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Farmer's Perceptions on Agricultural Risks and their Determinants: The Case of Tea Production in Thai Nguyen Province, Vietnam

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The study outlined the main sources of risk and the relationships between socio–economic variables and risk perception of the tea farmers in Vietnam. The data was collected from a survey in study area in July and August, 2016. After the survey, data of 326 sampled farmers were available for analysis in this study. Farmer's risk perception was firstly studied using principal component analysis to reduce the dimensionality of the data. Then, multiple linear regression was used to examine the relationship between farmer's risk perception and socio–economic variables. Our finding indicated that price volatility, pest and disease, increase of production cost were the most serious risks in tea farmers' perception as single risks. A number of socio–economic variables had significant impacts on risk perceptions. Notably, the agricultural education through extension programs was found to reduce worries and risk perception. Thus, policy intervention should be paid more attention on improving farmers' knowledge in agricultural production and tea production, especially in pest and disease prevention.

Key words: Principal component analysis, Risk perception, Tea farmers, Vietnam

INTRODUCTION

Tea plays an important role in Vietnam in terms of the culture and the economy. From an economic point of view, tea is an important cash crop for rural farmers in the northern provinces of Vietnam. In 2012, about 146,700 tons of tea products were exported, valued at about USD 224.6 million (FAO, 2012). With over 130,000 ha of tea plantation area, this crop contributes significantly to job generation. There were about 400,000 households involving in tea production for their income and livelihood (SOMO, 2007). In other words, the tea industry sector supplies about 1.5 million jobs for Vietnamese people.

Agricultural production is exposed to various types of risks and uncertainties because its production activities are strongly linked to natural conditions and environment in which farming operates (Akcaoz and Ozkan, 2005). Tea production in Vietnam is generally affected by those risk factors under the context of agriculture. Risk sources and uncertainties are not uniformly spread over all farmers, neither are they constant over time (Riwthong *et al*., 2017). Farmers are less likely to take on farming activities and its related investment to get higher expected revenue if they face risks of failure (Alderman, 2008). Many causes are attributable to agricultural risks, such as climate variability and change, the complexity of biological processes, the seasonality of production, the geographical spreading of production, yield and price variability of products, imperfect markets of input and output supply (Jain and Parshad, 2007). In literature, studies on the risk of agricultural production can be classified in various ways. They could be categorized into production risk, price risk, disaster risk and technological risk (Miller *et al*., 2004). Another way of viewing risk also can be seen in the study of the European Commission where risks were classified as following: personal (loss of health), institutional (political, trade rules), financial (access to loans and credit conditions), production (damages are due to pest, disease, climate change, fire, etc) and price (unfavorable changes in output and input price) (Bielza *et al*., 2009). Besides, agricultural risks could be also grouped into five main sources of risk, namely production risk, marketing risk, financial risk, legal and environmental risk, human resource risk (USDA, 1997).

Since risks negatively affect production output which is the main source of revenue for farmers, it is very important for farmers to identify and manage the risks (Drollette, 2009). Uncertainties and risk management in agricultural production is also crucial and is generally considered as a key matter in farmers' decision–making and to the policies that affect these decisions. Sufficient knowledge on farmers' risk perceptions and their response towards the risk are very meaningful for researchers and policy makers in designing an appropriate risk management system for the farmers (Flaten *et al*., 2005). Sufficient understanding of farmers' risk perceptions and their response is also important factors in creating improved risk management tools to reduce losses arise from various risk sources. Although its importance has been shown in literature, identifying the determinants of tea farmer's perception on risk sources and their management response has drawn little attention in Vietnam. Therefore, the objective of the study was to determine the tea farmers' risk perceptions and their determinant factors among characteristics of the farm and farmer.

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MATERIALS AND METHODS

Data collection

The survey was conducted in July and August, 2016 in Thai Nguyen Province, which is one of major tea producing areas in Vietnam, for fresh tea quantity and quality. The data was collected from the sampled farmers by asking them the risks in their tea production. A structured questionnaire was designed with support from consultants and experienced experts in the field. Number of risk sources were selected and listed in the questionnaire based on real situation of agricultural production and previous studies (Meuwissen *et al*., 2001; Flaten *et al*., 2005). A trial pretest was conducted to check the questionnaire in the study area. Based on the feedback from the pretest, the questionnaire was updated and modified. Finally, the completed version was used to gather the data. In total 17, sources of risk were finally suggested in the questionnaire to collect the data for the analysis. The tea farmers were asked to rank each source of risk on a Likert scale from levels 1 to 5 to evaluate how significant they considered each risk source to be in terms of its potential impact on the economic performance of their tea farm. The level 1 stands for the least importance and level 5 stands for the most importance. In the study area, many farmers have adopted VietGAP standards in their tea production, thus the samples cover both VietGAP and conventional tea practices. We used a two–stage sampling technique for data collection. First, large VietGAP and conventional tea–producing districts in the region were selected for purposive sampling, including three districts of the province, i.e., Thai Nguyen city, Dai Tu and Dong Hy. Second, a random sampling technique was adopted to select the representative VietGAP and conventional tea farmers within the same study site. After field survey, a dataset of 116 VietGAP and 210 conventional tea farmers was used for analysis in the study.

Theoretical framework and analysis technique

Studies related to the field of risk perception originate from two distinct theories, namely "psychometric paradigm" and "cultural theory" in which the psychometric paradigm has been widely applied (Sjöberg *et al*., 2004). Many researchers have employed this theory for their different studies since it was first presented in 1978 (Wählberg, 2001). One of the most important assumption using the psychometric approach is that risk is inherently subjective. Specifically, the psychometric paradigm encompasses a theoretical framework which assumes risk to be subjectively defined by individuals who can be affected by a wide array of factors, such as psychological, social, institutional and cultural ones (Sjöberg *et al*., 2004). In other words, this approach must go with the questionnaire and analysis techniques because they have not been validated in other manners (Wählberg, 2001).

Risk perception of tea farmers were analyzed using descriptive analyses. Due to the number of variables was quite large, a statistical technique known as Principal Component Analysis (PCA) was popularly applied to reduce its dimension. According to Abdi and Williams (2010), PCA is one of statistic technique that enables to analyze data tables in which its relationships could be described by inter–correlated quantitative dependent variables. The objective of the technique is to extract the important information from the dataset, which is likely to represent it as a set of new orthogonal variables called principle components. In this study, there were 17 risk sources faced by tea farmers. PCA is a powerful tool to reduce the dimension of the variables without losing much information. Its application has also been applied in several previous studies. Thus, PCA was suitably used to analyze the data in this study. Finally, the relationship between tea farmers' risk perception and socioeconomic variables was explored using multiple linear regressions which can be written as follow:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_{ij} X_i + \varepsilon_i$$

where Y_i is score obtained from i^{th} farmer's risk perception (i = 1, 2, …, n); X_j is exploratory variables to be included in the analysis (j = 1, 2, …, 13) as described in Table 1; β_{ij} is coefficients to be estimated in the regression model; ε_i is a random error.

Description of variables used in the regression model

The dependent variables were farmer's perceptions on sources of risk, based on which six components were extracted after PCA application. All exploratory variables used in the model were selected on basis of economic theories, findings of the previous studies, and actual status of agricultural production in the study area. Previous analysts have shown that a farmer's risk perception could be affected by farm and farmer characteristics, such as gender, formal education, farming system, agricultural education, off–farm work, occupation etc (Flaten *et al*., 2005; Ullah *et al*., 2015; Riwthong *et al*., 2017). Definitions of the variables and their descriptive statistics are presented in table 1. The average tea farmland was 0.35 ha per household, was generally characterized by small scale agricultural production in northern Vietnam. The study area is dominated with favorable land area suited for tea production. Thus tea farmers have much experience in tea production of 22 years on average. Most tea farmers had a formal education to get basic knowledge that was not closely related to cropping techniques.

Although agricultural production is the main source of income for households in the study area, many farmers also involved in off–farm works to utilize availability of their family labors and get more income as well. Especially, highly educated members of family often involve in other sectors, such as government staffs, teachers, enterprises, etc. About 70% of the interviewed farmers responded that tea production was main occupation of their family. To minimize production cost and share experience in production, many farmers partici-

Table 1. Summary statistics of variables used in multiple linear regression

Exploratory variables	Unit	Mean	Std.err	Min	Max
Farming system (1: VietGAP, 0: otherwise)	dummy	0.356	0.479	0	1
Gender (1: male, 0: female)	dummy	0.598	0.491	0	1
Education (1: if > 9 year; 0: otherwise)	dummy	0.448	0.498	0	1
Experience (involving in tea production)	years	22.303	8.734	4	45
Farm size (tea farmland)	hectares	0.353	0.163	0.11	1.3
Off–farm work (1: yes, 0: otherwise)	dummy	0.736	0.441	0	1
Main occupation (1: agriculture, 0: otherwise)	dummy	0.668	0.471	0	1
Production groups (1: member, 0: otherwise)	dummy	0.592	0.492	0	1
Agricultural education (1: yes, 0: otherwise)	dummy	0.644	0.479	0	1
Machine ownership (1: owner, 0: otherwise)	dummy	0.779	0.415	0	1
Irrigation access (1: yes, 0: otherwise)	dummy	0.681	0.466	0	1
Credit access (1: yes, 0: otherwise)	dummy	0.150	0.357	0	1
Family labor (aged from 16–65s)	persons	2.898	0.934	1	5

Source: author's surveyed data in 2016

pated in production groups and machinery sharing groups.

RESULTS AND DISCUSSION

Farmer's perception on risk sources

Table 2 indicates the farmer's perception on the main sources of risk in tea production. The third and forth columns of the table show the average scores of household's perception on each source of risk and its standard deviation, respectively. Farmer's risk perception was ranked according to the average scores, where the higher value implies more risk than lower one. According to the study, there are 17 risk sources exposed by tea farmers in the area. It also covers all aspects confronting farmers in tea production. Most sources of risk had standard deviation less than one, suggesting a high level of consensus among respondents. The average score of risk sources varies from 1.34 to 4.83.

In general, outcome of agricultural production involves in input usage and selling price of output that directly affect the total production value and income as well. Thus, volatility of tea and fertilizer price in the market are considered as the most important risks in tea farmer's perception. Besides, this partly reflects the fact

Table 2. Mean score and rank for risk sources perceived by farmers

Risk sources	Rank	Mean	Std.dev	Min	Max
Tea price volatility	1	4.83	0.42	3	5
Fertilizer price volatility	2	4.65	0.61	3	5
Pest and disease	3	3.87	0.89	2	5
Market control	4	3.87	0.97	2	5
Fresh tea quality	5	3.84	0.92	2	5
Tea yield volatility	6	3.69	1.11	1	5
Fertilizer quality	7	3.39	0.97	2	5
Insufficient supply water	8	2.99	1.30	1	5
Food safety issue happened	9	2.85	0.59	2	5
Availability of credit source	10	2.67	1.03	1	5
Limited technical knowledge	11	2.41	0.92	1	5
Breeding quality	12	2.27	0.77	1	5
Price variation of related products	13	2.25	0.70	1	4
Health issue of family members	14	1.98	0.87	1	5
Consumer preference	15	1.92	1.02	1	5
Interest rate change	16	1.63	0.67	1	3
Lack of farming labor	17	1.34	0.60	1	3

Source: author's surveyed data in 2016
Note: the order of risk is based on mean score of each one (column 3)

that small–scale producers can not control the price of inputs and output in the market. Lowly ranked risks are given to issue of family health, change of interest rate, lack of labor, and change of consumer preference. Due to small scale production, lack of farming labors, change of consumer preference are not serious worries of the tea farmers. Generally, credit access is one of most important factors directly involving in farming production, but tea farmers placed credit access as less risk than others. This may indicate that only a small proportion of tea farmers (15%) borrowed credit loans from agencies for tea production (Bac *et al.*, 2017). As explained in the section of analysis technique above, risk perception is subjective to the individuals and is influenced by questions asked. Moreover, farming system, institutional, cultural and risk environments are different across the nations. Thus, comparisons of risks with findings of previous studies are difficult. However, high scores of market tea price volatility and crop pest/disease in the study are also similar to the finding of previous studies in crop production. Riwthong *et al.* (2017) indicated that commercial farmers in Thailand perceived crop pests and disease, low crop prices as the most important risk source than other sources of risk.

Before PCA was applied to the data to reduce the number of risk source variables, sampling adequacy using the Kaiser–Mayer–Olkin (KMO) criteria was tested to check whether the data would be suited well. KMO ranges from 0 to 1, and the overall KMO should be equal or greater than 0.5 value that is considered as an acceptable condition (Chow, 2004). In this study, the overall KMO was 0.52, suggesting that the data matrix was suitable for using principal component analysis. Table 3 presents the varimax rotated factor loading for sources of risk. The number of risk source variables was reduced from 17 to 6 risk sources (components) with eigenvalues greater than 1, accounting for 53.57% total variance. On basis of loading scores presented in table 3, components 1–6 are labeled as "institutional risk", "yield & quality", "market risk", "production risk", "human risk", "input quality", respectively. Specifically, component 1 has the highest loading of market control. This comes from farmer's concerns about unfair competition in collecting tea material among enterprises and middle collectors or traders. Another issue is that the origin of the products and its safety condition in the market are not strictly controlled. As a result, consumers did not completely trust in safe product trademarks in the market such as VietGAP, organic tea products, etc. Besides, institutional risk also included other food safety issues happened outside of tea production, so that the loading is negative. A high variation of tea quality and yield goes into risk of output in component 2. Output risk is likely to reflect changes in yield and quality caused by lack of active irri-

Table 3. Varimax rotated factor loading for risk sources

Risk sources	Comp 1 (institutional risk)	Comp 2 (yield & quality)	Comp 3 (market risk)	Comp 4 (production risk)	Comp 5 (human risk)	Comp 6 (input risk)
Fertilizer quality	0.029	–0.047	–0.097	–0.005	–0.040	**0.635**
Fresh tea quality	0.115	**0.542**	0.005	0.052	0.180	–0.088
Consumer preference	–0.026	0.088	**0.485**	–0.282	0.098	0.290
Breeding quality	–0.179	–0.015	0.066	0.290	0.198	**0.416**
Tea yield variability	–0.152	**0.523**	–0.005	0.061	0.124	0.055
Insufficient supply water	0.063	–0.152	–0.041	**0.341**	0.243	–0.260
Pest and disease	–0.129	0.240	–0.150	**0.485**	–0.054	v0.113
Tea price volatility	0.094	0.018	**0.581**	0.028	–0.033	–0.231
Fertilizer price volatility	0.011	–0.283	0.004	**0.354**	0.251	v0.108
Market control	**0.579**	–0.084	–0.019	0.007	–0.054	–0.034
Food safety issue happened	**–0.330**	–0.043	–0.203	–0.085	–0.160	–0.272
Availability of credit source	**0.458**	0.250	0.097	–0.024	–0.046	–0.116
Price effect of related product	0.169	0.261	**–0.449**	–0.134	0.121	–0.036
Interest rate change	**0.389**	–0.045	–0.092	–0.029	0.053	0.184
Health of family members	0.039	0.015	0.003	–0.021	**0.672**	0.057
Lack of farming labor	–0.221	0.046	–0.086	–0.132	**0.492**	–0.091
Limited technical knowledge	0.058	0.043	0.035	**0.554**	–0.164	0.212
Eigen value	2.169	1.651	1.455	1.385	1.289	1.057
Cumulative percent of the explanation (%)	11.15	20.91	29.47	37.98	46.14	53.57

Source: author's surveyed data in 2016
Extraction method: Principal Component Analysis using Varimax rotation. Loadings of ≥ 0.3 are in Bold
Adequacy measurement: Kaiser–Mayer–Olkin criteria (KMO = 0.52)

gation, climate change and other factors. The change of consumer preference and volatility of market tea price are related to the component 3, namely market risk. While variability of tea price shows the highest loading in this factor that mainly reflects change of tea price in world market, change in consumer preference refers to the situation such as consumers would consume more imported tea products or other substitutable products.

In component 4 indicating "production risks", the highest loadings go into pest and disease, lack of technical knowledge. Farmer's perception on this source of risk reflects a spreading and resistance of pest and disease caused by inappropriate use of pesticide in tea production. Also, it implies that tea farmers expect updated technical knowledge for efficient prevention of pest and disease. The issue of family health and shortage of farming labor are grouped in component 5 "human risk". This source of risk reflects the change in number of family labor due to health problems and participating in off–farm work. Finally, loading scores of risks regarding to input and breeding quality focus on component 6. Risk of input quality refers to the fact that market for production inputs is very diversified in the study area. Choice of input provision depends mainly on farmers' experience. The origin and products sold in the market have not been sufficiently controlled by agencies as expected.

Risk perception in relation to farm and farmer characteristics

A multiple linear regression model was used to explore the relationship between risk perception and farm /farmer characteristics. Regression coefficients and goodness–of–fit measures are presented in table 4.

The result indicates that 3 out of 5 models were highly significant with an exception of "market risk" and "input quality". Absence of socio–economic variables of potential importance was judged not to be likely because of careful selection of input variables in the regression model. Thus, the goodness–of–fit coefficients in ordinary least square models were quite low due to very personal perception of tea farmers. Another possible explanation of low goodness–of–fit in all models is natural in cross–sectional data with highly diverse observations (Gujarati, 2011). Many previous studies also resulted in similarly low goodness–of–fit of the regression models (Meuwissen *et al.*, 2001; Flaten *et al.*, 2005; Aditto *et al.*, 2012). As shown in table 4, farming system is not statistically significant to all risk components perceived by farmers. This reflects the similarity in the production process used by tea farmers. The difference is that VietGAP farmers must strictly follow safe standards to minimize the risk of hazards. When all standards are met and they paid a fee as required by agencies, their product in the market is certified as a certification of VietGAP tea. As a result, these products might get slightly higher price. However, in fact, some farmers following VietGAP standards did not request a certification due to other reasons such as highly certified fee, short validation, complicated process. Of the socio–economic variables, off–farm income, occupation, group member, agricultural education and number of family labors had significant effects on the perception of risk sources. Tea farmers who had off–farm income perceived institutional risk as much less relevant, while human risk much more relevant. This is because these families often have some members joining in off–farm activities, they do not have only an income source from tea production. Farmers perceived output risk and production risk as significantly

Table 4. Estimation of multiple linear regression model for risk sources

Variables	Institutional risk (comp 1)	Yield & quality (comp 2)	Market risk (comp 3)	Production risk (comp 4)	Human risk (comp 5)	Input quality (comp 6)
Farming system	0.143	–0.036	0.126	–0.013	0.087	0.132
Gender	0.171	0.067	0.144	0.003	0.093	0.235
Education	0.138	–0.145	–0.036	0.087	**0.251***	–0.079
Experience	0.008	0.009	0.008	–0.010	0.013	–0.002
Farm size	–0.156	0.056	0.203	0.199	–0.154	–0.152
Off–farm work	**–1.010*****	0.196	0.165	0.023	**0.603*****	–0.010
Main occupation	–0.108	**0.561*****	–0.175	**0.795*****	0.084	–0.050
Production group	**–0.501*****	0.091	0.035	0.056	0.026	**–0.245***
Agricultural education	–0.229	**–0.988*****	**–0.250****	**–0.306****	0.112	**–0.415*****
Machine ownership	–0.005	0.123	0.236	0.028	–0.206	0.031
Irrigation access	0.219	0.081	–0.160	–0.045	–0.179	–0.134
Credit access	–0.016	0.247	0.064	–0.279	–0.016	–0.085
Family labor	**–0.162***	–0.054	0.019	0.013	–0.101	0.026
Constant	1.239***	–0.139	–0.362	–0.450	–0.453	0.397
R^2	0.162***	0.226***	0.036	0.142***	0.079**	0.056

Source: author's surveyed data in 2016

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively

more important, especially farmers involved in tea production as main occupation. Becoming membership of production groups or cooperatives reduced the perception of risk sources in term of institutional and input risk. Sharing technical knowledge and experience in agricultural production became more meaningful for tea farmers to reduce risks related to input quality and credit access. Notably, agricultural education had positive effects on reducing worry on output risk, market risk, production risk and input risk for tea farmers. Farmers having more family labors often have more options in overcoming institutional risk than other ones, perhaps associated with other income generation sources such as off–farm jobs.

CONCLUSION AND POLICY IMPLICATION

The study was conducted in the northern part of Vietnam, where tea production accounts for around 70% total national tea farmland and quantity. Descriptive analysis was used to rank the order of risk sources. The PCA was applied to reduce dimension of the data in the study. Then, multiple regression was used to explore the relationship between tea farmers' risk perception and socio–economic variables. In study area, there are 17 risk sources perceived by tea farmers and are categorized to be six components as institutional risk, output risk, market risk, production risk, human risk and input risk. Of these risk sources, tea price variability in the market, pest and disease risk in agricultural production and an increase of input cost in total production cost are the most serious in tea farmers' perception as single risks. The result also showed that there is no significant difference in farmers' perception on sources of risk between VietGAP and conventional tea farming systems. A number of socio–economic variables had significant effects on risk perceptions. Notably, agricultural educated farmers were found to be related to lower worries and risk perception. Thus, policy intervention should be paid more attention on improving farmers' knowledge in agricultural production. Other support policies toward stabilizing tea, input price in the market, and support for disease/pest prevention are also very important for farmers, as might help them to reduce related losses.

AUTHOR CONTRIBUTIONS

H. V. BAC designed the study, conducted data collection and statistical analysis, and then wrote the manuscript. T. NANSEKI and Y. CHOMEI supervised all steps of the study, improved the study's design, refined the interpretation of the results and discussion. All authors assisted in editing of the manuscript and approved the final version.

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REFERENCES

Abdi, H. and Williams, L. J. 2010 Principal component analysis. *WIREs Comp Stats*, **2**: 433–459

Aditto, S., Gan, C. and Nartea, G. V. 2012 Sources of risk and risk management strategies: The case of smallholder farmers in a developing economy. *In* "Risk management – Current issues and challenges", Ch. 20, ed. by N. Banaitiene, Intech, Croatia, pp. 449–474

Akcaoz, H. and Ozkan, B. 2005 Determining risk sources and strategies among farmers of contrasting risk awareness: A case study for Cukurova region of Turkey. *J. Arid Envir*, **62**: 661–675

Alderman, H. 2008 Managing Risks to Increase Efficiency and Reduce Poverty. *World Development Report 2008*, World Bank, Washington, DC. https://openknowledge.worldbank.org/bitstream/handle/10986/9165/WDR2008_0001.pdf. Accessed 22 Mar 2018

Bac, H. V., Nanseki, T. and Chomei, Y. 2017 Factors influencing tea farmers' decision to adopt Vietnamese Good Agricultural Practices in Northern Vietnam. *J. Agr Eco Dev*, **6**(2): 012–020

Bielza, M., Conte, C. G., Dittmann, C., Gallego, F. J., Stroblmair, J., Catenaro, R. and Dittmann, C. 2009 Agicultural insurance schemes, European Commission. https://ec.europa.eu/agriculture/sites/agriculture/files/external–studies/2006/insurance/full–report–rev_en.pdf. Accessed 20 Mar 2018

Chow, W. S. 2004 An exploratory study of the success factors for extranet adoption in e–supply chain. *J. Glo Info Mana*, **12** (1): 60–67

Drollette, S. A. 2009 Managing Production Risk in Agriculture, Department of Applied Economics, Utah State University, United States. https://apecextension.usu.edu/files–ou/uploads/Agribusiness–and–Food/Risk–Management/Risk–Management–Fact-sheets/Managing–Production–Risk.pdf. Accessed 20 Mar 2018

FAO. 2012 *Yearly crops and livestock database of Vietnam*, Food and Agriculture Organization of the United Nations, USA. http://www.fao.org/faostat/en/#data/TP. Accessed 18 Feb 2018

Flaten, O., Lien, G., Koesling, M., Valle, P. S. and Ebbesvik, M. 2005 Comparing risk perceptions and risk management in organic and conventional dairy farming: empirical results from Norway. *Livest Prod Scie*, **95**: 11–25

Gujarati, D. 2011 *Econometrics by example*, Palgrave Macmillan, Hampshire, UK, 25–81

Jain, R. C. A. and Parshad, M. 2007 Working Group on Risk Management in Agriculture for XI Five Year Plan, Government of India, Planning Commission, New Delhi

Meuwissen, M. P. M., Huirne, R. B. M. and Hardaker, J. B. 2001 Risk and risk management: An empirical analysis of Dutch livestock farmers. *Livest Prod Scie*, **69**: 43–53

Miller, A., Dobbins, C., Pritchett, J., Boehlje, M. and Ehmke, C. 2004 Risk Management for Farmers, Staff Paper 04–11, Department of Agricultural Economics, Purdue University, 1–27. http://ageonsearch.umn.edu/bitstream/28640/1/sp04001.pdf. Accessed 22 Mar 2018

Riwthong, S., Schreinemachers, P., Grovermann, C. and Berger, T. 2017 Agricultural commercialization: Risk perceptions, risk management and the role of pesticides in Thailand. *Kasetsart J. Socio Scie*, **38**: 264–272

Sjöberg, L., Moen, B–E. and Rundmo, T. 2004 Explaining risk perception: An evaluation of the psychometric paradigm in risk perception research. Norwegian University of Science and Technology, Department of Psychology, 7491 Trondheim, Norway. http://www.svt.ntnu.no/spy/torbjorn.rundmo/psychometric_paradigm.pdf. Accessed 18 Feb 2018

SOMO. 2007 Report on comparative international research on the tea sector in Vietnam. Centre for Research on Multinational Corporations, 1–56. https://www.somo.nl/wpcontent/

uploads/2007/01/Comparative–international–research–on–the–tea–sector–in–Vietnam.pdf. Accessed 23 Feb 2018

Ullah, R., Shivakoti, G. P. and Ali, G. 2015 Factors effecting farmers' risk attitude and risk perceptions: The case of Khyber Pakhtunkhwa, Pakistan. *Inte J. Disa Risk Reduc*, **13**: 151–157

USDA. 1997 Introduction to Risk Management, United States Department of Agriculture, Risk Management Agency. http://uwagec.org/riskmgt/GeneralTopics/IntroRiskMgt.pdf. Accessed 22 Feb 2018

Wählberge, A. E. AF. 2001 The theoretical features of some current approaches to risk perception. *J. Risk Res*, **4**(3): 237–250