7.5	7.6	
Highest education	%				17.79***
Illiterate		3.3	2.0	2.6	
Primary school		69.5	81.8	75.6	
Secondary school		23.5	14.0	18.8	
Vocational training		2.3	0.8	1.5	
Bachelor degree		1.5	1.5	1.5	
Farming experience	%				105.69***
Less than 10 years		12.8	6.5	9.6	
11-20 years		29.3	10.0	19.6	
21-30 years		22.5	16.0	19.3	
31-40 years		19.5	22.8	21.1	
Over 40 years		16.0	44.8	30.4	
Household size	Persons	4.36	4.28	4.32	-0.66
Total farm size	rai [b]	21.40	14.80	18.09	-10.10***
Land ownership status	%				168.93***
Owner-self operated		64.8	89.5	77.1	
Lease-self operated		29.3	2.0	15.6	
Tenant		0	8.5	4.3	
Other		6.0	0	3.0	
Finance farm business	%				0.15
Yes		69.3	68.0	68.6	
Average net farm income [c]	baht	166,450	42,632	104,541	-19.26***
Working off-farm	%				43.29***
Yes		63.3	40.0	51.6	
Annual household income	%				113.16***
Less than 10,000 baht		0	1.3	0.6	

Item	Unit	Region		Overall (n=800)	Test of differrence [a]
		Central (n=400)	North-east (n=400)		
10,001-30,000 baht		0.8	14.3	7.5	
30,001-50,000 baht		5.0	16.3	10.6	
50,001-70,000 baht		11.0	15.8	13.4	
70,001-90,000 baht		11.5	11.0	11.3	
More than 90,001 baht		71.8	41.5	56.6	

[a] Test of differences of the central and north-east household and farm characteristics based on chi-square and independent *t* test; * significant at 10%, ** significant at 5% and *** significant at 1%
[b] 1 rai = 0.16 ha. [c] Net farm income is based on the 2008 crop year.
Source: Field survey, 2009

Table 1. Household and farm characteristics of the farmers in central and north-east Thailand

Item	Region		Overall (n=800)
	Central (n=400)	North-east (n=400)	
Sources of finance [a]			
Bank of Agriculture and Agricultural Cooperative	57.5	34.3	44.6
Cooperatives	23.7	15.9	19.4
Village funds	11.8	25.4	19.4
Personal funds	3.2	12.4	8.3
Commercial bank	6.8	0.3	3.9
Duration of credit			
Less than 1 year	65.0	72.8	68.9
Greater than 3 years	6.9	20.6	13.7
Outstanding loan debt			
Under 30,000 baht	14.4	29.4	21.9
31,000-50,000 baht	27.4	23.2	25.3
Over 91,000 baht	13.7	21.0	17.3
Average percentage of loan used			
On-farm activities	79.8	65.1	72.6
Household expenses	20.1	34.7	27.4

[a] Multiple responses
Source: Field survey, 2009

Table 2. Financial background of the farmers in central and north-east Thailand

4.2. Farmers' perceptions of sources of risk and risk management strategies

4.2.1. Sources of risk

The mean scores of each source of risk were ranked and the standard deviation (SD) was used to indicate the variation in the ratings. Independent sample t-test was employed to compare mean score differences between the farmers in the central and north-east regions.

Table 3 summarizes the results of the most important perceived sources of risk for the farmers in the central and north-east regions. The table shows that marketing risks associated with 'unexpected variability of input prices' and 'unexpected variability of product prices' had the highest and second highest mean scores for sources risk, respectively rated by the farmers in both regions. The SDs of both sources of risk in each group were less than one and this indicates that those sources of risk gained a high level of consensus among the farmers in both regions.(24)

Source of risk	*Overall (n=800)*			*Central (n=400)*			*North-east (n=400)*			*Test of diff.* [b]
	Mean [a]	*SD*	*Rank*	*Mean* [a]	*SD*	*Rank*	*Mean* [a]	*SD*	*Rank*	
Unexpected variability of input prices	4.22	0.910	*(1)*	4.09	0.901	*(1)*	4.34	0.904	*(1)*	3.92***
Unexpected variability of product prices	3.82	0.926	*(2)*	3.83	0.861	*(2)*	3.82	0.988	*(2)*	-0.11
Diseases and pests that affect plants and animals	3.52	1.153	*(3)*	3.70	1.014	*(3)*	3.34	1.252	*(3)*	-4.47***
Changes in Thailand's economic and political situation	3.48	1.080	*(4)*	3.44	0.992	*(4)*	3.53	1.161	*(4)*	1.28
Unexpected variability of yields	3.47	0.946	*(5)*	3.58	0.965	*(5)*	3.36	0.915	*(5)*	-3.35***
Changes in national government laws and policies	3.38	1.090	*(6)*	3.38	1.024	*(6)*	3.39	1.154	*(6)*	0.16
Natural disasters such as heat, fire, flood, storm	3.38	1.345	*(7)*	3.47	1.092	*(7)*	3.29	1.554	*(7)*	-1.92*
Changes in the world economic and political situation	3.30	1.097	*(8)*	3.27	1.029	*(8)*	3.32	1.161	*(8)*	0.71
Excess rainfall	3.27	1.293	*(9)*	3.59	1.017	*(9)*	2.95	1.453	*(9)*	-7.16***
Deficiency in rainfall causing drought	3.11	1.441	*(10)*	3.09	1.372	*(10)*	3.13	1.508	*(10)*	0.44
Problems with hired labour	3.02	1.259		2.95	1.161		3.10	1.347		1.72*
High level of debt	2.84	1.075		2.90	1.052		2.77	1.095		-1.75*
Accidents or problems with health	2.74	1.145		2.56	1.007		2.91	1.245		4.34***
Changes in interest rates	2.73	1.106		2.86	1.054		2.60	1.144		-3.28***

Source of risk	*Overall (n=800)*			*Central (n=400)*			*North-east (n=400)*			*Test of diff.* [b]
	Mean [a]	*SD*	*Rank*	*Mean* [a]	*SD*	*Rank*	*Mean* [a]	*SD*	*Rank*	
Changes in technology and breeding	2.52	1.089		2.49	0.952		2.55	1.211		0.75
Changes in land prices	2.47	1.222		2.56	1.241		2.38	1.198		-2.03**
Risk from theft	2.19	1.179		2.57	1.144		1.82	1.094		-9.44***
Changes in family situation such as marital status, inheritances, etc.	1.98	1.032		2.11	0.966		1.85	1.081		-3.52***
Being unable to meet contracting obligations	1.82	1.046		2.13	1.038		1.52	0.965		-8.50***

[a] Likert scale is used from 1 (not important) to 5 (extremely important).
[b] The mean scores of central and north-east farmers are significantly difference at *P<0.1, **P<0.05 and ***P<0.01 based on independent samples t test.
Source: Field survey, 2009

Table 3. Ranking of perceptions of sources of risk by sampled farmers in central and north-east Thailand

The survey results showed that the uncertainty of input prices and product prices have become increasingly worrying among smallholder farmers in the central and north-east regions. This is probably due to the fact that both sources of risk are out of the farmers' control but directly affect their farm incomes. The prices of the major cash crops in Thailand, such as rice, cassava and sugarcane, are unstable; they depend on supply and demand in both local and international markets. Similarly, the average prices of the major farm inputs such as fertilizer NPK 16-20-0, which is widely used by rice farmers, fluctuated from 9,485 baht/tonne in 2006 to a peak of 19,386 baht/tonne in 2008 and then dropped to 16,199 baht/tonne in 2009.(16)

This finding is consistent with those of Patrick et al., Martin, and Flaten et al. who argued that marketing risks associated with the variability of product and input prices were the most important sources of risk considered by the farmers in their respective study areas.(19, 22, 23)

The production risks related to 'diseases and pests affecting plants and animals', 'excess rainfall' and 'natural disasters such as floods' were ranked third, fourth and sixth, among the farmers in the central region with mean scores of 3.70, 3.59 and 3.47, respectively. The results reflect the heavy floods that inundated the central provinces during September 2008. Following this incident, 100,000 rai (16,000 ha.) of farmland in the central region were damaged.(32)

Institutional risks related to 'changes in Thailand's economic and political situation' and 'changes in national government laws and policies' were ranked third and fourth, among the north-east region farmers, respectively. This finding revealed that smallholder farmers were concerned about the effect of the political conflicts in Thailand on their farm operation.

'Unexpected variability of yields' was ranked the fifth most important source of risk in both regions. In addition, the financial risks associated with 'changes in interest rates' and 'high levels of debt' were considered as 'quite important' by all farmers.

Sources of risk that obtained low mean scores included 'changes in technology and breeding', 'changes in land prices', 'risk from theft', 'changes in the situation of farm families' and 'unable to meet contracting obligations'.

Comparisons of risk perception between the farmers in the central and north-east regions showed significant differences in most sources of risk. This interesting finding might be attributable to the fact that sources of risk vary depending on the farm's geographical condition, farm type, the environmental impact and the country's political and economic situation. Evidently, the small farm business may be affected in different ways by changes in these sources of risk.

4.2.2. Risk management strategies

Table 4 summarizes the results of the perceptions of risk management strategies elicited from the farmers in the central and north-east regions. Production and financial strategies were considered more important managerial responses to risk than marketing strategies by the farmers in both regions.

Among the production strategies perceived by the central region farmers, 'purchase farm machinery to replace labour' was the most important with an average rating of 3.45. Nearly 60 per cent of central region farmers reported using this strategy to cope with hired agricultural labour problems on their farms. From the survey, farm machinery, such as hand tractors and four-wheel tractors, was widely used among the central region farmers. This reflects the imbalance problem between agricultural and industrial labour forces in Thailand. This finding supports Ahmad and Isvilanonda who argued that the rural labour force preferred to work in the industrial sector more than in the agricultural sector due to the gap in wage rates.[33] This may be caused by the lack of agricultural labour especially in the central region, which has many factories located there.

'Storing feed and/or seed reserves' and 'have a farm reservoir for water supplies in dry season' showed significant differences in importance between the farmers in the central and north-east regions ($P<0.01$). North-east farmers perceived the importance of these two production strategies higher than central region farmers. They rated 'storing feed and/or seed reserves' as the most important production strategies and 'having a farm reservoir for water supplies in dry season' was ranked third with mean ratings of 3.61 and 3.47, respectively. Over 80 per cent of the north-east farmers preferred 'storing feed and/or seed reserves' in managing their small farm operations and approximately 65 per cent of them preferred using the 'having a farm reservoir for water supplies in dry season' strategy on their farm. This indicates that the north-east farmers were confronted with the variability of input prices and severe droughts.

'Having diversified crop, animal or other enterprises' and 'planting several varieties of crops' were the least important production strategies for both groups. The north-east

farmers considered these two production strategies as 'important' but the central region farmers rated them as 'quite important', which is statistically significant different (P<0.01). The results indicated that the lack of farm resources may affect the diversification performance of the farmers in both groups.

Financial strategies associated with 'holding cash and easily converted cash assets' and 'working off farm to supplement household income' were considered 'important' by the farmers in the central and north-east regions. Approximately 60 per cent of the farmers in both regions reported that they used these two financial strategies. However, the north-east farmers perceived the importance of 'holding cash and easily converted cash assets' significantly higher than the central region farmers. In addition, 'reduce debt level' was given greater importance by the north-east farmers, whereas 'investing in non-farm businesses' was more important among the central region farmers. In terms of marketing strategies, north-east farmers assigned significantly greater rating scores than central region farmers to 'obtaining market information', 'spread sale over several time period' and 'selection of crop and/or animal varieties with low price variability'.

Source of risk	*Overall (n=800)*			*Central (n=400)*			*North-east (n=400)*			*Test of diff.* [c]
	Mean [a]	*%* [b]	*Rank*	*Mean* [a]	*%* [b]	*Rank*	*Mean* [a]	*%* [b]	*Rank*	
Production strategies:										
Purchase farm machinery to replace labour	3.44	61.6	*(1)*	3.45	58.8	*(1)*	3.43	64.5	*(5)*	-0.26
Storing feed and/or seed reserves	3.40	60.9	*(3)*	3.20	40.8	*(6)*	3.61	81.0	*(1)*	5.49***
Apply pests and diseases program	3.23	53.9	*(7)*	3.26	53.8	*(4)*	3.19	54.0	*(9)*	-0.89
Have a farm reservoir	3.06	47.9	*(10)*	2.65	35.5		3.47	60.3	*(3)*	9.40***
Having diversified crop, animal or other enterprises	2.94	33.4		2.84	26.0		3.05	40.8		2.65***
Planting several varieties of crops	2.86	30.0		2.71	19.5		3.01	40.5		3.64***
Marketing strategies:										
Obtaining market information	3.27	65.3	*(5)*	3.09	51.8	*(7)*	3.46	78.8	*(4)*	4.89***
Spreading sale over several time periods	3.19	41.6	*(8)*	3.01	31.5	*(9)*	3.39	51.8	*(6)*	4.48***
Selection of crop and/or animal varieties with low price variability	2.70	24.8		2.61	21.0		2.79	28.5		2.46**

Source of risk	*Overall (n=800)*			*Central (n=400)*			*North-east (n=400)*			*Test of diff.* [c]
	Mean [a]	*%* [b]	*Rank*	*Mean* [a]	*%* [b]	*Rank*	*Mean* [a]	*%* [b]	*Rank*	
Use forward contracts	2.13	12.4		2.32	12.3		1.95	12.5		-4.59***
Financial strategies:										
Holding cash	3.41	64.8	*(2)*	3.31	60.0	*(3)*	3.52	69.5	*(2)*	2.98***
Working off farm	3.28	63.3	*(4)*	3.33	68.8	*(2)*	3.24	57.8	*(8)*	-1.07
Reduce debt level	3.27	60.0	*(6)*	3.20	48.5	*(5)*	3.33	71.5	*(7)*	1.73*
Leasing farm machinery	3.13	48.9	*(9)*	3.08	38.5	*(8)*	3.17	59.3	*(10)*	1.17
Investing in non-farm businesses	2.64	31.3		2.92	42.3		2.36	20.3		-6.30***
Miscellaneous strategies:										
Able to adjust quickly to weather, price and other adverse factors	3.02	42.6		2.98	42.0	*(10)*	3.06	43.3		1.18

[a] Likert scale is used from 1 (not important) to 5 (extremely important).
[b] The percentage of farmers using each risk management strategy.
[c] The mean scores of central and north-east farmers are significantly difference at *P<0.1, **P<0.05 and ***P<0.01 based on independent samples t test
Source: Field survey, 2009

Table 4. Ranking of perceptions of risk management strategies by sampled farmers in central and north-east Thailand

'Use forward contracts' was the least important marketing strategy considered by most central and north-east regions farmers. Only 10 per cent of the farmers in both regions had used this strategy to manage risk. This suggests that the agricultural production under forward contracts in Thailand is still in its developmental stages and is not popular among the smallholder farmers in rural areas. However, the central region farmers perceived the importance of this marketing strategy significantly more than the north-east farmers (P<0.01) with the mean scores of 2.32 and 1.95, respectively.

The perceptions of risk responses between the farmers in the central and north-east regions were statistically different in many strategies similar to their perceived sources of risk (see Table 4). The findings from the survey revealed that the smallholder farmers in both regions used a mix of risk strategies to manage and reduce the sources of risk they are confronted with. The findings support Martin, who argued that the farmers' selection criteria for risk management strategies varied depending on farm type, climatic conditions, marketing factors and agricultural rules and regulations.[23]

4.3. Factor analysis

In this section, the results of the factor analysis of sources of risk and risk management strategies are discussed. Exploratory factor analysis with varimax orthogonal rotation

was applied to the data using SPSS version 15. Exploratory factor analysis is used to reduce the number of sources of risk and risk management strategies for each group of farmers.

4.3.1. Sources of risk

The rotated factor loadings of risk sources for all farmers in the central and north-east regions, obtained from the principal component analysis and a varimax orthogonal rotation, are discussed in this section. The KMO measure of data sufficiency was 0.779 and the Bartlett's Test of Sphericity achieved statistical significance (χ^2 = 4927.58, P<0.01), both indicating that the data set was appropriate for factor analysis. However, the preliminary results indicated three sources of risk including 'accidents or problems with health', 'deficiency rainfall' and 'changes in technology or breeding' should be eliminated from the factor analysis because of their low communalities (<0.40).[28] Following this, iteration of varimax orthogonal rotation was performed.

The results are presented in Table 5. Latent root criteria (eigenvalues > 1) were specified for six factors (AS1-6) from the 16 sources of risk variables for all farmers in both regions. These six factors can explain almost 71.2 per cent of the total variance. The Cronbach's Alpha values for factors AS1-5 ranged from 0.671 to 0.899, which exceeded the minimum requirement of 0.6. This demonstrates an adequate reliability among those factors. However, the alpha value was somewhat lower (0.426) for factor AS6. Factors AS1-6 can be labelled in accordance with the significant loading variables that were obtained for each factor and explained as follows:

Factor AS1: this factor is named 'economic and political' because of the relatively high loadings on the sources of risk variables with the changes in Thailand and the world economic and political situations and changes in the government laws and policies that affected the small farm operations.

Factor AS2: this factor incorporates a number of sources of risk related to the farm business environment, including risk from being unable to meet contracting obligations, problems with hired labour, theft and changes in land prices. Moreover, risk from changes in family situation (also as personal risk) loaded highly on this factor. Therefore, this factor is named 'personal and farm business environment'.

Factor AS3: this factor consists of the significant loading of 'excess rainfall' and 'natural disaster'. Factor AS3 is labelled 'natural disaster'.

Factor AS4: this factor can be interpreted as the 'financial situation' because of the high factor loadings on the changes in interest rates and high level of debt.

Factor AS5: this factor is related to the risk from unexpected variability in yields and the unpredictable product prices. Thus, this factor is classified as 'yields and product prices'.

Factor AS6: this factor is labelled 'input prices' because of the highest factor loading of the unexpected variability in input prices in this factor.

Source of risk	*Factors* [a]						*Commu-nality*
	AS1	*AS2*	*AS3*	*AS4*	*AS5*	*AS6*	
Changes in Thailand's economic and political situation	**0.923**	0.091	0.005	0.092	0.134	0.053	0.890
Changes in the world economic and political situation	**0.875**	0.064	0.066	0.164	0.030	0.050	0.804
Changes in national government laws and policies	**0.833**	0.220	0.003	0.048	0.179	0.094	0.786
Changes in family situation	0.087	**0.748**	0.097	0.079	0.126	-0.176	0.629
Being unable to meet contracting obligations	0.009	**0.747**	0.121	0.285	0.042	-0.082	0.663
Risk from theft	0.107	**0.700**	0.078	0.203	0.151	0.108	0.583
Problems with hired labour and contractors	0.132	**0.616**	-0.170	-0.147	-0.127	0.427	0.646
Changes in land prices	0.315	**0.559**	-0.014	0.242	0.107	0.087	0.489
Excess rainfall	0.018	0.050	**0.895**	0.086	0.085	-0.039	0.821
Natural disasters	0.033	0.077	**0.862**	-0.056	-0.007	0.190	0.789
Changes in interest rates	0.119	0.261	-0.024	**0.827**	0.065	0.162	0.797
High level of debt	0.169	0.220	0.070	**0.825**	0.064	0.010	0.768
Unexpected variability of yields	0.141	0.103	0.053	0.071	**0.846**	0.017	0.755
Unexpected variability of product prices	0.131	0.122	0.033	0.046	**0.823**	0.135	0.730
Unexpected variability of input prices	0.077	-0.094	-0.014	0.064	0.115	**0.852**	0.758
Diseases and pests that affect plants and animals	0.073	0.104	0.329	0.135	0.071	**0.579**	0.483
Eigenvalues	4.35	1.83	1.71	1.22	1.21	1.07	
Per cent of total variance explained	27.17	11.46	10.70	7.61	7.55	6.69	
Cumulative per cent of the variance explained	27.17	38.63	49.33	56.95	64.49	71.19	
Cronbach's Alpha	0.889	0.743	0.776	0.763	0.671	0.426	
Number of variables	3	5	2	2	2	2	

[a] Factors AS1-6 are labelled as AS1=economic and political, AS2=personal and farm business environment, AS3=natural disaster, AS4=financial situation, AS5=yields and product prices and AS6=input prices.
'Accidents or problems with health', 'deficiency in rainfall causing drought' and 'changes in technology and breeding' are deleted from the analysis due to these sources of risk have low communalities.
Factor loadings for an absolute value greater than 0.4 are in **bold**.
Source: Field survey, 2009

Table 5. Varimax rotated factor loadings of sources of risk for all sampled in Thailand farmers (n=800)

4.3.2. Risk management strategies

Factor analysis was employed to reduce the risk strategy categories as perceived by the farmers in both the central and north-east regions. The KMO measure of data sufficiency was 0.887. In addition, Bartlett's Test of Sphericity was statistically significant at the one per cent level ($\chi^2 = 3301$). This indicates that the data were suitable for factor analysis.

The first iteration of factor analysis resulted in the removal of 'able to adjust quickly to weather, price and other adverse factors' and 'purchase farm machinery to replace of labour', because these variables exhibited low communalities. Following this, the second rotation was performed with 14 risk strategies.

The final results of the varimax rotated factor loadings for each risk strategy are documented in Table 6. Factor analysis grouped the 14 risk management strategies into four factors. These four factors explained almost 58.33 per cent of the variance.

With regard to reliability, the Cronbach's Alpha values for factors AR1-3 were 0.742, 0.711 and 0.642, respectively. The alpha value for factor AR4 was 0.596, which is very close to the minimum cut-off level of 0.6. The factors AR1-4 can be named according to each factor structure as follows:

Factor one (AR1): this factor has a relatively high loading of the risk strategy variables related to 'apply pests and diseases programme', 'storing feed and/or seed reserves', 'have a farm reservoir for water supplies in dry season', 'spreading sale over several time period' and 'obtaining market information on prices forecast and trends'. This factor is named 'farm production and marketing management'.

Factor two (AR2): this factor is described as 'diversification' because there were significant loadings of risk strategy variables related to 'having diversified crop, animal or other enterprises', 'planting several varieties of crops' and 'selection of crop and/or animal varieties with low price variability'.

Factor three (AR3): this factor is loaded highly on 'investing in non-farm investment/business' and 'working off farm to supplement net farm income', which represent the influence of off-farm income. Thus, factor three is named 'off-farm income'.

Factor four (AR4): this factor is interpreted as 'financial management', which is concerned with 'reduce debt level', 'leasing farm machinery rather than owning them' and 'holding cash and easily converted cash assets'.

Risk management strategy	*Factors* [a]				*Communality*
	AR1	*AR2*	*AR3*	*AR4*	
Apply pests and diseases program	**0.655**	-0.035	0.318	0.047	0.533
Storing feed and/or seed reserves	**0.651**	0.162	-0.025	0.339	0.565
Have a farm reservoir for water supplies in dry season	**0.641**	0.288	0.022	0.031	0.495
Spreading sale over several time period	**0.618**	0.301	0.183	0.159	0.531

Risk management strategy	*Factors* [a]				*Communality*
	AR1	*AR2*	*AR3*	*AR4*	
Obtaining market information on prices forecast and trends	**0.505**	0.363	0.259	0.280	0.532
Having diversified crop, animal or other enterprises	0.211	**0.796**	-0.030	0.147	0.700
Planting several varieties of crops	0.252	**0.742**	0.093	0.095	0.632
Selection of crop and/or animal varieties with low price variability	0.387	**0.505**	0.345	-0.039	0.525
Investing in non-farm investment/business	0.172	-0.001	**0.807**	0.124	0.696
Working off farm to supplement net farm income	0.341	0.058	**0.711**	0.143	0.646
Use forward contracts	-0.121	**0.441**	**0.590**	0.076	0.563
Reduce debt level	0.094	0.117	0.061	**0.787**	0.645
Leasing farm machinery rather than owning them	0.164	-0.023	0.111	**0.715**	0.551
Holding cash and easily converted cash assets	0.117	**0.440**	0.177	**0.559**	0.552
Eigenvalues	4.69	1.28	1.19	1.01	
Per cent of total variance explained	33.48	9.14	8.48	7.24	
Cumulative per cent of the variance explained	33.48	42.62	51.09	58.33	
Cronbach's Alpha	0.742	0.711	0.642	0.596	
Number of variables	5	3	3	3	

[a] Factors AR1-4 labelled as AR1=farm production and marketing management, AR2=diversification, AR3=off-farm income and AR4=financial management.
'Able to adjust quickly to weather, price and other adverse factors' and 'purchase farm machinery to replace of labour' are deleted from the analysis due to these risk management strategies have low communalities.
Factor loadings for an absolute values greater than 0.4 are in **bold**.
Source: Field survey, 2009

Table 6. Varimax rotated factor loadings of risk management strategies for all farmers sampled inThailand (n=800)

However, in factor AR3, factor analysis grouped the 'use forward contracts' variable, which is unrelated to the definition of this factor. Therefore, the 'use forward contracts' variable was deleted from factor AR3 and the Cronbach Alpha coefficient slightly improved from 0.642 to 0.697. This result illustrated that factor AR3 had a stronger internal consistency after 'use forward contracts' variable was deleted.

4.4. The association between the farmers' characteristics and source of risk and management perception of risks

Multiple regression analysis was employed to investigate the relationship between the farmers' socioeconomic characteristics and the perceptions of sources of risk and risk management strategy components obtained from the factor analysis. The summated scales of sources of risk and risk strategy factors of each group of farmers were summed up and averaged based on the relevant variables in each factor structure and their internal

consistency. Before performing multiple regression analysis, all models were assessed for normality, linearity, multicollinearity and homoscedasticity to ensure the appropriateness of the equations.[29]

4.4.1. Sources of risk

Table 7 shows the relationship between all farmers' socioeconomic status and the different perceptions of sources of risk components. Models 1-4 are statistically significant at the one per cent level. However, the coefficients of determination (R^2) of most of the models are low. This result is consistent with the findings of Flaten et al. and Meuwissen et al. who found low explanatory power of regression models between the perceptions of sources of risk and risk strategies with the farmers' characteristics.[19, 24] Both authors argued that the lower R^2 in the regression models implies that the farmers' perceptions of sources of risk and risk strategies differed from farmer to farmer.

Gender is negatively related to the 'personal and farm business environment' and 'natural disaster' risks on farm. This implies that female heads of farm households are likely to perceive these sources of risk as significantly more important than male household heads. Similarly, the age of farmers and farm size are negatively related to the 'natural disaster' risk, which means young farmers and farmers who have smaller farm sizes tended to perceive 'natural disaster' as a higher on-farm source of risk. This finding may be attributable to the severe floods across Thailand in 2008.

The highest educational level is positively related to the 'personal and farm business environment' risk, which indicates that more educated farmers perceived this source of risk as significantly more important in farming. The reason is because the more educated farmers realized that the family farm situation and the changes in farm business environment, such as high labour wages and relatively high prices of agricultural land, may indirectly affect their farm operations.

The number of years in farming is negatively related to the 'economic and political' risk perceptions. However, the annual household income and the size of farm household exhibited a positive relationship with this source of risk. This result suggests that less experienced farmers, farmers who have higher annual household income and farmers with larger household size tended to perceive risk related to 'economic and political' as highly important. This finding may have resulted from the instability of Thailand political situation since September 2006.

Farm business finance is positively related to the 'financial situations' risk factor and is statistically significant at the one per cent level. This suggests that farmers who have loans are more likely to pay more attention to the changes to their farm financial situation, such as interest rates and level of debt. In addition, farm business finance is positively related to the 'natural disaster' risk factor. This implies that farmers who have loans perceived this source of risk as highly important. This may be due to the 'natural disaster' risk damaging their farm crops, which results in insecurity of their farm income and debt repayment capacity.

Risks related to the 'economic and political' and 'personal and farm business environment' were perceived as highly important by farmers who had off-farm work. This suggests that farmers who have off-farm work are very concerned about those risks that can disrupt their off-farm income.

With regard to the farm location variable, the regression result showed a strong relationship with more than half of the risk factors. Farmers in the central region perceive the 'personal and farm business environment', 'natural disaster' and 'financial situation' as more important risk factors than north-east farmers; north-east farmers are more concerned about 'economic and political' risk. This finding suggests that the sources of risk on small-holding farms differ significantly between these two regions.

Independent variables	*Risk source components* [b]				
	AS1	*AS2*	*AS3*	*AS4*	*AS5*
Constant	3.170***	1.943***	3.287***	2.466***	3.619***
Age [c]	-0.039	-0.079	-0.306**	-0.056	-0.118
Gender [d]	-0.024	-0.199***	-0.182*	-0.063	-0.056
Highest education [e]	0.068	0.233***	0.123	0.122	0.123
Farming experiences [f]	-0.139*	0.024	0.134	-0.098	0.013
Off-farm work [g]	0.135*	0.281***	0.037	0.067	0.092
Farm size	-0.003	0.005	-0.011**	-0.004	0.001
Net farm income	-2.37E-07	-9.81E-07***	1.35E-06**	-6.90E-07	-2.77E07
Farm location [h]	-0.166*	0.301***	0.313***	0.196**	0.079
Finance farm business [i]	0.028	-0.038	0.294***	0.408***	0.027
Annual household income [j]	0.231***	0.068	0.009	0.130	0.100
Household size	0.063***	0.051***	0.008	0.023	0.001
R^2	0.034***	0.124***	0.064***	0.061***	0.021

[a] Variables and models significant at $^{*}P<0.1$, $^{**}P<0.05$ and $^{***}P<0.01$;
[b] Factors AS1-6 are labelled as AS1=economic and political, AS2=personal and farm business environment, AS3=natural disaster, AS4=financial situation, AS5=yields and product prices and AS6=input prices;
[c] 1, if the farmer's age over 40 years old, 0 otherwise;
[d] 1, if the farmer is male, 0 if female;
[e] 1, if the highest education of the farmer is high school and higher, 0 if primary school education or less;
[f] 1, if the farming experience over 30 years, 0 otherwise;
[g] 1, if the farmer has off-farm work, 0 if no off-farm work;
[h] 1, if farmer's farm is located in central region, 0 if a farm located in north-east region;
[i] 1, if farm has a loan, 0 if farm without a loan; and
[j] 1, if household income greater than 90,001 baht and 0 represent otherwise.
Source: Field survey, 2009

Table 7. Multivariate regression of the source of risk components and household and farm characteristics of all sampled Thai farmers (n=800) [a]

4.4.2. Risk management strategies

Table 8 summarizes the multiple regression models of the risk management strategy components and the socioeconomic variables for all farmers. The goodness-of-fit coefficients of all models were rather low, except for model three where the coefficient explained around 27 per cent of the variation of the dependent variable. Models 1-4 are statistically significant ($P< 0.01$).The age variable is insignificant in relation to the risk strategy components of all farmers.

Gender was negatively related to 'off-farm income', which means that female household heads perceived this risk strategy as more important than male household heads. The reason is because the female farmers or wives can easily find off-farm work, such as weaving and/or handicrafts that are widely found throughout the north-east region, to supplement their household income.

The highest educational level was positively related to the 'farm production and marketing management', 'diversification' and 'off-farm income' risk strategies. This implies that the more educated farmers perceived these risk management strategies as highly important. This finding is similar to that of Mustafa who argued that the more educated farmers performed better in managing their farm business compared with less educated farmers.(30)

The length of farming experience was negatively related to the 'farm production and marketing management', 'diversification' and 'financial management' risk strategies. This suggests that less experienced farmers were more likely to be interested in employing these strategies to manage risk on their farms than the more experienced farmers.

Off-farm work was positively related to all four risk strategy components. These relationships may be due to the farmers who have off-farm work to enhance their farm income; they are willing to adopt such strategies to improve and maintain their farm income. Similarly, the net farm income coefficient shows a negative relationship with all four risk strategy components. This suggests that the farmers who have a lower net farm income believe that these risk strategies can help to increase their farm income.

Farm size was positively related to the 'diversification' strategy. Farmers with larger farms perceived a diversification strategy as highly important. It should be noted that farm size is one of the constraints to diversification, that is, farmers with a small holding have limited ability to diversify their farm activities.(33)

Farmers who had higher annual household incomes perceived the 'financial management' strategy as highly important. In contrast, they perceived the 'diversification' strategy as less important than farmers who had lower annual income. In addition, risk management strategies related to 'farm production and marketing management' and 'off-farm income' were perceived as less important by the farmers who had loans. Farmers with larger households perceived 'farm production and marketing management' as slightly more important than smaller household farmers.

The farm location coefficient was negatively related to 'farm production and marketing management', 'diversification' and 'financial management' risk strategies. This may imply

that farmers in the north-east region perceived these risk strategies as more important than the central region farmers. This is because most north-east farmers are poorer.

Independent variables	*Risk strategy components* [b]			
	AR1	*AR2*	*AR3*	*AR4*
Constant	3.310***	2.956***	2.523***	3.428***
Age [c]	0.054	0.124	0.003	-0.002
Gender [d]	-0.019	-0.107	-0.136*	-0.047
Highest education [e]	0.258***	0.167**	0.378***	0.110
Farming experiences [f]	-0.132**	-0.238***	-0.100	-0.121*
Off-farm work [g]	0.249***	0.227***	0.944***	0.150**
Farm size	0.001	0.015***	0.003	-0.004
Net farm income	-1.11E-06***	-1.98E-06***	-7.67E-07*	-7.32E-07**
Farm location [h]	-0.383***	-0.143*	0.092	-0.160**
Finance farm business [i]	-0.126**	-0.039	-0.202***	-0.026
Annual household income [j]	0.023	-0.275***	0.054	0.158**
Household size	0.033*	0.002	0.026	-0.001
R^2	0.146***	0.138***	0.267***	0.053***

[a] Variables and models significant at *P<0.1, **P<0.05 and ***P<0.01;
[b] Factors AR1-4 are labelled as AR1=farm production and marketing management, AR2=diversification, AR3=off-farm income and AR4=financial management;
[c] 1, if the farmer's age over 40 years old, 0 otherwise;
[d] 1, if farmer is male, 0 if female;
[e] 1, if the highest education of the farmer is high school and higher, 0 if primary school education or less;
[f] 1, if the farming experience over 30 years, 0 otherwise;
[g] 1, if the farmer has off-farm work, 0 if no off-farm work;
[h] 1, if the farmer's farm is located in central region, 0 if a farm located in north-east region;
[i] 1, if farm has a loan, 0 if farm without a loan; and
[j] 1, if household income greater than 90,001 baht and 0 represent otherwise.
Source: Field survey, 2009

Table 8. Multivariate regression of the risk strategy components and household and farm characteristics of all sampled Thai farmers (n=800) [a]

5. Implication of the results

Farmers in both regions perceived 'unexpected variability of input prices' as the most important sources of risk on the farm. In addition to the prices of chemical fertilizer, the increase in wage rates and higher land rental rates are the main factors that pushed the farm production costs upward. Over the past decade, the intervention of the Thai government in agricultural input policies had actually declined. The distribution of chemical fertilizers at reduced cost was the only scheme that the government organized to assist poor rural farmers. However, this scheme has recently been terminated due to limited government budget and this consequently reduced opportunities for the farmers to control production costs.

The results of the sources of risk perceptions, showed that 'unexpected variability of product prices' was the second most important source of risk among the central and north east region farmers. The Thai government operated a pledging scheme for the major cash crops such as wet rice, dry rice, cassava and maize.[34] This scheme aimed to help farmers when commodity market prices fluctuated early in the harvesting season. However, the pledging scheme has been widely debated among policy experts, especially for rice.[35-37] The advantage of the rice pledging scheme is that farmers can obtain low-interest loans from the government when they decided to pledge their rice to the Bank of Agriculture and Agricultural Cooperatives (BAAC) at the pledging prices and the rice will be transferred to storage at the Public Warehouse Organisation. The government allowed the farmers to redeem and sell their rice in the market when market prices increased above the pledging prices. The pledging price was set by a government announcement and generally the pledging period is approximately five to seven months each year.[38] Conversely, some economists argued that the pledging scheme would have long-term negative impacts on the efficiency of the country's rice market and it seems that the management of the scheme is shaped by political forces.[35] The pledging scheme persuaded farmers to increase their production, but the quality of the products was frequently ignored.[39] Some economists also suggested that the government should discontinue this highly-interventional price policy and should encourage farmers to sell their products using futures contracts to reduce the risk of price and income volatilities.[40, 41] This challenged policy makers to create mechanisms to stabilize agricultural prices at levels that are economically reasonable for both farmers and consumers. In addition, the effects of price policies such as the pledging scheme should be assessed cautiously to improve the effectiveness of the scheme. Direct access to futures trading markets may perhaps be too complicated for smallholder farmers in Thailand. Hence, government agencies such as Ministry of Agriculture and Cooperatives, Ministry of Commerce and The Agricultural Futures Exchange of Thailand should develop strategies that would increase small farmers' access to the futures market.

The development of a national agricultural crop insurance scheme should be one of the Thai government's priorities. Crop insurance is, theoretically, an efficient instrument in managing risks and can facilitate efforts to protect farmers from either the loss of their crops or farm income caused by natural disasters or drops in commodity prices. To date, a new crop insurance scheme for Thai farmers that has been operated by BAAC since 2008 is still in the pilot project stage.[42] The government expects this crop insurance scheme will continue to develop to cover all farmers and crops countrywide in the near future.[43] In addition, there are some obstacles that policy makers should consider for the successful implementation of the crop insurance schemes.[1, 42, 44]

First, the crop insurance scheme itself should not be too complicated because it could lead to high administrative costs for the scheme. Second, the appropriate insurance premiums and coverage accessibility under the scheme for each crop must be carefully considered. Low premiums may not always cover all the losses from the large-scale disasters, but the high insurance premiums will lead to increased farm production costs. Lastly, the government

should promote the benefits of crop insurance schemes that could increase farmers' understanding and participation.

Strengthening the role of farmer groups or cooperatives should be considered as part of agricultural risk reduction policies in Thailand. This is because farmers' groups or cooperatives can help farmers to improve their negotiating power. Higher product prices and lower input prices can then be achieved more easily due to economies of scale.(1)

Author details

Satit Aditto
Department of Agricultural Economics, Faculty of Agriculture, Khon Kaen University, Thailand

Christopher Gan and Gilbert V. Nartea
Department of Accounting, Economics and Finance, Faculty of Commerce, Lincoln University, Christchurch, New Zealand

6. References

[1] Hardaker JB, Huirne RBM, Anderson JR, Lien G. Coping with risk in agriculture. Cambridge, MA: CABI Pub.; 2004.
[2] Hazell PBR, Norton RD. Mathematical programming for economic analysis in agriculture. New York: Macmillan; 1986.
[3] Dunn JW. Farm level risk analysis for Kansas farmers [doctoral thesis]. Manhattan, Kansas: Kansas State University; 2002.
[4] Hossain S, Mustapha NHN, Chen LT. A quadratic application in farm planning under uncertainty. International Journal of Social Economics. 2002;29(4):282-98.
[5] Nyikal RA, Kosura WO. Risk preference and optimal enterprise combinations in Kahuro division of Murang'a district, Kenya. Agricultural Economics. 2005;32(2):131-40.
[6] Pannell DJ, Malcolm B, Kingwell RS. Are we risking too much? Perspectives on risk in farm modeling. Agricultural Economics. 2000;23(1):69-78.
[7] Harwood J, Heifner R, Coble K, Perry J, Somwaru A. Managing risk in farming: concepts, research, and analysis. [report]. In press 1999.
[8] Shadbolt NM, Martin SK. Farm management in New Zealand. Auckland: Oxford University Press; 2005.
[9] Pellegrino JM. Risk management in agriculture: Argentine evidence of perceived sources of risk, risk management strategies and risk efficiency in rice farming [master thesis]. Lincoln, New Zealand: Lincoln University; 1999.
[10] Katikarn K. Risk and uncertainty of farmers in the central plain of Thailand [doctoral thesis]. Lexington, Kentucky: University of Kentucky; 1981.
[11] Patamakitsakul S. Thailand agriculture in the 10th National Economic and Social Development Plan (2007-2011) (in Thai)2006.

[12] Sayaphan C. Crop production planing under risk situations in Pitsanulok province crop year 1998/99 (in Thai) [master thesis]. Bangkok, Thailand: Kasetsart University; 2001.
[13] Kermel-Torrès D. Atlas of Thailand: spatial structures and development. Paris: IRD Editions; 2004.
[14] Bank of Thailand [BOT]. Thailand key economic indicators. 2012 [cited 2012 1 June]; Available from: http://www.bot.or.th/English/Statistics/Indicators/Pages/index.aspx.
[15] Ministry of Finance [MOF]. Value of exports. 2012 [cited 2012 1 June]; Available from: http://dwfoc.mof.go.th/.
[16] Office of Agricultural Economics [OAE]. Agricultural statistics of Thailand. 2012 [cited 2012 1 June]; Available from: http://www.oae.go.th.
[17] National Statistical Office of Thailand [NSO]. The 2003 agriculture census. 2006 [cited 2006 26 October]; Available from: http://web.nso.go.th/en/census/agricult/cen_agri03-1.htm.
[18] Lovelace GW, Subhadhira S, Simaraks S. Rapid rural appraisal in northeast Thailand: case studies. [working paper]. In press 1988.
[19] Flaten O, Lien G, Koesling M, Valle PS, Ebbesvik M. Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway. Livestock Production Science. 2005;95(1-2):11-25.
[20] Nicol RM, Ortmann GF, Ferrer SR. Perceptions of key business and financial risks by large-scale sugarcane farmers in KwaZulu-Natal in a dynamic socio-political environment. Agrekon. 2007;46(3):351-70.
[21] Boggess WG, Anaman KA, Hanson GD. Importance, causes, and management responses to farm risks: evidence from Florida and Alabama. Southern Journal of Agricultural Economics. 1985;17(2):105-16.
[22] Patrick GR, Wilson PN, Barry PJ, Boggess WG, Young DL. Risk perceptions and management responses: producer-generated hypotheses for risk modeling. Southern Journal of Agricultural Economics. 1985;17(2):231-8.
[23] Martin S. Risk management strategies in New Zealand agriculture and horticulture. Review of Marketing and Agricultural Economics. 1996;64(1):31-44.
[24] Meuwissen MPM, Huirne RBM, Hardaker JB. Risk and risk management: an empirical analysis of Dutch livestock farmers. Livestock Production Science. 2001;69(1):43-53.
[25] Hall DC, Knight TO, Coble KH, Baquet AE, Patrick GF. Analysis of beef producers' risk management perceptions and desire for further risk management education. Review of Agricultural Economics. 2003;25(2):430-48.
[26] Akasinha B, Ngamsomsuk K, Thongngam K, Sinchaikul S, Ngamsomsuk V, editors. Risk perceptions among rice farmers (in Thai). Multiple Cropping Center annual seminar; 2006; Chiangmai, Thailand.
[27] Sirisup S, Kammeier HD. Government policy and farmers' decision making: the agricultural diversification programme for the Chao Phraya river basin (1993-1995). [working paper]. In press 2003.

[28] Hair JF. Multivariate data analysis. 6th ed. New Jersey: Pearson Prentice Hall; 2006.
[29] Pallant J. SPSS survival manual: a step by step guide to data analysis using SPSS for Windows. 3rd ed. New York: McGraw Hill/Open University Press; 2007.
[30] Mustafa RH. Risk management in the rain-fed sector of Sudan: case study, Gedaref area Eastern Sudan [doctoral thesis]. Giessen, Germany: Justus Liebig University; 2006.
[31] Limsombunchai V. Rural financing in Thailand [doctoral thesis]. Lincoln, New Zealand: Lincoln University; 2006.
[32] IRINNews. Thailand: Flash floods continue to batter farmlands. 2008 [cited 2009 24 November]; Available from: http://www.irinnews.org/PrintReport.aspx?ReportId=80360.
[33] Ahmad A, Isvilanonda S. Rural poverty and agricultural diversification in Thailand. [Working Papers]. In press 2003.
[34] Department of Internal Trade. Pledging schemes. 2010 [cited 2010 10 October]; Available from: http://www.dit.go.th/contentmain.asp?typeid=8&catid=133.
[35] Forssell S. Rice policy in Thailand: policy making and recent developments. Minor Field Study Series. [working paper]. In press 2009.
[36] Hayami Y. An emerging agricultural problem in high-performing Asian economies. Policy Research Working Paper. [working paper]. In press 2007.
[37] Kajisa K, Akiyama T. The evolution of rice price policies over four decades: Thailand, Indonesia and the Philippines. [working paper]. In press 2004.
[38] Isvilanonda S, Bunyasiri I, editors. Food security in Thailand: status, rural poor vulnerability and some policy options. agricultural and food policy reforms: food security from the perspective of Asian small-scale farmers, 24-28 August 2009; 2009; Seoul, South Korea.
[39] Chantanusornsiri W. Crop insurance programe not expected to hit rice exports. Bangkok Post. 2009 September 18.
[40] Arunmas P. Ammar slams 'corrupt' rice scheme. Bangkok Post. 2008 November 21.
[41] Pratruangkrai P. Rice pledging scheme putting exports at risk. The Nation. 2009 February 23.
[42] Yimlamai A. Agricultural weather index insurance in Thailand. 2010 [cited 2010 19 December]; Available from: http://www.foodsecurity-asiapacific.com/wp-content/uploads/2010/10/pdf/Session5/3%20A%20Yimlamai-Agricultural%20Weather%20Index%20Insurance%20in%20Thailand.pdf.
[43] Commodity Online. Thailand to extend crop insurance plan. 2010 [cited 2010 20 December]; Available from: http://www.commodityonline.com/crops-weather/Thailand-to-extend-crop-insurance-plan-2010-03-09-26289-3-1.html.

[44] Abada J. Micro and area-based schemes: project and program issues. In: Ortiz ID, editor. Social protection in Asia and the Pacific: Asian Development Bank; 2001. p. 408-27.

IntechOpen