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Responses of Filipino farmers to harsh weather phenomena: A risk perception and attitude study

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Abstract

Small-scale farmers, whose livelihood and food security greatly depends on farming, are constantly exposed and vulnerable to the risks of extreme weather events. The current study explored how the perception and attitude on agricultural risks of small-scale farmers from the upland, lowland and waterside ecosystems in Siniloan, Laguna in Philippines influence the way they respond and cope with extreme weather events. The study employed quantitative and qualitative data collection methods particularly farm surveys, focus group discussions, key informant interviews and secondary data from the office of the municipal agriculturist. The small-scale farmer-respondents recognised that they were exposed and at risk of extreme weather events and perceived climate as a major farming risk (85 %). However, pest and diseases (not climate) was perceived as the biggest risk to their production (94 %). The respondents had a risk-neutral attitude towards extreme weather events and tended to have 'band-aid' solutions to the impacts and tolerated the outcome. Based on correlation, the perceptions and attitudes of the small-scale farmers were influenced by socioeconomic factors that generally identified the experiences, roles and spending power of the farmer namely age, education, household size, income, land ownership, farm size and farming experience. The risk perception and risk attitude on various extreme weather events influenced the small-scale farmers' agricultural practices, such as farm decisions. Therefore, risk perception, risk attitude and socioeconomic factors of the farmers are important factors to consider in risk management strategies for the local agricultural sector of the Philippines. Raising awareness and education on effective adaptation strategies and improved climate forecasting are recommended to minimize losses from extreme weather events.

Keywords: adaptation, coping mechanisms, correlation analysis, resilience, survey

1 Introduction

In tropical Southeast Asia, agriculture is a major source of livelihood in almost every country where approximately 115 million hectares of land is devoted for agricultural production (ADB, 2009). In the Philippines, agriculture provides 30 % of employment and 10 % of the country's gross domestic product in 2013 (NEDA, 2015). However, agriculture in the Philippines is highly vulnerable to climate change (FAO, 2017; IPCC, 2014). The increase in global temperature and rainfall variability has a critical impact on the country's agriculture sector.

The adverse impacts of climate change such as more frequent and severe typhoons, floods and drought increase the regularity of pest infestations therefore intensifying the farmers' risks in production. In fact, over the last decade, about 37 % of the economic impacts of natural and climate-related events was assimilated by the Philippine's agriculture sector (FAO, 2017). Hence, these events threaten the country's food security, rural livelihoods and economy since most of the country's economy relies on agriculture and natural resources as a primary source of income (Redfern *et al.*, 2012), such as small-scale farmers. Hence, climate extremes threaten and disproportionately affect small-scale farmers, which remain to be the poorest members of the population (FAO, 2017). Small-scale farmers produce 80 %

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of the food consumed in Asia and occupy 85 % of Asia's farmlands (FAO, 2012, 2014). Their significant contribution on an Asian country's economy will be severely affected by the effects of climate change as well as worsening issues of food security, especially for developing countries such as the Philippines. Their livelihood's dependence on acceptable temperature ranges and patterns of rainfall makes their crop yields at risk due to climatic variability. Any sudden or unexpected climatic change directly affects their agricultural production hence, affecting their household's food security, income and well-being (Vignola *et al.*, 2015; IPCC, 2007). Moreover, the risk associated with their livelihood is high. Farming's dependence on climate makes small-scale farmers' livelihood exposed to possibilities of losses of production and uncertainty of return on their investment (Lucas & Pabuayon, 2011). Moreover, they have few livelihood options when typhoons and floods wipe out their production. Although small-scale farmers are well experienced in dealing with climatic variability, the increased variability brought about by climate change is beyond the capacity of traditional coping strategies practiced (Pettengell, 2010).

Therefore, as the impacts of climate change is expected to continue to intensify, it is important to enhance small-scale farmers' adaptive capacity to reduce their vulnerability to these impacts through determining and understanding how these farmers decide under risky situations, which is through understanding a farmers' risk perception and risk attitude. This study was therefore conducted with the objective of identifying and understanding the risks perceived by small-scale farmers as well as their chosen response to those risks, which is important in designing improved risk management strategies and policies to improve not only their agricultural production, but also the resilience and capacity of small-scale farmers to current and future extreme weather events brought about by climate change.

2 Materials and methods

2.1 Study area

The study was conducted in Siniloan, Laguna, Philippines, wherein it is considered as a rice producing municipality which is suitable for the targeted respondents for the study. Moreover, the geographic location of the municipality best represents the ridge-to-reef approach method in the study where in respondents from the upland, lowland and waterside were collected. Laguna is located in South-Eastern Luzon, about 30 km outside the Philippines' capital, Manila (Fig. 1). It is highly exposed to multitude of hazards, predominantly flooding. This is due to the overflow from the province's largest lake, Laguna de Bay, during heavy downpours causing the inland rivers to turn farmlands into vast bodies of water. The Ridge-to-Reef Approach was used in site collection with Barangays Kapatalan and Magsaysay being chosen in consultation with the local municipality to represent the upland whilst Halayhayin and Wawa to represent the lowland and waterside, respectively.

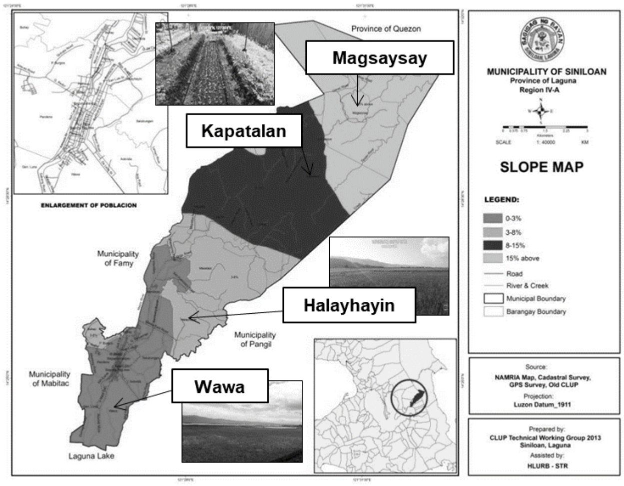

Fig. 1: *Slope map of Siniloan, Laguna highlighting the study areas in the upland, lowland and waterside (CLUP, 2013)*

2.2 Selection of respondents

The municipality of Siniloan, Laguna was divided into three domains and respondents were chosen purposively selecting only rice and vegetable farmers. For the farm survey, the number of respondents was determined by the population of small-scale rice and vegetable farmers in each elevation gradient using the Slovin's equation at 90 % confidence level shown below. The Slovin's relationship was used as Eqs. 1 and 2, since nothing about the behaviour of the population is known at all.

$$n = \frac{N}{1 + Ne^2} \tag{1}$$

Where: n = sample size;
N = Total population size;
e = desired margin of error (acceptable error); and

$$n_i = \left(\frac{N_i}{N}\right) n \tag{2}$$

Where: n_i = proportionate allocation of group i;
N_i = population of group i;
N = total population size; and
n = sample size.

There were a total of 96 respondents; 74 were rice farmers and 22 were vegetable farmers.

2.3 *Survey and data gathering procedures*

A farm survey questionnaire with structured questions was used in the study. This was pre-tested to determine ease of facilitation and to assess its validity. The questionnaire used for the survey had five sections; 1) personal information; 2) farming system and experience; 3) perceived farm risks; 4) risk perception, attitude and adaptation strategies and; 5) key production decisions influenced by climate extremes. A focus group discussion (FGD) that mirrored the farm survey questionnaire was conveyed with selected rice farmers in each category and selected vegetable farmers in the upland area. Key informant interviews (KII) were also held with the members of the Office of the Municipal Agriculturist responsible for the rice and vegetable sectors. A camera and voice recorder was used to capture images and record the answers of the selected respondents from the FGD and KII, which were used to validate the results and to enrich the discussion of this study.

2.4 *Data evaluation*

Descriptive statistics was used to summarize the data obtained. Frequency distribution and percentages were calculated as well as data range, mean and standard deviation. For the relationship analyses, The Chi-squared Test of Independence (X2) was used to identify the relationship between risk attitudes and risk perceptions of the respondents. The Pearson Correlation Coefficient (Pearson's r) was used to analyse the relationship between the farmers' socioeconomic characteristics and agricultural practices to their risk perception and risk attitude. The Simple Linear Regression and Ordered Probit Regression were used to analyse the relationship between the farmers' agricultural practices to their risk perception and risk attitude, respectively. These quantitative analyses were all implemented in STATA v. 15.

2.5 *Eliciting farmer's perceptions*

The farmers' risk perceptions were determined by identifying the risks they recognised to influence their livelihood and by ranking these based on their significance. Furthermore, the farmers' risk perceptions were also determined through questions on the events of weather extremities (i.e. drought, flood, excessive rains, typhoon), which was answered using a five-point Likert scale (1= very low, 2= low, 3= neutral, 4= high, and 5= very high) to represent the probability and potential loss (1 = 1 to 20, 2 = 21 to 40, 3 = 41 to 60, 4 = 61 to 80, 5 = 81 to 100) of the stated climate extreme on destroying their production. To calculate the risk perception, the data from the probability and potential loss in risk rates was then multiplied (risk perception = probability x potential loss). The product of these two variables elicits farmers' risk perception (Ogurtsov *et al.*, 2008; Fahad *et al.*, 2018) (Fig. 2).

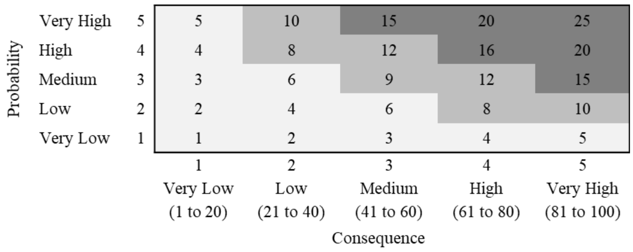

Fig. 2: *Risk matrix (adopted from Fahad et al. (2018))*

2.6 *Eliciting farmers' risk attitudes*

The analysis of the farmers' risk attitudes involved a situational question. Specifically, they were asked on their adaptation strategy to avoid potential risks and impacts of an extreme weather event as well as their adaptation strategy during/after the event. The farmers' chosen adaptation strategy to secure their income will elicit their risk attitude with more adaptation strategies the farmers do to avoid the potential impacts of the hazards, the more they were likely to be risk averse. The risk attitudes, risk-neutral and risk-tolerant, were considered as one, being risk-neutral.

3 Results

3.1 *Socio-economic characteristics and farm profile*

The small-scale rice farmers were predominantly male (85 %) and 59 % of the vegetable farmers were female. Most of the rice (45 %) and vegetable (50 %) farmers had attained elementary education and had an average age of 56 and 54 years old, respectively (Table 1). The average household size was 4 with majority of rice farmers and vegetable farmers having 4-6 and 1-3 family members, respectively (Table 1). In terms of farm profile, the average farmland for rice farmers was 2.1 ha and 0.5 ha for the vegetable farmers. Rice farmers predominantly (51 %) have only one cropping season with an average farming experience of 26.9 years and 12 years for vegetable farmers.

3.2 *Risks to farming*

Mono-cropping and intercropping was practiced by rice and vegetable farmers, respectively. The results showed that 94.1 % of the farmers perceived that they were most exposed to the risk of pests and diseases, followed by climate (84.8 %) and price variations (10.8 %) (Table 2).

Half of all rice farmers and 36 % of all vegetable farmers perceived typhoon and excessive rains as major climatic

Table 1: *Socio-economic characteristics and farm profile of rice and vegetable farmers.*

	Rice farmers (in %)			*Vegetable farmers (in %)*		
Variable	*Waterside (n=33)*	*Lowland (n=31)*	*Upland (n=10)*	*Waterside (n=7)*	*Lowland (n=7)*	*Upland (n=8)*
Gender						
Male	97.0	77.4	70.0	42.9	57.1	25.0
Female	3.0	22.6	30.0	57.1	42.9	75.0
Age						
38-40	12.1	3.2	0.0	0.0	0.0	25.0
41-50	27.3	16.1	70.0	28.6	14.3	37.5
51-60	33.3	25.8	10.0	42.9	71.4	37.5
61-70	24.2	35.5	20.0	14.3	14.3	0.0
71-80	0.0	16.1	0.0	0.0	0.0	0.0
81-90	3.0	3.2	0.0	14.3	0.0	0.0
Mean age:	56.2			53.7		
Education						
Elementary undergraduate	30.3	29.0	50.0	42.9	14.3	25.0
Elementary grad.	15.2	9.7	10.0	14.3	28.6	25.0
High school undergrad.	15.2	25.8	10.0	42.9	14.3	12.5
High school grad.	9.1	3.2	20.0	0.0	28.6	12.5
College undergrad.	21.2	19.4	0.0	0.0	0.0	12.5
College grad.	6.1	9.7	0.0	0.0	14.3	12.5
Post-graduate	0.0	3.2	0.0	0.0	0.0	0.0
Vocational	3.0	0.0	10.0	0.0	0.0	0.0
Household size						
1-3	36.4	48.4	30.0	42.9	42.9	57.1
4-6	51.5	38.7	50.0	28.6	57.1	14.3
7-9	12.1	9.7	10.0	28.6	0.0	42.9
10-12	0.0	3.2	10.0	0.0	0.0	0.0
Mean household size:	4.3			4.3		
Farm area (ha)						
0.2 to 1	39.4	48.4	40.0	100.0	100.0	87.5
1.1 to 2	21.2	19.4	0.0	0.0	0.0	0.0
2.1 to 3	18.2	12.9	30.0	0.0	0.0	0.0
3.1 to 4	9.1	9.7	0.0	0.0	0.0	12.5
4.1 to 5	9.1	3.2	20.0	0.0	0.0	0.0
>5	3.0	6.5	10.0	0.0	0.0	0.0
Mean farm area:	2.1 ha			0.5 ha		
Cropping seasons						
1	84.9	0.0	100.0	n.a.	n.a.	n.a
2	15.2	100.0	0.0	n.a.	n.a.	n.a
Farming experience (years)						
1 to 10	12.1	25.8	0.0	57.1	57.1	50.0
11 to 20	21.2	16.1	50.0	28.6	42.9	37.5
21 to 30	33.3	19.4	30.0	0.0	0.0	0.0
31 to 40	21.2	25.8	10.0	14.3	0.0	12.5
41 to 50	9.1	12.9	0.0	0.0	0.0	0.0
>50	3.0	0.0	10.0	0.0	0.0	0.0
Mean farming years:	26.9			12.0		

risks to their production, respectively. In terms of perceived risks depending on their geographic location, rice farmers in the upland perceived typhoon (70 %) as a major risk source while farmers in lower elevation considered flood (49 %) as a major risk source on their production. Vegetable farmers in the upland, lowland, and waterside perceived excessive rains (75 %), drought (57 %), and flood (86 %) as a major risk, respectively. Climate was perceived by the farmers as one of the major risks because of its significant negative impact on crop yield.

Table 2: *Perceived risks to farming by rice and vegetable farmer-respondents (in percentage).*

Rice farmers	*Waterside (n=33)*	*Lowland (n=31)*	*Upland (n=10)*	*Total (n=74)*
Drought	6.1	6.5	0.0	5.4
Typhoon	45.5	48.4	70.0	50.0
Excessive rains	0.0	12.9	10.0	6.8
Flood	48.5	28.5	10.0	40.5
Strong winds	3.0	3.2	30.0	6.8
Climate-related	87.9	83.9	100.0	87.8
Pests and diseases	97.0	96.8	100.0	97.3
Price variation	3.0	22.6	0.0	10.8
Others	0.0	6.5	0.0	2.7
Vegetable farmers	*Waterside (n=7)*	*Lowland (n=7)*	*Upland (n=8)*	*Total (n=22)*
Drought	0.0	57.1	12.5	22.7
Typhoon	14.3	0.0	12.5	9.1
Excessive rains	14.3	14.3	75.0	36.4
Flood	85.7	0.0	0.0	27.3
Strong winds	0.0	0.0	25.0	9.1
Climate	85.7	57.1	100.0	81.8
Pests and diseases	100.0	100.0	75.0	90.9
Others	14.3	0.0	25.0	13.6

3.3 Risk perception

The results of the study showed that risk perception was influenced by the farmers' crop and geographic location (Fig. 3). Typhoon was recognised to bring the highest risk for both rice (46 %) and vegetable farmers (68 %). In the waterside area, majority of the rice (73 %) and vegetable farmers (71 %) perceived flood as the major farming risk considering both its likelihood of occurrence and impacts.

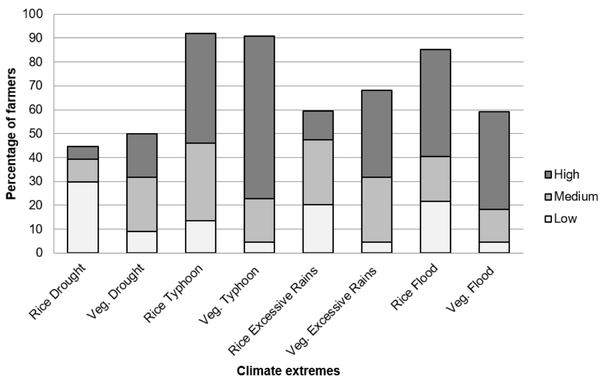

Fig. 3: *Overall risk perception of the farmers on different extreme weather events.*

3.4 Risk attitude

The risk attitude of the small-scale farmers was predominantly risk-neutral on each extreme weather event in which the farmers were uncomfortable with uncertainty therefore performed necessary short-term actions to cope with the risks. Risk-neutral individuals have discomfort with uncertainty therefore perform any short-term actions necessary for the hazard (Hillson & Murray-Webster, 2005). Also, a significant number of rice farmers had a risk-averse attitude on typhoon (46 %) and excessive rains (41 %) (Fig. 4).

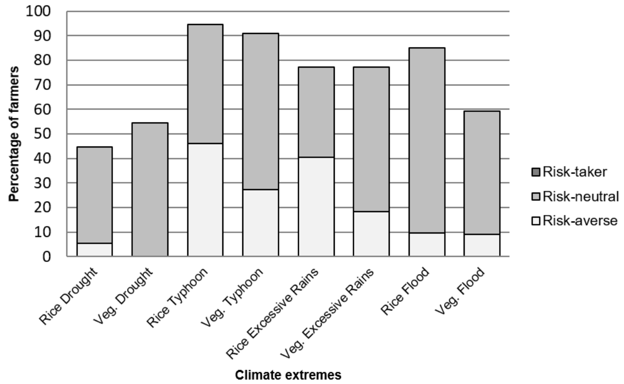

Fig. 4: *Risk attitude of the farmers towards extreme weather event.*

Concerning the vegetable farmers (n=20), only the variables age (p-value = 0.4973) and income (p-value = -0.5597) had a significant ($p < 0.1$) relationship with risk perception and risk attitude on typhoon, respectively. The results showed that only the correlation of farmers' risk perception and risk attitude on excessive rains was found to be significant (significance = 0.012) (Table 3). Moreover, farming experience had a significant negative relationship with the farmers' risk perception on drought (p-value = -0.2950) and excessive rains (p-value = -0.0759). In terms of drought, socioeconomic characteristics of a farmer such as the household size (p-value = -0.2924), farm area (p-value = 0.3330), farming experience (p-value = -0.2857) and total income (p-value = -0.3555) had a significant relationship with farmers' risk attitude. In terms of typhoon, age (p-value = 0.1868) and land ownership (p-value = -0.2102) had a significant relationship with the farmers' risk attitude on typhoon. The results showed that age had a positive relationship while land ownership has a negative relationship. Moreover, education has a significant relationship with the risk attitude of the farmers on excessive rains (p-value = -0.2566) and flood (p-value = -0.2049).

Table 3: *Summary table of significant correlation estimates on rice and vegetable farmers' risk perception and risk attitude on selected variables.*

Hazard	*Significant correlations*	*Pearson correlation*	*Sig.*	*n*
Drought	Risk attitude × risk perception (rice)	-	0.068*	31
	Risk perception × age (rice)	0.3598	0.0773*	31
	Risk perception × gender (rice)	0.3952	0.0505*	31
	Risk perception × household size (rice)	0.3553	0.0813*	31
	Risk perception × land ownership (rice)	0.3840	0.0851*	31
	Risk perception × farming experience (rice)	−0.4325	0.0308**	31
	Risk perception × farming experience (overall)	−0.2950	0.0807*	37
	Risk attitude × income (rice)	−0.3562	0.0805*	31
	Risk attitude × household size (overall)	−0.2924	0.0791*	37
	Risk attitude × farm area (overall)	0.3330	0.0440**	37
	Risk attitude × farming experience (overall)	−0.2857	0.0865*	37
	Risk attitude × total income (overall)	−0.3555	0.0308**	37
Typhoon	Risk attitude × land ownership (rice)	−0.2334	0.0727*	68
	Risk perception × age (vegetables)	0.4973	0.1000*	20
	Risk attitude × income (vegetables)	−0.5597	0.0584*	20
	Risk perception × farming experience(overall)	−0.2049	0.0683*	88
	Risk attitude × age (overall)	0.1868	0.0971*	88
	Risk attitude × land ownership (overall)	−0.2102	0.0612*	88
Excessive rains	Risk attitude × risk perception (rice)	-	0.011**	44
	Risk perception × household size (rice)	0.3337	0.0467**	44
	Risk perception × total income (rice)	0.3324	0.0476**	44
	Risk attitude × gender (rice)	−0.3082	0.0675*	44
	Risk attitude × risk perception (overall)	-	0.012**	59
	Risk perception × farming experience (overall)	−0.0759	0.0066***	59
	Risk attitude × education (overall)	−0.2566	0.0691*	59
Flood	Risk perception × civil status (rice)	0.3269	0.0148**	63
	Risk perception × total income (rice)	0.1033	0.0136**	63
	Risk attitude × education (overall)	−0.2094	0.0866*	76

Note: ***, **, * = significant at 1 %, 5 %, and 10 %, respectively. - = chi-squared test

3.5 *Relationship between risk perception, risk attitude and agricultural practices*

The results of the correlation analysis on the risk perception and agricultural practices of the farmers showed that extreme weather events have a significant relationship with the crops planted, cropping season and the practices of the farmer after the impacts of extreme weather events (Table 4). The risk perception of the farmer on drought (p-value = 0.4137), typhoon (p-value = 0.2398), excessive rains (p-value = 0.4929) and flood (p-value = 0.2364) had a significant positive relationship with the crop planted while typhoon (p-value = -0.2534) and flood (p-value = -0.2428) had a significant negative relationship with the cropping season of the farmers. In addition, the agricultural practices of the farmers had a significant negative relationship with the risk perception on drought (p-value = -0.2654) and flood (p-value = -0.2169). The 10 % significance level was used in accordance to the study of Peria *et al.* 2016.

The results of the regression analysis showed that the risk perception of the farmers towards extreme weather events had a positive relationship with the crop planted (Table 5). Vegetable farmers were more likely to have a higher risk perception on extreme weather events. The cropping season and agricultural practices before and after the impacts of extreme weather events had a significant negative relationship with risk perception on extreme weather events. In terms of cropping season, the probability of a farmer having two cropping seasons decreases if their perception on extreme

Table 4: *Overall correlation analysis on the relationship between rice and vegetable farmers' agricultural practices and risk perception towards extreme weather events.*

Variable		*Crop*		*Cropping season*		*Before impact*		*After impact*	
Hazard	*n*	*P-value*	*Sig.*	*P-value*	*Sig.*	*P-value*	*Sig.*	*P-value*	*Sig.*
Drought	45	0.4137	0.0052***	-0.1700	0.2698	-0.2654	0.0817*	-0.0783	0.6136
Typhoon	88	0.2398	0.0244**	-0.2534	0.0059***	0.0109	0.9199	0.2398	0.4433
Excessive rains	59	0.4929	0.0001***	-0.1145	0.3877	0.0731	0.5821	0.1751	0.1927
Flood	76	0.2364	0.0398**	-0.2428	0.0346**	-0.0522	0.6545	-0.2169	0.0635*

Note: ***, **, * = significant at 1 %, 5 %, and 10 %, respectively. - = chi-squared test

weather events was high, namely typhoon (R^2 = 85 %) and flood (R^2 = 6 %). The chances of a farmer having more agricultural practices before (R^2 = 7 %) and after (R^2 = 5 %) the impacts of extreme weather events such as harvesting early, planting of other crops, digging of canals and use of water pumps decreases if the farmers' perception on extreme weather events was high.

Table 5: *Overall simple linear regression analysis on the relationship between rice and vegetable farmers' agricultural practices and risk perception towards extreme weather events.*

Hazard	*n*	*Regression estimate*	*R^2 (%)*	*p-value*
		Crop		
Drought	45	0.029	17.1	0.005***
Typhoon	88	0.015	58.0	0.024**
Excessive rains	59	0.034	24.3	0.000***
Flood	76	0.011	5.6	0.040**
		Cropping season		
Drought	45	-0.013	2.9	0.270
Typhoon	88	-0.021	85.0	0.006***
Excessive rains	59	-0.009	1.3	0.388
Flood	76	-0.02	5.9	0.035**
		Before impact		
Drought	45	-0.243	7.0	0.082*
Typhoon	88	0.005	0.0	0.920
Excessive rains	59	0.04	0.5	0.582
Flood	76	-0.025	0.3	0.654
		After impact		
Drought	45	-0.066	0.6	0.614
Typhoon	88	0.056	0.7	0.443
Excessive rains	59	0.127	3.1	0.193
Flood	76	-0.104	4.7	0.063*

Note: ***, **, * = significant at 1 %, 5 %, and 10 %, respectively.

Furthermore, the agricultural practices of the farmers before and after the impacts of hazards (typhoon, excessive rains and flood) had a significant negative relationship with the risk attitude of the farmers towards extreme weather events whilst the practices of the farmers after the impacts of excessive rains had a positive relationship with risk attitude (Table 6). This is because most of the farmers' strategies to amend the impacts of the risks were to avoid the risk completely by skipping that cropping season or to perform mitigating measures to salvage the affected crops.

The risk attitude of the farmers had a negative relationship with the agricultural practices before and after extreme weather events (Table 7). The probability of the farmers having more appropriate agricultural practices before extreme weather events (typhoon (R^2 = 16.80 %); excessive rains (R^2 = 19.23 %); flood (R^2 = 9.63 %)) and after (typhoon (R^2 = 1.43 %)) decreases the more these farmers were risk-averse. Risk-averse farmers avoid risks that may negatively affect their farm. For example, risk-averse farmers avoid the risk of extreme weather events by not planting at all while the less they were risk-averse, the more actions were undertaken (such as harvesting early, planting of other crops, digging of canals and use of water pumps) before and after the weather events to still gain income despite its impacts.

4 Discussion

Pest and diseases were recognised as a major risk to farming of Philippine small-scale farmers (Table 2). This finding is in congruence to the studies of Ullah *et al.* (2015) in Pakistan and Riwthong *et al.* (2016) in Thailand on factors affecting farmers' risk perception. The increased frequency of extreme weather events increased the incidence of pest infestations and diseases (Dinesh *et al.*, 2015; Rosenzweig *et al.*, 2001; USAID, 2017). Hence, after these extreme weather events, the crops would not only suffer potential loss of yield due to these events but on the aftermath of pest and diseases as well, which usually resulted in further decrease of the already low yield and potentially having no

Table 6: *Overall correlation analysis on the relationship between rice and vegetable farmers' agricultural practices and risk attitude towards extreme weather events.*

Variable		*Crop*		*Cropping season*		*Before impact*		*After impact*	
Hazard	*n*	*P-value*	*Sig.*	*P-value*	*Sig.*	*P-value*	*Sig.*	*P-value*	*Sig.*
Drought	45	0.1884	0.2153	-0.1274	0.4041	-0.0380	0.804	0.0597	0.6969
Typhoon	88	0.1443	0.1797	-0.0212	0.8445	-0.4505	0.000***	-0.2251	0.0395**
Excessive rains	59	0.1714	0.1942	-0.0659	0.6199	-0.5032	0.000***	0.2557	0.0548**
Flood	76	-0.0498	0.6692	-0.0076	0.9483	-0.2520	0.0281**	-0.0648	0.5834

Note: ***, **, * = significant at 1 %, 5 %, and 10 %

Table 7: *Overall ordered probit regression analysis on the relationship between rice and vegetable farmers' agricultural practices and risk attitude towards extreme weather events.*

Hazard	*n*	*Regression estimate*	*R^2 (%)*	*Prob>Chi^2*	*LR Chi^2 (1)*	*p-value*
			Crop			
Drought	45	4.71	5.02	0.1055	2.62	0.989
Typhoon	88	0.42	2.0	0.1697	1.89	0.174
Excessive rains	59	0.53	2.76	0.1742	1.85	0.184
Flood	76	-0.21	0.26	0.6736	0.18	0.671
			Cropping season			
Drought	45	-0.55	1.22	0.4090	0.68	0.408
Typhoon	88	-0.05	0.03	0.8423	0.04	0.842
Excessive rains	59	-0.18	0.33	0.6140	0.25	0.614
Flood	76	-0.03	0.00	0.9474	0.00	0.947
			Before impact			
Drought	45	-1.12	3.95	0.0496	3.85	0.052*
Typhoon	88	-1.68	16.80	0.0000	41.17	0.000***
Excessive rains	59	-1.80	19.23	0.0000	29.55	0.000***
Flood	76	-1.372	9.63	0.0004	12.73	0.000**
			After impact			
Drought	45	-0.126	0.03	0.8288	0.05	0.829
Typhoon	88	-0.498	1.43	0.0385	4.28	0.040**
Excessive rains	59	0.489	1.15	0.1133	2.51	0.114
Flood	76	-0.218	0.10	0.6081	0.26	0.608

Note: ***, **, * = significant at 1 %, 5 %, and 10 %, respectively.

yield at all. This was supported by the findings of Dinesh *et al*. (2015) on the CGIAR research program on CCAFS (Climate Change, Agriculture and Food security) in which crop pests were found to be accounted for one-sixth of farm productivity losses. The farmers rank the perceived risks on climate differently from every geographic location and crop planted which validated the results of Sulewski & Kloczko-Gajewska (2014) and Lucas & Pabuayon (2011), respectively. The findings validated the results from the FGD with the rice farmers on potential hazards to their production. The findings again validated the results from the FGD when local vegetable and rice farmers were asked about the potential hazards to their production.

Considering risk perspectives, it seems that the farmers' perceptions about crop and geographic location (lowland, upland and waterside) (Fig. 3) were in agreement with previous literatures on risk perception (Lucas & Pabuayon, 2011; Sulewski & Kloczko-Gajewska, 2014; Fahad *et al.*, 2018) wherein farmers perceive climate risk differently depending on their geographic location and crop. A possible reason for the high-risk perception of the farmers on typhoon events was due to recent and frequent hits of this hazard in the country. In the previous years, the farmers experienced Typhoons Glenda (2014), Lando (2015) and Maring (2017) which brought damages to crops and loss of production. Previous studies (Eiser *et al.*, 2012; Rohrmann, 2008; Wauters *et al.*, 2012) validated the results wherein past experiences and recent events influenced risk perception. In addition, the direct experiences of the farmers with typhoons lead to a high risk perception which validated the study of Wachinger *et al.* (2013). Saqib *et al.* (2016) found similar results wherein farmers had a high risk perception after multiple flood events. Flood caused crop failure which lead to detrimental impacts on the livelihood of the farmers, specifically those whose main income and employment source depended on farming. A possible reason for the risk perception of the waterside farmers was due to Barangay's close proximity to the lake; being a flood-prone zone with farmers constantly dealing wih the risk of flood during the wet season. The findings validated the results from the FGD when asked of the potential hazards to their production. However, for some farmers, an extreme weather event did not necessarily have a negative impact on their household income. The results showed that waterside rice farmers perceived extreme weather events such as La Niña induced floods or typhoons as a risk to their rice production, but when negatively affected by these events, they turned to other livelihoods to still gain income. Due to their vicinity to the lake these farmers could work as fishermen after such events. In vegetable farming, the major risk perceived by all upland farmers was a typhoon. This result validated the findings in the FGD when asked of the potential hazards on their production in which the respondents had considered excessive rains as a major hazard since farmers fairly recognised typhoon, excessive rains and flood similarly. Moreover, it had been noted by the respondents that the precipitation pattern in the upland was fairly different than areas with lower elevation. Upland farmers normally experience continuous rainfall which farmers could recognise as typhoon due to the frequency and intensity of the rainfall.

The risk attitude of the farmers was predominantly risk-neutral (Fig. 4) on each extreme weather event. The results were in agreement with the study of Peria *et al.* (2016) and Roumasset (1976) that Philippine farmers were found to be generally risk-neutral. Majority of the farmers had only a few adaptation strategies to avoid the potential risks of extreme climatic events because they perceived that these events are unpredictable, unavoidable, and had no knowledge how to avoid such events. Hence, they chose to tolerate whatever outcome from the risks of extreme weather events, harvest what they can after the calamity, and try again in the next cropping season in hope of a better yield. Similar with the results of the rice farmers, majority of the vegetable farmers were risk-neutral. The respondents tended to accept the impacts of extreme weather events and implemented 'band-aid' solutions as adaptive measures after the events. These are minimal and temporary solutions towards the impacts but do not address the problem. A possible explanation for the risk-neutral attitude of the respondents was the '*bahala na*' (come what may) mentality of the Filipino culture, which suggests that Filipinos in general tend to just go with the flow and not mind what the outcome might be. Similar results were found by Tapia *et al.* (2014) in which communities mostly performed 'band-aid' solutions to adapt to climate change, variability and extreme weather events.

4.1 Relationship of socio-economic characteristics to risk perception and risk attitude

The farmers' years of experience had a significant relationship with their perception towards the extreme weather events (Table 3). Through the famers' length of experience, they gained local knowledge on the environment, weather, extreme weather events and possible pests and diseases; therefore, farming experience significantly influenced their perception towards extreme weather events. In addition, a possible explanation for the significant relationship of the household size and income with risk attitude (Table 3) was that farmers tend to seek to meet the needs of his household before anything else, sacrificing a possible income in the long-run (Peria *et al.*, 2016; Dadzie & Acquah, 2012). In terms of farming experience, the results supported the findings of Saqib *et al.* (2016) wherein the farmers' risk-taking behaviours vary depending on their years in farming. Moreover, the results also support the findings of Saqib *et al.* (2016), Sulewski & Kloczko-Gajewska (2014) and Iqbal *et al.* (2016) wherein farm size had a significant influence on the farmers' risk attitude in which the larger the farm size, the less likely they were to be risk averse. The same results were found by Dadzie & Acquah (2012) which found that older farmers tended to take more risks than younger farmers. A possible explanation for the results was older farmers tend to be more experienced thus, being able to gauge the most appropriate adaptation strategy towards the hazard. In terms of land ownership, Ullah *et al.* (2015) found similar results in which tenure farmers were found be more likely to be risk-averse than landowners and older farmers were found to be more likely to be risk-takers. Educated farmers may have better knowledge on the risks in farming as well as the potential adaptation strategies towards those hazards, specifically extreme weather events; thus, being able to effectively gauge the hazard more wisely. The findings were in agreement with Dadzie & Acquah (2012), Saqib *et al.* (2016) and Ullah *et al.* (2015) in which education had a significant relationship with the farmers' risk attitude. They found that educated farmers were more risk averse and act more wisely than less educated farmers. In totality, the findings of this study revealed that the variable that had a significant relationship with the risk attitude of the farmers were age, education, household size, land ownership, farm area, farming experience and total income. Meanwhile, farming experience had a significant relationship with risk perception.

The results showed that only the correlation of farmers' risk perception and risk attitude on excessive rains was found to be significant (significance = 0.012) (Table 3). A possible explanation for this result was that the farmers perceived excessive rains as a medium-risk to their production and acted accordingly, having a risk-neutral attitude. In contrast with the other climate extremes, the farmers had a high-risk perception on the hazard however they had a risk-neutral attitude towards the risk. These results were similar with the findings of Saqib *et al.* (2016) and Peria *et al.* (2016) in which the farmers' risk perception had a significant relationship with risk attitude.

4.2 Relationship between risk perception, risk attitude and agricultural practices

Risk perception of the farmer on extreme weather events had a significant positive relationship with the crop (Table 4). A possible explanation was that different crops have different levels of tolerance and cropping seasons with some being more tolerant to climate extremes and have shorter cropping seasons than others. For example, vegetables were fragile crops therefore highly vulnerable to extreme weather events but could be harvested quicker than other crops. On the other hand, rice was also vulnerable to extreme weather events but was less fragile than vegetables and had a longer waiting period on harvesting. The results were consistent with the findings of Lucas & Pabuayon (2011) which found that risk perception varies depending on the crop.

Since typhoon and flood events frequently occurred during the wet seasons, the decision of the farmer whether to risk planting during that season was therefore significantly influenced. Lucas & Pabuayon (2011) found similar results in which the risk perception of the farmers were influenced by the cropping season, specifically during wet season. They have found that higher risk was perceived on crops during the wet season due to higher fertiliser prices and erratic climatic conditions. In terms of drought, preventive measures were highly practiced by the farmers such as the use of water pumps. In contrast, most of the farmers tend to amend the impacts of flood after the hazard has occurred. Therefore, the practices of the farmers during the supposed harvest season were significantly affected. Since the small-scale farmers have limited resources, the more destructive the extreme weather event is, the less likely they had resources to mitigate the effects; therefore, fewer actions were made. In contrast, low-risk extreme weather events require minimal resources and were easier to act upon. Therefore, farmers had more additional agricultural practices

5 Conclusion

The study documented and analysed how the small-scale farmers in the upland, lowland and waterside in Siniloan, Laguna, Philippines perceived and coped with risks of extreme weather events. Majority of the small-scale farmers had been farming for more than a decade and adapting to climate variations. They recognised that they were highly vulnerable to extreme weather events. In terms of climate-related risks, the small-scale farmers perceived typhoons as the biggest threat for their farm production and drought being the least. However, considering all of the possible hazards in farming, climate extremes were not perceived as the biggest risk but rather the infestation of pest and diseases to their crops. The results validated the risk studies that farmers understand the risks of climate, but have other urgent issues to prioritise. The risk-neutral attitude of both small-scale rice and vegetable farmers tended to perform short-term 'band-aid' solutions to the potential impacts of extreme weather events and tolerate the aftermath of the impacts due to minimal resources. However, the farmers were willing to make more adaptive strategies if their resources permitted, such as using quality seeds better adapted to certain weather events. The farmers' primary concern was to securer the basic needs of their family such as food on a daily basis and with minimal resources to adapt to the potential impacts of extreme weather events, hence, the possibility of profit in the long-run was sacrificed. The risk perception of the small-scale farmers on extreme weather events was found to have a significant relationship with risk attitude. Specifically, how the small-scale rice farmers perceived the risk of drought and excessive rains significantly influenced their adaptation strategies towards the risks. Small-scale farmers' risk perceptions were significantly influenced by socioeconomic characteristics age, education, household size, farm size, farming experience, land ownership and income. Meanwhile, the small-scale farmers' risk attitudes were significantly influenced by land ownership and farm income. The stated socioeconomic factors generally represent the experiences, roles and spending power of the farmer therefore having a significant influence on the farmers' risk perception and risk attitude. This implied that how farmers perceived and acted upon the risk of extreme weather events varied depending on the farmers' socioeconomic characteristics. Therefore, these factors were important in determining farmers' risk perception and risk attitudes towards extreme weather events. The agricultural practices of the small-scale farmers were significantly influenced by the farmers' risk perception and risk attitude towards extreme weather events. Farm decisions such as crops to be planted, the start of the cropping season as well as practices before and after the impacts of the extreme weather events was significantly affected by the farmers' risk perception while only the decisions before and after the impacts on extreme weather events were influenced by risk attitude. Since most of the farmers' adaptation strategies towards extreme weather events were short-term solutions, agricultural practices were compromised because of the farmers' perception and attitude towards the risks. The significant results of the study implied that the risk perception, risk attitude and socioeconomic factors of the farmers were important in risk disaster management strategies that will be implemented for the Philippines.

Supplement

The supplement related to this article is available online on the same landing page at: https://doi.org/10.17170/kobra-20191212866 .

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Conflict of interest

Authors state they have no conflict of interests.

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