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CASE STUDY

CLIMATE INFORMATION USE BY FARMERS: A CASE OF SMALLHOLDER RICE FARMERS IN VULNERABLE COMMUNITIES IN THE PHILIPPINES

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Abstract

How farmers integrate climate information into their decision-making process and the outcomes of such use are less understood. Focus group discussions and in-depth interviews were conducted with rice farmers in vulnerable communities in the Philippines. Results showed that participants experienced such climate extremes as floods, droughts, and typhoons. They obtained weather forecasts from the mass media, including radio and television, and seasonal climate forecasts from the agro-meteorological offices set up by the local government units. They used climate information to develop their planting calendar, decide the variety to sow, and decide whether to grow rice or other crops. Use of climate information resulted in farmers gaining confidence in their farm decision, maximizing output from alternative crops, and maximising the use of time and resources. Farmers who did not follow the climate advisory experienced crop failure and psychological discomfort. Results showed that the use of climate information enable farmers to adapt to the impacts of climate change. Findings also highlight the need for interventions to enable more farmers to use climate information and adapt to the changing climate.

Keywords: climate change adaptation, farmer resilience, seasonal climate forecast, climate information dissemination

Introduction

As with many countries in the world, rice is an important food crop in the Philippines. Among Filipinos, rice is life and tied to the Filipino culture. As a staple food, rice comprises the big chunk of the Filipino family budget and serves as an important source of carbohydrates. Of the food items, rice and its products constitute 37% of the average daily food of a Filipino family (Ponce & Inocencio, 2017).

Rice has a large contribution to the Philippine economy. According to Sebastian, Alviola, and Francisco (2000), rice farming is the source of income and employment of 11.5 million Filipino farmers and contributes 13% to the consumer price index (CPI), 16% to the gross value added of agriculture, and 3.5% to the gross domestic product. Given the social, cultural and economic importance of rice, the Philippine government is giving top priority on rice production. Thus, today, various programmes are being implemented to ensure rice sufficiency.

Unfortunately, as with other countries, rice production in the Philippines is challenged by the changing climate. Major documents highlight the reduction of rice yields due to extreme climate events. For example, Comiso et al. (2014) pointed out that the strong El Niños in 1972-1973, 1982-1983, and 1997-1998 reduced rice production in the country, an observation supported by the Lansigan (2005), and Stuecker, Tigchelaar and Kantar (2018). Through simulations, the International Food Policy Research (Thomas, Pradesha & Perez, 2015) concluded that the Philippines will experience a significant reduction in rice production for the period 2000-2050 due to climate extremes.

Given the challenges posed by climate change, current development efforts are being targeted to build farmers' adaptive capacity to extreme climate events. Briefly, adaptive capacity refers to an individual's or group's ability to deal with the impacts of a changing climate and the uncertain social and ecological conditions (Levine, Ludi & Jones, 2011).

It is widely agreed that the use of climate information has the potentials to develop farmers' adaptive capacity. More specifically, seasonal climate forecasts (SCF), referred to as probabilistic predictions on the amount of rain expected during the season (Washington & Downing, 1999), enable farmers to plan management strategies and other farming activities based on the forecast (Ibrahim et al., 2019). The strategies farmers apply alleviate the vulnerability of farming to climate variability.

Experience and research have proven the contributions of climate information as a tool for early-warning systems and agricultural risk management strategy (Vogel & O'Brien, 2006) and gain profit (Nguyen-Huy et al., 2020). A study in Kenya that assessed the impact of SCF on on-farm management and productivity of smallholder farms showed that changes in farm practices based on SCF led to improved farm productivity (Rao et al., 2015). More specifically, results showed that farmers who received climate information reduced their cropped area, invested in intensive crop management, and achieved higher yields with greater returns in investment.

In the Philippines, initiatives are being implemented to disseminate the SCF innovation to farmers. For instance, the country's meteorological bureau, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is developing specialised forecasts for agriculture, extension advisory services, and implement weather-crop relationship studies. Likewise, the Department of Agriculture and other organisations, and groups are implementing programmes to enable farmers to integrate climate information into their tactical decision-making.

At this time, however, we lack understanding of the mechanisms by which farmers obtain and use climate information, the outcomes of applying climate information, and evidence on climate information and services' ability to improve agriculture (Lugen, Diaz, Sanfo, & Salack, 2018). A clear understanding of how farmers use climate information is needed for improving the climate services (Ptaff, Broad & Glantz, 1999). This paper provides insights into the outcomes of farmers' use of climate information.

Materials and Methods

Research Design

This study is anchored on the social construction of reality framework postulated by Berger and Luckmann (1966). This theoretical framework holds that reality is socially constructed and is a product of our interaction with the environment. Within social construction thinking, reality is subjective and the goal of research is to capture the reality held by the people being studied.

This study applied the case study method. Yin (2003), and Baxter and Jack (2008) described a case study as an inquiry that investigates a phenomenon occurring within its real-life context using a variety of data sources. This design is appropriate for a study that investigates farmers' experiences using an innovation including climate information, in decision-making.

Locale and Participants

Data were gathered in Ormoc City in Leyte and in Dumangas, Iloilo (Fig 1), communities that are considered as among the top rice-producing communities in the Philippines. The sites provide a good case for the study of farmers' uptake of climate information because their respective local government units have implemented climate field schools for the farmers. Likewise, the communities were affected by the El Niño from February to June 2019. The villages are generally accessible to transportation. Data for this study were gathered in January to March 2019.

Sixty-five farmers participated in the focus group discussions. Twelve of them were interviewed to gather more in-depth information. There were more women than men participants in the FGDs. This high participation of women in this study could be explained by two reasons: 1) in the Philippines, the mothers are the ones usually sent to represent the family in community and social activities, and 2) men are busy in their farms.

The age of the participants ranged from 44-83 years old. Old farmers dominated the participants. The dominance of the old farmers is understandable because Filipino farmers are ageing (Manalo, 2017). The primary means of livelihood was farming. In both sites, the average rice farm is 1.5 hectares.

Data Gathering and Analysis

This study applied methodological triangulation to ensure reliability and validity of interpretation (Mathison, 1988). These methods included FGDs, ocular observations, and analysis of secondary data.

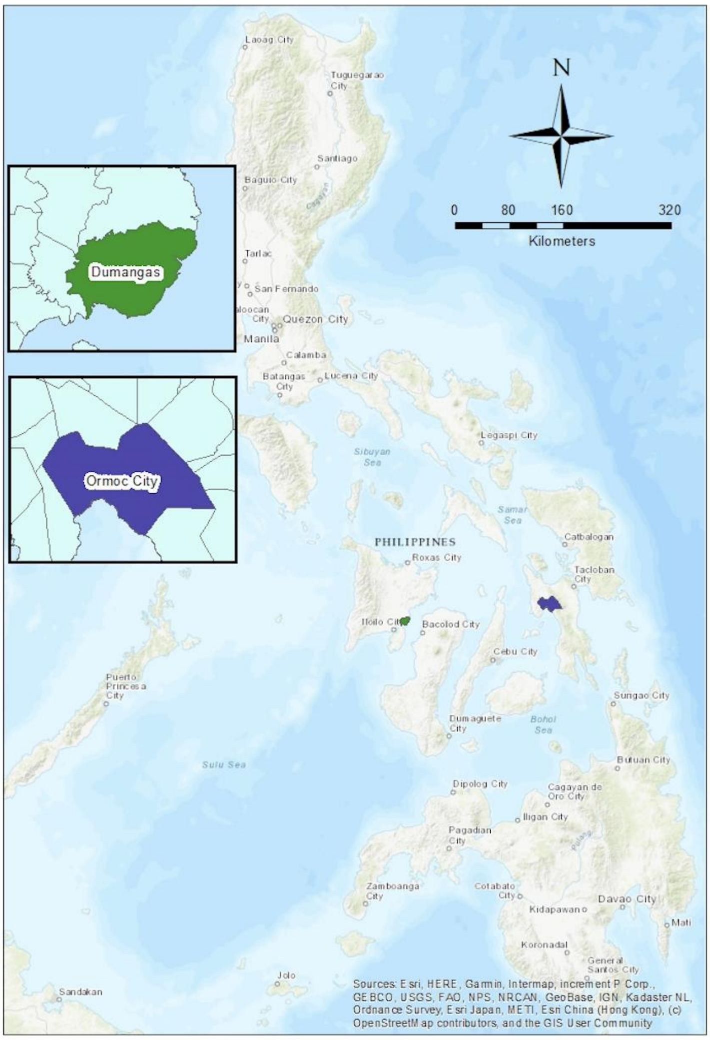

Figure 1: *The Philippine map showing the study sites, the Municipality of Dumangas, Iloilo and Ormoc City, Leyte, Philippines.*

Before the fieldwork, permission was obtained from authorities. In Dumangas, permission to gather the data was obtained from the municipal mayor. The officer-in-charge of the agrometeorological station facilitated the researcher's access to the communities. In Ormoc City, permission was obtained from the city agriculturist. The person in-charge of the climate services programme and his staff guided the researcher to the communities. Before the fieldwork, FGD and interview guides were developed. Questions revolved around the farmers' experiences of climate variability, sources of climate information, their use of climate information and the outcomes of such use. Data from the FGDs and in-depth interviews were transcribed and were subjected to a thematic analysis.

All participants agreed to participate in this study and gave permission to record the proceedings of the FGDs and answers to the interviews. In this report, typical quotes are included in the presentation of results to clarify the points raised. However, the identity of the participants was hidden to maintain confidentiality.

Results and Discussion

Experience of Climate Variability

Participants reported that the most frequent natural calamities they are experiencing are flooding due to heavy rains, droughts, and typhoons. They also reported that heavy rains and flooding have become more frequent and intense. Rivers surrounding their communities are sources of the flood. For example, in Dumangas, Iloilo, farmers shared that during heavy rains, a river locally called Jalaur River, overflows, thus flooding their rice fields. The same holds in Ormoc City, that when a river locally known as Mas-in River overflows during the rainy season, not only their rice fields but also their homes are flooded. Participants reported that during floods, they need to take boats to go to their neighbours.

In the last five years, respondents in both sites reported that the 2019 El Niño affected them. Although climatologists considered it a slight El Niño, farmers in this study said it was a heavy El Niño as it significantly reduced their rice yields.

Farmers in this study wish not to experience any disaster. However, if given the choice, some farmers "prefer" drought over floods, while others "prefer" floods. Those who said they would rather have floods than droughts explained that based on their experience with floods, their rice plants would just lodge and recover after a few days. Also, floods just last for days only. Whereas, with droughts, rice plants could not grow well due to lack of water. They could not also plant other crops because they lack sources of water.

On the other hand, those who said they would rather have droughts explained that, in the farmer field school, they have learned that droughts can be predicted and as farmers, they can devise ways to reduce its impact. Floods, however, may come anytime, catching the farmer off-guard.

Access to Climate Information

Farmers in this study reported that they have good access to climate information. They obtain weather forecasts from the mass media, including radio and from national TV. Given the climate information initiatives in the sites, farmers receive weather and seasonal climate forecasts (SCFs) from their respective agro-meteorological stations (Figure 2).

In Dumangas, the Municipal Agricultural Office issues a 24-hour weather forecast for farmers and fishermen. The advisory includes rainfall, wind speed, and humidity. In Ormoc City, the climate service project issues a 5-day forecast and releases the forecast through weatherboards installed in the barangays. Aside from the weather, the advisories include recommended farm activities appropriate for the weather, including fertiliser application, pest control, and other activities.

Farmers have access to SCFs delivered by the agriculture office through advisories (or bulletins) and a climate forum is held before the rice cropping season. For example, in both case study sites, a climate forum was held in October 2018 to inform farmers of the impending El Niño in February-June 2019. In that forum, farmers were advised on the best dates to plant and the pests and diseases to watch for.

Local Forecasting and Experiences with Rainfall

Farmers reported some indigenous forecasting systems and these relate to the amount and onset of rain. According to them, ants getting inside the house and sparrows flying are signs that rain is coming. However, they admitted that recently, unlike in the old days, these signs are no longer good indicators of rain, suggesting that the indigenous forecasting system has become unreliable, a finding consistent with that by Roncoli, Ingram and Kirshen (2002).

In the absence of a climate forecast, the participants use the onset (timing) and amount of rain as a guide in the timing for cultivating their rice fields. As with the findings of Gravoso, Patindol and Predo (2014), farmers in this study start cultivating their rice farms (sowing and ploughing) for the June-October cropping season if these two conditions are met: 1) there is rain towards the end of May, and 2) about one-third of each rice paddy is filled with water. Participants said that their experience of the onset and amount of rain is more reliable compared to the forecasting system involving animals, birds, and insects. "For one, some the birds and insects have become invisible these days," shared a farmer.

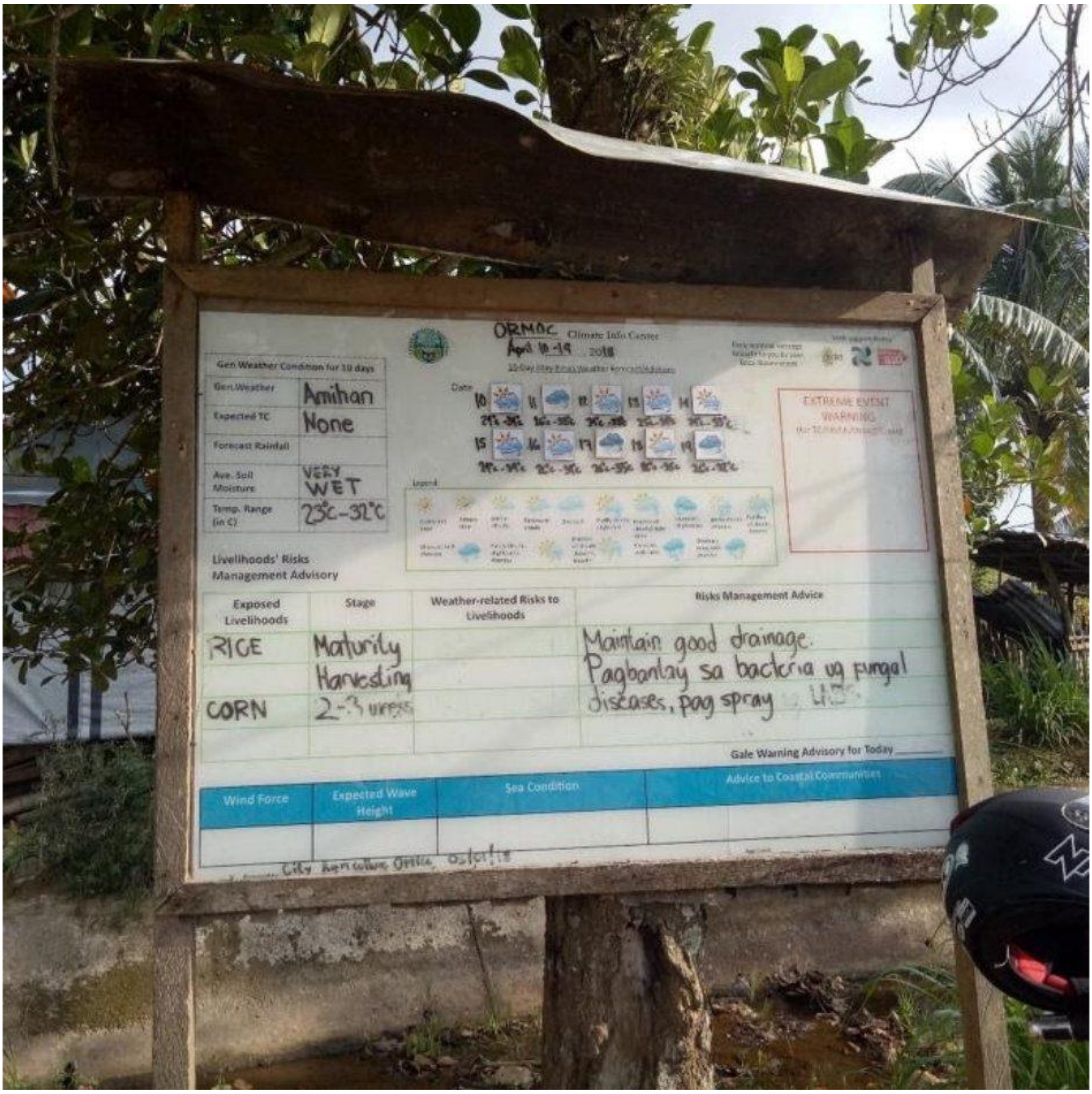

Figure 2: A Weather Board Installed in a Local Community in Ormoc City to Inform Farmers of the Upcoming Weather and Climactic Conditions

Farmers' Use of Climate Information

Consistent with the results obtained by other studies (e.g., Niyikahadzoi, Kefai, Ozian & Zamasiya, 2017; Kom, Nethengme & Mpandeli, 2020), farmers in this study use climate information in making tactical farm decisions. They said that in these decisions, the forecasts shared by their agriculture offices are weightier than the one disseminated by the mass media. According to them, the weather forecasts are used for short-term operations but the SCFs are used for long-term planning. They said that the SCFs are used for developing planting calendar for the season, deciding on rice variety to sow, and in deciding whether to grow rice or other crops, a finding consistent with that by Roncoli, Ingram, and Kirshen (2002).

Farmers said that they apply the SCF as a guide in developing their cropping calendar. A case in point is the cropping season in November 2018. Given the advice from their agricultural offices of the impending El Niño in February-June 2019, farmers have scheduled to plant by the early part of December.

> *Climate information is very important to us, as farmers, because the information we get from our forecaster serves as a basis for developing our planting calendar. We develop our planting calendar based on the predicted amount and onset of rain.*
>
> *Among the three factors – good seeds, fertiliser, and climate information – we consider climate information as the most important factor, because we can't use the good seeds and fertiliser if the climate is not favourable [Participant 5].*

Participants recognise that growing rice is dependent on the availability of water. Thus, the SCF is used to decide the rice variety to sow for the cropping season. For example, given the El Niño forecast in the second cropping in 2018, some farmers used the early maturing rice variety called RC-216. This enabled them to maximise the rainy days before the El Niño. Accordingly, RC-216 matures at 80-85 days. Other varieties mature at 100-110 days.

> *I planted an early-maturing variety. It can be harvested within 80-85 days, unlike the other varieties that mature within 100 days or longer. It's called RC-216. It's a rice variety that has a good eating quality, has sturdy stems, and the grains weigh heavier than the other varieties [Participant 1].*

SCFs also serve as a guide in deciding whether to plant rice or other crops. If the forecast is not favourable for rice production, they opt to grow other crops including vegetables. For example, in normal forecasts, farmers grow rice three times a year – in June, November, and April. However, in 2019, given the El Niño forecast, they decided to plant vegetables in April instead of planting rice due to a lack of rain. According to them, vegetables require less amount of water.

Outcomes of Using Science-based Climate Information

Farmers reported several benefits from using climate information. These benefits included gaining confidence in the farm decision, maximising output from alternative crops, and maximising the use of time and resources.

Participants have recalled that they have experienced crop losses due to the mismatch between their farm and the climate. According to a farmer, one time, they have experienced planting watermelon (*Citrullus lanatus*) in summer months in the Philippines (April to May). The watermelon grew well but did not bear fruits. Instead, the watermelon plant got rotten due to heavy rains.

The same farmer tested the accuracy of the forecast. There was a forecast of rain. However, she planted mongo (*Vigna radiata*). As with their experience with watermelon, the mongo grew but failed to bear fruit.

> *Climate information is very necessary for our farm activities. Without climate information, we seem to operate on a blank wall. For example, before we enrolled in the Climate Field School, we planted watermelon. However, we didn't know that there was La Niña because we had no*

way to get a seasonal climate forecast at that time. When our watermelon reached the fruiting stage, it rained heavily for a month. We failed and we lost PHP 150,000 in one hectare.

After finishing the climate field school, there was a forecast of La Niña, so we challenged the forecast and planted mongo bean. However, our mongo plants did not bear fruit due to the heavy rains brought about by La Niña. I only tried it to prove if the climate forecast will turn out to be true. This time, we are following the forecast (Participant 25).

Farmers reported that in seasons when there is insufficient rain, they resort to growing alternative crops such as vegetables. According to them, vegetables need less water and grow well during El Niño. The shift from rice to vegetables enable them to gain profit. They confided that had they stuck to rice, they would have suffered losses.

Before we studied through the Climate Field School, we experienced planting rice during El Niño. As early as December, our rice crops were already drying up. We planted rice for second cropping in September. When we started ploughing, we irrigated our farmlands until we planted rice. When our rice plants started to grow, we observed that the damage brought by El Niño can't anymore be recovered by the use of irrigation, because the field has dried up and we can no longer support the expenses for the diesel for the irrigation pump. We let our rice fields dry.

You will notice here, there are rice farms planted with rice despite the El Niño. I asked them why they did so. They answered that they have a deep well. But as you could see, rice plants have grown but growth were so poor [Participant 25].

Farmers said that the forecasts enabled them to maximise the use of their time and resources. In Ormoc City, farmers said that information posted on the weatherboards advised them on farm activities that may be done in a particular day – to sow, fertilise, or spray. They said that in the absence of the weather advisory and SCF, they will not only waste their resources but also their time. For example, applying fertiliser on a rainy day will just mean wasting the costly fertiliser as well as the time spent applying fertiliser.

The above results invariably show that the integration of climate forecasts, particularly the SCF, into the farmers' decision, help them to adapt to the impacts of extreme climate events, in this case, the El Niño, that struck their farms in February to June 2019. These results are consistent with the those obtained by many researchers (e.g., Haigh et al., 2015; Gunda, Bazwin, Nay & Yeung, 2017; FAO, 2019) indicating that applying SCF as an adaptation strategy enables farmers to obtain higher average net agricultural income.

Implementers of the climate service projects have also reported that they gained benefits from their respective projects. An agriculture staff shared that the implementation of the climate service project in their respective communities has provided extension workers a science-based guide for advising farmers on the upcoming climatic conditions.

Now that we have the weather information board, I've seen that farmers now get an idea of what weather to expect and use this as a guide for planning the farm activities this week or in the coming weeks. In many ways, the climate board helps farmers increase their harvest at a lesser cost. For example, if you apply fertiliser (on the field) on a warm day, the fertiliser will only come to waste because there is no water, especially when the rice field is rainfed. The information board is also helpful in controlling pests. For example, when water is insufficient, insects develop quickly. If you spray organic concoctions, you need water, so the information board is needed to guide farmers on the proper application of organic concoction and fertiliser (Extension Staff 1).

The agriculture staff reported that rice productivity has improved due to integration of climate information into their farm decisions. In Dumangas, the municipal agricultural officer reported that currently (during the data gathering), the municipality holds the distinction of being the top rice-producing municipality in the entire Iloilo Province during the first cropping season.

Farmers have reported that their production increased by 15-20%. They said that they have applied the techniques learned from the Climate Field School (CFS) – techniques that require less inputs (Extension Staff 2).

Before the climate field school (CFS), where the use of climate information was introduced, farmers were using traditional farming methods. They changed their cropping pattern after graduating from the CFS. Before, they just plant their crops whenever they want and operate their farms based on their beliefs. But now, they make decisions based on the seasonal forecast.

In terms of production, Dumangas used to be the least rice producer in the entire Iloilo Province. But after the Climate Field School, we ranked first. Farmers realized that they spend less and produce more if they apply climate information (Extension Staff 3).

The agriculture staff reported that farmers' use of climate information has improved the community's trust in their office and their services. The lead staff of the climate services project in Ormoc City Agricultural Service Office recalled that when they started the climate information project, farmers seemed to ignore their advice. The situation has changed after some farmers proved that following the advice based on climate information reduces farm risks.

The most important change that we have experienced from the farmers here is that they now keep on thanking us. They say thank you to us because they could now predict the rainfall pattern for the next cropping season.

It was a struggle when we started the climate information dissemination. Farmers called us by many names back then, including sorcerers or witches, just because we can predict the climate, the pests, and diseases that are likely to attack. They even thought that we were the ones bringing the misfortunes. Now, they are starting to understand that the City Agriculture's Office can predict the climate for the coming season. During this second cropping season (2018), for example, those who followed our advice are coming back to us to say "thank you" for the advice. Others who did not follow are saying "sorry" and realised that they should have listened to us. All these suggest that these farmers now understand the need to integrate climate information into their farm management practices [Extension Staff 4).

Outcomes from Climate Information Non-Usage

In this study, some farmers did not follow the SCF. These farmers reported that they have suffered crop failure and emotional discomfort. More specifically, they said that they experienced the loss of production and profit and that they felt that they have just wasted their time and resources.

We planted rice on December 13, 18, and 28. The farm planted on December 28 is about one-fourth of a hectare. Among these areas, only the one that we planted on December 28 turned out to be a failure due to the lack of water. We only get water when it rains. In this field, the rice plants grew but you could see a few panicles only. We spent PHP16,345[1] for this farm, but I think we could harvest about 2 sacks only (80 kg[2]). But the farm we planted on December 13 and 15, the rice crop grew well. We lost in the field that we planted on December 28 [Participant 9].

Farmers who experienced crop loss shared that they knew that El Niño was coming in February-June 2019 and that planting in late December 2018 was very risky. However, they confided that usually, in their locality, rain still comes until February of every year. Hoping that the situation would remain the same in 2019, they pushed through with planting. However, the rain stopped in late December, thus, they applied irrigation to their rice crop. But since there were already leaks in their rice fields, irrigation did not serve the purpose. Given this situation, they stopped irrigating their field, thus resulted in poor growth of the rice plant.

[1] Approximately $326.90
[2] Approximate value is $18.46

Although for some farmers crop loss does not seem to bother them, for some it causes emotional discomfort. Farmers confided that knowing their crop loss, they could not sleep well thinking of the money, time and effort they spent. However, they hoped that the next cropping season will be better for them.

> *I have recognised the risk (of planting in late December or in January). But many persuaded and advised me that there are so many of us who will pray (that it will rain in January). They said that God will listen to us. I spent so much for the motorised (irrigation) pump but it didn't help the rice crop. I can still harvest from my rice farm but I think I will lose 30%*[3].
>
> *I wish to suggest to everyone not to plant anymore in January. Also, if we don't get advice based on the forecast, it is best not to plant [Participant 15].*

These narratives emphasise the fact that while there are farmers who are already able to adapt to the impacts of climate extremes, a number of them continue to succumb to these impacts. There is, therefore, a need to strengthen climate initiatives including the climate field school, to reach and capacitate a broader mass of farmers on the use of climate information as an adaptation strategy (Davi & Whitebread, 2017; Oyekale, 2015). These results also show that while some farmers are now taking advantage of the benefits afforded by the SCF, many remain skeptical about its accuracy to predict the climate for the upcoming cropping season. It is now high time to design and develop knowledge products that demonstrate the potential contributions of SCF in building farmers' adaptive capacity. These knowledge products may be distributed and used in training programmes for farmers or made available through various online platforms.

Conclusions

Findings of this study have demonstrated the value of using climate information –that is, it enables farmers to adapt to the impacts of a changing climate. Farmers in this study use the information to plan their planting calendar, decide the variety to sow, and decide whether to grow rice or other crops. Use of climate information resulted in farmers gaining confidence in their farm decision, maximising output from alternative crops, and maximising the use of time and resources. Farmers who did not follow the climate advisory experienced crop failure and psychological discomfort.

Consistent with Oyekele's (2015) observations, this study has proven that a strong meteorological service programme enhances farmers' preparedness and capacity to withstand the impacts of extreme climate events. In this study, given the strength of the forecast (i.e., it was able to predict upcoming climate events), farmers were able to develop trust in the forecast. The strong forecast came about due to functional facilities installed at the agro-meteorological offices of the local agricultural offices.

It must be highlighted that the climate service projects in the case study sites are initiatives of local government units (LGUs)[4]. This development suggests that LGUs that intend to build farmers' livelihood should give top priority and mainstream climate services (Naab, Abubakari & Ahmed, 2019) into their respective development programmes. As demonstrated in this study, a climate service programme implemented by the local government unit allows for a localised forecast, a strategy suggested by a number of experts (e.g., Hansen, et al., 2019).

Overall findings from this study emphasise the important role of extension agents in developing farmers' skills in applying climate information in their farming activities. Firstly, these agriculture staff were the ones who designed and implemented the climate service projects in their respective service areas. But to do this, these extension agents went through training workshops on the application of climate information in farming. These developments emphasise the need to develop the capability of extension agents for them to effectively arm farmers with evidence-based information about climate change and production management issues (Haigh et al., 2015; Borrelli, et al., 2018).

Although such strategies under the climate service project as the use of weatherboard, climate advisory, and climate forum to disseminate climate information is commendable, these have inherent

[3] Data were gathered in the first week of March 2019; this farmers' rice crop was scheduled for harvest in April 2019.

[4] In the Philippines, the local government units or LGUs, are divided into three levels: provinces, independent cities, component cities, and municipalities and barangays or villages. Ormoc is an independent city while Dumangas is a municipality.

weaknesses. Aside from the limited reach, sending the information from the meteorological office to the communities take some time. It is, therefore, recommended that climate services include the use of mainstream media such as the local radio stations. Many authors (e.g., Manyozo, 2012; Badiru & Akpabio, 2017) have pointed out that radio is effective as a medium of communication in rural communities due to its accessibility and understandability.

The increasing frequency and magnitude of extreme events that make rice farming more vulnerable underscore the need to provide farmers with crop insurance. Crop insurance safeguards from the risks brought about by climate uncertainty (Decena, 2017).

Farmers in this study have emphasised that aside from efficient and effective climate services, they need assistance in pest control, fertiliser, labour, capital, market, and other needs. In pest control, the most pressing problem is the attack of golden apple snail (*Pomacea canaliculate*). Farmers have also reported the decreasing number of residents who are willing to work on the farm for a fee unlike before. This lack of labour force has caused a delay in their farm operation.

Suggestions for Further Research

While this study has answered several questions, this has also given rise to some. Thus, more studies need to be conducted to improve our understanding of farmers' use of climate information. One potential research is conducting a similar study in other areas including farmers in upland ecosystem cultivating paddy rice.

The current study applied qualitative methods to determine the outcomes of farmers' climate information use. A study that uses quantitative measures in finding out the outcomes of integrating climate into the farmers' decision-making is wanting.

An investigation on the climate risk management strategies applied by farmers to adapt to the changing climate is also wanting. These data can then be used to design interventions to improve the suite of strategies they are currently using. As demonstrated in this study, the intervention may include promoting farmers' use of climate information.

Farmers have shared some indigenous forecasting system. There is, therefore, scope for integrating indigenous forecasting system into efforts of developing climate forecasts by meteorological agencies.

Farmers in this study considered climate information as the most important factor in farming. It will be interesting to find out the farmers' willingness to pay for climate information.

The study has highlighted the role of extension agents in developing farmers' capability for applying climate information as a climate change adaptation strategy. Determining the extension agents' knowledge and skills in the use of climate information are wanting. Likewise, there is a need to examine if the curricular programmes that train professionals to become extension agents are aligned with the current thrusts of building farmers' adaptive capacity to climate change.

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References

Badiru, I. O., & Akpabio, N. (2017). Farmers' utilization of Utom Inwang agricultural broadcast on Atlantic FM 104.5 Radio Station, Akwa Ibom State, Nigeria. Journal of Agricultural & Food Information, 19(4), 377-386. https://doi.org/10.1080/10496505.2017.1401481

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13(4), 544-559. https://nsuworks.nova.edu/tqr/vol13/iss4/2

Berger, P. L. & Luckmann, T. (1966). The social construction of reality: A treatise in the sociology of knowledge. Penguin Books.

Borrelli, K. A., Roesch-McNally, G. E., Wulfhorst, J. D., Eigenbrode, S. D., Yorgey, G. G., Kruger, C. E., Houston, L. L., Bernacchi, L. A., & Mahler, R. L. (2018). Farmers' trust in sources of production and climate information and their use of technology. Journal of Extension, 56(3). https://www.joe.org/joe/2018june/a7.php

Comiso, J. C., Blanche, C. A., Sarigumba, T. I., Espaldon, V. O., Lansigan, F. P, Baguinon, N. T., Birosel, R. C., Coladilla, J. O., Cruz, R. V. O., Florece, L. M., Guerrero, R. D., Lasco, R. D., Perez, R. T., Pulhin, J. M., Tibig, L. V. (2014). Changing Philippine climate: Impacts on agriculture and natural resources. The University of the Philippines Press.

Decena, F. L. C. (2016). Agricultural insurance in the Philippines. https://ap.fftc.org.tw/article/1056

Dewi, E. R., & Whitbread, A. M. (2017). Use of climate forecast information to manage lowland rice-based cropping systems in Jakenan, Central Java, Indonesia. Asian Journal of Agricultural Research, 11(3), 66-77. https://doi.org/10.3923/ajar.2017.66.77

Food and Agriculture Organization of the United Nations. (2019). Handbook on climate information for farming communities: What farmers need and what is available. http://www.fao.org/3/ca4059en/ca4059en.pdf?

Gravoso, R. S., Patindol, R. A., & Predo, C. D. (2014). Behavioral responses to climate information: A case of small scale rice farmers in vulnerable communities in Leyte, Philippines. Annals of Tropical Research, 36(2), 45-62. https://doi.org/10.32945/atr3623.2014

Gunda, T., Bazuin, J. T., Nay, J., & Yeung, K. L. (2017). Impact of seasonal forecast use on agricultural income in a system with varying crop costs and returns: An empirically-grounded simulation. Environmental Research Letter, 12(3). https://doi.org/10.1088/1748-9326/aa5ef7

Haigh, T., Morton, L. W., Lemos, M. C., Knutson, C., Prokopy, L. S., Lo, Y. J., & Angel, J. (2015). Agricultural advisors as climate information intermediaries: Exploring differences in capacity to communicate climate. Weather, Climate, and Society, 7(1), 83-93. https://doi.org/10.1175/WCAS-D-14-00015.1

Hansen, J. W., Vaughan, C., Kagabo, D. M., Dinku, T., Carr, E. R., Korner, J., & Zougmore, R. B. (2019.). Climate services can support African farmers' context-specific adaptation needs at scale. Frontliners in Sustainable Food Systems, 3, 1-16. https://doi.org/10.3389/fsufs.2019.00021

Ibrahim, N., Mensah, K. T., Alhassan, H., Adzawla, W., & Adjei-Mensah, C. (2019). Analysis of smallholder farmers' perceptions on climate change, preference and willingness-to-pay for seasonal climate forecasts information in Savelugu Municipality, Ghana. Asian Journal of Environment & Ecology, 9(1), 1-11. https://doi.org/10.9734/ajee/2019/v9i130084

Kom, Z., Nethengwe, N. S., Mpandeli, N. S., & Chikoore, H. (2020). Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. GeoJournal. https://doi.org/10.1007/s10708-020-10272-7

Levine, S., Ludi, E., & Jones, L. (2011). Rethinking support for adaptive capacity to climate change: The role of development interventions. Overseas Development Institute.

Lugen, M., Diaz, J., Sanfo, S., & Salack, S. (2018). Using climate information and services to strengthen resilience in agriculture: The APTE-21 Project in Burkina Faso (KLIMOS Working Paper No. 15). https://doi.org/10.13140/rg.2.2.27501.03044

Mathison, S. (1988). Why triangulate?. Educational Researcher, 17(2), 13-17. https://doi.org/10.3102/0013189X017002013

Manyozo, L. (2011). People's radio: Communicating change across Africa. Southbound.

Naab, F. Z., Abubakari, Z., & Ahmed, A. (2019). The role of climate services in agricultural productivity in Ghana: The perspectives of farmers and institutions. Climate Services, 13, 24-32. https://doi.org/10.1016/j.cliser.2019.01.007

Nguyen-Huy, T., Kath, J., Mushtaq, S., Cobon, D., Stone, G., & Stone, R. (2020). Integrating El Niño-Southern Oscillation information and spatial diversification to minimize risk and maximize profit for Australian grazing enterprises. Agronomy for Sustainable Development, 40(4). https://doi.org/10.1007/s13593-020-0605-z

Nyikahadzoi, K., Mombo, O., Zamasiya, B., & Warinda, P. (2017). Enhancing household food security under changing climatic conditions: A case study of Gokwe North and Hurungwe Districts in Zimbabwe. Journal of Agricultural & Food Information, 18(2), 96-109. https://doi.org/10.1080/10496505.2017.1297239

Oyekale, A. S. (2015). Access to risk mitigating weather forecasts and changes in farming operations in East and West Africa: Evidence from a baseline survey. Sustainability, 7(11), 14599-14617. https://doi.org/10.3390/su71114599

Pfaff, A., Broad, K., & Glantz, M. (1999). Who benefits from climate forecasts?. Nature, 397, 645-646. https://doi.org/10.1038/17676

Ponce, E. R., & Inocencio, A. B. (2017). Toward a more resilient and competitive Philippine rice industry: Lessons from the past three decades. International Rice Research Institute and Department of Agriculture.

Rao, K. P. C., Hansen, J., Njiru, E., Githungo, W. N., & Oyoo, A. (2015). Impacts of seasonal climate communication strategies on farm management and livelihoods in Wote, Kenya (CCAFS Working Paper No. 137). CGIAR Research Program on Climate Change, Agriculture and Food Security. https://cgspace.cgiar.org/handle/10568/68832

Roncoli, C., Ingram, K., & Kirshen, P. (2002). Reading the rains: Local knowledge and rainfall forecasting in Burkina Faso. Society & Natural Resources, 15(5), 409-427. https://doi.org/10.1080/08941920252866774

Sebastian, L. S. (2000). Bridging the rice yield gap in the Philippines. In M. K. Papademetriou, F. J. Dent, & E. M. Herath (Eds.), Bridging the rice yield gap in the Asia-Pacific Region (pp. 122-134). Food and Agriculture Organization of the United Nations.

Thomas, T. S., Pradesha, A., & Perez, N. (2015). Agricultural growth and climate resilience in the Philippines: Subnational impacts of selected investment strategies and policies (Policy Note 2). International Food Policy Research Institute. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/129543

Vogel, C., & O'Brien, K. (2006). Who can eat information? Examining the effectiveness of seasonal climate forecasts and regional climate-risk management strategies. Climate Research, 33(1), 111-122. https:doi.org/10.3354/cr033111

Washington, R., & Downing, T. E. (1999). Seasonal forecasting of African rainfall: Prediction, responses and household food security. The Geographical Journal, 165(3), 255-274. https://doi.org/10.2307/3060442

Yin, R. K. (2003). Applications of case study research (2nd ed.). Sage Publication.