Farmers' Risk Preferences and the Determinants of Risk Preferences in Upland Areas of Vietnam

Nguyen Van Song[1]; Ho Ngoc Cuong[1];

Dinh Van Tien[2], Thai Van Ha[2], Vu Ngoc Huyen[1];

Abstract

This study conducted to examine the risk preferences of upland farmers of Vietnam. The modified multiple price list method of Holt and Laury (2002) was used to elicit the farmers' risk preferences. A linear regression was estimated to determine the socio-demographic factors affecting farmers' risk preferences. The results indicated that 80.5% of respondents are risk averse, 12% are risk neutral and 7.5% are risk loving. There exists the relationship between risk preferences with socio-demographic characteristics such as nonfarm and farm income, sex, age. The majority of respondents are risk averse, which will influence farm operations and management decision. The policies in the uplands of Vietnam must consider reduce the risk or make them less risk averse to the farmers by generating more farm and non-farm income, investing on farmers' education and training, and supporting risk management strategies.

Key words: farmers, risk preferences, determinants, upland, Vietnam

1. Introduction

In agricultural activities, upland farmers of Vietnam have to face so many risks and constraints, namely, climate change, notably, erratic rainfall patterns and more frequent extreme weather; the small markets, unstable market price, poor infrastructure, and farm diseases. Therefore, risk is an integral part of decision-making processes, especially in upland agriculture in developing countries (Keil & Nielsen, 2012).Risk preferences might influence farm operations and management decisions (Akhtar et al., 2018) like adoption of technologies, participation in different enterprises, choice of adaptation mechanisms.

Ascertaining the attitude of farmers toward risk is an important first step in understanding their behavior and coping strategies they normally adopt to mitigate the effects of risk they constantly face within the environment they operate (Dadzie &

Acquah, 2012). Unfortunately, measures of risk preferences in low income countries are fairly rare (Bezabih & Sarr, 2012). This study was conducted aim to explore risk preference of upland farmers and analyze the potential impacts of various factors on their risk preferences. This finding may provide better understanding of the farmers' risk preferences that ultimately shape their decisions under risky situations.

2. Literature Review

Risk preference refers to the attitude people hold towards risks (Dadzie & Acquah, 2012). In terms of farmers' attitudes toward risk, farmers differ in the degree to which they accept risk. Some farmers are willing to accept more risk than others. Attitudes to risk are often related to the financial ability of the farmer to accept a small gain or loss.

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1 Vietnam National University of Agriculture (VNUA), Trau Quy, Gia Lam, Ha Noi, Vietnam
2. Ha Noi University of Business and Technology (HUBT), Vinh Tuy, Hai Ba Trung, Ha Noi, Vietnam
Corresponding Author email: hongoccuonghn@gmail.com

Farmers' attitudes may be classified as risk-averse, those who try to avoid taking risks; risk-takers, those who are open to more risky business options; and risk-neutral farmers, those who lie between the risk-averse and risk-taking position. Some recent studies from Wang, Gao, Wang, and Li (2016); Mao, Zhou, Ifft, and Ying (2019); Saguye (2017a,b); Liu, Bruins, and Heberling (2018) contributed a stronger conclusion about the relationship between risk preferences and farming decision.

Expected utility theory (EUT) has been the most widely used theoretical framework for eliciting farmers' risk attitudes (Bard & Barry, 2001). Laboratory experiments over the years have adopted the multiple price list method of Holt and Laury (2002) as the gold standard for eliciting the complete range of risk attitudes (HL, henceforth) Dasgupta, Mani, Sharma, and Singhal (2016); Khor, Ufer, Nielsen, and Zeller (2018);Anderson and Mellor (2008) cited by Hellerstein, Higgins, and Horowitz (2013). Theoretical and empirical research has shown that the most frequent forms of the investors' utility functions are quadratic function, power function and exponential function (Campbell & Viceira, 2001 cited by Stanković and Petrović (2016). The form of utility function used in the studies of Khor et al. (2018), Cameron and Shah (2015), Brick et al. (2012), and Hellerstein et al. (2013) was u(x) = $\frac{y^{1-\rho}}{1-\rho}$ where x is the lottery prize and ρ is the latent risk coefficient. In this specification, risk aversion is completely determined by the curvature of the utility function, with $\rho = 0$

denoting risk neutrality, $\rho > 0$ indicating risk aversion, and $\rho < 0$ denoting risk-loving. he factors affecting risk preferences as well as risk behavior of farming households are rarely discussed in the literature. It is clearly seen from the studies of Ayinde (2008), Tanaka, Camerer, and Nguyen (2010), Mehta (2012) and Akhtar et al. (2018) such as: household size, household disposable income, amount of capital, risk behavior, farming experience proportion of cropped land off-farm income, disposable assets, crop diversification and cooperative membership.

3. Research Methodology

3.1 Selection of The Study Area

Na Ri district where this study was conducted belongs to the Bac Kan province which is one of the most degraded upland areas of Vietnam. This is a typical district of the uplands of Vietnam. In Na Ri district, farmers face multiple risk factors related to the biological nature of production, small market and farm diseases. In addition, the constraints include the high ecological fragility of the sloping land, farmers' limited access to resources for agricultural production, lack of alternative forms of employment, education, and technology, and weak markets for both agricultural inputs and outputs.

3.2 Source of Data

The 200 farmer- respondents were invited for interview. All of them are main decision makers in their households in Na Ri district randomly selected from 9 villages of 2 communes (table 1).

Table 1. **Survey respondents in Na Ri district, Bac Kan, Vietnam, 2019**

Na Ri	Male	Female	Total
Lamson commune	81	24	105
Cule commune	54	41	95
Total	135	65	200

3.3 Eliciting the Farmers' Risk Preferences

The modified multiple price list method of Holt and Laury (2002) was used to elicit the farmers' risk preferences. The subjects were provided with documentation detailing instructions and outlining the various lottery asks. They were also encouraged to ask questions. Table 2 replicates the eight tasks presented to subjects. For each binary-choice lottery task, subjects picked either Lottery A or Lottery B. In this study, fixed probabilities of 100% and 50% were used in the experiment. In the first task, subjects have a 100% chance of receiving Vnd80,000 under Lottery A; under Lottery B they have a 50% chance

of receiving Vnd80,000, and a 50% chance of receiving nothing. The payoff associated with Lottery A declines systematically throughout the eight tasks, while the payoff for Lottery B remains unchanged. The numbers of safe decision choices (NSCs) from the MPL game was converted into risk preferences. Number of safe choice was the number of safe lottery the respondent chose in the game (Lottery A) before he/she switched to the risky lottery (Lottery B). For example, the subject who chose (1A, 2A, 3A) from 8 tasks of MPL has NSCs of 3 because three of these choices are the safer one in the lotteries A and B. The NSCs range from 0 to 8. A

Lower value of NSCs indicates a greater willingness to bear risk. NSCs were used as measure of each subject's risk preferences by using a CRRA utility function defined over the lottery prize. The

CRRA function is of the form $u(w) = \frac{w^{1-r}}{1-r}$ where w is the lottery prize and r is the latent risk coefficient.

Table 2. **The experimental game tasks to elicit risk preferences**

Task	Lottery A	Lottery B	EV_Lot A	EV_Lot B	CRRA	Risk classification
0-1	Vnd 80,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 80,000	Vnd 40,000	r <-4.19	Highly risk-loving
2	Vnd 70,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 70,000	Vnd 40,000	-4.19 <r < -1.40	Very risk-loving
3	Vnd 60,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 60,000	Vnd 40,000	-1.40<r<-0.47	Risk-loving
4	Vnd 50,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 50,000	Vnd 40,000	-0.47<r<0	Slightly risk-loving
5	Vnd 40,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 40,000	Vnd 40,000	0<r<0.29	Risk neutral
6	Vnd 30,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 30,000	Vnd 40,000	0.29<r<0.5	Slightly risk averse
7	Vnd 20,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 20,000	Vnd 40,000	0.50<r<0.67	Risk averse
8	Vnd 10,000	0.5 of Vnd 80,000 and 0.5 of Vnd 0	Vnd 10,000	Vnd 40,000	0.67< r	Highly risk averse

Note: $U(W) = \frac{w^{1-r}}{1-r}$ (CRRA utility function)

3.4 Determining the factors affecting farmers' risk preferences

In this study, a linear regression was estimated to determine the socio-demographic factors affecting farmers' risk preferences. The linear regression model was expressed as:

$RP = \alpha_0 + \alpha_i SE_i + \mu_i$

Where: RP is Relative risk aversion coefficient
SE_i is a vector of socio-demographic factors and μ_i is the error term.
α_i is a vector of parameters to be estimated
The dependent and explanatory variables are shown in Table 3.

Table 3. **Definitions of explanatory variables used in the risk preference model**

Item	Unit	Mean	Std.Dev
Respondents	Person	200	-
Male	Person	135	-
Female	Person	65	-
Age	Year	46.5	11.5
Education	School year	8.5	2.7
Household size (number of persons)	Person	4.3	1.2
Labor	Person	2.7	0.9
Experience	Year	22.7	11.5
Total annual crops area	m2	3,776	1,620
Total forest and perennial crop area	m2	5,208	4,804
Total income	Million dong	47.2	25.8
Farm income/year	Million dong	39.1	13.5
Non-Farm income/year	Million dong	8.1	21.9

4. Results and Discussion

4.1 The Description of The Respondents

The survey was conducted with 200 respondents in Na Ri district to study the situation of land degradation at the household level. Table 4 shows the general characteristics of selected households in Na Ri district. There were 200 respondents interviewed, of which 65 are female and 135 are male. The results from the table show that the typical farmer in the Na Ri district is an adult with an average age of 47 years. Also, the majority (67.5%) of the farmers in the Na Ri district are males with an average education of 8.5 years.

Table 4. **Description of farm-households, 200 respondents, Na Ri district, Bac Kan, 2019**

Item	Unit	Mean	Std.Dev
Respondents	Person	200	-
Male	Person	135	-
Female	Person	65	-
Age	Year	46.5	11.5
Education	School year	8.5	2.7
Household size (number of persons)	Person	4.3	1.2
Labor	Person	2.7	0.9
Experience	Year	22.7	11.5
Total annual crops area	m2	3,776	1,620
Total forest and perennial crop area	m2	5,208	4,804
Total income	Million dongs	47.2	25.8
Farm income/year	Million dongs	39.1	13.5
Non-Farm income/year	Million dongs	8.1	21.9

Source: Survey results, 2019; 1 US$=23,000 VND

The average household size is 4.3 persons/household and 2.7 working persons on average. Almost all of them have long experience in farming (22.7 years on average). Total average annual crop size is about 3,776 square meters, while total forest and perennial crop area is 5,208 square meters on average. The total average income per household per year is 47.2 million dongs (US$ 2,052), of which 39.1 million dongs (US$ 1,700) is farm income per year equivalent to 82.83% total income.

4.2 The risk preferences of farmers in Na Ri district

In this study, risk preferences of farmers in Na Ri district were elicited by multiple price list method and then categorized into seven groups, namely, highly risk-loving, very risk-loving, slightly risk-loving, risk neutral, slightly risk averse, risk averse, and highly risk-averse depending on the number of safe decision choices generated through the game tasks (Table 5). From the experimental game results, there is no respondent who always chose 8 risky choices (Lottery B). There is no one who chose only 1 safe decision choice (Lottery A) or 7 risky choices. There is only 1 who chose 2 safe decision choices (Lottery A) in the game or 6 risky choices (Lottery B) so that he or she is very risk-loving. There are 5 risk-loving respondents since they chose 3 safe decision choices (Lottery A) or 5 risky choices (Lottery B). There are 9 slightly risk-loving respondents because the number of safe decision choices is 4. There are 24 risk-neutral respondents and 37 slightly risk-averse respondents since they chose 5 safe decision choices and 6 safe decision choices, respectively. The risk-averse respondents and highly risk-averse respondents are 53 and 71, respectively. By multiple price list method, there are 0% highly risk-loving, 0.5% very risk-loving, 2.5% risk-loving, 4.5% slightly risk-loving, 12% risk neutral, 18.5% slightly risk averse, 26.5% risk-averse and 35.5% highly risk-averse in the total 200 respondents.

It is evident from the Table 5 that the majority of respondents in Na Ri district are risk-averse (80.5%). It is worth to indicate that the risk-averse farmers are not willing to receive the higher benefit because of high risks. This finding is in line with the findings of Binswanger (1980), Teklewold and Köhlin (2011); Lucas and Pabuayon (2011), Dadzie and Acquah (2012), Akhtar et al. (2018), Ihli, Gassner, and Musshoff (2018); and Mukasa (2018). However, the degree of relative risk aversion varies from farmer to farmer.

Table 5. **Distribution of lottery choices, 200 farmer-respondents, Na Ri district, Bac Kan, 2019**

NSCs /Lottery A	NRCs /Lottery B	Number of Respondents	Risk Preference Classification	Range of RRA	Percent (%)
0-1	7-8	0	Highly risk-loving	$r < -4.19$	0
2	6	1	Very risk-loving	$-4.19 < r < -1.40$	0.5
3	5	5	Risk-loving	$-1.40 < r < -0.47$	2.5
4	4	9	Slightly risk-loving	$-0.47 < r < 0$	4.5
5	3	24	Risk neutral	$0 < r < 0.29$	12.0
6	2	37	Slightly risk averse	$0.29 < r < 0.5$	18.5
7	1	53	Risk averse	$0.50 < r < 0.67$	26.5
8	0	71	Highly risk averse	$0.67 < r$	35.5

Source: Survey results, 2019

The socio-demographic characteristics of the seven risk aversion groups are shown in Table 6. The last column shows the results of ANOVA (Single Factor Test) for parametric variables and Chi square test for non-parametric variables. The results indicate that there are significant differences among the risk aversion groups at 1% probability level in some variables such as non-farm income, farm-income, age, and education. However, the difference in terms of sex among the seven risk preferences groups was not significant.

The findings in Table 6 indicate that the risk-averse farmers are older, have less non-farm and farm income, and less educated than the risk-loving farmers. Risk-averse farmers are likely to be about 49.43 years old, have non-farm income of around 7.25 million dong (US$ 315.21) and farm income of 38.51 million dong (US$1,674.35), and have 8.75 years in school years, on average. In contrast, risk-loving farmers are likely to be 37 years old, have non-farm income of 20 million dong (US$ 869.56) and farm income of 53.4 million dong (US$ 2,321.74). The risk-loving farmers have 10 years in school, on average.

Table 6. **Socio-demographic characteristics by risk preference, 200 farmer-respondents, Na Ri district, Bac Kan, 2019**

Item	Very risk-loving	Risk loving	Slightly risk-loving	Risk neutral	Slightly risk averse	Risk averse	Highly risk averse	p-Value
Observations	1	5	9	24	37	53	71	
Non-farm income (million dong)	200.00	20.00	10.00	5.42	7.30	7.25	6.27	0.000
Farm income (million dong)	55.10	53.40	45.68	47.63	40.40	38.51	33.99	0.000
Sex[a]	1.00	0.80	0.89	0.83	0.73	0.64	0.58	0.157
Age (years)	34.00	37.00	36.22	35.17	40.59	49.43	53.32	0.000
Education (school years)	12.00	10.00	10.78	8.88	9.46	8.75	7.30	0.000

Source: Survey results, 2019; a: Chi-square test for non-parametric variable

1 US$ = 23,000 VND

4.3 Factors affecting Farmers' Risk preferences in the Study Area

Multiple-linear regression was applied to estimate the factors affecting the farmers' risk preferences. The dependent variable is risk preference denoted by the relative risk aversion coefficient. The independent variables include non-farm income, farm income, age, sex and education. To avoid bias in estimation, possible problems of multicollinearity problem was checked. The regression results are shown in the Table 7. The values of R-squared $=0.457$, $F (5,194) = 32.65$ and Prob>F $= 0.00$ indicate the significance of the estimated risk preference model.

Table 7. **Estimated regression results on the socio-demographic characteristics affecting upland farmers' relative risk aversion, Na Ri district, Bac Kan, 2019**

Independent Variable	Coef.	Std.Error	t-Value	p-Value
Non-farm income	-0.0070***	0.0010	-6.97	0.00
Farm income	-0.0088***	0.0015	-5.59	0.00
Sex	-0.0730*	0.0450	-1.62	0.10
Age	0.0139***	0.0018	7.48	0.00
Education	-0.0041ns	0.0083	-0.49	0.62
R2	0.457			
Prob>F	0.00			
F (5,194)	32.65			
n	200			

Note: ***, **, * denote significance at 1%, 5% and 10% probability, respectively; ns: non-significant.

The result indicates that 45.7% of the variations in relative risk aversion coefficient of upland farmers are explained by the independent variables included. Non-farm income, farm income, and age of farmers significantly influence relative risk aversion at 1% probability level, while sex of farmer significantly affects farmers' risk preferences at 10% probability level. However, the education level of farmer is not a significant determinant of relative risk aversion also it has the expected negative sign. Both non-farm and farm income of farmers have negative statistically significant relationship with the relative risk aversion coefficient of upland farmers. The higher the non-farm income and farm income of farmers are, the more risk-loving they are or they are more likely to take risk. Higher income enhances farmers' access to technological learning and improved production inputs which could lead to

increased productivity. Farmers with low income (both non-farm and farm income) were found to be more risk-averse compared with farmers with higher off-farm income. This finding is in line with the studies of Akhtar et al. (2018) and Mehta (2012) but in contrast to the result of Ayinde (2008) .In this model, the age of upland farmers was found positively related to relative risk aversion coefficient. This implied that the younger the farmer, the more risk-loving he/she will be. The younger farmers may have higher school years and more information than the older ones. Education of the farmer may expand his/her information on several sources of risk, its effects at farm level and possible strategies which can be used to protect his earnings from various sources of risk. In addition, the young farmer is healthier and stronger than the old one so that he may be more willing to take risk than the old one. Furthermore, the older farmer usually has higher experience include unfavorable about health, business, or farming operations. These past experiences might make them less confident in taking risk. However, this finding is not in line with the findings of

The result also shows that there was a negative relationship between the sex of upland farmer and relative risk aversion coefficient. This means that male farmers are more likely to take risks as compared to female farmers. This finding has not been mentioned in the literature before. From the result, the less risk-averse farmers are younger and they have higher in education compared with the risk-averse farmers. Better education makes farmers less risk-averse and better in managing risks. The less risk-averse farmers have more incentive to generate more non-farm and farm income by accessing micro-credit for various activities. This is because the financial support will enhance farmers' access to technological learning and improved production inputs for higher productivity and income

However, farmers were mentioned before that farmers usually lack capital for farm and non-farm investment. It is not easy to borrow money from bank or other credit sources due to difficulty of complying with bank requirements such as formal documents and collateral. The socio-finance funds such as People's Credit Fund and Vietnam Bank for Social Policies allow farmers to borrow up to about 50 million dongs to 70 million dong/ per household (equivalent to US$ 2,173.9 to US$ 3,043.4) with 9% interest rate per year. The farmers have to repay their loan before making a new loan. However, given the high interest rate, farmers find it difficult to pay

the loan. Thus, it is likely that they will borrow small amount instead of bigger loans for their farm and non-farm investment requirements.

From the estimated model, all the significant factors excluding the age of respondent have negative effects on relative risk aversion coefficient. This mean that an increase in these factors will lead to a decrease in relative risk aversion coefficient, or the respondents will more likely be risk-loving. In order to change the attitude of farmers toward risk, non-farm and farm income, sex, age of the respondents should be considered.

5. Conclusions and Recommendations

The majority of respondents are risk-averse but the degree of relative risk aversion varies from farmer to farmer, which will influence farm operations and management decision. There are significant differences among the risk preference groups in term of socio-demographic characteristic (age, education, farm income, non-farm income). Multiple-linear regression found that there existed a significant relationship between risk preferences and socio-demographic factors such as non-farm income, farm income, sex, age. The policies in the uplands of Vietnam must consider reduce risk to the upland farmers or make them less risk averse by increasing farm and non-farm income, investing on farmers' education and training.

References

Anderson, L. R. and Mellor, J. M. (2008). Predicting health behaviours with an experimental measure of risk preference. Journal of Health Economics 27(5): 1260–1274.

Campbell, J. Y., Viceira, L. M. (2002) Strategic asset allocation: portfolio choice for long-term investors.
Oxford University Press.

BRICK, K., M. VISSER and J. BURNS. 2012. Risk Aversion: Experimental Evidence from South African Fishing. American Journal of Agricultural Economics: Amer. J. Agr. Econ 94(1): 133–152.

LIU, T., R.J. BRUINS and M.T. HEBERLING. 2018. Factors Influencing Farmers' Adoption of Best Management Practices: A Review and Synthesis. Available online at:
https://www.researchgate.net/publication/3 22989235_Factors_Influencing_Farmers'_Ad

option of Best Management Practices A Review_and_Synthesis

SAGUYE, T.S. 2017a. An Empirical Analysis of Land Degradation Risk from Local Community Knowledge Perspective: The Case of Geze Gofa District, Southern Ethiopia. Journal of Culture, Society and Development 28: 48-64.

SAGUYE, T.S. 2017b. Determinants of Adoption of Sustainable Land Management (SLM) Practices among Smallholder Farmers' in Jeldu District, West Shewa Zone, Oromia Region, Ethiopia. Global journal of Science Frontier Research (H) 17 (1): 67-83.

Akhtar, S., LI, G.-c., Ullah, R., Nazir, A., Iqbal, M. A., Raza, M. H., . . . Faisal, M. (2018). Factors influencing hybrid maize farmers' risk attitudes and their perceptions in Punjab Province, Pakistan. *Journal of Integrative Agriculture, 17*(6), 1454-1462. doi:https://doi.org/10.1016/S2095-3119(17)61796-9

Ayinde, O. (2008). Effect of socio-economic factors on risk behaviour of farming households: an empirical evidence of small-scale crop producers in Kwara State. *Nigeria. Agricultural Journal, 3*(6), 447-453.

Bard, S. K., & Barry, P. J. (2001). Assessing farmers' attitudes toward risk using the" closing-in" method. *Journal of Agricultural and Resource Economics*, 248-260.

Bezabih, M., & Sarr, M. (2012). Risk preferences and environmental uncertainty: Implications for crop diversification decisions in Ethiopia. *Environmental and Resource Economics, 53*(4), 483-505. doi:10.1007/s10640-012-9573-3

Binswanger, H. P. (1980). Attitudes toward risk: Experimental measurement in rural India. *American journal of agricultural economics, 62*(3), 395-407. doi:https://doi.org/10.2307/1240194

Cameron, L., & Shah, M. (2015). Risk-taking behavior in the wake of natural disasters. *Journal of Human Resources, 50*(2), 484-515. doi:doi: 10.3368/jhr.50.2.484

Dadzie, S. K. N., & Acquah, H. (2012). Attitudes toward risk and coping responses: The case of food crop farmers at Agona Duakwa in Agona East District of Ghana. *International Journal of agriculture and Forestry, 2*(2), 29-37. doi:DOI: 10.5923/j.ijaf.20120202.06

Dasgupta, U., Mani, S., Sharma, S., & Singhal, S. (2016). Eliciting risk preferences: Firefighting in the field.

Hellerstein, D., Higgins, N., & Horowitz, J. (2013). The predictive power of risk preference measures for farming decisions. *European Review of Agricultural Economics, 40*(5), 807-833. doi:https://doi.org/10.1093/erae/jbs043

Holt, C. A., & Laury, S. K. (2002). Risk aversion and incentive effects. *American economic review, 92*(5), 1644-1655.

Ihli, H. J., Gassner, A., & Musshoff, O. (2018). Experimental insights on the investment behavior of small-scale coffee farmers in central Uganda under risk and uncertainty. *Journal of Behavioral and Experimental Economics, 75*, 31-44. doi:https://doi.org/10.1016/j.socec.2018.04.011

Keil, A., & Nielsen, T. (2012). *Accounting for farmers' risk preferences in investigating land allocation decisions in marginal environments: a test of various elicitation measures in an application from Vietnam*. Retrieved from

Khor, L. Y., Ufer, S., Nielsen, T., & Zeller, M. (2018). Impact of risk aversion on fertiliser use: evidence from Vietnam. *Oxford Development Studies, 46*(4), 483-496. doi:https://doi.org/10.1080/13600818.2018.1445212

Liu, T., Bruins, R. J., & Heberling, M. T. (2018). Factors influencing farmers' adoption of best management practices: A review and synthesis. *Sustainability, 10*(2), 432. doi:https://doi.org/10.3390/su10020432

Lucas, M. P., & Pabuayon, I. M. (2011). Risk perceptions, attitudes, and influential factors of rainfed lowland rice farmers in Ilocos Norte, Philippines. *Asian Journal of Agriculture and Development, 8*(1362-2016-107714), 61-77. doi:10.22004/ag.econ.199327

Mao, H., Zhou, L., Ifft, J., & Ying, R. (2019). Risk preferences, production contracts and technology adoption by broiler farmers in China. *China Economic Review, 54*, 147-159.

Mehta, P. K. (2012). Farmers' Behaviour towards Risk in Production of Fruit and Vegetable Crops. *Journal of Rural Development, 31*(4), 457-468.

Mukasa, A. N. (2018). Technology adoption and risk exposure among smallholder farmers: Panel data evidence from Tanzania and Uganda. *World Development, 105*, 299-309. doi:https://doi.org/10.1016/j.worlddev.2017.12.006

Stanković, J. Z., & Petrović, E. (2016). Expected utility theory under extreme risks. *Facta universitatis, Series: Economics and Organization*, 31-44.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American economic review, 100*(1), 557-571. doi:DOI: 10.1257/aer.100.1.557

Teklewold, H., & Köhlin, G. (2011). Risk preferences as determinants of soil conservation decisions in Ethiopia. *journal of soil and water conservation, 66*(2), 87-96. doi:https://doi.org/10.2489/jswc.66.2.87

Wang, N., Gao, Y., Wang, Y., & Li, X. (2016). Adoption of eco-friendly soil-management practices by smallholder farmers in Shandong Province of China. *Soil Science and Plant Nutrition, 62*(2), 185-193. doi:https://doi.org/10.1080/00380768.2016.1149779