

Farmers' Perspectives on Risk and Adaptation Strategies in the Mekong, Cambodia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JGEESI/2016/23523

Editor(s):

- (1) Dr. Irvine, Kim N. Associate Professor, Humanities and Social Studies Education, National Institute of Education, 1 Nanyang Walk, Singapore.
- (2) Dr. Chew Hung Chang, National Institute of Education, 1 Nanyang Walk, Singapore.
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Reviewers:

- (1) Kim Irvine.
- (2) Heng Chinda.

Complete Peer review History: <http://sciencedomain.org/review-history/13397>

Conference Proceeding

Received 7th February 2015
Accepted 11th February 2015
Published 23rd February 2016

ABSTRACT

Aims: In Cambodia the frequency and impacts of natural disasters has been increasing. The impacts of droughts and floods are most severe within the agricultural sector which accounts for around 29% of Cambodia's GDP and 59% of the work force. In this paper we assess the farmers' perspectives on risk and adaptation strategies in the Mekong, Cambodia.

Methodology: Interviews were conducted with 280 farmers in four Mekong provinces in Cambodia as well as at least 10 representatives of local authority and civil society staff from each of the four provinces.

Place and Duration of Study: Prey Veng, Kampong Cham, Stung Treng, and Ratanakiri provinces, Cambodia, 2013.

Results: Having experienced the adverse effects of flood many times, the farmers ranked flood highest among other risks. Drought was ranked second in particular in areas with lack of access to irrigation. Other risks considered by farmers were fluctuations in agriculture input and output prices,

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Note: This paper was presented in SEAGA (Southeast Asian Geographers Association) International Conference 2014, Siem Reap, Cambodia (at Royal University of Phnom Penh), 25 - 28 November 2014.

change in weather and shortage of irrigation water. The perception of farmers about the level of risk was closely linked with their adaptation strategy. If risks are perceived as low, no action is taken to cope with the risk. The government pays more attention to floods compared to other disasters. The research shows that most farmers (88%) got support from government and NGOs when there was a flood. The government and NGOs distributed food and hygiene packages during floods and crop seeds after floods. Because this support only lasts a short time, it does not compensate all impacts of the flood. Beside this emergency relief, the government and NGOs support the farmers to improve their livelihood through agriculture extension. However, the farmers did not think the program fit with them. They applied their own adaptation strategies such as selling labor and borrowing money to recover from the flood damage.

Conclusion: This study provides evidence that the ongoing climate change programs initiated by NGOs and government alone cannot help farmers recover from the impact of floods. Consequently in this paper we argue that the government should improve their programs to help farmers cope with floods, droughts and other risks.

Keywords: Risk and adaptation strategies; climate change; natural disasters; farming; Cambodia.

1. INTRODUCTION

Cambodia is prone to natural disasters such as flood, fire, drought, storms, lightening, pest outbreaks, epidemics and river bank collapse. In total, 2,050 people died from natural disasters during 1996 to 2013 [1]. The country has been hit by natural disasters, especially floods and droughts in recent decades, and sometimes both disasters occurred in the same year. For instance, floods in 1999 affected 37,527 people, destroyed 17,732 hectares of rice fields, and 491 homes. In 2000, floods affected 3,448,629 people, damaged 317,975 houses, and caused 347 deaths. In 2002, the Ministry of Health (MoH) reported more than 2 million people were affected by drought [2]. In 2010, approximately 20,661 ha of crops were reportedly destroyed by drought, flood and insect infestation [3]. In 2011, a serious flood affected 279,868 families, 332,634 ha of transplanted rice, and 693 ha of rice seedlings in 17 of 24 provinces in Cambodia. Some 158,447 ha of transplanted rice and 534 ha of rice seedling were destroyed. This disaster contributed to food insecurity in Cambodia as many people had no rice to harvest in 2011 [4]. In 2013, floods affected some 1.8 million individuals, killing 168 people, mostly children. Approximately 125,000 hectares of rice were damaged with a total loss of about 356 million US\$.

The Cambodia Disaster Loss and Damage Information System [1] stated that drought is the second largest hazard after flood in terms of damage to agriculture products. The Ministry of Agriculture, Forestry and Fisheries recorded that in 2010, drought affected 14,103 ha and damaged 2,934 ha [3]. In 2011, drought affected

3,659 ha and damaged 53 ha (MAFF, 2012). In 2012, drought affected 167,819 ha of rice field and damaged 19,420 ha (MAFF, 2013). In 2013, drought affected 9,542 ha and damaged 178 ha [5], leading to reduced agricultural yields and incomes.

The frequency of disasters is increasing and impacts are worsening due to a changing climate, natural resources degradation, and overuse of resources for economic development in the country and region [6]. Because a large proportion of the Cambodian population depends on agriculture, the country is highly vulnerable to climate change [7]. The adaptive capacity of villagers to cope with extreme climate events generally is low [8]. There are several examples of failed attempts to improve adaptation and resiliency, including shifting planting dates, which was unsuccessful due to lack of forecasting of local weather; switching to flood resistant rice varieties, which could not survive periods of drought; construction of wells to pump groundwater to irrigate agricultural fields, which yielded water for one season only and lowered the water table [9].

A study by UNDP showed that the most common coping strategy was incurring additional debt (used by 64 percent of households), followed by the reduction of food intake by adults (48 percent), including decreasing consumption of preferred types of food (31 percent). These coping strategies burden farmers with another problem: 48 percent of affected households took out new loans as a direct result of floods and 22 percent of them used the loans for food consumption or to pay off existing debt with negative consequences on the household's

future ability to pay off debt [10]. For most farmers it takes a long time to recover from natural disasters due to the severity of impact, lack of resources, low adaptation capacity to climate change and limited support from the government in terms of forecasting information, early warning system and agriculture innovation.

Current national policies and programs tend to focus on post-disaster emergency relief. National programs for improving a community's capacity to cope with climate risks and adapt to climate variability receive relatively little attention. Programs for developing and disseminating weather forecasts are limited and long term programs for addressing climate variability and climate change have not been well developed [8]. Farmers have not been able to fully benefit from the ongoing climate change programs initiated by NGOs and government because climate change policies and programs are not well aligned with what farmers themselves think about climate change and what measures they themselves already are taking to cope with climate related risks. Effective policies and programs to address farmers' ability to cope and recover from floods and droughts are necessary. But to be effective these programs need to be aligned with farmers' views.

In this paper we explore the farmers' perspectives on the hazards they face in agricultural production and the strategies they employ to minimize the risks and recover from the consequences when they occur.

2. METHODOLOGY

This study is based on a survey of 280 randomly selected farmers who are vulnerable to climate hazards; 70 farmers in each target province were selected for interview. The sample is differentiated by gender, climate vulnerability and

living conditions. Individual questionnaires were developed, tested, adapted and implemented. Table 1 provides details on the characteristics of the group of farmers who were interviewed, differentiated by wealth situation (according to the definition used by the Cambodian government). Further, interviews were held with key informants and stakeholders such as representatives of local authority and civil societies' staff. In each study site approximately 10 respondents from local authority and civil society were selected for interview based on the relevance of their activities, programs, projects and responsibilities. The interviews with the farmers and key informants took place in the period July to October 2013. After data collection, the data was coded and analyzed in SPSS using frequency, average and crosstab.

Four field study sites were selected based on criteria such as proximity to the Mekong River or Sesan, Sre Pok and Sekong River (3S River), vulnerability to climate hazards, and differences in farming systems and environmental resources. As such, the surveys were conducted in Prey Veng, Kampong Cham, Stung Treng and Rattanakiri provinces. Prey Veng province is identified as the most vulnerable province to flood and drought in Cambodia [9]. Prey Veng is also classified as a province with many poor families and among the 5 poorest provinces in Cambodia. In Kampong Cham province, one of major rice producing provinces in Cambodia, flood and drought happen almost every year [11]. Stung Treng province is placed along the Se San River (3S River) on which the Se San 2 hydropower dam is being constructed. The people living downstream of Se San 2 may suffer from water shortage as well as the result of hydropower development. Rattanakiri province along the Se San River is downstream of the Yali dam. Table 2 provides details on respondents based on their location.

Table 1. General description of the sample group farmers by wealth group

	Wealth group poor		Wealth group medium	
	Average	Stdev	Average	Stdev
Family size	5.5	2.09	6	1.81
Landholding size	1.8	0.95	2.14	2.1
Education	4	2.6	4	3.56
Head of household female	28%		12%	
Access to irrigation	3%		10%	
Double cropping system	7%		41%	

Table 2. General description of the sample group farmers by location

	Stung treng		Ratanakiri		Kampong cham		Prey veng	
	Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev
Family size	6	2.1	7	2.31	6	1.54	4	1.63
Landholding size	1.65	1.60	1.66	0.33	0.86	0.53	2.45	0.91
Education	4	3.4	3	1.2	4	3.08	5	2.26
Head of household female	4%		17%		27%		7%	
Access to irrigation	4%		0		3%		7%	
Use pumping machine for surface water	21%		0		91%		60%	
Double cropping system	65%		0		44%		1%	

3. PERCEIVED RISKS IN AGRICULTURAL PRODUCTION

During the interviews farmers were asked to provide their assessment of risks related to crop production, categorizing them as high, medium or low risk, based on the impacts on their livelihoods. We followed the types of risks relevant to the Mekong farmers as identified by [12] who performed a similar study in the Upper Mekong, China. First, we asked farmers whether they had experienced adverse effects from floods, droughts, irrigation water shortage, fluctuating prices and changing government policies, and if so, how many times over the past 10 years. Then we asked them to categorize the risks in terms of adverse effects to their livelihoods, such as loss of life of family or livestock, damage to properties, health issues, safety, or disruption of livelihoods.

Nearly all interviewed people indicated that they have experienced the adverse effects of hazards, such as flood, drought, shortage of water for irrigation, change in weather and fluctuating input and output prices during the past decade. Fig. 1 provides details. Some 94% of the respondents indicated that they perceive floods as a major risk, though this percentage differs by location. Drought was seen as major risk by 85% of the respondents overall. While well over 90% of the respondents experienced fluctuating prices (decrease of commodity prices during harvest time; increase of fertilizer prices during the growing season), it was seen as a major risk by roughly half of the respondents. While respondents have experience with disasters, not all are seen as major risks, depending on the extent and frequency of damage or loss. Changes in policies (such as output pricing, subsidies, land concessions and dam development) generally were not perceived as a major problem; less than 15% of the respondents identified them as risk.

Our survey results are in line with the data and findings from NCDM which also showed flood as the main issue based on its impact on human life and agriculture sector. From 1996 to 2013, flood damaged 1,695,969 hectares of paddy fields equal to 67 percent of total damage from natural disasters. The second risk is drought, based on damage to crops and impact on farmers' livelihoods. From 1996 to 2013, drought damaged 775,519 hectares of paddy field equal to 31 percent of the damage [1]. Table 3 compares our findings with data from [1] based on agricultural damage and loss of life.

NDCM [1] found a difference between risk ranking based on human life lost and ranking based damage (except for flood occupying the first place in both rankings). Disasters claiming lives such as lightening, fire, epidemics and storms cause relatively little damage to crops as compared to droughts which do not cause loss of life directly.

3.1 Floods

Having experienced frequent floods during the last decade, almost all farmers in our study area identified floods as high risk for their livelihoods. They may have lost (or had damaged) property, animals and crops such as rice, vegetable, and fruit trees. Risks of drowning and snake bites increase (particularly for children). During and in the aftermath of flooding it takes more time collect household water and fodder for cattle. Children have to postpone study. Floods also lead to lost opportunities to earn money through selling labor.

Recently, the frequency of flooding in the provinces along the Mekong River has been increasing. Most farmers report that the flood occurs two times every three years. This is confirmed by research from UNDP and NCDM

reporting more frequent and heavier flooding in recent years [13]. There is no significant difference between poor and better-off farmers: 94 percent of the poor and 95 percent of medium households think flood is high risk. Poorer families may have more difficulty to recover from flood damage than the medium or better-off families. On the other hand, better-off farmers may suffer greater losses than the poorer families because they have more property. For instance, they have larger paddy fields, therefore, they may lose more rice than the poor who have smaller paddy fields.

Fig. 2 shows that there is not much difference between the different study sites in ranking floods as a major concern, although Ratanakiri does stand out as having the highest proportion. Although the people in Prey Veng did not face flood for a long time, most of them rank flood as higher risk compared to drought, which they

often face, and other risks. They feel they cannot control the loss of their rice crop due to flood but they can take measures to minimize the loss of rice in case of drought. These measures include pumping water from canals, ponds, rivers and groundwater and using short duration rice varieties.

The farmers in Ratanakiri province ranked flood as highest because they regularly face extensive flooding exacerbated by water releases from the Yali dam in Vietnam. This type of flash flood occurs fast and is bigger compared to 'regular' floods from the Mekong River (without dam releases), leaving inhabitants of Ratanakiri hardly any time to prepare for the flood wave. Thus, more farmers in Ratanakiri province identified flood as a high risk than the farmers in other provinces along the Mekong without dam releases.

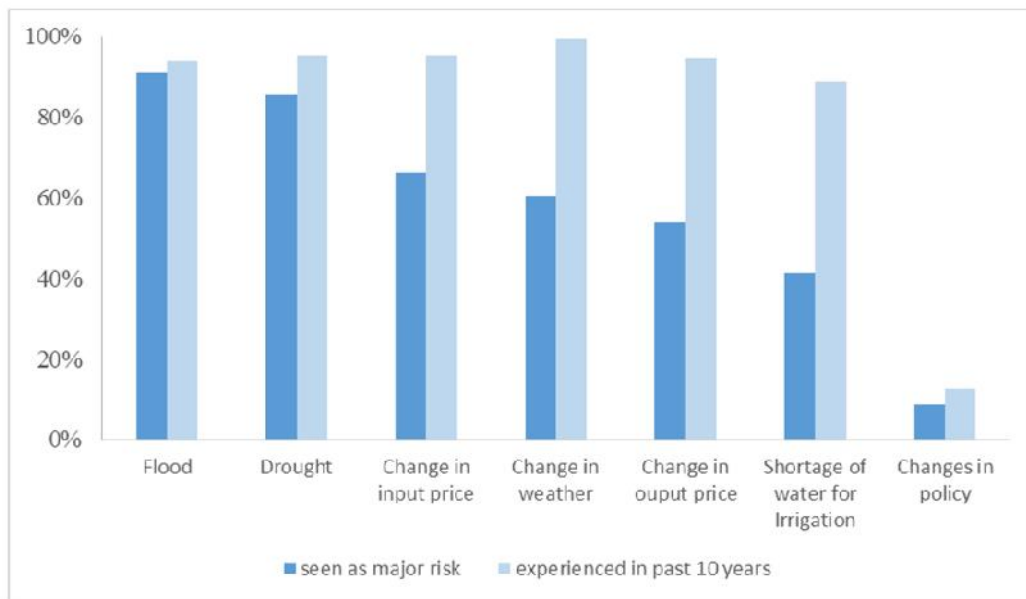


Fig. 1. Farmers' experience and assessment of risks

Table 3. Risk ranking by farmer perception and findings from NCDM – change table!!

No.	Ranking based on number of farmers identifying it as major risk (our study)	From [1] Based on cause of human life loss	From [1] Based on it damaged on agriculture sector
1	Floods	Flood	Flood
2	Droughts	Lightening	Drought
3	Change in input price	Fire	
4	Change in weather	Storm	
5	Change in output price	Epidemic	
6	Shortage of water for irrigation		
7	Changes in policy		

3.2 Drought

Some 85 percent of the interviewed farmers in our study area identified drought as a major risk for their livelihood because of its impact on the agriculture sector which is their main source of income. Only 10 percent ranked drought as a moderate risk and 5 percent ranked drought as a low risk. Some 95 percent of the farmers experienced drought during the past ten years, even though the study sites are not regarded as drought prone. Some 59 percent of the respondents said they were affected by drought one to three times over the last 10 years, 31 percent were affected four to six times, 3 percent seven to nine times and 7 percent every year.

According to farmers' experience, drought affects their rice crop in particular, while flood damages all crops. Generally rice yields decrease due to drought and in case of serious drought some farmers lose their entire crop in the paddy fields located far from a water source. Some farmers spent money on pumping to irrigate to save their crop. Even with irrigation, rice yields are affected during drought periods. These observations are confirmed by the findings from the literature showing that drought diminishes rice yields in particular when drought hits during the reproductive stage [14].

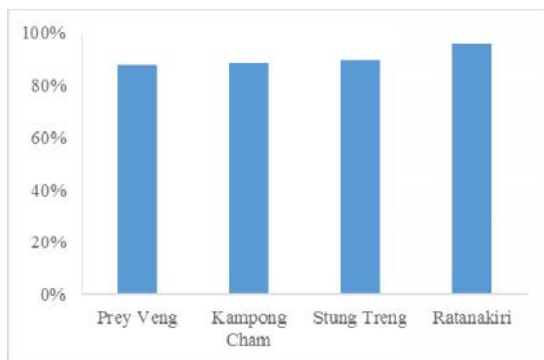


Fig. 2. Percentage of farmers identifying flood as high risk by geographic location

There is not much difference in the risk ranking between the poor and medium families regarding droughts. 94 percent of the poor families and 90 percent of medium wealth families consider drought as a high risk. However, there is a marked difference between the respondents of different provinces. In the Prey Veng and Kampong Cham province drought is regularly occurring and poses a severe problem, particularly for those without access to irrigation

infrastructure, though those with access to irrigation indicated the risk of lack of irrigation water in case of shortfall in supply. Ratanakiri lies in an upland area where the farmers grow upland rice using a different technique than rainfed lowland rice. Their conventional rice growing practices are generally poor in terms of water management, and also due to lack of appropriate infrastructure for farming and water management. Fewer farmers in Stung Treng rank drought as high risk as compared to other provinces because they live along the Se San River and droughts are less frequent.

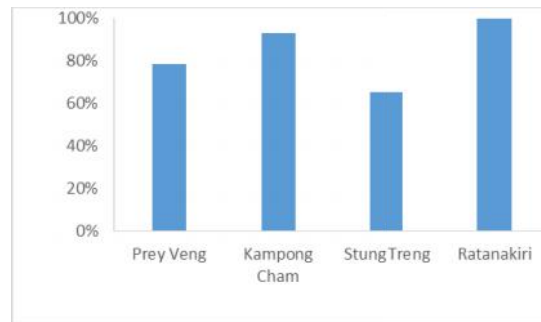


Fig. 3. Percentage of farmers who identify drought as a high risk, by location

3.3 Change in Input Price

The main inputs to agriculture in the study sites are fertilizer, pesticide and animal feed. In the dry season or during droughts, fuel to pump irrigation water may be needed. Farmers normally use more fertilizer and pesticide for their dry season rice than wet season rice. Farmers are concerned about steadily increasing fertilizer prices and the quality of fertilizer. Theng and Khiev [15] found that the nutrient element in fertilizers sold in the market was below acceptable quality indices because it was mixed with low quality elements. Poor quality fertilizer is packaged in the bag belonging to the high quality fertilizer. The Phnom Penh Post [16] estimated that about 40 percent of fertilizer currently on the market is fake.

This research found that almost all farmers experienced changes in input price. Due to this experience, 66 percent of respondent rank the change in input price as high, 27 percent as moderate and 3 percent as low risk while 4 percent has no idea. During the last ten years, 34 percent reported that they experienced this risk one to three times, 48 percent four to six times, 3 percent seven to nine times and 15 percent every year.

There is not much difference between the poor and medium wealth households in their response to this risk, with 64 percent of poor and 63 percent of medium wealth families ranking this risk as high. However, there is a difference between research study sites (Fig. 4). In Ratanakiri, fewer farmers identify changing prices as high risk compared to farmers in other provinces. Farmers in Ratanakiri, generally belonging to ethnic minorities, cultivate crops using traditional techniques without fertilizer and pesticide. Hence rising fertilizer and pesticide prices do not affect their income.

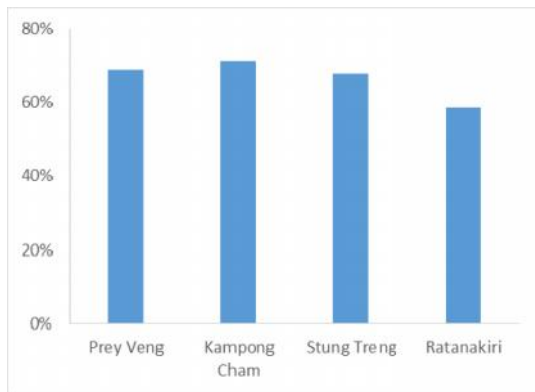


Fig. 4. Percentage of farmers who identify changes in agriculture input prices as a high risk

3.4 Change in Weather

Farmers interpret changes in weather as higher temperatures, changed rainfall patterns and higher incidences of storm and lightning. All farmers responded that they have experienced this during the last ten years, with 60 percent assessing this change as a high risk, 36 percent as a moderate and 4 percent as a low risk. During the last ten years, 28 percent said that they experienced changes in weather one to three times, 56 percent four to six times, 7 percent seven to nine times and 9 percent every year. They reported that their chickens died, their vegetables burned and rice crops developed diseases when the temperature became hotter.

There is marked difference in perception between the poor and medium wealth households in their risk ranking. Only 38 percent of the poor think the change in weather is a high risk against 68 percent of medium income households. Most of the poor think that change in weather is a moderate risk compared to flood and drought. In Ratanakiri, the province with a

relatively high incidence of poverty, only a few farmers rank change in weather as a high risk (Fig. 5).

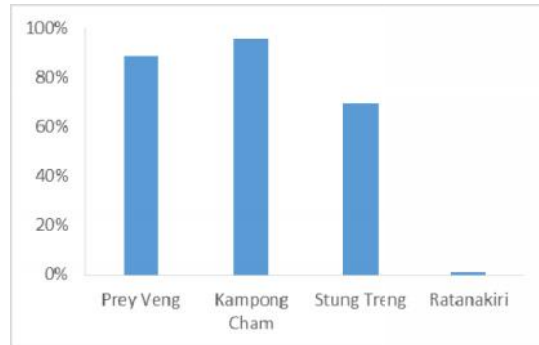


Fig. 5. Percentage of farmers who consider changes in weather as a high risk, by location

3.5 Change in Output Price

Some 95 percent of interviewed farmers stated that they had experienced fluctuating commodity prices over the past years, affecting their income from selling agriculture products. Sometimes output prices decreased while expenditure on purchasing agriculture inputs increased. 54 percent of farmers rank change in output price as a high risk, 40 percent as a moderate risk and 6 percent as a low risk. Some 55 percent of respondents said that they experienced declining commodity prices one to three times in the last ten years, 40 percent four to six times and 5 percent met this risk seven to nine times. These data are confirmed by research from World Food Programme (WFP) [17] and World Bank [18] which found that in 2013 the nominal price of retail rice decreased by 14.3 percent and in 2012, the consumer price index declined to 2.5 percent compared to 4.9 percent in 2011. Another reason for declining product prices is farmers' dependence on middlemen. Sometimes farmers sell their products to middlemen for a lower price than the prevailing market price due to ignorance or need for cash. For example, the UNDP [13] found that ethnic minorities in Ratanakiri reported selling cashews at 400 riel/kg, while others got almost 1,000 riels for the same crop quality in the same market. Lack of information and lack of finance are the main reasons forcing farmers to dispose of their stock quickly at whatever price is available [17].

There is marked difference between the poor group and medium wealth group. Only 32 percent of the poor think declining commodity

prices is a high risk compared to 76 percent of medium wealth households. The medium wealth families sell more of their products to the market than poor families do and are more aware of prevailing market prices. Hence, farmers in Ratanakiri who are generally poorer than farmers in other provinces, rank this risk low (Fig. 6).

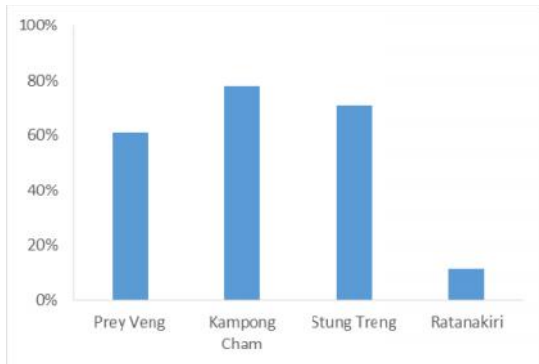


Fig. 6. Percentage of farmers who consider change in output prices as a high risk, by location

3.6 Shortage of Irrigation

Only 4 percent of the respondents have access to a surface irrigation system. This figure is lower than the national data for irrigation which estimated that about 27 percent of the country's rice land is (partially) irrigated [19]. WEPA [20] estimates that 12 percent of the wet season rice is irrigated and half of the dry season crop is irrigated with the flood recession. Few irrigation schemes can provide water all year round [20]. Some 55 percent of farmers identified the lack of irrigation as a high risk. At the study sites, only some farmers in Prey Veng province have access to an irrigation scheme, funded by UNDP. Without irrigation farmers face a high risk of losing their rice crop during drought. Some irrigation schemes also play a role in flood protection. Beside access to the irrigation scheme, 43 percent have access to a pumping machine. During drought, they pump water from river, canals or ponds. Some farmers in Prey Veng province pumped groundwater from wells installed in or close to their fields, though groundwater levels declined and wells dried up.

Many factors influence farmers' ranking of shortage of irrigation water. For instance, the size of the paddy field, the availability of water resources, the ecosystem of the rice field and the reliability of the family on agriculture activities,

etc. This research found that poor families rank this risk lower than medium wealth farmers. Only 33 percent of the poor rank the shortage of irrigation scheme as a high risk, while for medium wealth households this is 51 percent. Bigger farmers (owning two to five hectares) who do not have access to reliable irrigation could lose more than smaller farms in case of drought, in particular if they grow for the market. For this reason, farmers in Stung Treng province consider shortage of irrigation water as a higher risk than farmers in other provinces. They grow cash crops and without irrigation, they are vulnerable to income loss due to drought (Fig. 7).

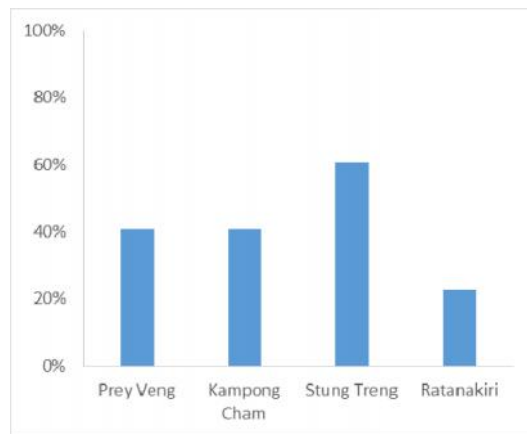


Fig. 7. Percentage of farmers who identify shortage of irrigation water as a high risk, by location

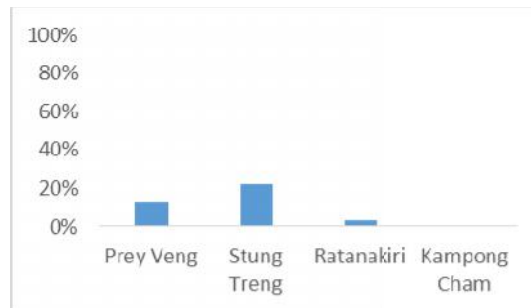


Fig. 8. Percentage of farmers who identify changes in policies as a high risk, by location

3.7 Government Changes Policy

Asked about government policies that potentially affect agricultural income (such as fixed output prices, subsidies, land concessions, dam development, among others) only 8 percent of the farmers consider policy changes as a high

risk. Almost half of the respondents do not know about this risk. In Stung Treng province where there are many economic land concessions and hydropower dam development, 22 percent of the farmers think that change in policy is a high risk. Farmers know that they can lose their land, house, crops, other properties and income through some changing government policy. In Kampong Cham province where there is no economic land concession company, nobody ranked this change as a high risk (Fig. 8).

4. STRATEGIES TO COPE WITH CONSEQUENCES OF DISASTER

Farmers have different strategies to cope with the consequences of disasters such as flood and drought. The farmers cope with drought by digging wells in their paddy field for irrigating their rice, using short term and drought resistant rice varieties, managing water at the rice field level and selling labor in their province, other provinces, Phnom Penh, Thailand, Malaysia or other countries. Among our study sites, only respondents in Prey Veng province got support from a local NGO for an irrigation scheme. This irrigation scheme is small and has no reservoir, so the farmers can only use it during the wet season.

For floods, there are two stages of coping, namely during and after the flood period. During the flood, the farmers cope by moving to safe and dry places; safeguard their children from flood water; reserve a boat for traveling and borrow money from the bank, micro finance institutes and local money lenders. For the post flood strategy, most farmers report that they sell labor for which they can get about USD 5 to USD 8 per day. Only a few people said that they grow vegetables, grow cash crops, raise chickens and borrow money for investing in their business while these are the measures promoted by government and NGOs (Fig. 9).

4.1 Sell Labor and Migration

Migration is the most common strategy for disaster recovery (Fig. 10). Most farmers think that selling labor is most effective. Selling labor may occur in their own province, other provinces, in cities or even in other countries. It yields immediate income from weekly wages which are considered better than raising chickens, or growing vegetables or other crops, which is only a seasonal income and takes time to yield. Once labor opportunities are found it is relatively low

risk compared to agriculture. Hence, farmers do not consider farming activities a suitable option to recover from a flood. However, organizations (such as NGOs and government departments whose work relates to migration in Cambodia) are concerned about the risks of migration because of human and sexual trafficking and abuse. In this research, only 15 percent of farmers indicated that migration is a high risk, particularly if they travel to Thailand, Malaysia and China, because of human trafficking, abuse and sometimes not getting their wage. Regardless if they have experience with migration or not, most farmers think that migration is a good strategy because of its immediate income and possibility to earn high incomes which can be sent back home.

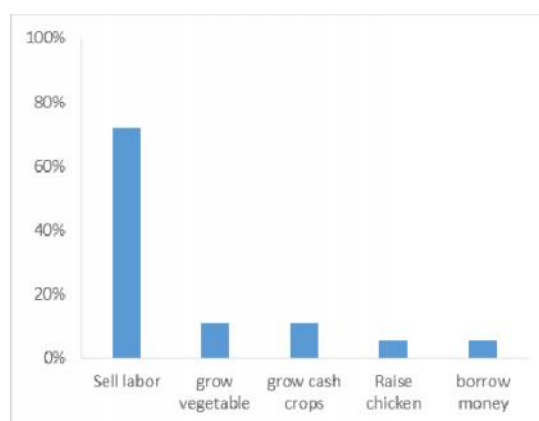


Fig. 9. Farmers' proposed strategies to cope with adverse livelihood effects of floods and droughts

This research found that 16 percent of the respondents have experience with migration as compared to the national average of 35 percent [21]. Most of them are irregular migrants facilitated by brokers. There are few migrants from Ratanakiri and Stung Treng since there are many jobs available in the province. Most prefer to work in their own province to be close to their family.

4.2 Borrow Money

All interviewed farmers have access to credit through micro-finance institutions (MFIs) and private loan providers based on their assets and income. Our research found that 26 percent of the farmers have debt with an interest rate range from 1.5 to 10 percent per month. The size of debt is from 0.1 to 20 million Riels (USD 25 to 5,000). The low interest rate is the rate from MFI

and the high interest rates are from private loan providers. Under the MFI, the more money that they borrow, the lower the interest rate. Most (89 percent) borrow money with interest rates from 1.5 to 3 percent per month. Table 4 shows that 71 percent of debt was reportedly used for agricultural activities namely to cultivate rice crops, grow cash crops, buy a pumping machine, raise animals and raise chickens. However, some farmers borrow money for consuming (e.g. food or medicine) but they state in the loan request form that they borrow money for investing in their agricultural activities.

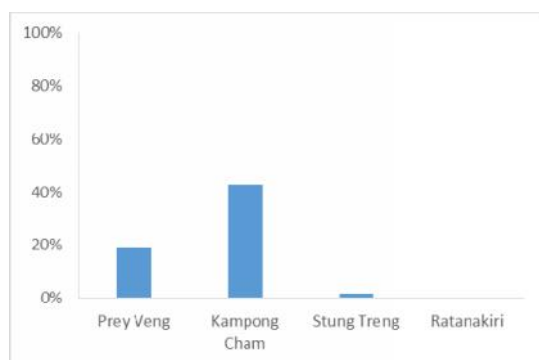


Fig. 10. Percentage of farmers who migrate to recover from adverse effects of floods or droughts, by location

Table 4. Amount of debt and its use

Activities	Percentage	Amount of money (Million riel)
Growing rice	18%	0.4 - 4.4
Purchasing goods	8%	0.3 - 2
Raising fish	2%	0.8
Purchasing fish tools	4%	2
Farming cash crops	27%	0.8 - 6
Raising animals	20%	0.2 - 4
Purchasing land	4%	5 - 10
Purchasing pumping machine	4%	1 - 4
Running small business	6%	0.2 - 1
Constructing house	6%	8 - 12
Treatment of disease	2%	4.8

The number of medium wealth families borrowing money is higher than the poor, with 11 percent of the poor and 22 percent of medium wealth families having debt. The average debt of

medium wealth families is higher than that of the poor. Medium wealth families can borrow more and have better ability to pay back to the loan. The farmers in Kampong Cham and Stung Treng have greater debt than other provinces because they invest in agriculture activities more than farmers in Prey Veng and Ratanakiri province (Fig. 11). They also own bigger farms than Prey Veng province.

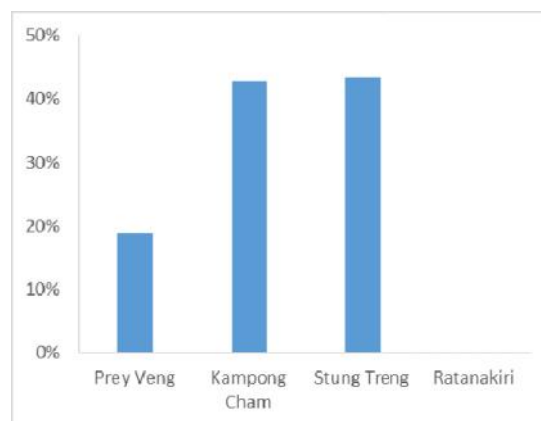


Fig. 11. Percentage of farmers having debt, by location

4.3 Government and NGO Programs

Government and NGOs support affected families during floods. There also is some support for flood recovery. For other disasters such as drought and storm, there are fewer support mechanisms. When there is drought, the government sometimes provides pumping machines for irrigation of paddy fields. However, they cannot serve all affected areas. According to this research, all flood affected families reported that they have received help from government or NGOs in forms that include handouts of rice, noodle, money, soya sauce, medicine, water purifier etc. One local NGO in Prey Veng province, who had funding from UNDP, supported their beneficiaries by building small scale irrigation, promoting home garden techniques and saving money in the group. In other provinces, NGOs do not build irrigation for farmers; they just promote agriculture techniques and group savings for farmers. Recently the government in collaboration with UNDP and local NGOs started developing the Cambodia Climate Change Strategic Plan 2014-2023 for supporting farmers to cope with a changing climate [22]. Action plans are now under development.

5. ADAPTATION TO MINIMIZE ADVERSE EFFECTS OF CLIMATE CHANGE

5.1 Irrigation from Canals and Groundwater

Irrigation is an effective measure to minimize drought impacts and enable farmers to grow rice or other crops in the dry season. Some irrigation schemes also play a role in flood control. The government considers irrigation infrastructure as a measure to reduce impacts of disasters, particularly drought. The policy of the Royal Government of Cambodia targets preserving, rehabilitating and expanding irrigation systems aiming at an increase of 3 to 4 percent annually from 374,603 ha in 2014. In our study area very few farmers have access to an irrigation scheme. In Prey Veng province the irrigation scheme built with NGO support is effective in reducing drought impacts during the rainy season. Prey Veng is prone to dry spells during the rainy season. However, it is not suitable for flood control and irrigation during the dry season because it lacks a reservoir.

Roughly one third of the interviewed farmers pump groundwater for irrigation of rice and vegetables. In Prey Veng province farmers pump groundwater to irrigate their rice crops during the wet and dry season rice. This effectively controls the damage from drought but costs money for fuel. Further, farmers noted that the water table is declining so that wells dry up after an average of 5 years of use. Thereafter, they need to dig a new well in a new place. They expressed their hope that the government will build a surface irrigation scheme for them which can be used for both dry season and wet season.

5.2 Change Cultivation Date and Crop Variety

Roughly 30 percent of the interviewed farmers made changes in cultivation date to reduce risks of crop damage due to floods and droughts. Most farmers obtain the necessary knowledge for this technique through their neighbors. In Prey Veng and Stung Treng province all farmers know and apply this technique as compared to only few farmers in Kampong Cham and Ratanakiri province.

Changing crop variety is another measure for coping with drought. All farmers in Prey Veng province know about this measure whereas 50 percent of farmers in Kampong Cham, Stung

Treng and Ratanakiri province know this measure. All farmers in Prey Veng province have changed their rice from long duration varieties (120/140 days) to short duration (90 days) and drought resistant varieties for dry season cultivation. They also recommended this technique to their neighbors because they think it is a good measure to combat the adverse impacts of drought. The yield of these new varieties is not different from traditional varieties. During the dry season higher yields are obtained, because of higher fertilizer use. This rice variety also uses less water than other varieties.

5.3 Early Flood Warning

The majority (62 percent) of farmers said that there is no early flood warning system in their village. Most people get to know about floods through the village chief. However, the government has installed a modern weather forecast system for improving the weather forecast. The weather forecast is posted on the ministry's website, in local newspapers and on the radio. Farmers hardly access this information as their preferred source is television. Thus, the farmers did not benefit from this improvement. An early warning system for floods would enable farmers to prepare moving their family, animals and other properties to a safe place on time. If the farmers know in advance that there will be a drought, they can prepare themselves by, for instance, changing to short term and drought resistant rice varieties, managing water in the rice field and water conservation, among others.

5.4 Crop Insurance

Crop insurance does not exist in Cambodia, nor is there any statement or plan regarding crop insurance in government policies, not even in the contract farming model in Cambodia. Not surprisingly, therefore, most of the farmers were not familiar with crop insurance. Farmers grow crops and raise animals at their own risk and due to the increased disasters of late, farmers face high risk of losing their agricultural products without compensation or insurance from the government. Also there is no support from the government for stabilizing the prices of agricultural products and controlling the quality and price of fertilizer and pesticide. Farmers claim that if they produce more the market price decreases. Thus, the farmers have diversified their livelihood strategy away from agriculture activities to selling labor and other off-farm activities. In this way farmers secure their

livelihood in times of disaster by complementing agricultural income with weekly or monthly wages, and sometimes advance money from their employers.

6. DISCUSSION AND CONCLUSIONS

6.1 Farmers' Perspectives and Coping Strategies

Flood and drought occur more often in Cambodia compared to the past. Farmers have trouble coping with the impacts of lost crops (such as rice, field crops and fruit trees), animals (poultry, cattle) and other properties. Some families lost family members due to the disasters. Responding to emergencies (mostly floods, storm and fire) the government distributes food, medicine, water purifiers and money to affected families. Based on these experiences, farmers rank flood as the highest risk, with drought second, followed by changes in agricultural input and output price, change in weather and shortage of water. The interviewed farmers consistently ranked floods as highest among all risks in all four provinces and among all wealth groups but there were some minor differences in rankings in droughts, and fluctuating prices depending on local circumstances and wealth. According to disaster statistics, the government ranks flood as the highest risk and drought as second highest risk based on damage to the agricultural sector. Thus, risk rankings by farmers and government are compatible.

However, the government and farmers have different perspectives about coping strategies. While the government and its partners try to promote agricultural improvements in existing and new activities, the farmers themselves try to find off-farm jobs in their village, province, city and other countries. Fig. 12 shows the farmers' coping strategies to natural disasters such as floods and droughts, differentiating between what farmers were planning and what they actually did. The graph reveals that most people choose to sell labor as a recovery strategy. The percentage of farmers who grow vegetables, raise chickens and raise pigs (as promoted by government and NGOs) is very low. Relatively many farmers intend to grow vegetables (following government and NGO advice) but in the end faced obstacles to implementation. Farmers feel they can get more money with immediate return and with low risk from selling their labor than from farming. Most of the interviewed farmers focus on rice

production for their own consumption primarily. They sell only a small amount of paddy to the local market. The income from growing rice is not enough for family expenditure, in particular in times of natural disasters. To complement their incomes farmers preferred selling labor or borrowing money because they argued that their livelihood situation will not improve significantly with agriculture activity alone. This finding is similar to [23] who argued that the farmers remain poor if they grow rice alone.

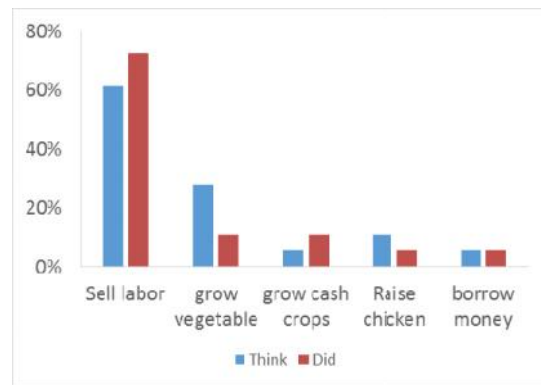


Fig. 12. The farmers' perspective about coping strategy and their practice

6.2 Mismatch between Farmers' Perspectives and Government Programs

Government programs focus on improving agriculture productivity for the farmers. NGOs align with the government strategy plan and focus on agricultural productivity. NGOs and government have been trying to improve farmers' livelihoods by disseminating agricultural techniques and supporting irrigation schemes for some communities, with mixed results. Farmers have not been able to fully benefit from the ongoing climate change programs initiated by NGOs and government because the programs are not compatible with what farmers themselves think about climate change and what coping measures they themselves already are taking. Some agricultural trainings offered to farmers and social mobilization programs initiated by government and NGOs are less effective when program participants migrate to earn money. These findings are consistent with the study by Van Dijk and Hao Li [12] who found similar discrepancies between farmers' adaption strategies and government policy in the Upper Mekong, China.

The coping strategies preferred by farmers yield more and immediate benefits compared to the strategies initiated by government and NGOs. However, some of the farmers' strategies come with their own risks (trafficking, sexual abuse etc), for instance, as they migrate to Phnom Penh and other countries (e.g. Thailand) illegally for selling labor. Creating jobs near the farmers' villages will reduce migration to cities and other countries and thus reduce the negative impacts of migration. Jobs closer to home will allow parents to take care of their children and economize on expenditures related to working away from their house (such as lodging, traveling, extra food and communication). Furthermore, increasing the salary for workers in factories, plantations and other institutions will contribute to improve the farmers' livelihood. With improved job opportunities and better salaries, farmers can feed their families and save money to recover from disasters.

Our findings underline the challenges of implementing the Climate Change Action Plan as spearheaded by the Cambodian government and supported by UNDP. When there are differences between government programs and farmers' perspectives and practices, it will be a big challenge to implement the program. The farmers will have limited participation in applying recommended techniques while the program is running. When the interventions finish, they may stop applying the techniques. Weak governance and corruption further compound challenges potentially affecting program implementation and performance of government officers at the provincial and district level. This could lead to not all government programs being fully or effectively implemented. Even programs that were designed in line with farmers' needs may not benefit them if they do not know about it. Lastly, the objectives of the Climate Change Action Plan may be conflicting. For instance, the first objective promotes climate resilience through improving food, water and energy security. But hydropower development, touted as solution for energy security, may affect fish stocks and water supply (and thus food security) for many Cambodians.

DISCLAIMER

SEAGA (Southeast Asian Geographers Association) International Conference 2014, Siem Reap, Cambodia (at Royal University of Phnom Penh), 25 - 28 November 2014.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:

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