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Improving Adaptive Capacity of Small-Scale Rice Farmers: Comparative Analysis of Lao Pdr and the Philippines

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Abstract: Lao PDR and the Philippines are among the Asian countries whose exposure to climate risks seriously threatens livelihood, particularly of those in the agriculture sector. The paper provides a comparative analysis of the adaptive capacity and current adaptation strategies of small-scale rice farm households in these countries. The analysis focused on two top rice-producing provinces in each country that are vulnerable to climate risks. It covered three rice production environments or ecozones - irrigated lowland, rainfed lowland and rainfed upland in two cropping seasons, wet and dry. Sources of data include survey of rice farmers; key informant interviews with local government officials; focus group discussions with farmer and village leaders and extension workers; and local government reports. Calculation of adaptive capacity index adopted the procedure applied by the United Nations Development Program (cited in Swanson *et al*. 2007) on the Human Development Index. It incorporates various bio-physical and socio-economic factors affecting adaptive capacity. The analysis shows specific interventions that could improve household adaptive capacity to a changing climate, particularly extreme events and draw comparative lessons for possible uptake of other countries. The losses and damages experienced by the households show that livelihood, particularly of the poor farmers, is largely natural resource-based which is highly vulnerable to climate risks. The impacts of extreme events such as drought and typhoon vary by location, ecozone and cropping season. Farmers, particularly in the rainfed areas, have limited access to adaptation technologies and alternative livelihood sources. In the Philippines, farmers expressed the need for improved farming technologies, funding, skills and knowledge on adaptation to changing climate and advance warning on climate events. In Lao PDR, farmers need support for flood resistant rice varieties and better infrastructure because of their farms' vulnerability to flooding and landslide.

Key words: Adaptation strategies · Climate change · Lao PDR · Philippines

INTRODUCTION

In developing countries with a large agricultural base, the risks posed by climate change and seasonal variability are a major policy concern. Farmers' livelihood system may suffer due to production losses associated with water stress and destruction of productive assets.

The increasing weather variability may require adjustments in cropping pattern in order to lessen possible adverse impacts. Given some level of uncertainty in climate change projections, adaptation actions require even more conscientious planning. With the limited capacity particularly of small-scale farmers, appropriate interventions may be necessary to enhance their means of coping.

Lao PDR and the Philippines are among the Asian countries whose exposure to climate risks seriously threatens the agriculture sector. Rice, the staple food for both countries, is a highly vulnerable crop to climate change because of its critical dependence on water supply. In Lao PDR, agriculture is the dominant livelihood source but farm production is low and poverty incidence is high. Previous extreme climatic events have caused significant losses but national government's measures to manage climate risks are limited in scope and scale [1].

The case of the Philippines also calls for urgent attention because of its large population and the nature of economic development pathway. An average of 20 typhoons per year hits the country and the intensity of these typhoons is increasing. Urbanization, land use

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conversion, the prevalence of small-scale farms and low level of irrigation development compound the risks posed by climate change. Rice land area has declined by 33.66 percent due to urban expansion [2, 3]. Irrigated area comprises only 57.3 percent of the total rice land area. In the dry season, less than half of this area gets irrigated due to water scarcity and irrigation inefficiency.

Small-scale and resource-limited farmers in both countries respond to climate-related hazards based on their level of knowledge and understanding about the phenomena and the resources that they have. Without an effective policy and institutional support for sustainable adaptation, farmers' responses may continue to be reactive and temporary. They will not be able to shift to long term strategies that will reduce the risks or prevent the recurrence of disasters.

Results of this study can be used by local governments in planning appropriate adaptation strategies and informing farmers about feasible adaptation options that can help secure food supply and their livelihood. Being the front liners in providing services to the community, the local governments should implement policies and programs that will cater to the specific needs of households to cope with changing climate. They should catalyze actions for managing and adapting to climate risks at the farm and community levels.

This paper presents a comparative analysis of the adaptive capacity and current adaptation strategies of small-scale rice farm households in Lao PDR and the Philippines. The objective is to determine specific interventions that would improve household adaptive capacity to a changing climate, particularly extreme events and draw comparative lessons for possible uptake of other countries.

MATERIALS AND METHODS

Conceptual Framework: Climate-related risks i.e. the likelihood of loss, harm, disaster, is a function of the climate hazard, exposure and vulnerability. Hazard is the underlying physical phenomenon, such as a tropical cyclone, drought and intense rainfall. Exposure refers to the elements affected by hazard e.g. population, sectors at risk. Vulnerability is the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed by climate change effects [4].

As argued in the Third Assessment Report of the IPCC [4], climate variability and extremes maybe used as a proxy indicator for climate change. Adaptation to climate variability and extremes could provide insights to appropriately adapting to anticipated climate change in the long term [5].

Adaptive capacity of a system could counteract the potential climate risks it faces. Adaptive capacity is the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability, or future climate conditions [6]. An array of factors influences adaptive capacity such as economic and natural resources, social entitlements, institutions and governance, human resources and technology [7 cited in 8]. In developing countries, lack of resources, inadequate institutional support and ineffective policy and governance, limit farmers' adaptation options [9].

However, high adaptive capacity may not necessarily translate into the best actions that reduce vulnerability. Awareness of climate change and impacts may not translate into actions because of social, economic, or institutional reasons [10]. A person's perception or appraisal of the situation or the seriousness of the problem or what others are doing influences behaviour towards environmental issues [10-12].

Scope and Data Collection: The study was conducted in Lao PDR and the Philippines during the period 2011-2012. It covered two top rice-producing provinces in each country that are vulnerable to climate risks, namely, Luang Prabang and Savanakhet, Lao PDR; and Tarlac and Pangasinan, Philippines. The analysis focused on three rice production environments or ecozones - irrigated lowland, rainfed lowland and rainfed upland; and two cropping seasons, wet and dry. Sources of data include survey of 200 rice farmers in each country; key informant interviews with local government officials; focus group discussions with farmer and village leaders and extension workers; and local government reports. The survey respondents were randomly chosen from the list of rice farmers obtained from the local government offices in the study municipalities/districts.

Data Analysis: Comparison of adaptive capacity across the study areas required the aggregation of indicators into an overall index of adaptive capacity. Calculation of adaptive capacity index (ACI) adopted the procedure applied by the United Nations Development Program [cited in 13] on the Human Development Index as shown in the following equations:

Table 1: Indicators of household adaptive capacity

Indicator	Indicator Variable	Assumptions
Natural capital	-Land: Percent of households reporting land degradation by climate related extremes during the past 30 years -Water: Percent of households reporting they have heard any conflict over water in the community Percent of households reporting deteriorating water supply Percent of households reporting deteriorating water quality	-The lesser the land degradation, the better the adaptive capacity of farmers is. -Water supply and quality also implies better adaptive capacity for farmers. -The lesser the conflict over water, the higher the adaptive capacity of farmers is.
Physical capital	Percent of households by - Location of house - Degree of permanence - Distance to town proper - With television set - With cell phone	-Characteristics and location of infrastructure affect adaptive capacity, i.e. permanent construction materials, location in flat lands (vs. hilly/upland) enhance adaptive capacity. -The nearer to town, the easier access to services and facilities -Presence of communication networks facilitate access to information
Economic/ Financial capital	-Area and ownership of land (residential, farm, aquaculture) -Household income and sources -Percent of households below/above threshold level -Percent of households with credit sources -Dependency ratio	- Greater economic resources increase adaptive capacity. -Ownership of house and lot can enhance adaptive capacity. -Lack of financial resources limits adaptation options. Greater financial assets mean more ability to recover from - material loss. -Diverse employment opportunities provide more options if climate affects particular type of occupation.
Social capital	Percent of households by -Membership in community organization -Sources and type of assistance available to households -Interaction in the community on climate-related and other issues	-Social/organization relations help reduce impacts of climate-related risks and therefore increase adaptive capacity. -Community-based participation can enhance adaptive capacity. -Connectivity/communication networks facilitate information flow and may enhance community access to assistance.
Human capital	Percent of households by -Educational attainment -Attendance in training in disaster preparedness -Indigenous knowledge	-Training and skill development can enhance adaptive capacity. -Greater access to information increases likelihood of timely and appropriate adaptation.

Note: Adapted from Swanson *et al*. 2007; Lamichhane, 2010

$$\text{Normalized value}_{(\text{Where higher is better})} = \frac{\text{Value of the indicator to be normalized- Minimum value of all indicators}}{\text{Maximum value of all indicators - Minimum value of all indicators}}$$

$$\text{Normalized value}_{(\text{Where lower is better})} = 1 - \frac{\text{Value of the indicator to be normalized- Minimum value of all indicators}}{\text{Maximum value of all indicators - Minimum value of all indicators}}$$

The indicators of adaptive capacity of households include natural resources conditions, physical assets, economic assets, social capital and human capital (Table 1). Giving equal weights for each indicator, the index values are numbers between 0 and 1. The score of 1 means the highest adaptive capacity and 0, the lowest.

The scores provide the relative position or ranking of the households and ecozones in the study areas. Such ranking helps in identifying which ecozones are weaker or stronger with respect to a specific adaptive capacity indicator. The low score on a particular indicator suggests the need for specific interventions to improve adaptive capacity.

RESULTS AND DISCUSSION

Exposure and Risks to Climate Change-related Hazards: Results of the study confirmed the vulnerability of the study provinces to climate change impacts. In Tarlac and Pangasinan, Philippines, typhoon and continuous intense rainfall are the most frequently observed climate-related hazards as reported by 82% and 95% of farmers, respectively. The extent of exposure, however, varies by location and ecological zone. More (24%) lowland farmers in Tarlac experienced flooding than those (4%) in Pangasinan. Over 20% of farmers reported the occurrence of drought while over 30% reported that continuous intense rainfall occurred several times during the last

20-30 years. On the other hand, farmers rarely observed dramatic increase in temperature. The farmers' observations were validated by records obtained from the local weather bureau. Records show that over the last 30 years, drought was experienced in 1982-1983, 1997-1998, 2003-2004 and 2009-2010 while continuous intense rainfall primarily due to typhoons was experienced five to ten times every year. Records further show that the intensity of typhoons in the last 59 years has been increasing [14].

In the two provinces, losses in farm income due to climate hazards are more severe compared to non-farm losses. This accounts for 70-90% of total losses in irrigated lowland and rainfed upland areas. But the proportion of total losses to household income varies by province and ecozone. In Tarlac, rainfed lowland is generally more affected by climate events than the irrigated lowland and rainfed upland.

In Pangasinan, rainfed upland farmers experienced higher losses due to flooding, typhoon and prolonged drought accounting for more than 20%, of the annual household income. In irrigated lowland, such losses account for around 13-17% of total household income. In irrigated lowland area, losses due to drought are highest, accounting for 7% of the annual household income (Table 2).

Other effects of climate-change related events on their farm resources are land degradation and soil erosion that could reduce yield by 30-70%. Downscaled climate projections in Tarlac province indicate that there will be more pronounced rainfall during wet season and a drier dry season in the years centred in 2020, 2050 and 2080. In Pangasinan, an increase in amount of rainfall is more likely to occur throughout the year [15].

In Lao PDR, majority of the farmers in all ecozones experience prolonged drought although more farmers in Luang Prabang than in Savannakhet noticed increases in temperature. Farm losses due to drought were highest in the rainfed upland areas. On the other hand, more farmers in Savannakhet reported frequent occurrence of typhoon, flooding and continuous intense rainfall compared to Luang Prabang.

In Luang Prabang, flooding and drought have caused major losses in all three ecozones. Lowland farmers reported the highest value of losses from flooding (Table 3). Losses due to typhoon Nock Ten, which was experienced by Luang Prabang farmers in August 2011, ranged from 40% to 56% of total income in all three ecozones.

In Savannakhet, flooding has caused higher losses than in Luang Prabang. Irrigated lowland farmers suffered higher losses from typhoon but lowland rainfed farmers suffered more losses from flooding. Due to the severity of Typhoon Nock-ten's impact in Savannakhet, the total value of losses reported by the respondents in 2011 was higher than their average annual income.

Downscaled projections also show increasing temperature and rainfall in Savannakhet and Luang Prabang. In Luang Prabang, amount of rainfall is expected to increase particularly in May to August in the years centred in 2020-2080. In Savannakhet, the period when rainfall is projected to increase is longer by one month

Table 2: Losses/damages experienced by sample households due to climate change-related events by ecozone in Tarlac and Pangasinan, Philippines

	Category of Respondent					
	Irrigated lowland		Rainfed lowland		Rainfed Upland	
Climate-related event	US$	% loss to income	US$	% loss to income	US$	% loss to income
			Tarlac Province			
Average household income	5,618		3,459		4,304	
Value of losses/damages						
Typhoon	712	12.68	584	16.90	415	9.64
Flooding	714	12.71	907	26.23	262	6.09
Continuous rain	776	13.81	432	12.50	331	7.68
Prolonged drought	650	11.58	665	19.23	600	13.94
			Pangasinan Province			
Average household income	2,077		1,970		1,255	
Value of losses/damages						
Typhoon	282	13.58	285	14.49	296	23.56
Flooding	294	14.14	104	5.27	269	21.40
Continuous rain	257	12.39	175	8.88	138	11.02
Prolonged drought	362	17.42	250	12.69	285	22.74

Note: US$1= PhP42

Table 3: Losses/damages experienced by sample households due to climate change-related events by ecozone in Luang Prabang and Savannakhet, Lao PDR.

	Category of Respondent					
	Irrigated lowland		Rainfed lowland		Rainfed Upland	
Climate-related event	US$	% loss to income	US$	% loss to income	US$	% loss to income
Luang Prabang Province						
Average household income	2,192		2,126		1,887	
Value of losses/damages						
Typhoon	62	2.83	95	4.47	47	4.47
Flooding	182	8.30	113	5.32	154	5.32
Continuous rain	80	3.65	58	2.73	79	2.73
Prolonged drought	105	4.79	147	6.91	240	12.72
Savannakhet Province						
Average household income	2,041		1,650		-	
Value of losses/damages						
Typhoon	397	19.45	227	13.76	-	-
Flooding	634	31.06	675	40.91	-	-
Continuous rain	199	9.75	247	14.97	-	-
Prolonged drought	182	8.92	191	11.58	-	-

Note: US$1= 7,995.50 Lao kip

(i.e. May to September). As a consequence, rice yield in rainfed lowland areas is expected to decrease by 54-71% particularly in the wet season [15].

Luang Prabang is generally more vulnerable to landslide than Savannakhet. However, the low lying areas of Luang Prabang and most parts of Savannakhet are vulnerable to flooding due to their low elevation.

Considering the damages already experienced by the households from past climate events, these projected climate scenarios, with a significant level of confidence, should be given attention in adaptation planning.

Adaptation Strategies

During Water Shortage: Farmers respond differently to different climatic conditions. In the Philippines, farmers adopt more varied adaptation strategies to cope with water stress compared to Lao PDR. During periods of water shortage, some farmers explore alternative sources of water while others adjust their farming system to take advantage of favourable weather condition. Under extreme water shortage, such as long dry spell and drought, however, more than 70% of the farmers are compelled not to plant rice during the dry season. In Tarlac, 30% of irrigated lowland farmers look for alternative sources of water such as small farm reservoir (SFR) or water impounding facilities, shallow tube well (STW), deep well and open surface water. Around 40% of rainfed lowland farmers and 8% of rainfed upland farmers have SFR that is also used as fishponds. In Pangasinan, around 20% of irrigated lowland farmers use water pump, SFR, or deep well; while only 8% of rainfed lowland farmers use water pump.

In Lao PDR, farmers in all ecozones practice intercropping and plant different crop varieties to reduce the impact of drought. Farmers received support from the government through tax reduction or exemption depending on the extent of damage. Local governments extend financial and technical support to help farmers recover from the effects of drought.

During Typhoon and Flooding: During rainy months when excessive water supply is usually experience, farmers and government agencies in the Philippines also adopt more varied strategies compared to Lao PDR. Irrigation system operators regulate the flow of water to the service area to prevent flooding of crop lands while some farmers construct drainage canals to protect the crops from being submerged under flood water. There are other farmers, however, who do not take any action and just let the flood water flow over their farms or wait for the flood water to subside before taking action such as replanting or salvaging submerged crops.

Other adaptation strategies aim to secure household needs such as storing food and potable water and reinforcing or protecting their houses against typhoon. Collective action in the community also involved assistance to repair damaged houses and clean-up drive. Around 52% of the households received assistance from the LGUs after a typhoon in the form of relief goods and seeds.

In Lao PDR, collective actions as reported by more than 30-40% of farmers in all ecozones include relay of information about climate-related events, construction of

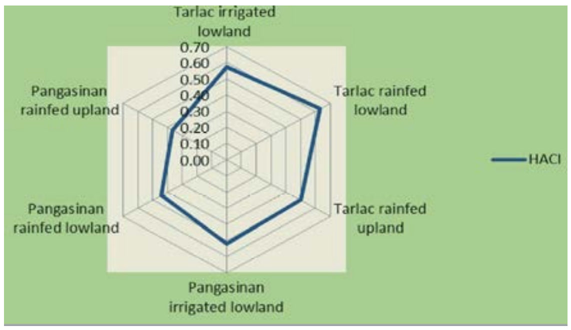

Fig. 1: Aggregate households' adaptive capacity index, by ecozone, Tarlac and Pangasinan, Philippines.

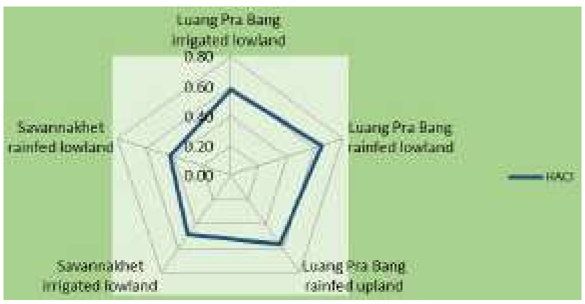

Fig. 2: Aggregate households' adaptive capacity index, by ecozone, Luang Pra Bang and Savannakhet, Lao PDR.

paddy field dike and sand bagging to protect rice fields from being flooded. Around 5% of farmers reported community efforts in construction of dike.

Early Warning: Around 70% of farmers in the Philippines receive warning on typhoon in 24 hours or less. But only 10% of farmers receive warning on flooding; 12% on continuous rain; 4% on drought; and 13% on temperature increase. Average lead time when farmers received the message until the event occurred ranged from 18-24 hours for Tarlac farmers and 16-25 hours for Pangasinan farmers. The most common source of information is the television, followed by radio. Other sources include the neighbor, relatives and friends and local government unit.

In Lao PDR, majority of the farmers do not receive early warning on climate events such as typhoon and flooding. Those who got the warning reported a 48 hour-lead time. Information on weather condition usually comes from other members of the community.

Households' Adaptive Capacity: Figure 1 illustrates the relative position of the households in terms of aggregate adaptive capacity index in the Philippines. The farther is the index value from the center (point 0) of the web, the higher is its adaptive capacity. The figure shows that, in general, Tarlac farmers have higher adaptive capacity compared to Pangasinan farmers. Across ecozones, Tarlac rainfed lowland households have the highest overall adaptive capacity (0.63) followed by Tarlac irrigated lowland households (0.57). However, households in Tarlac rainfed upland have relatively low adaptive capacity (0.50) due to their low social capital and should be given priority attention by the local government. Pangasinan rainfed upland households, on the other hand, have the lowest adaptive capacity index (0.37) due to the fragility of their natural capital followed by Pangasinan rainfed lowland households (0.44), which have low human capital. Households in these ecozones should likewise get a higher priority in getting support to improve their adaptive capacity.

These values also suggest that the local governments should analyze the vulnerability of households in the different ecozones, identify adaptation options and design appropriate interventions.

In Lao PDR, Luang Prabang farmers have higher adaptive capacity than the Savannakhet farmers (Figure 2). Rainfed lowland farmers in Luang Prabang have the highest adaptive capacity index (0.63) while rainfed upland farmers have the lowest adaptive capacity index (0.57), although still higher than that of the Savannakhet farmers.

In Savannakhet, both the irrigated lowland and rainfed lowland households have an adaptive capacity index of less than 0.50. The low ACI of irrigated lowland farmers (0.49) maybe attributed to low natural capital brought about by high incidence of land degradation and deterioration in water supply. The low ACI of the rainfed lowland households, on the other hand, is attributable to low human capital as indicated by their low level of education. These ACI values can guide local governments in developing programs that could help the farmers cope with the changing climate.

The index values of each specific indicator can inform policy makers about the strengths and weaknesses of the households in the different ecozones and the interventions needed to explore opportunities, identify alternatives and enhance their adaptive capacity. Comparing the index values of the capital assets across ecozones reveals their relative ranking (number in parenthesis) and order of priority for intervention (Tables 4 and 5).

In the Philippines, Tarlac rainfed lowland households have the highest adaptive capacity owing to their high natural, physical, economic and human capital (Table 4). Their weakest base is social capital, which is measured in

Table 4: Household adaptive capacity index, by ecozone and relative ranking, Tarlac and Pangasinan, Philippines.

	Indicators					
Ecozone	Natural	Physical	Economic	Social	Human	Overall adaptive capacity index
Tarlac irrigated lowland	0.63 (2)	0.78 (2)	0.62 (1)	0.45 (2)	0.37 (5)	0.57 (2)
Tarlac rainfed lowland	0.82 (1)	0.88 (1)	0.57 (2)	0.35 (4)	0.55 (2)	0.63 (1)
Tarlac rainfed upland	0.63 (2)	0.50 (4)	0.56 (3)	0.34 (5)	0.48 (4)	0.50 (4)
Pangasinan irrigated lowland	0.34 (4)	0.69 (3)	0.52 (4)	0.49 (1)	0.57 (1)	0.52 (3)
Pangasinan rainfed lowland	0.62 (3)	0.46 (5)	0.52 (4)	0.32 (6)	0.30 (6)	0.44 (5)
Pangasinan rainfed upland	0.13 (5)	0.28 (6)	0.49 (5)	0.41 (3)	0.51 (3)	0.37 (6)

Table 5: Household adaptive capacity index, by ecozone and relative ranking, Luang Pra Bang and Savannakhet, Lao PDR.

	Indicators					
Ecozone	Natural	Physical	Economic	Social	Human capital	Overall adaptive capacity index
Luang Pra Bang irrigated lowland	0.51 (3)	0.77 (1)	0.69 (1)	0.51 (2)	0.41 (3)	0.58 (2)
Luang Pra Bang rainfed lowland	0.88 (1)	0.68 (2)	0.69 (1)	0.27 (4)	0.73 (1)	0.65 (1)
Luang Pra Bang rainfed upland	0.86 (2)	0.46 (3)	0.40 (4)	0.51 (2)	0.63 (2)	0.57 (3)
Savannakhet irrigated lowland	0.24 (5)	0.31 (5)	0.58 (3)	0.69 (1)	0.63 (2)	0.49 (4)
Savannakhet rainfed lowland	0.44 (4)	0.38 (4)	0.59 (2)	0.44 (3)	0.30 (4)	0.43 (5)

terms of membership in organizations, assistance from external sources and community interactions related to climate and disasters. This implies that interventions are needed to strengthen collective action and community mobilization in climate risk and disaster management.

Pangasinan rainfed upland farmers ranked the lowest particularly because of its low index in natural, physical and socio-economic assets. Majority (63%) of respondents' houses are located along the slopes, thus more exposed to natural disasters like typhoon and landslide.

Furthermore, many households have limited source of information on climate events and have limited access to social services and economic facilities because their houses are located about 7-10 km away from the town proper. Pangasinan irrigated lowland households also have a low index on natural capital, thus, interventions to address problems such as land degradation and deteriorating water supply are necessary.

In terms of human capital, Pangasinan rainfed lowland farmers ranked lowest due to low level of education among more than 54% of the respondents. Capacity building activities will be important to enhance their adaptive capacity. Around 90% of the respondents in the lowland areas and 77% in upland areas did not have any training on disaster preparedness. Those who attended training reported that their local governments sponsored such activities.

Pangasinan rainfed upland farmers ranked lowest in economic capital and would therefore need interventions particularly in augmenting and diversifying income sources. Poverty incidence is highest in this ecozone.

In Lao PDR, Luang Prabang rainfed lowland households are weak in social capital because of low membership of the farmers in organizations and rare interaction in the community about climate change. In rainfed upland, economic capital needs to be improved due to the low average household income (Table 5).

The farm households in Savannakhet are weak in physical capital because around 90% of the households are located along coastal areas or river banks. The respondents' houses are also farther (15 km) from the town proper than Luang Prabang houses (5-10 km). More than 90% of farmers in Savannakhet do not have television set, which is an important source of information on climate events by the other repondents.

Natural capital is lowest in irrigated lowland because of the highest percentage of farmers reporting deteriorating water quality and water supply. Human capital is low in the rainfed lowland because of the high proportion of farmers (23%) who did not even reach primary school. Majority of households in both provinces have indigenous knowledge on the occurrence of climate-related events.

Farmer's Perception of Climate-Related Risks: Farmers' attitude and perception towards climate risks could dictate their decisions and course of actions. In the Philippines, more irrigated lowland farmers assess the damages caused by climate-related events as moderate than severe while rainfed lowland farmers consider damages from typhoon and flooding as severe. For upland farmers, the impact of drought is relatively more severe compared to other events.

About 40% of the farmers perceived that the impact of climate events would be more severe in the future. A greater majority believes that climate change-related event is a matter of fate and beyond their control. Those who think that climate change impacts would be more severe attribute these to overexploitation of resources, more rainfall and poorly planned infrastructure.

In Tarlac, 70% (irrigated lowland) to 90% (rainfed upland) of farmers have no specific long term plan to cope with future climate-change related events. In Pangasinan, about 70% of the farmers in all ecozones have the same attitude. Farmers' adaptation plans are mostly limited to renovating their houses to make it stronger and withstand strong winds and look for other jobs to diversify income source. This is probably because about 80% reported easy access to shelter during severe disaster incidence and 90% of the households in all ecozones own a tricycle that would facilitate their mobility.

In general, the respondents prefer to manage climate-related risks with minimal dislocation. Most of them would not consider moving out of their present place of residence because of old age (average of 50 years) and familiarity with social and economic conditions in their current place of residence, having lived there for more than 40 years.

To mitigate impacts of climate change, farmer respondents from Pangasinan expressed that they would need seed varieties that are suitable to drought and flooded conditions. They also expressed the need for assistance to buy water pump and construct water impounding facilities. For additional livelihood source, they would benefit from livestock (e.g. pig, cattle and goat) dispersal program of the local government unit. They could also engage in barangay intensive gardening if provided with vegetable seeds.

Tarlac farmers pointed out the need for drought tolerant seeds and subsidy for farm inputs. They also hope to be beneficiaries of the government's livestock dispersal program.

In contrast, majority of farmers across ecozones in Lao PDR strongly disagree that climate change-related events is their fate and beyond their control. Around 30-40% of farmers in the three ecozones perceive that the impacts of climate change will be more severe in the future as borne by their previous experience, which they think is associated with overexploitation of natural resources and construction of infrastructures that block the waterways. Most of the farmers are not aware of the policies on water use, land use and forest conservation.

Majority of farmers in all ecozones also expressed some plans to reduce impacts of climate change. About 30-40% plans to move out and transfer to other areas, either to continue farming or find other jobs. Farmers also expressed their need for financial, community support and skills and knowledge enhancement to cope with climate-related events.

CONCLUSIONS AND RECOMMENDATIONS

Small-scale rice farmers in both Philippines and Lao PDR reported that typhoon, flooding and drought are the major climate hazards that affect their food production and livelihood. They believe that with climate change, the impacts of these events will be more severe in the future. They also share the same observation that man made causes such as overexploitation of natural resources and construction of infrastructures that block waterways will worsen the impacts of climate change.

However, farmers in the two countries differ in their perception about climate change. The Philippine farmers have a more fatalistic notion that climate change is a matter of fate which is beyond their control. Thus, they have no concrete plans to mitigate its impact. On the other hand, Lao PDR farmers believed that climate change is associated with human activities and have adaptation plans to reduce impacts of climate-related events.

In general, Tarlac and Luang Prabang farmers have higher adaptive capacity compared to Pangasinan and Savannakhet farmers. The affected farmers received different forms of assistance from their local governments. In the Philippines, some farmers usually receive assistance in the form of relief goods and farm inputs such as seeds after a disastrous climate event. In Lao PDR, farmers avail of tax exemption or reduction depending on the extent of crop damage.

External interventions, particularly from the local government, are needed to improve the farmers' adaptive capacity. Policy makers have to be aware of their specific needs in order to provide the appropriate interventions. This will also help them prioritize their efforts given their limited resources.

In the Philippines, improving human and social capital is a priority in all ecozones in Tarlac province. Interventions such as information, education and communication campaigns would help improve their awareness of climate change and build capacities of the rice farm households in the study areas. In Pangasinan, enhancing natural and physical capital should be a priority in irrigated lowland and rainfed upland areas.

The government should assist the vulnerable households living along the slopes and addressed problems due to land degradation and deteriorating water supply. Improving economic capital through enhancement of livelihood and income sources is a third priority particularly in the lowland ecozones.

In Lao PDR, enhancing human capital is a top priority for Luang Prabang irrigated lowland and Savannakhet rainfed lowland. Policy makers must also be aware that social capital is low in Luang Prabang rainfed lowland while natural capital is low in Savannakhet irrigated lowland. Second priority for intervention in all ecozones is physical capital enhancement except for Luang Prabang irrigated lowland where both social and natural capital shares second priority. Like the Philippines, improving economic capital is the next priority in Luang Prabang lowland areas as well as Savannakhet irrigated lowland.

For their part, farmers can take various options to specifically address their adaptive capacity limitations. They should develop knowledge and skills on the use of crop varieties that are suitable to extreme weather conditions, adopt alternate wetting and drying technique, adjust cropping schedule based on climate forecasts (e.g. drought) in the forthcoming season, attend seminars conducted by local government units on climate preparedness and the use of early warning system information and learn how to apply appropriate climate change preparedness options.

To enhance social capital, the community of farmers should also organize themselves and collectively plan appropriate adaptation measures and encourage community preparedness to shield community members and prevent disasters during extreme weather events.

To enhance natural and physical capital and cope with water shortage, alternative sources of water such as shallow tube well and small water impounding facilities should be explored. During periods of intense rainfall or continuous rain, water harvesting should be promoted. Farmers should also construct river levees and drainage canals to divert flood waters and prevent crop damages. They should also explore other livelihood options that are not sensitive to climatic stresses such as non-farm livelihood sources.

The Philippines has explicit policies addressing climate change, which local government units can use to assist farm households in improving their adaptive capacity. Lao PDR apparently has not yet developed its climate risk management policies other than rules on land, water and forest use. Policy makers should address these issues particularly since scientists project that climate change is unequivocal. Information on the climate risks and the potential impact of climate change on food security and the livelihood of the small scale farmers as well as their adaptive capacity are important inputs that Lao PDR policy makers can benefit from.

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