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Knowledge, Risk Attitudes and Perceptions on Extreme Weather Events of Smallholder Farmers in Ligao City, Albay, Bicol, Philippines

ABSTRACT

Smallholder farmers in the Philippines, whose survival and livelihood largely depend on the environment, constantly face risks and bear the impacts of the changing climate. This paper explored how climate change knowledge as well as attitudes and perceptions to risk of smallholder farmers from upland, lowland and coastal ecosystems influence the manner on which they respond and cope with extreme events. Guided by the Adaptation Policy Framework, a questionnaire was developed and administered to 313 smallholder farmers to determine the kind of information that farmers have and how they respond to climate risks towards enhanced adaptive capacity. Seventy-nine percent of respondents lack basic knowledge on climate change. Majority (79%) of respondents recognized that they are exposed to extreme weather risks and perceived climate as a major farming risk. However, availability and access to capital (not climate change) is the biggest perceived threat. Sixty-nine percent of respondents are risk-neutral while farmers who live in less risk-prone areas tend to be risk-takers. Based on correlation, attitudes on risk are influenced by exposure, economic factors and availability of resources. This paper recommends a more targeted climate change information dissemination and customized trainings that enhance capacity, improve livelihood choices and conserve the natural resources.

Key words: *extreme events, capacity, attitudes and perceptions to risk, smallholder farmers*

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INTRODUCTION

In Southeast Asia and particularly the Philippines, many poor communities are highly vulnerable to the effects of climate-related events such as tropical cyclones, floods, and drought. Using the 2015 Global Climate Risk Index (*Kreft et al. 2014*), the Germanwatch (*2015*) analyzed the extent countries worldwide have been affected by the impacts of climate extremes. The Philippines is ranked 5th worldwide in terms of countries most threatened by climate change from 1994-2013.

Smallholder farmers belong to the most vulnerable sectors of society to weather extremes brought about by climate change because they tend to live in geographically “at-risk” and fragile environments, such as the uplands and coastal areas (*Reid et al. 2009*). Recent data from UNEP (*2013*) show that smallholder farmers manage over 80 % of an estimated 500 M small farms worldwide and provide over 80 % of food consumed in the developing world. With over 1.5 B people in the world living in rural areas whose livelihoods depend on agricultural activities, smallholder farmers who take risks on a daily basis are disproportionately affected (*World Bank 2008*). In addition, they are often poor, have very limited assets, and are heavily dependent on the natural resources. Since their livelihood depends on climate and weather, they learned to live and adapt to varied uncertainties and risks.

Unfortunately, the unprecedented rate of these extreme events may be beyond their realms of experience. *Reid et al.* (*2009*) noted that, “poor communities already struggle to cope with existing challenges of poverty and climate shocks, but climate change could push many beyond their ability to cope or even survive.” It is therefore necessary to introduce expertise and approaches needed to raise the resilience and capacities of smallholder farmers, to sustain and improve livelihoods, as well as to reduce the risk of falling deeper into poverty owing to current and future extreme weather events.

Generally, the term "smallholder" refers to farmers' limited resource endowments relative to others and that the definition differs between countries and agro-ecological zones. In the Philippines, the Agriculture and Fisheries Modernization Act (AFMA) or Republic Act (RA) 8435 of 1997 and the Magna Carta of Small Farmers or RA 7607 of 1993 define smallholder "as natural persons dependent on small-scale subsistence farming as their primary source of income". This paper adopts the same definition.

Knowledge on Climate Change

Smallholder farmers are already facing multiple stresses and enhanced capacity through provision of science-based knowledge on how to cope with extreme events is necessary so they can make informed decisions. According to *Wheeler* (*2011*), the future ability to cope with climate change is influenced by the knowledge on where, when, and how much climate change will affect human communities. In addition, climate change awareness is a potentially important factor that influences capacity to cope and adapt to climate change (*Marshall et al. 2013*). However, there is generally lack of public awareness or complete misunderstanding of climate change (*Seacrest et al. 2000*).

At the local scene, *Peñalba et al.* (*2012*) studied the social and institutional dimensions of climate change adaptation in five communities in the Philippines. One of the findings was that both the local government unit (LGU) and communities were not aware of the climate change phenomenon. This finding merits more immediate and targeted efforts to downscale climate change information, especially to vulnerable farming communities in the country.

Risk Attitudes and Perception

Determining the attitudes of farmers to risk is the first step in understanding behaviors and coping strategies. Literatures on climate change generally define risk as expected damage or loss due to combination of vulnerability and hazards. The Intergovernmental Panel on Climate Change or *IPCC* (*2001 and 2013*) defines risk as "function of probability and magnitude of different impacts." *Covello and Merkhofer* (*1993*) explain risk as "the possibility of an adverse outcome and uncertainty over the occurrence, timing or magnitude of that adverse outcome."

According to *Slovic* (*1987*), as cited by *Tokushige et al.* (*2006*), the general public uses intuitive judgement in perceiving risk. Coined as risk perception, judgement is influenced by several factors such as personal values and experiences and that the attitudes of people toward something is generally based on their intuitive judgement of risk. It is important to know the attitudes of farmers towards risks as these influence decisions made, particularly in risk management and adaptive capacity. In an FAO extension manual developed by *Kahan* (*2008*), farmers differ in the degree to which they accept risk. Some farmers are willing to accept more risk, and that their attitudes to risk are often based on many factors such as personal feelings, available information, and financial ability to accept a small gain or loss, to name a few. The manual also categorized farmers' attitudes to risk, namely: risk-averse, risk-neutral and risk-takers. Risk-averse farmers avoid taking risks and are more cautious particularly when it comes to sacrificing income. They tend to protect themselves from potential losses. On the other hand, risk-taker farmers are more open to risks and choose alternatives that would give them a chance to earn more even if the possibility is small. They are willing to take a chance, even if it is minimal, to make more profit. Risk-neutral farmers lie between the risk-averse and risk-takers. Their primary concern is to provide food for their dependents, and thus the possibility of monetary reward in the long-run is sacrificed.

Studies reveal that most smallholder farmers tend to be the most risk-averse (*Binswanger 1980* and *Antle 1987*). The research findings of *Roumasset* (*1976*) were the first of very few that found Philippine farmers to be generally risk-neutral using a lexicographic model of risk attitude assessment. It is important to note that risk attitudes are not fixed and may vary, depending on the nature of the risk or other influencing factors such as age, education, exposure to information, farm input costs, market value of farm produce, family commitments and responsibilities, as well as past experiences. Thus, a farmer may be risk-averse in one situation and a risk-taker in another.

The Need for Capacity Building in Response to Risks

Studies show that farmers have developed many innovative responses and strategies to adapt to difficult, marginal environmental conditions. Research into these actions provide insight for adaptation policy and how it can potentially manifest (*Challinor et al. 2007*). Farmers who have very limited resources and are continually coping with a variety of risks on a daily basis must be capacitated to adapt to threats of extreme events. The United Nations Development Program (UNDP) defines capacity as "the ability to perform functions effectively, efficiently and sustainably" (*Fukuda-Parr et al. 2002*). According to the *IPCC* (*2001*), adaptive capacity is "the ability of a system to adjust to climate change in order to reduce or mitigate potential damage; to take advantage of opportunities, or to cope with the consequences."

Capacity is increasing in some parts of Asia, but remains restrained due to poverty, poor resource bases, income inequities, weak institutions and limited technology. For a smallholder farmer to effectively do their job, it is important to provide him or her with science-based knowledge, new sets of skills and/or climate-smart technologies through workshops and trainings. Researches affirm that farmers can benefit from training; and that failure to address both agricultural and capacity needs has constrained agricultural growth. To better understand the extent to which capacity building efforts can help farmers cope with extreme events, this paper explored the smallholder farmers' knowledge, risk attitudes and perception to extreme weather events.

METHODOLOGY

Data Used in the Study

The data used in this paper is part of a three-year study, "Adapting to Extreme Events in Southeast Asia through Sustainable Land Management Systems", administered by the World Agroforestry Centre (ICRAF), with the College of Forestry and Natural Resources (CFNR) of the University of the Philippines Los Baños (UPLB), as co-implementer. The study was carried out from 2012-2014. The main goal is to develop resilient farming systems adaptable to extreme climatic events by first understanding the vulnerability of smallholder farmers to identified stressors.

The study used the Adaptation Policy Framework (APF) in assessing the impacts, vulnerability, adaptation, and resilience of smallholder farmers to extreme events. The APF was developed by UNDP and serves as a flexible guide or approach in designing and implementing projects aimed at reducing vulnerability to climate change. Stakeholders can be involved in all five phases, which can be used in different combinations: defining project scope and design, assessing vulnerability under current climate, characterizing future climate related risks, developing an adaptation strategy and continuing the adaptation process. Of interest to this paper is the interplay between two crosscutting APF stages: assessing and enhancing adaptive capacity and assessing current vulnerability and assessing future climate risks. The UNDP allows the use of one or two components, even modifications, to better suit the objectives, needs, goals and resources of the framework user. Thus, knowledge of smallholder farmers as well as their risk attitudes and perception (identified through determination of risks considered in farm production and preferred yield type forecast per cropping season in future scenarios) were analyzed as inputs to capacity building efforts to reduce vulnerability.

To determine how smallholder farmers cope with climate extremes and gain a deeper insight on their vulnerability and resilience, a 10-page survey questionnaire was developed, pretested, pilot-tested and used as research instrument after the conduct of participatory rural appraisals as well as review of primary and secondary data. For this paper, details from the questionnaire such as socio-economic profile, farm profile and farming practices, risk attitudes and perception, as well as vulnerability and adaptation to extreme events at both present and future scenarios were used. In addition, a one-page questionnaire was administered to the same respondents to determine their knowledge on climate change, how this knowledge helped them in making farm decisions, their interest level in learning more about climate change, preferred learning styles and training needs. The household survey was administered in November 2012.

Location of the Study

The study was conducted in Ligao City in Albay province, Philippines. Albay is located in the Bicol region in South-eastern Luzon and is highly vulnerable to a wide range of natural disasters and risks of climate extremes such as strong typhoons, heavy rainfall, droughts, tsunami and volcano eruptions (**Figure 1**).

Ligao is a fourth-class city located 502 km south of Manila. It has a total land area of 24,640 ha, of which 89 % is alienable and disposable land, and 11 % is forest land. Majority of the population are coconut and rice farmers and only a small portion own the land. The 2010 data from the National Statistics Office (NSO) showed a population of 104,914 in 55 barangays, three of which are in the coastal area.

To better understand the interconnectedness of social, environmental and ecological processes critical for sustainable development, the Landscape or Ridge-to-Reef Approach was used in site selection. Barangays Oma-Oma, Herrera and Maonon were chosen in consultation with the local municipality, to represent upland, lowland and coastal ecosystems, respectively (**Figure 2**). Two of the barangays, Maonon and Oma-Oma, are Conservation Farming Villages or CFV recipients due to its hilly and mountainous terrain. The CFV is a government technology transfer program incorporating agroforestry on hilly areas. As a sustainable upland production system, it aimed to conserve soil and water as well as minimize runoff and erosion by planting crops that require minimal tillage. With proper land conservation strategies, sloping lands are potential areas that can help in reducing degradation and at the same time motivate smallholder farmers to address both livelihood needs and resilience to climate extremes. The coastal area

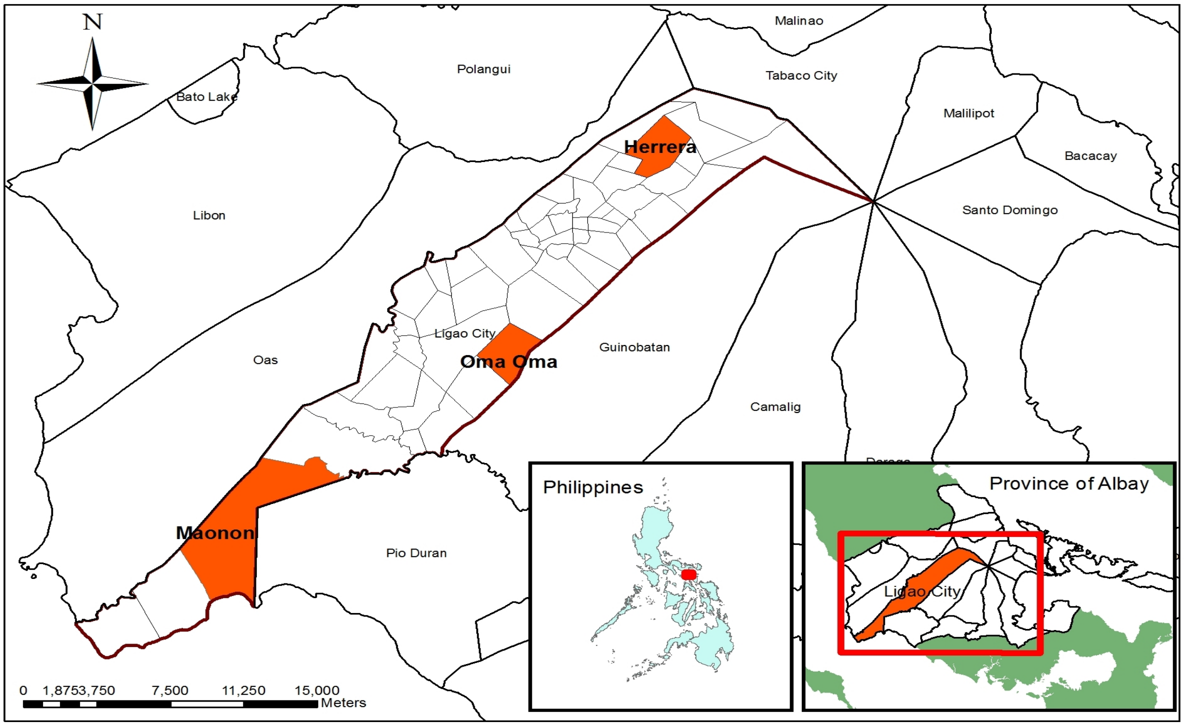

Figure 1. Location map of Albay Province.

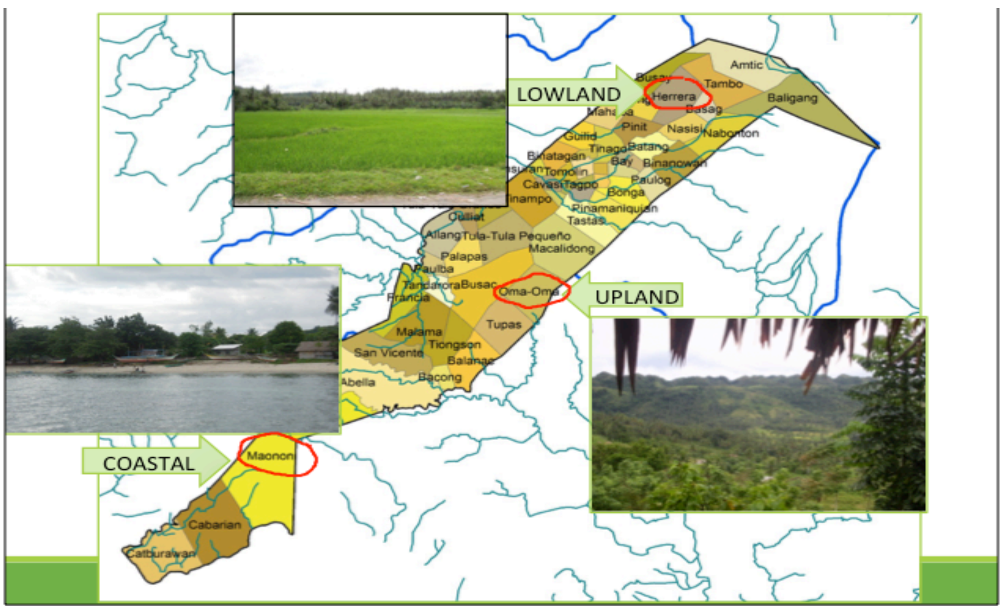

Figure 2. Map of Ligao City highlighting the three study areas.

of Brgy. Maonon has the biggest area with 2,493.57 ha and 220 registered farmers. Brgy. Oma-Oma has 1,011.75 ha with 169 registered smallholder farmers. On the other hand, Brgy. Herrera is the smallest of the three sites in terms of area with 473 ha and has the lowest number of 69 registered smallholder rice farmers. Being a lowland ecosystem, majority of its working residents are employed and/or owners of small business establishments (**Table 1**).

Data Collection and Analysis

Three hundred twenty respondents were obtained through systematic random sampling from 458 registered smallholder farmers in the three barangays. Using the Slovin's formula at 95% confidence level, the sample size for each barangay was calculated as follows:

Slovin's formula: $n = \frac{N}{1+Ne^2}$

where: n = sample size
N = number of population
e = margin of error

The final number of respondents considered in this

Table 1. Summary description of the three study areas in Ligao City.

Brgy. Oma-Oma (upland ecosystem)	Brgy. Herrera (lowland ecosystem)	Brgy. Maonon (coastal ecosystem)
Total area: 1,011.75 ha Population: 1,655 (2010) Households: 367 Livelihood: Farming No. of registered smallholder farmers: 169 Sample size (by Slovin's Formula): 119	Total area of 473.09 ha Population: 2,440 (2010) Households: 455 Livelihood: Farming, laborers, small business owners No. of registered smallholder farmers: 69 Sample size (by Slovin's Formula): 59	Total area of 2,493.57 ha Population: 2,960 (2010) Households: 610 Livelihood: farming and fishing No. of registered smallholder farmers: 220 Sample size (by Slovin's Formula): 142

study was set at 313 smallholder farmers based on ability and willingness to provide information (**Table 1**). Information obtained from the survey were complemented with different data collection techniques such as focus group discussions, key informant interviews and community validation.

Methods of analyses used in this study were descriptive statistics and frequency distribution. The chi-squared test of independence was employed to determine association of farmers' risk attitudes to perceived risks in farming.

RESULTS AND DISCUSSIONS

Profile of Respondents

The smallholder farmers in the three barangays of Ligao City are predominantly male (58%), married (86%) and with an average age of 48 years old. Most have obtained elementary education (61%) and are Roman Catholic (88%). Almost all respondents (98%) are full-time farmers and about one-quarter also work as fishermen (24%) (**Table 2**).

In terms of livelihood, most of the respondents are smallholder farmers (98%). Respondents in the lowland area of Brgy. Herrera are mostly rice farmers. In the upland area of Brgy. Oma-Oma, most respondents are smallholder farmers and CFV members. The respondents from the coastal area of Brgy. Maonon are also smallholder farmers but have the option to fish during lean months and/or extreme weather events such as drought and heavy rainfall. Almost all respondents (92%) are native Bicolanos while a few (3%) are Visayans. Majority (91%) were born in their respective barangays and the average number of years of residency is 25 years. These findings on ethnicity and residency are important to this paper, as it implies that respondents are knowledgeable of the local climate system and thus, have the ability to recall climate extremes and its impacts with greater accuracy.

The average household size is 5 with majority (60%) of the respondents having 1 to 5 family members. Majority of respondents own their houses (94%) while house structure is almost equally distributed between light (32%), semi-light (34%) and concrete (32%). Thirty-six percent of the respondents claimed that they own the residential land while almost half (49%) occupied the land for free. In terms of farm size, 64% of respondents cultivated 0.1 to 1 ha of farm land and that the mean farm size is 1.56 ha. Majority of the respondents were tenants (43%) and farm owners (38%) (**Table 3**). This merits further validation, as most of the houses and farms visited during the survey are located in mountainous and highly sloping lands, which are most of the time categorized as government-owned.

With respect to income, more than half of the respondents (80%) were living below the average family income in Albay, which is PhP 18,726 (PhP 44 = US$ 1 as of December 2013) per capita per year (NCSB 2013). The mean annual total income was PhP 63,534.30 (US$ 1,443.96), while the average annual farm income was PhP 27,723.29 (US$ 630.07). In response, some respondents engaged in off-farm employment such as contractual/temporary laborer and fishing to make ends meet and/or as common adaptive methods during extreme weather events. Some respondents also plant vegetables and crops in their backyard and/or raised chickens or pigs primarily for family consumption.

Respondents' Knowledge on Climate Change

Smallholder farmers in Ligao City have been dealing with extreme weather events for a long time. Results from focus group discussions with the smallholder farmers and key informant interviews with city government officials and barangay residents revealed that the locals can recall the names of strong typhoons that hit the area, as well as La Niña and El Niño episodes. These results were crosschecked with records from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and revealed a close similarity. For the upland Brgy. Oma-Oma, Typhoons Reming in 2007 and Sisang in 1987, La Niña from October 2009 to June 2010 and El Niño in 2009 were recalled. In lowland Brgy. Herrera, Typhoons Sening in

Table 2. Type and spread of farm level adaptation.

Gender	Farmer-Respondent (n=313)		Civil Status	Farmer-Respondent (n=313)	
	Frequency	Percentage		Frequency	Percentage
Female	130	42	Single	15	5
Male	183	58	Married	269	86
			Widow/widower	29	9
Education	**Frequency**	**Percentage**	**Religion**	**Frequency**	**Percentage**
Elementary	190	60.70	Roman Catholic	277	88.50
High School	92	29.39	Born Again Christian	9	2.88
College	11	3.51	Iglesia Ni Cristo	7	2.23
Post-graduate	1	0.32	Methodist	2	0.63
Vocational	2	0.64	No response	18	5.75
No response	17	5.43	**Major Occupation**	**Frequency**	**Percentage**
Age	**Frequency**	**Percentage**	Farming	307	98.08
21-29	19	6.07	Fishing	1	0.32
30-39	60	19.17	Vendor	2	0.64
40-49	86	27.48	Barangay employee	2	0.64
50-59	84	26.84	No response	1	0.32
60-69	50	15.97	**Ethnicity**	**Frequency**	**Percentage**
70-79	12	3.83	Bicolano	287	91.69
80-89	2	0.64	Visayan	8	2.56
Average age (in years): 48			Tagalog	1	0.32
Range: 21-89			No response	17	5.43

Table 3. Household and farm profile of respondents.

Household Size	Farmer-Respondent (n=313)		Farm Size	Farmer-Respondent (n=313)	
	Frequency	Percentage		Frequency	Percentage
1-5	187	59.74	0.1 to 1	200	64
6-10	115	36.74	1.1 to 2	43	14
11-15	11	3.51	2.1 to 3	31	10
			2.1 to 4	15	5
House Structure	**Frequency**	**Percentage**	4.1 to 5	9	3
Light	100	31.95	> 5	13	4
Semi-light	108	34.50	No response	2	1
Concrete	101	32.27	**Mean Farm Size:**	**1.56 ha**	
No answer	4	1.28			
House Ownership	**Frequency**	**Percentage**	**Farm Land Ownership**	**Frequency**	**Percentage**
Owned	293	93.61	Tenant	134	42.8
Occupied for free	16	5.11	Owner	118	37.7
Amortized	2	0.64	Inherited	20	6.4
Rented	1	0.32	Government-owned	11	3.5
Owned by in-laws	1	0.32	Free occupant	10	3.2
Residential Land Ownership	**Frequency**	**Percentage**	Rented/leased	9	2.9
Owned	113	36.10	Mortgaged	2	0.6
Occupied for free	154	49.20	No response	9	2.9
Rented	35	11.18			
Annual Total Income (PhP)	**Frequency**	**Percentage**	**Annual Farm Income (PhP)**	**Frequency**	**Percentage**
0 to 50,000	181	57.8	< 25,000	189	60
50,001 to 100,000	73	23.3	25,001 to 50,000	61	19
100,001 to 150,000	25	8	50,001 to 75,000	30	10
150,001 to 200,000	16	5.1	75,001 to 100,000	14	4
200,001 to 250,000	9	2.9	> 100,001	19	6
250,001 to 300,000	4	1.3			
300,001 to 350,000	4	1.3	**Mean Annual Farm Income:**	**PhP 27,723**	
> 350,000	1	0.3			
Mean Annual Total Income:	**PhP 63,534**				

1970, Sisang in 1988 and Juaning in 2011 were recalled along with incidences of El Niño in 1987 and 1990s. In the coastal area of Brgy. Maonon, Typhoons Trix in the 1950s, Sisang in 1987, Rosing in 1996, and Reming in 2006 were recalled along with La Niña in 2005 and El Niño in 1970, 1990s and 2009. Data from PAGASA categorized Typhoons Reming, Rosing and Sisang as super typhoons. Thus, people tend to remember extreme events with the highest intensity, particularly the magnitude of its impacts or damages such as loss of lives and properties. Of all extreme weather events in Ligao City, the most frequently mentioned and ranked in terms of severity were typhoon, followed by drought, then excessive rains.

Sixty-five survey respondents (21 %) revealed that they have basic knowledge on climate change, particularly with respect to changes in climate conditions, onset of hot temperatures and sudden rains and effects of cutting of trees (**Table 4**). Respondents who claimed to have basic knowledge on climate change were CFV members and received trainings that included climate change concepts. When asked if such knowledge helped them in farm decision-making, 69 respondents said that it encouraged them to plant trees, while 10 respondents adjusted farm planting schedules according to the existing climate condition.

Almost three-fourths of respondents (79%) were not aware of climate change, despite the frequent occurrence of extreme events in their locality. This validates research findings by *Beck 1992, Peñalba et al. 2012* and *Seacrest 2000*, which state that the nature, seriousness and consequences of most environmental problems are uncertain and unfamiliar to people. More importantly, 98% of respondents opined that they needed additional knowledge on climate change, and that this need can be met through trainings (96%) (**Table 5**). This suggests that most of smallholder farmers in the area want to learn more about climate change to guide their decisions and actions.

Table 4. Respondents' knowledge on climate change.

Basic Knowledge on Climate Change	Farmer Respondent (n=313)	
	Frequency	Percent
Yes	65	20.77
No	248	79.23
If yes, what is/are this/these*:		
Change in climate condition	17	
Hot temperature and sudden rain	13	
Cutting of trees	11	
How does this help in farm decision-making?		
Need to plant trees	69	
Knowledge on climate change	9	
Adjust planting according to climate	10	

In addition, respondents were asked to identify training topics which they felt were needed to help them adapt to climate change and extreme events (**Table 6**). Five topics were listed in the questionnaire, namely: basic knowledge on climate change and extreme events, choice of climate-resilient species, sustainable farm management, tools for assessing and monitoring impacts of climate extremes, and soil and water conservation technologies. More than half of the respondents signified interest to include all five listed topics in the training. Specifically, 275 respondents (88%) preferred "basic knowledge on climate change and extreme events", while 235 respondents selected "choice of climate-resilient species such as crops and trees".

When respondents were asked about their preferred learning styles for the training (based on the three general adult learning styles), most (83%) preferred "hearing" or learning through lectures (auditory learning style), followed by "learning by doing" (77%) through actual experience (tactile or kinesthetic learning style) and then by "seeing" (74%) through the use of visuals (visual learning style). Based on learning preference where respondents are assumed to be auditory learners, information is therefore best processed through lectures and discussions, which is a typical training methodology (**Table 7**). This approach can be complemented with active participation and/or discussions, illustrations or graphics, workshops and field observations.

Risk Perception and Attitudes to Extreme Events

In terms of perceived risks, respondents generally recognized that they are exposed to risks of extreme events **(Table 8**). Majority (79%) consider climate as the number one risk influencing livelihood, followed by price changes (56%) and yield variations (29%). These findings validate the results of previously conducted FGDs with local communities and stakeholders when they were asked to recall extreme events, particularly the names and dates of typhoons, as well as El Niño and La Niña episodes. Respondents accurately recalled extreme events such as Typhoon Reming and El Niño episodes from 1997 to 1998 particularly due to magnitude of its impacts and/or damages.

To gauge respondents' risk attitudes given future scenarios of climate extremes, results of climate projections using SimCLIM model from the Asia Pacific Network for Global Change Research by *Pulhin* (*2009*) was used. Respondents were presented with local future scenarios and asked about their perceived potential risks and impacts that such situations might bring on their livelihood. In particular, they were asked on preferred yield per cropping season

Table 5. Respondents' need for additional knowledge on climate change.

Need Additional Knowledge on Climate Change?	Farmer Respondent (n=310)	
	Frequency	Percent
Yes	305	98.39
No	5	1.61
Thru additional training?		
Yes	299	96.45
No	9	2.90
No answer	2	0.65

Table 6. Training topics suggested by respondents.

Training Topics	Farmer Respondents* (n=311)	
	Frequency	Percent
Basic knowledge on climate change and extreme events	275	88.42
Choice of climate-resilient species (crops and trees)	235	75.56
Soil and water conservation technologies	224	72.02
Sustainable farm management	201	64.63
Tools for assessing and monitoring impacts of climate extremes	179	57.56

*multiple responses

Table 7. Preferred learning styles of the respondents.

Preferred Learning Styles*	Farmer Respondent (n=313)	
	Frequency	Percent
Seeing (visual)	231	73.80
Hearing (auditory)	261	83.39
Learning by doing (tactile)	240	76.68

*multiple responses

Table 8. Farming risks perceived by respondents.

Types of Farming Risks*	Farmer-Respondent (n=313)	
	Frequency	Percentage
Climate	247	78.91
Price changes	174	55.59
Changes or variation in yield	92	29.39
Pests	54	17.25
Fire	24	7.67

*multiple responses

using three parameters: low yield but with 100% certainty; moderate yield with 50/50% chance of obtaining it, and high yield with only 70/30% chance of obtaining it. These parameters were determined if the smallholder farmer is risk-averse, risk-neutral or risk-takers, respectively (**Table 9**). With future scenario presented, most (40.26%) of the respondents preferred the moderate yield at 50/50 certainty in designing farms with 50:50 trees and crops ratio; while 37.06% lean towards high yield with 20:80 trees and crops ratio. Majority also preferred moderate labor requirements (73.16%) as well as soil and water conservation capacity for their farms (57.51%). Almost half (49%) of the respondents wanted high market demand for their products.

More than half of respondents (69%) were risk-neutral, and it applies to the three barangays (**Table 10**). However, there were more risk-takers in Brgy. Herrera (lowland) with 30%, followed by Brgy. Maonon (coastal) with 20%, and 16% in Brgy. Oma-oma (upland). This may be explained by the fact that the lowland farmers (Brgy. Herrera) were less exposed to extreme events as they have continuous supply of water from numerous springs even during drought, and were not greatly affected by floods during typhoons or heavy rains. In the upland Brgy. Oma-oma, smallholder farmers regularly deal with drought, soil erosion and floods that sweep away crops, livestock, properties and even lives. Thus, findings validated the study of *Roumasset* (*1976*) that found Philippine farmers to be generally risk-neutral.

Relationship of Risk Attitudes to Perceived Farming Risks

It was observed that price changes and pests have positive relationship (90% and 99% level of significance) to risk attitudes (**Table 11**). Climate change and related calamities were not perceived to be the biggest risk. Instead, smallholder farmers' generally risk-neutral attitudes are influenced by economic factors such as price changes and onset of pest and/or diseases.

In terms of relationship of key farming production variables to risk attitudes, capital, cost of inputs, selling price of produce and food consumption have a positive relationship to risk attitudes at 99%, 95%, 95% and 99% level of significance, respectively (**Table 12**). Again, smallholder farmers' risk attitudes are generally influenced by economic variables.

Capacity Building through Training

In response to the survey results particularly on the respondents' clamor for information on climate change, a two-day capacity-building activity through training and workshop was organized by ICRAF and UPLB-CFNR in collaboration with the City Government of Ligao. The activity initially trained 20 smallholder farmers from the three study sites and LGU representatives in sustainable and resilient land use systems. The activity aimed to provide the local farmers with an overview on climate change and extreme weather events, its ramifications to agriculture, and sustainable farming/land use systems in response to climate extremes. Experts from UPLB-CFNR, ICRAF and City Government of Ligao were invited to lecture on the following topics: Climate Change: Science, Impacts, and

Table 9. Respondents' preferred farm design and attributes using future scenarios to determine risk attitudes.

Farm Attributes	High Yield with 70/30% Chance (20:80 Trees & Crops)		Moderate Yield with 50/50% Chance (50:50 Trees & Crops)		Low Yield with 100% Chance (80:20 Trees & Crops)	
	Frequency	%	Frequency	%	Frequency	%
Trees and crops combination	116	37.06	126	40.26	58	18.53
Labor requirement	56	17.89	229	73.16	17	5.43
Soil and water conservation capacity	109	34.82	180	57.51	11	3.51
Market demand	154	49.20	139	44.41	7	2.24

Table 10. Risk attitudes of respondents.

Farmer-Respondent (n=302)	Risk-Averse		Risk-Neutral		Risk-Taker	
	Percent	Number	Percent	Number	Percent	Number
Brgy. Maonon	13.43	18	66.42	89	20.15	27
Brgy. Herrera	2.17	1	67.39	31	30.43	14
Brgy. Oma-Oma	14.75	18	68.85	84	16.39	20
TOTAL	12.25	37	67.55	204	20.20	61

Table 11. Relationship of respondents' risk attitudes to perceived farming risks.

Types of Farm Risks	Chi Square	Probability	Significance
Unintentional grass-land fire	4.292	0.114	
Price Changes	4.7461	0.093	*
Yield variations	3.0935	0.293	
Climate and other calamities	1.8241	0.402	***
Pests	36.1825	0	

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

Table 12. Relationship of respondents' risk attitudes to key farm production variables.

Key Farm Production Variables	Chi Square	Probability	Significance
Capital	9.9415	0.007	***
Cost of inputs	7.9336	0.019	**
Selling price of produce	6.8764	0.032	**
Climate information	2.2611	0.323	
Pest	0.73	0.694	
Market	2.8401	0.242	
Food Consumption	29.0332	0	***

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

Responses in the Philippine Context, Fostering Conservation Agriculture with Trees (CAwT) in the Philippine Uplands, Initiatives of Ligao City and Needs on Sustainable Land Use Systems and Formulation of the Barangay Development Plan. Complementing workshops were also carried out after the lectures. Participants were grouped into three based on barangay/ecosystem and took the lead in illustrating current land use plans and desired landscape in the future, perceived vulnerable crops and trees, and ideal farming systems considering impacts of extreme events.

SUMMARY AND CONCLUSION

This study documented and analyzed how smallholder farmers from upland, lowland and coastal ecosystems in Ligao City, Albay, Bicol, Philippines, cope with risks from extreme weather events. Interestingly, more than three-fourths of respondents have no basic knowledge on climate change. This indicates that farmers, who are one of the most affected by climate change and extreme events, are generally lacking basic and necessary knowledge, awareness and skills to be able to effectively respond/adapt to risks.

Majority of smallholder farmers, who are mostly dependent on rain and have long been adapting to climate variations, recognize that they are vulnerable to risks of extreme events. However, climate extremes and future climate trends were not perceived to be the biggest risks. Such finding validates risk studies that highlight the fact that people often understand the message regarding risks, but have other more urgent issues to consider prioritizing. In the case of smallholder farmers in Ligao, livelihood particularly availability and access to capital is the biggest threat.

In terms of risk attitudes, more than half of smallholder farmers were risk-neutral and that most of the risk-takersreside in an area less exposed to extreme events. Furthermore, the risk-neutral attitudes of respondents were predominantly influenced by economic variables such as price changes, capital and cost of inputs. Their primary concern is to provide food for the family on a daily basis, and with minimal resources, the possibility of profit in the long-run is sacrificed.

Nevertheless, even if these smallholder farmers were not predominantly risk-takers, they are problem-solvers and make do with what they have as they face risks on a daily basis. They are also willing to adapt and/or change their practices to protect their livelihood, even if on a short-term basis and as long as their limited resources permit.

Smallholder farmers' knowledge, attitudes and perceptions to climate extremes are important considerations when developing policies, plans and programs to improve their ability to manage risks. With varying knowledge, perceptions and attitudes of smallholder farmers, this paper validated the fact that cascading climate change information at the local level remains to be a tremendous concern up to this day. More than ever, smallholder farmers will require more support to withstand the challenges and threats by climate change as their existence are at stake. Thus, strategies and approaches focused on enhancing the capacity of smallholder farmers is of utmost importance so they can cope with the fast changing climate, make informed decisions and take more effective actions.

RECOMMENDATIONS

Overall, smallholder farmers perceived that they are not at-risk from experiencing the effects of extreme weather events. Results justify the need for immediate and more intensive information and communication efforts regarding what climate change is, its associated risks, as well as critical effects (with focus on extreme events) on the lives of smallholder farmers both at present and future scenarios. Equally important is the impetus to provide science-based information that can address their livelihood and personal concerns. Risk communication is a widely-used sociological approach that can be used to increase knowledge and understanding of the nature of climate change and extreme events, enhance trust and credibility, and facilitate dialogue, to arrive at effective and appropriate decisions and actions.

Smallholder farmers generally want information on climate change and identified training as preferred learning approach. Providing opportunities for training and education are also crucial to enable smallholder farmers to better manage risks in the light of scarce resources. This is where climate-smart agriculture or CSA can come in. According to *FAO* (*2013*), it is "an approach to help guide actions to transform and reorient agricultural systems to effectively and sustainably support development and food security under a changing climate." Launched in 2010, this system focuses on identifying the appropriate production systems and enabling institutions "best suited" to respond to site-specific climate change effects while increasing agricultural production in a sustainable manner. More importantly, provision of support to improve the livelihood choices of smallholder farmers, particularly development of entrepreneurial capacities, organization of networks and farmer groups, setting up of social safety nets, and crafting insurance policies can be considered as training and/or workshop topics.

At the academe, private, nongovernment, and LGU levels, regular trainings and seminars for smallholder farmers on climate change related subjects, (such as climate change phenomena and disaster preparedness) must be intensified to enhance understanding without causing confusion or anxiety. Efforts to minimize scientific complexity must always be kept in mind. In addition, efforts must also include drawing up from smallholder farmers' knowledge, experiences, values and opinions in relation to risks of extreme events as some may be different from experts. Such openness and transparency may lead to better decisions and actions towards better resiliency. Finally, it is also necessary to incorporate traditional or indigenous knowledge in research and development programs; as well as provide smallholder farmers with innovative technologies and approaches that are available and require minimal capital inputs.

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