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Behavioral Responses to Climate Information: A Case of Small Scale Rice Farmers in Vulnerable Communities in Leyte, Philippines

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ABSTRACT

As in many developing countries, the advent of extreme climatic events, including El Niño and La Niña phenomena has exposed the livelihoods of small scale Filipino farmers to climate vulnerabilities. Recent developments in climate prediction suggest that seasonal climate forecasts (SCF) have potentials for alleviating the vulnerability of farmers' livelihoods. In the Philippines, however, farmers' uptake of SCF is low. This study pilot-tested SCF dissemination and examined if small rice farmers from communities vulnerable to flooding and drought would use the information in their farming and management decisions. Farmers then participated in a seminar on the basic concepts of climate and were advised of the climate forecast for the July 2012 cropping season. Focus group discussions were conducted four months after, that is, during the harvest season. Respondents assessed the SCF as "accurate" but in making farm decisions, they relied on their experiences on the onset and amount of rain. For some farmers, the shortage of rainfall in the middle of the cropping season led to crop failure. Thus, they resorted to growing other crops. Results of this study highlighted the need to inform farmers of the onset, amount, and duration and distribution of rainfall for the incoming cropping season. Overall results indicate the need for the meteorological agency to improve the skill and to down-scale (localize) the climate forecast.

Keywords: Climate change risk, climate change adaptation, seasonal climate forecast, forecast skill

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INTRODUCTION

Rice is the staple food in the Philippines. However, as in many developing countries, most small scale rice farmers in the country rely mainly on natural rainfall to grow this crop. The advent of extreme events, including El Niño and La Niña, has exposed their livelihoods to vulnerabilities.

Located within the west rim of the Pacific Ring of Fire (Global Facility for Disaster Reduction and Recovery, n.d.), the Philippines is among the countries vulnerable to climate change impacts. In fact, recent data show that the country has been experiencing frequent climate-induced natural disasters (CINDs), including typhoons, floods, and droughts (Rincón and Virtucio, 2008). Unfortunately, among the sectors affected by climate variability is agriculture, the main source of livelihood. Long droughts and floods have reduced farm productivity.

Recent developments in climate predictions suggest that rainfall forecasts have potentials for alleviating the vulnerability of livelihoods to climate variability. Seasonal climate forecasts (SCF), which are probabilistic predictions of how much rain is expected during the season, based on the principle that the ocean forces atmospheric behavior (Washington and Downing 1999), predict some of this climatic variability. Farmers could potentially use forecasts to plan management strategies and resource allocation based on anticipated climate. For example, based on the advance climate information, farmers can decide which land to use for a particular crop, chart out production schedules, and device commercialization strategies – decisions that are made by farmers long before the sowing season starts (Bert *et al*., 2006). Evidence abounds that farm decisions inappropriate to climatic conditions result in great production losses.

Experience in various countries show that use of the SCF innovation allows farmers to reduce risks and take advantage of the opportunities offered by climate variability. This development comes from initiatives implemented for marginalized groups of farmers in Africa (Ziervogel, 2004; Patt, 2000; Patt, Suarez and Gwatta, 2005; Ziervogel, Bharwani, and Downing, 2006; O'Brien *et al*., 2000), India (Svaraju, 2004), and Indonesia (Boer, Tamkani. and Subbiah, n.d.) that consistently reveal that farmers' understanding of climate variability and use of SCF leads to increase in farm productivity. In the Philippines, Reyes, *et al*. (2009) showed that in corn production, the value of forecast information is about Php 273.12/ha.

While admitting that the benefit could be considered very marginal for the individual subsistence farmers whose average landholdings is 3.65 ha, Reyes and her group stressed that the SCF could be of great value to the Philippine agriculture if the total land area planted to corm (which was about 2.6 million hectares as of 2007) is considered.

Considering the potentials of SCF for managing climate change risks, efforts are underway to disseminate the SCF innovation to farmers. The task is being carried out by the country's meteorological agency, called the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA). Thus, at this time, PAGASA is developing specialized forecasts for agriculture, extension advisory services, and conducts weather crop relationship studies. It has also upgraded its agricultural weather observation stations throughout the country.

Use of SCF, however, by Filipino farmers is low. This gap in research and utilization is evident in the research conducted by Borines, Gravoso and Predo (2009). The major reason for this situation is weak dissemination resulting in farmers' lack of understanding of the forecast and skills to apply it.

This study pilot-tested dissemination of SCF to motivate farmers to use the forecast in making tactical farm decisions. This research is in response to call for studies on the use of climate information in farming by various groups. For example, in 1999, Pafaff, Broad and Glantz (1999) suggested that to maximize the effectiveness of climate forecast, there is a need to study its utilization and use for improving dissemination strategies that will help address such constraints as limited access to forecasts and the distortion of forecast information. In 2007, the same call was sounded by Stigter (2007) saying that to improve the provision of meteorological information and services, there is a need to ascertain the actual needs for that information, especially in sustaining livelihood systems of groups vulnerable to climate variability.

RESEARCH METHODS

Research Design, Setting and Respondents

This study focused on two issues. First was on the respondents' experiences of climate variability and second, their responses to SCF. The breadth and nature of the problem required the use of data gathering tools that will ferret out information not doable in surveys. Thus, the case study design was applied. Yin (1993) described a case study as an inquiry that investigates a phenomenon occurring within its real-life context. This design is appropriate for a study that investigates experiences of climate variability and farmers' decision-making. To increase reliability and validity of interpretation, methodological triangulation (Mathison, 1988) was applied. These methods included focus group discussions, ocular observations, and analysis of secondary data.

This study was conducted in two barangays (or villages) in Leyte that are vulnerable to flooding and drought (Fig. 1). Located along the national highway, both communities are accessible to transportation, reached by radio and television, and served by extension workers. They reported that the climate information they usually receive are on weather forecasts. SCFs are not part of the extension activities in the communities.

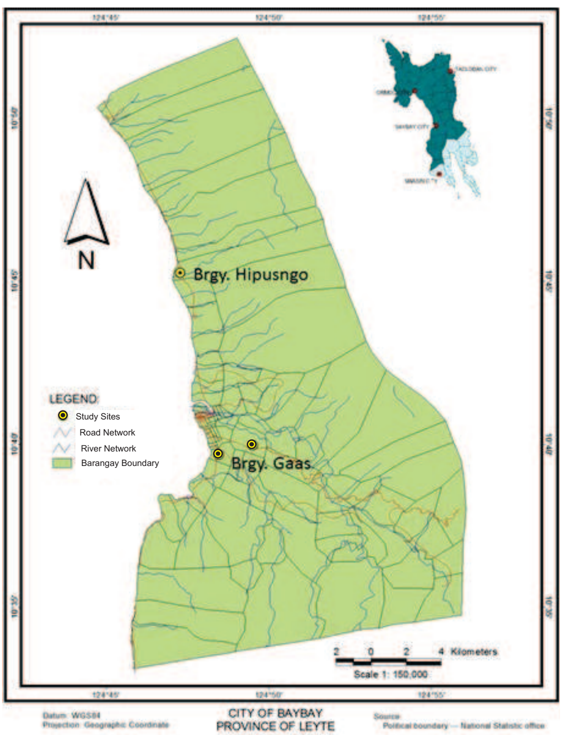

Figure 1. Study sites.

To gather the data, two FGDs were conducted. The first one was in the first week of May 2012. This first FGD aimed to gather information on farmers' experiences of climate variability. The second FGD was conducted in September 2012 and was aimed to gather data on farmers' use of SCF advised to them in the seminar.

Respondents for this study were rice farmers whose average age was 53 years old. Average size of their rice farm was 1/4 ha. Farmers grew hybrid varieties. In both FGDs, male and female farmers were equally represented. Interestingly, all of them claimed to be participants in farm decision-making. Most of them held positions in the village as members of the council, barangay health workers (BHW), or officers of some organizations.

The sample size of this study is not large, but this is not of great concern because the results are not to be generalized for the whole population. The objective is to get a basic understanding of the respondents' use of SCF.

Dissemination of Seasonal Climate Forecast

During the FGD in May 2012, farmers have expressed interest in participating in a short seminar on climate information and SCF. Thus, in cooperation with the Philippine meteorological agency, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), a seminar was conducted in the last week of May, in time for the July cropping season. The climate seminar focused on basic concepts of climate. Likewise, participants were also advised that the forecast for the July and August 2012 cropping season is normal – that is, rainfall will be sufficient by July and August (Fig. 2).

In this seminar, participants also asked questions related to the changing climate. Most of these questions revolved around the change in the onset and amount of rainfall, severe flooding, and frequent lightning.

Data Gathering Tools and Procedure

The FGD in May 2012 aimed to gather farmers' experiences of climate variability. It applied the field guides adapted from the *Climate Variability and Capacity Analysis Handbook* (Chambers, 2009) published by CARE International. Secondary data were gathered through documents review, while primary data were gathered using participatory tools (Table 1).

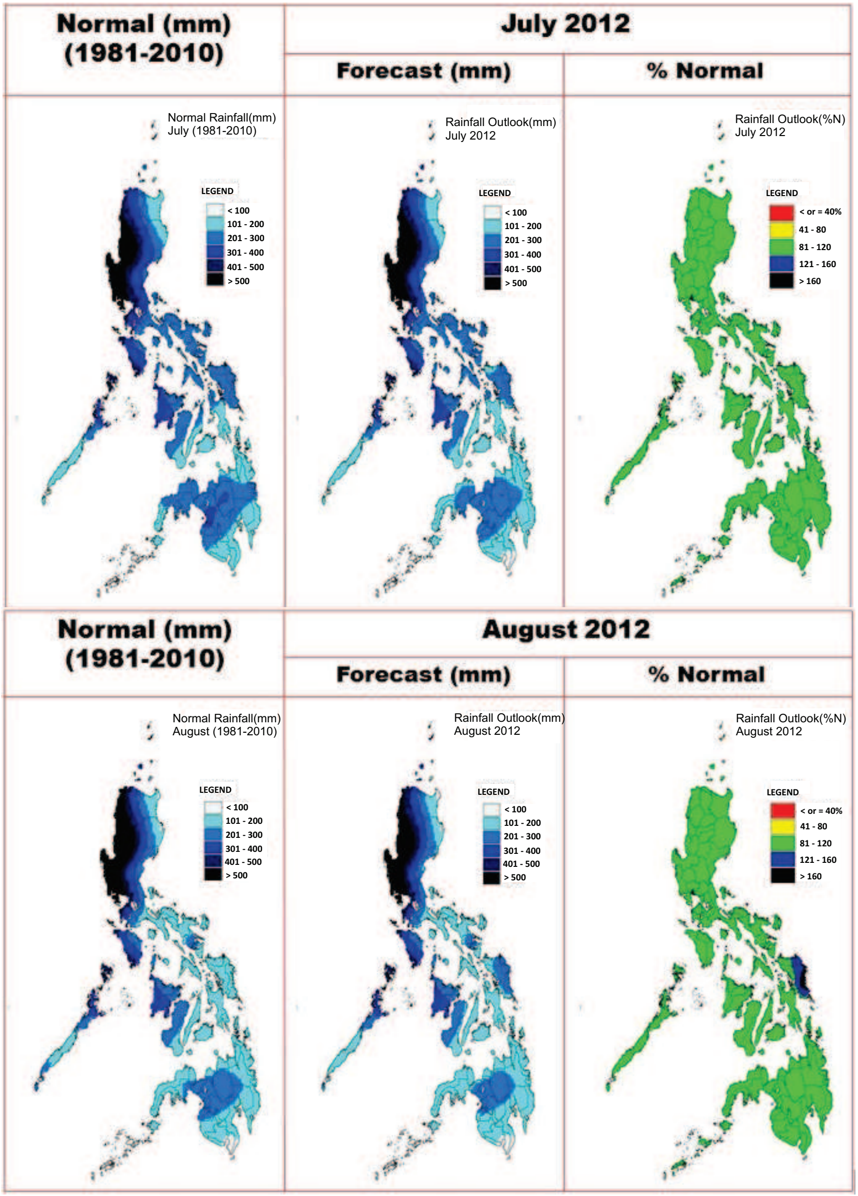

Fig. 2. Seasonal climate forecasts for July and August 2012

Table 1. Field guides and description of the activities integrated in the FGD.

Field Guide	Purpose
Hazard map	To identify the hazards as perceived and the specific risks from these hazards.
Seasonal calendar	To identify important events in the community, including the risks and coping strategies for climate induced natural disasters, including drought and drought.
Historical timeline	To find out significant events in the community related to climate variability that can also be considered part of history and obtain insight into past hazards, and make people aware of trends and changes over time.
Vulnerability matrix	To determine the hazards and most serious impacts on important livelihoods resources and to identify coping strategies currently used to address the hazards identified.
Venn diagram	To show the most important institutions working in the community and to analyze engagement of different groups in local planning processes.

Another FGD was conducted in September 2012 to determine farmers' use of SCF. Most of the farmers who participated in the May FGD participated in the November FGD. Mean age was 54. Male and female groups were equally represented.

Focus of the second FGD were on farmers' use or non-use of SCF, reasons for doing so, and to explore ways with farmers on how to improve climate information dissemination. After the preliminary analysis, findings were presented to community representatives to confirm the validity of the conclusions.

RESULTS AND DISCUSSION

Community Profile

Sources of Climate Information. Respondents reported that their communities could be reached by the leading TV stations in the Philippines and by radio stations in the locality and in Cebu City. They reported that they receive climate information from the mass media. However, these information are weather forecasts, not SCFs.

The communities are served by extension agents from the city agriculture office. Respondents reported that they get advice from their extension agents on seeds, fertilizer, pest control and other agricultural issues, but not on the use of SCF.

From the Venn diagrams, respondents reported that a number of organizations are providing them various forms of assistance. They reported that the city government has assigned to their respective villages an extension agent. They also said that health personnel from the city's Rural Health Unit also visit their villages to provide basic health services, including pre-natal and child care activities.

Respondents also reported that credit organizations have also extended them assistance. They emphasized that they always turn to these credit services during planting season and in times of emergencies.

Respondents also reported that the Department of Education (DepEd) has also been providing them assistance by way of maintaining the elementary school in their respective communities, which in turn makes education accessible to their children.

Respondents also said that the Department of Agrarian Reform through its city office, has also been extending them assistance in the form of securing tenure of the lands they are tilling and on their rights on the land they cultivate as tenants. Those who have obtained land titles recently attributed their success to the assistance of DAR.

The Leyte Electric Cooperative IV (LEYECO IV) has also been reported as among the organizations working in the communities studied. According to them, through LEYECO, supply of electricity is sustained.

The Senior Citizens' Office is also providing the communities with assistance. Targeted specifically to the senior citizens (residents with ages 60 years old and above), the assistance comes in the form of insurance and seminar sessions on the rights and privileges of senior citizens.

Respondents also mentioned the Visayas State University (VSU) as among the organizations extending assistance to them. They reported that VSU has been conducting training programs on various farming technologies with them as the beneficiaries.

Experiences on Climate Variability

Sources of hazards. The hazard maps prepared by the respondents (Fig. 3) highlighted that the most important hazard source in their communities is the Hipusngo Creek that spans these villages. According to them, during heavy rains, the creek overflows, thus causing flooding in the villages. In Brgy. Gaas, respondents said that there were already many times that the floods rendered the highway unpassable. Respondents blame this condition to the dumping of garbage into the creek. "Some residents have also built their houses and pig pens within the creek. Dumping of garbage and these structures clog the creek. So, when there is a heavy rain, we get flooded easily", says one respondent.

Important community activities. From the seasonal calendar, respondents revealed that for rice, they observe two cropping seasons. The first one is in July and the other in December. Harvest seasons are in the months of March to April and in October to November, respectively. Respondents reported that they usually experience flooding in the months of December to February and drought in the months of March to May and in the months of August to September.

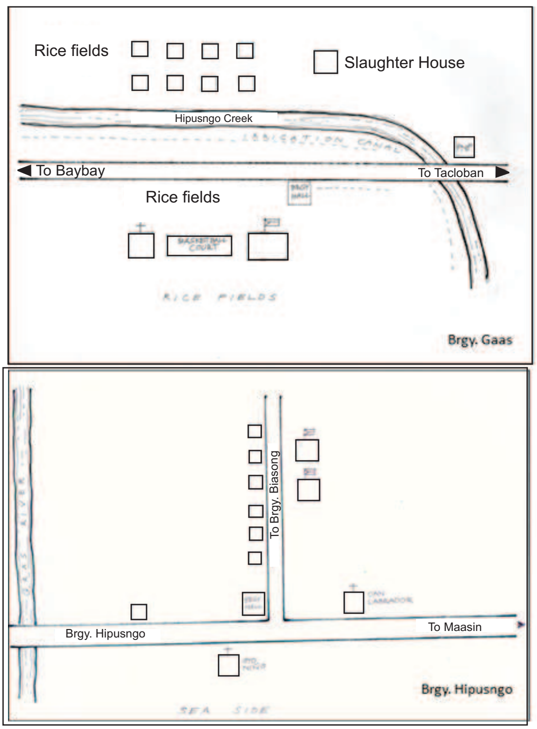

Fig. 3. Spot map of the study sites showing Hipusngo Creek as the source of flooding in the communities (In Brgy. Gaas, the creek is known as Hipusngo Creek but in Hipusngo, the same creek is known as Gaas Creek.)

Threats to livelihoods. Aside from flooding and drought, respondents reported a number of factors they consider as threats to their livelihoods. For their rice farms, aside from floods and drought, they are also faced with pests and diseases. These pests included the golden apple snail *(Pomacea canaliculata*), locally known as "kuhol", "bao-bao" (*Harmonia octomaculata), and "bunlod" (Gryllus rubens*). Respondents pointed out that these pests strike every cropping season. But they have noticed the golden apple snail, the pest they consider as most serious, has become "smarter" recently. They said that during dry months, the snail hides under the soil but emerges when the field is flooded.

To minimize the golden apple snail's damage, respondents confided that they combine manual (i.e., picking up the snail and putting it on the road to be run over by vehicles) and use of molluscicides. With other pests, respondents reported that they spray. "Based on our experience, we will have nothing to harvest if we will not spray", respondents said.

Another issue raised was on weeds. According to them, weeds are not a problem if there is sufficient water in their fields. "In the past years, we'd weed our farms mechanically two weeks after transplanting, but the more frequent occurrence of drought has rendered mechanical weeding ineffective", reported the respondents. "So, there's no other way out than to spray chemicals for the weeds", another respondent confided. "Normally, we weed two weeks after transplanting", said one respondent.

Respondents also reported that they raise chicken for home consumption. However, their chickens are at risk with white castle disease. They also reported that their coconut, banana, and chicken are also at risk to stealing.

Experiences of floods and drought. When asked for their experiences of floods and drought in the last 5 years, respondents reported that the biggest floods they have experienced in their village were in 2006 and 2011. According to them, in both floods, their rice farms were already about to be harvested. While some were able to harvest a few rice plants that withstood the flood, most of them did not harvest any. In 2011, aside from washing their rice crops, the flood had overflown the highway, making the road unpassable. In 2010, farmers said that they experienced drought. Most of their rice plants died due to lack of water. Farmers from Gaas said that although there is an irrigation system in the ricefields, only a few of the ricefields are serviced by this irrigation system. In Hipusngo, farmers said that they do not have any irrigation system; farmers whose farms are located adjacent to the canals and rivers, impound water for their ricefields.

Respondents confided that in those drought and flood years, they grew crops other than rice including vegetables and rootcrops, while others looked for temporary employment as carpenters and laborers. "Most if not all residents here have applied for loan", one respondent said.

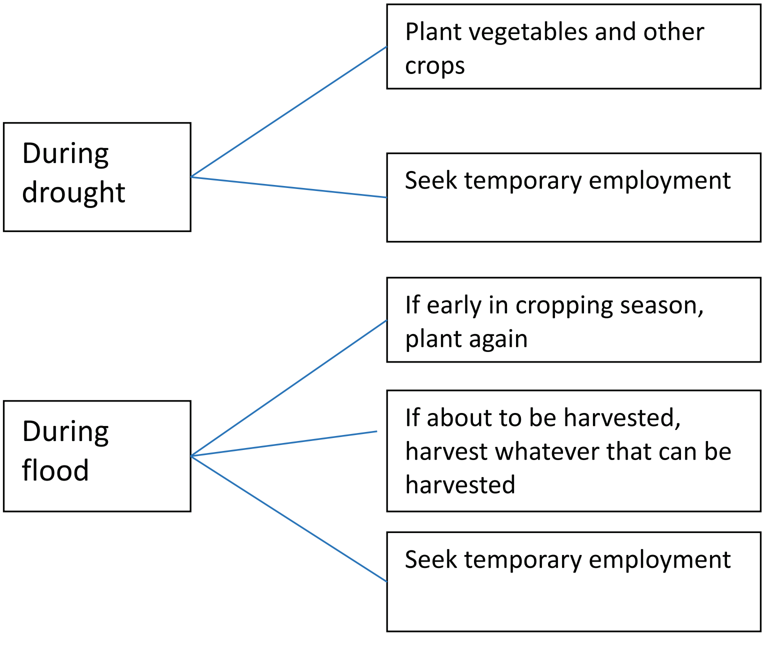

Fig. 4. Actions taken by respondents during drought and flood in their respective communities.

Behavioral Responses to the Climate Forecast

For these respondents, the onset and amount of rainfall during the planting season are the most reliable predictors of availability of rain. According to them, for the July cropping season, they can expect favorable conditions if it rains for about 2-4 days from the last week of May until the first week June and if their rice paddies are filled with water by this rain. These two conditions must be satisfied; absence of one would mean for them less rainfall. Respondents said that unlike their forefathers, they do not anymore use their indigenous forecasting system, including sounds of frogs and flowering of some plants because these are not anymore reliable.

For the July 2012 cropping season, respondents said that the normal rainfall pattern occurred. Thus, they cultivated their farms as they normally do – that is, they did not make any adjustments in terms of amount seeds sown and the size of farms cultivated. However, unlike in the previous years, the rain stopped in August. Thus, those who have sown and prepared the land in the last week of July and first week of August were unable to transplant and for them, the cropping season was only up to sowing. As an alternative, these farmers resorted to planting other crops including root crops, maize and vegetables. Other farmers looked for temporary employment as carpenters and as "pot-pot" drivers. But they felt that the money and time spent for seeds, sowing, and land preparation have all gone to waste.

Feedback on the Seasonal Forecast

When asked for their feedback on the PAGASA forecast, respondents said that it was "accurate" – that is, it was consistent with their experience on the onset and amount of rainfall. However, they have emphasized that the most important basis for their farm decision in the July 2012 cropping season was their experience with the onset and amount of rain in the last week of May until the first of week of June.

Considering their frustrations on the shortage of rain in August, respondents said that although the forecast was consistent with their experience on the onset of rain, they did not know regarding the distribution and duration of the rain. So, they have suggested to improve the forecast—that is, to include information on the duration and distribution of rainfall throughout the cropping season.

Although respondents rely more on their experiences, they suggested to sustain dissemination of seasonal climate forecast. Strategies they have suggested to disseminate SCF were: short seminars, posters and television. They said that the seminar may come in the form of a class with an agricultural technician or a staff from PAGASA as resource person. Respondents said that the posters may just be produced in an ordinary bond paper and posted in strategic locations in their respective communities including the bulletin boards and *sari-sari* stores. They also suggested that SCF be disseminated through radio and TV. They also said that SCF should be translated into their local language.

Suggestions to Alleviate Vulnerability to Flooding and Drought

Respondents offered suggestions to alleviate their livelihood from flooding and drought. First suggestion is related to dumping of garbage and building of structures (including houses and pig pens) near and within the Hipusngo Creek. To minimize flooding, they suggested for a concerted effort to stop dumping of garbage into their creek to implement the policy regulating the building of structures near the creek. Respondents also believed that an effective way of preventing floods is building of dikes.

As for the impacts of drought, respondents said that this problem can be minimized if their fields will be provided an irrigation system. Respondents reported that at this time, only a few rice farms are provided with irrigation. They reported that the city government through the City Engineering Office has discussed with them the plan to establish an irrigation system. But until now, the plan has yet to be materialized. Respondents opined that given the creeks and river systems surrounding their farms, it is possible to establish an irrigation system in their farms.

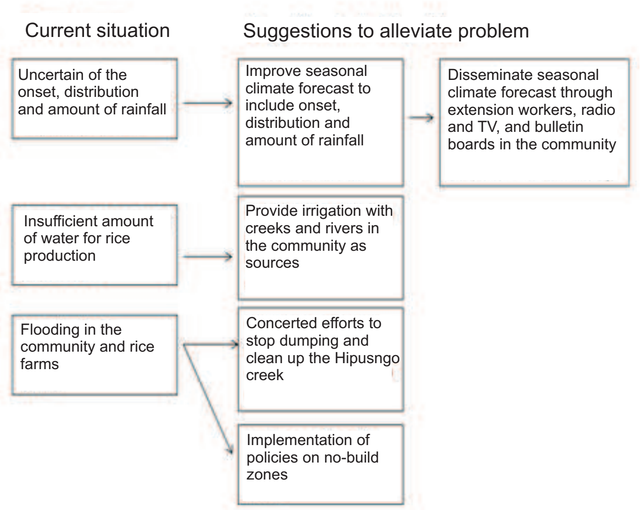

Fig. 5. Respondents' suggestions to alleviate themselves from flooding and drought.

IMPLICATIONS AND RECOMMENDATIONS

The purpose of this study was to explore small-scale rice farmers' use of science-based climate forecast. As in other studies that documented farmers' responses to climate information, this study has shown that although farmers put value on climate information, this information seems not to bear in their tactical decision-making. From the respondents' report on how they made decisions for the July 2012 cropping season, it appears that they have ignored the PAGASA forecast but relied more on their experiences on the onset and amount of rain. Fortunately, the forecast was consistent with their experiences. This result is consistent with the results of Bryan (2009) that in making decisions based on probabilistic information, farmers give weight to personal experiences. This scenario suggests the need for meteorological agencies to find ways to integrate farmers' experiences of rainfall patterns into the development of climate forecasts.

Although farmers have expressed satisfaction with the onset and amount of rain for the July 2012 cropping season, they were also frustrated with the drought that occurred in August. Given this experience, respondents suggested to improve the forecast and include information on the distribution of rainfall throughout the season. In short, respondents need localized forecast. They recognized that the forecast was developed based on the data gathered from the observation stations in Tacloban City, the provincial center, approximately 107 km away from these respondents' communities. To develop localized forecasts, there is a need to improve observation facilities of PAGASA, the meteorological agency of the Philippines.

Respondents' sources of climate information did not include the extension agents serving their respective communities. It appears that use of seasonal climate forecast is not a part of the extension drives of the agricultural technologists. Our discussions with extension agents have suggested that they are reluctant to discuss use of climate information in farming decisions due to their lack of skills in applying the forecast. This result echoes the suggestion of Recha et al (2008), Habiba, Shaw and Takeuchi (2012), and Moeletsi *et al*. (2013) on the need to equip extension agents with skills on how to use climate information as an innovation for managing climate risk. Accordingly, extension workers have strategic roles in changing farmers practice due to their credibility and accessibility to the farmers.

Respondents in this study recognized the fact that flooding in their communities is caused by anthropogenic factors. Also, they recognized that this problem can be solved through their concerted efforts. The problem, however, is that, no one appears to take the first step considering the power and influence of those who built houses and pig pens that now invade the creek.

Respondents believed that their problem on shortage of rain could be addressed by installing irrigation system for their farms. A way to do this is to mobilize the communities in putting up a water impounding system. The system may be improved later through the assistance of the local government unit.

The case presented in this paper highlights the need to integrate climate change framework in development planning by agencies and organizations that are trying to provide assistance to farmers in marginal areas.

Suggestions for Further Research

While the present study has answered some questions related to farmers' uptake of SCF, it also raised a number of questions. Thus, more studies are needed to understand farmers' use of this innovation. One study may be a similar research in areas adjacent to the meteorological agency to find out if smallholder farmers consider SCF in their farm decision-making. A study on the use of SCF by farmers in marginal uplands is also wanting. In the Philippines, since rice is a staple food, upland farmers grow rice. Based on data, rice farming in upland areas is highly vulnerable to the insufficient amount of rainfall. It is also suggested to conduct a survey involving a larger sample to find out, in quantitative terms, the factors that determine uptake of SCF. This study may be framed within the theory of planned behavior by Ajzen and Fishbein (2005).

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REFERENCES

AJZEN, I., and M. FISHBIEN. 2005. The influence of attitudes on behavior. In D. Albarracin, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (pp. 173-221). Mahwah, N J: Erlbaum.

BERT, F.E., E.H. SATORRE, F.R. RUIZ, and G.P. PODESTA. 2006. Climatic information and decision-making in maize crop production systems of the Argentinean Pampas. *Natural Resources Forum* **30**: 294-305.

BIRD, D.K. 2009. The use of questionnaires for acquiring information on public perception of natural hazards and risk mitigation, a review of current knowledge and practice. *Natural Hazards and Earth Systems* **9**, 1307-1325. Accessed from http://dx.doi.org/10.5194/nhess-9-1307-2009.

BOER, R., K. TAMKANI, and A.R. SUBBAH. n.d. Communicating climate forecasts to farmers through the field school: Indonesian experience. Retrieved on December 26, 2007 from http://www.ogp.noaa.gov/events/climate_adapt/boer.pdf.

BORINES, G.C., R.S. GRAVOSO, and C.D. PREDO. 2009. Corn farmers' decision-making based on seasonal climate forecasts. *Philippine Journal of Development* **36**(1): 85-100.

BRYAN, E., I.I. DERESSA, G.A. GBETIBONO, and C. RINGLER. 2009. Adaptation to climate in Ethiopia and South Africa: Options and constraints. *Environmental Science and Policy* **12**: 413-426.

BUREAU OF AGRICULTURAL STATTISTICS. 2010. Performance of Philippine agriculture: January-September 2010. Retrieved 10 December 2011 from http://www.bas.gov.ph/?id=406&ids=download_now.

CHAMBERS, R. (2009). *Climate vulnerability and capacity analysis handbook*. Merrifield, VA: Cooperative for Assistance and Relief Everywhere, Inc.

GLOBAL FACILITY FOR DISASTER REDUCTION AND RECOVERY. n.d. Philippines. Retrieved 10 December 2010 from http://gfdrr.org/ctrydrmnotes/Philippines.pdf.

HABIBI, U., R. SHAW, and Y. TAKEUCHI. 2012. Farmers' perception and adaptation practices to cope with drought: Perspectives from Northwestern Bangladesh. *International Journal of Disaster Risk Reduction*. http://dx.doi.org/10.1016/j.ijdrr.20.05.004.

MOELETSI, M.E., E.A.R. MELLAART, N.S. MPANDI, and H. HAMANDAWA. 2013. The use of rainfall forecasts as decision guide for small-scale farming in Limpopo Province, South Africa. *The Journal of Agricultural Education and Extension* **19**(2): 133-145.

O'BRIEN, K., I. SYGNA, O. NAESS, R. KINGAMKONO, R. HOCHOBEB. 2000. Is information enough? User responses to seasonal climate forecasts in Southern Africa. Report 2000—2003. Centre for International Climate and Environmental Research, Oslo.

PATT, A. 2000. Helping farmers in Zimbabwe use seasonal climate forecasts: Six constraints to effectiveness. Paper presented at the Open Meeting of the Human Dimensions of Global Environmental Change research Community, Rio de Janeiro, Brazil, 6-8 October 2000.

PATT, A., P. SUAREZ, and C. GWATA. 2005. Effects of seasonal climate forecasts and participatory workshops among subsistence farmers in Zimbabwe. Proceedings of the National Academic Science 102:12623–12628.

RECHA, C.W. C.A. SHISANYA, G.L. MAKOCHA, and R.N. KINUTHIA. 2008. Perception and use of climate forecast information amongst smallholder farmers in Semi-Arid Keyna. *Asian Journal of Applied Sciences* 1(2):123-135.

REILLY, R.C. 2010. Participatory case study. In A. Mills, G. Durepos, & E. Wiebe (Eds.), Encyclopedia of case study research (pp. 658-661). Thousand Oaks, CA: Sage.

RINCON, M.F.G. and F.K. VIRTUCIO. 2008. Climate change in the Philippines: A contribution to the country environmental analysis. Retrieved 9 January 2011 from http://siteresources.worldbank.org/INTPHILIPPINES/Resources/PhilippineCEACC1July.pdf.

SELVARAJU, R. H. MEINKE, and J. HANSEN. 2004. Approaches allowing smallholder farmers in India to benefit from seasonal climate forecasting. Proceedings of the Fourth International Crop Science Congress -- New directions for a diverse planet – held on 26 September-1 October 2004, Brisbane, Australia. Retrieved on December 20 2007 from www.cropscience.org.au.

WASHINGTON, R. and T.E. DOWNING. 1999. Seasonal forecasting of African rainfall: Prediction, responses and household food security. *The Geographical Journal* 165: 255-274.

WORLD BANK. 2009. Philippines: Typhoons *Ondoy* and *Pepeng*: Post-disaster needs assessment. Retrieved 16 January 2011 from http://www.pdrf.org/pdf/POPJAVolume1.pdf.

YIN, R.K. 2003. *Applications of a case study research: Applied social research methods series*, 34. Thousand Oaks, CA: Sage.

ZIERVOGEL, G. 2004. Targeting seasonal climate forecasts for integration into household level decisions: The case of smallholder farmers in Lesotho. *The Geographical Journal* 170(1): 6-21.

ZIERVOGEL, G., S. BHARWANI, and T. DOWNING. 2006. Adapting to climate variability: Pumpkins, people and policy. *Natural Resources Forum* 30: 294-305.