WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Climate Change and Rice Production in Victoria, Oriental Mindoro Philippines

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ABSTRACT

In order to suggest adaptation strategies to increase production in response to climate change, it is imperative that this study on how climate change affects rice farm yield be carried out. Although the quantitative approach was the primary strategy employed in this study, the qualitative approach was equally helpful and beneficial. The subjects of the study were 104 rice farmers of Victoria, Oriental Mindoro, Philippines. This study used purposive sampling technique. The primary tool used to collect the study's data was the survey questionnaire. Key informant interviews with individuals who had significant roles in community-level adaptation and mitigation measures enabled the use of an additional data source. The procedure of gathering data also involved field observations. The yield and productivity of rice increase with farmers' ability to adjust to climatic change. It is becoming increasingly important for rice growers to understand how climatic variability and change may impact rice output and yield. Rice growers have made steps to lessen climate change's influence on rice yield and production. Farmers have changed their rice-growing techniques and procedures to better respond to climate change. More studies are required on how rice is grown in extremely hot or cold climates, as well as on adaptation strategies such changing the date of sowing.

Keywords: adaptive capacities; knowledge; response and climate change; rice production

Introduction

The average global temperature, humidity, and precipitation patterns over extended periods of time are referred to as the climate. The Earth's atmosphere is enriched with heat-trapping substances because of the combustion fuels from fossils, which is the main driver of changes in the climate, one of the many global phenomena. In addition to the raising temperatures brought on by global warming, these effects include melting ice masses, changed plant bloom, rising sea levels, and extreme weather occurrences (NASA, 2016).

The economic development of a nation can be significantly derailed by climate change. The consequences climate change's impact on agriculture are a global issue for many agricultural nations, as they are the most vulnerable to the phenomenon. In these countries, the livelihoods of a greater number of people are at danger, and the agricultural sector alone contributes a higher amount of their GDP. Climate change is having a detrimental effect on rice productivity, which causes issues with the security of food and livelihood.

Agriculture is greatly impacted by changes in the climate. Global food security is predicted to be threatened by climate change. Warmer weather speeds up the growth of major crop kinds, but it also lowers yields. Warmer temperatures tend to accelerate crop growth. Faster growth can shorten the time it takes for seeds to develop and mature, which can lower yields for some crops, like grains (IPCC, 2014).

Climate change is a major worldwide issue that needs immediate attention from all areas of society. The significant and pervasive impacts of changing temperature on individuals and the natural world render it a critical issue pertaining to agriculture industry.

As to The United Nations Framework Convention on Climate Change (2007), adaptation pertains to the strategies that societies employ to enhance their capacity to manage an uncertain future. The core of climatic alteration modification is making the required adjustments and changes to either minimize its negative consequences or take advantage of its positive elements.

"The effects of these changing conditions on agriculture are obvious, but there are significant gaps in our knowledge of how agricultural systems can be affected by both short-term and long-term changes in climate and what implications these changes will have for rural livelihoods, particularly among the most vulnerable," in accordance with the Inter- Climate Change Panel of the Government (2007). Global net agricultural production suffers because there are opportunities for increased production for some regions and crops, but for the majority, there is a paucity of information regarding the consequences at scales that are pertinent to research priorities.

Climate patterns and fluctuations like temperature, precipitation, and solar radiation have a significant impact on agriculture. Crop yields are affected in different ways by temperature changes, CO2 levels, and the severity of extreme weather. For instance, an increase in temperature may be advantageous

for certain crops while having a negative effect on others. By altering factors like nutrient levels, soil moisture, water availability, etc., climate change may indirectly affect agriculture in South East Asia. Changing the climate is predicted to possess a variety of effects on agriculture. Crop yield may be impacted by variations in precipitation and runoff, which in turn may impact the quality and availability of water. However, the area already has water stress because of its dense population, and the consequences agricultural production will be influenced by both climate change's direct and indirect consequences on regional rainfall. World Resources Institute, (IPCC, 2007)

Current investigation of output levels over the past over the course of three decades suggests that temperature has a stronger influence than rainfall, and that while levels of rice output have risen in elevated latitudes, certain losses have occurred in regions with higher temperatures, according to a recent key study by Lobell et al. (2011). They said that scientific assessments usually understate the implications of climate change by ignoring its more subtle effects, including more severe precipitation episodes and very high-temperature days.

According to study by Allison et al. (2009), the level of education of a nation's citizens affects both its capacity to adapt to and vulnerability to the consequences of climate change.

Furthermore, Chithranayana and Punyawardena (2008) pointed out that if adaptive strategies are used, the negative consequences of climate change will be much reduced and farmers will be ready to manage the uncertainties caused by the phenomena.

The Philippines is another country that is concerned about climate change. Climate change has affected rice production in the municipality of Victoria in the province of Oriental Mindoro. Extreme weather phenomena like protracted drought and devastating recurring floods are a result of climate change. Given their limited capacity to withstand extended droughts, floods, and other extreme weather events, rice producers are known to be concerned about climate change. In order to suggest adaptation strategies to increase production in response to climate change, it is imperative that this study on how climate change affects rice farm yield be carried out.

The effects of climatic change on the rice output of certain farmers in Victoria, Oriental Mindoro, Philippines, were ascertained in this study. This research specifically sought to determine the adaptive capacities of the chosen rice farmers with regard to adaptation activities, climate information utilization, and weather event and seasonality climate prediction knowledge; to identify the knowledge of the chosen rice farmers with regard to climate variability and change awareness, exposure to hydromet hazards over a five-year time horizon, and decision-making influenced by weather and alterations in the climate; to ascertain the responses of the chosen rice farmers' adaptation to climatic unpredictability and change; and to suggest adaptation measures to improve rice production.

Methods

This study used descriptive research. The study was conducted in Victoria, Philippines' Oriental Mindoro. The most frequent extreme weather events linked in response to the region's climate change were droughts and floods. El Niño periods were typically associated with drought and heavy precipitation, but typhoons were often associated with flooding. Additionally, the surrounding river basin's rainfall distribution showed significant temporal and spatial variability due to the monsoon system. A time frame that exceptionally long periods of dry weather was called a period of dearth. The drought was characterized by unusual variations in the amount, duration, or arrival of rainfall during the wet season, unpredictable delayed appearance of rainfall during the early seasonal rainfall and an early conclusion of rainfall during the wet season. Lastly, flood levels were quite high, and in most places, they were likewise high for wet rice farming.

Purposive sampling method was used to gather the data in this study using the 104 rice farmers. The respondents were chosen on the basis of their capacity to provide the most comprehensive answers, describe the ways in which rice production is influenced by natural extreme events, and talk about the precautions acquired. They were the farmers who made their living from agriculture, particularly from farming rice. They were believed to exist as the group highest degree of vulnerability to the consequences of climate change, in particular flooding and drought.

The primary tool used to collect the study's data was the survey questionnaire. Key informant interviews with individuals who had significant roles in community-level adaptation and mitigation measures enabled the use of an additional data source. The procedure of gathering data also involved field observations. The year 2023 was covered in the study.

All empirical data gathered were subjected to the most appropriate statistical methods. All responses to the survey questionnaire was coded and processed automatically. For Part I to III, the data gathered were tabulated, analyzed and interpreted using frequency and percentage of responses to adaptive capacities, climate change events knowledge and responses to climate variability and change of selected rice farmers.

Results and Discussion

The adaptable capacities of a subset of rice farmers are shown in Table 1 with regard to adaptation activities. Sixty-one, or 58.65%, of the rice farmers harvest their harvests ahead of schedule, and 67, or 64.42%, of them join cooperatives, savings groups, or credit groups to consider rice crop insurance. Seventy-seven percent, or 77.04%, of rice farmers look for alternative ways to supplement their income. Additionally, because they are uncomfortable and unable to trust others with these, they oppose moving rice farm equipment to a safe location during flooding and typhoons with frequencies of 58 or 55.77%.

Table 1

Adaptive Capacities of Selected Rice Farmers in Terms of Adaptation Activities

Items	Yes		No		Total	%
	f	%	f	%		
1. Harvest the rice crops earlier than schedule.	61	58.65	43	41.35	104	100
2. Move farm equipment to safe place during flooding and typhoon.	58	55.77	46	44.23	104	100
3. Join savings/credit group/cooperative for consideration rice crops insurance.	67	64.42	37	35.58	104	100
4. Pursue other means to generate additional income for rice farming.	77	77.04	27	25.96	104	100

The adaptive capacities of a subset of rice farmers with regard to the use of climate data are shown in Table 2. In particular, before planting, fertilizing, and harvesting rice crops with 89 or 85.58% frequencies, rice farmers make sure to examine the weather updates. Additionally, they take climate weather forecasts into account when planting, weeding, fertilizing, and harvesting (89 or 85.58%); when deciding how to use land and making long-term farm investments for rice crops (87 or 83.65%); when predicting the climate for the rice crop, planting schedule, and levels of input use (86 or 82.69%); and when forecasting the weather for transporting rice crops (83 or 79.61%).

Table 2

Adaptive Capacities of Selected Rice Farmers in Terms of Utilization of Climate Information

Items	Yes		No		Total	%
	f	%	f	%		
1. Prior to planting, fertilizing, and harvesting rice crops, make sure to check the weather forecast	89	85.58	15	14.42	104	100
2. When planting, weeding, fertilizing, and harvesting, take the climate and weather forecast into consideration.	89	85.58	15	14.42	104	100
3. Take into account the rice crop's climate forecast, the planting schedule, and the number of agricultural inputs used.	86	82.69	18	17.31	104	100
4. When moving rice harvests, take weather forecasting into account.	83	79.61	21	20.69	104	100
5. When making decisions about land use and long-term farm investments for rice crops, take climate projections into account.	87	83.65	17	16.35	104	100

Table 3 presents the adaptive capacities of selected rice farmers in terms of prediction knowledge on weather events and seasonality climate. Rice farmers have no knowledge on forecasting methods for the onset of rainy season or occurrence of heavy rains (72 or 69.23%); no knowledge on forecasting methods for the onset of dry season (84 or 80.77%); no knowledge on forecasting methods for the onset of drought (95 or 91.35%); no knowledge on forecasting methods for the El Niño phenomenon (103 or 99.04%); no knowledge on forecasting methods for the La Niño phenomenon (103 or 99.04%); lacking any firm beliefs about whether it is good or bad luck to begin preparing land for a rice farm (103 or 99.04%), or whether the upcoming rice cropping season will be good or bad (104 or 100%).

Table 3

Adaptive Capacities of Selected Rice Farmers in Terms of Prediction Knowledge on Weather Events and Seasonality Climate

Items	Yes		No		Total	%
	f	%	f	%		
1. Have knowledge on forecasting methods for the onset of rainy season or occurrence of heavy rains.	32	30.77	72	69.23	104	100
2. Have knowledge on forecasting methods for the onset of dry season.	20	19.23	84	80.77	104	100
3. Have knowledge on forecasting methods for the onset of drought.	9	8.65	95	91.35	104	100
4. Have knowledge on forecasting methods for the El Niño phenomenon.	1	0.96	103	99.04	104	100
5. Have knowledge on forecasting methods for the La Niño phenomenon.	1	0.96	103	99.04	104	100

6. Do you have any specific beliefs that affect whether starting to prepare land for a rice plantation is lucky or unlucky?	1	0.96	103	99.04	104	100
7. Have any certain belief if the coming rice cropping season would be poor or good.			104	100	104	100

A selection of rice farmers' awareness of climate change and unpredictability is shown in Table 4. With frequencies ranging from 72 or 69.23% to 103 or 99.04%, rice farmers are aware of climate variability and change because of significant temperature changes in the last three decades, long-term variations in precipitation over the last three decades, changes in the frequency of drought occurrence changes in the previous three decades have been the frequency of flooding over the last three decades, alterations in water availability over the past 30 years, and the occurrence of El Niño and La Niña over the past 30 years.

Table 4

Knowledge of Selected Rice Farmers in Terms of Awareness on Climate Variability and Change

Items	**Yes**		**No**		**Total**	**%**
	f	**%**	**f**	**%**		
1. Have noticed any significant changes in the temperature over the last 30 years.	102	98.08	2	1.92	104	100
2. Have noticed any long-term changes in the rainfall over the last 30 years.	103	99.04	1	0.96	104	100
3. Have noticed any changes in the frequency of drought occurrence over the last 30 years.	102	99.08	2	1.92	104	100
4. Have noticed any changes in flooding occurrence over the last 30 years.	92	88.46	12	11.54	104	100
5. Have noticed any changes in water availability over the last 30 years.	98	94.23	6	5.77	104	100
6. Have noticed the occurrence of El Niño over the last 30 years.	94	90.38	10	9.62	104	100
7. Have noticed the occurrence of La Niña over the last 30 years.	72	69.23	32	30.77	104	100

Table 5 presents the knowledge of selected rice farmers in terms of exposure to hydromet hazards over the five-year time horizon. Rice farmers are exposed to hydromet hazards over the five-year time horizon in terms of having unusually strong winds that affect the community in the last five years (100 or 96.15%); having flooding events that affect the community/ barangay in the last five years (94 or 90.38%); having typhoons that affect people in the community/ barangay in the last five years (104 or 100%); having drought events that affect community/ barangay in the last five years (93 or 89.42%); having rainfall variabilities that affect the community/barangay (98 or 94.23%); and have price volatilities of inputs and outputs that affect the community/barangay (100 or 96.15%).

Table 5

Knowledge of Selected Rice Farmers in Terms Exposure to Hydromet Hazards Over the Five-Year Time Horizon

Items	**Yes**		**No**		**Total**	**%**
	f	**%**	**f**	**%**		
1. Have unusually strong winds that affect the community in the last five years.	100	96.15	4	3.85	104	100
2. Have flooding events that affect the community/ barangay in the last five years.	94	90.38	10	9.61	104	100
3. Have typhoons that affect people in the community/ barangay in the last five years.	104	100			104	100
4. Have drought events that affect community/ barangay in the last five years.	93	89.42	11	10.58	104	100
5. Have rainfall variabilities that affect the community/barangay.	98	94.23	8	5.77	104	100
6. Have price volatilities of inputs and outputs that affect the community/barangay.	100	96.15	4	3.85	104	100

Table 6 presents the knowledge of selected rice farmers in terms of decision-making influenced by weather and climate change. Rice farmers' decisions in different situations of flood and drought are influenced by weather and climate change with frequencies ranging from 89 or 85.53% to 104 or 100%.

Typically, farmers budget for the repair or restart of their rice production in the future and have an adequate supply of rice seeds on hand. They have enough seed for a second crop in case the first is destroyed by flooding. In addition to saving money to make sure they have an adequate supply in case they require it purchase new fertilizer and seedlings; farmers frequently keep their farm equipment in locations that are less susceptible to flooding.

The drought typically lasts from March to April. Agricultural droughts have been caused in part by unpredictable rainfall (both in terms of volume and duration) and the postponement or early termination of monsoon rains. The drought has caused harm to transplanted seedlings or prevented farmers from planting wet season rice.

Table 6

Knowledge of Selected Rice Farmers in Terms Decision-Making Influenced by Weather and Climate Change

Items	**Flood**						**Drought**					
	Yes		**No**		**Total**	**%**	**Yes**		**No**		**Total**	**%**
	f	**%**	**f**	**%**			**f**	**%**	**f**	**%**		
Influence the decision on the schedule and level of fertilizer application.	104	100			104	100	104	100			104	100
Influence the decision on the schedule and level of pesticide application.	102	99.08	2	1.92	104	100	99	95.19	5	4.91	104	100
Influence the irrigation decisions.	102	99.08	2	1.92	104	100	100	96.15	4	3.85	104	100
Influence the decision to implement rice crop protection measures or build protective structure.	99	95.19	5	4.91	104	100	100	96.15	4	3.85	104	100
Influence the harvesting decisions.	104	100			104	100	95	91.35	9	8.65	104	100
Influence the storage decisions.	102	99.08	2	1.92	104	100	93	89.42	11	10.58	104	100
Influence the rice crop choice for the next season.	102	99.08	2	1.92	104	100	103	99.04	1	0.96	104	100
Influence the rice planting schedule for the next season.	102	99.08	2	1.92	104	100	102	99.08	2	1.92	104	100
Influence the decision to look for off-farm labor next season.	89	85.58	15	14.42	104	100	91	87.50	13	12.50	104	100
Influence the allocation of financial resources for the next season.	103	99.04	1	0.96	104	100	103	99.04	1	0.96	104	100
Influence the allocation of rice farm land for the next season.	101	97.12	3	2.85	104	100	103	99.04	1	0.96	104	100

Table 7 responses of the selected rice farmers to climate variability and change. All are adaptive options of rice farmers to climate change for improvement of rice production except for Install water-harvesting system for rice crops (89 or 85.58%), terracing (72 or 69.23%) and mulching (92 or 88.46%).

Table 7

Responses of the Selected Rice Farmers to Climate Variability and Change

Items	Yes		No		Total	%
	f	%	f	%		
1. Change rice crop or variety to plant.	79	75.96	25	24.04	104	100
2. Change timing of rice planting.	88	84.62	16	15.38	104	100
3. Change location of area planted.	83	79.81	21	20.19	104	100
4. Use of rice cropping calendar.	103	99.04	1	0.93	104	100
5. Buy rice insurance.	103	99.04	1	0.93	104	100
6. Install water-harvesting system for rice crops.	15	14.42	89	85.58	104	100
7. Install water irrigation.	103	99.04	1	0.93	104	100
8. Build ditches to direct water or floods away from certain areas.	103	99.04	1	0.93	104	100
9. Replant rice crops after flooding subsided.	86	82.69	18	17.31	104	100
10. Terracing.	32	30.77	72	69.23	104	100
11. Mulching.	12	11.54	92	88.46	104	100
12. Increase amount of money used for acquisition of farm inputs, etc.	103	99.04	1	0.93	104	100
13. Land management (maintain yields and soil fertility).	103	99.04	1	0.93	104	100
14. Transfer to another rice farm.	0		104	100	104	100

Response times to floods were frequently brief. Notwithstanding the works of all parties involved throughout the crisis intervention phase, farmers have been severely impacted by the effects of severe flooding. Agriculturalists must invest much time and effort, and money to compensate for the losses caused by flooding. People can recover rapidly if they have enough money stored up.

Farmers have responded to droughts in a variety of ways, depending on their own capabilities and resources. Farmers that grow rice have changed the dates of their plantings and employed new seeds and methods. However, they have largely failed because to the lack of surface water sources, sensitive rainfall volatility, and inaccurate local weather forecasts. In several areas, farmers have constructed wells to pump groundwater for household consumption instead of irrigating fields, in contrast to other parts of the region. If there is little rain at the onset of the rice cultivation season, agriculturists will need to modify their cultivation schedule.

The study offers valuable insights into the mitigation and adaptation processes of climate change within the context and experiences of impacted rice-farming communities in Victoria, Philippines' Oriental Mindoro. To mitigate the long-term impacts on agricultural systems and the environment, this identifies strategies for anticipating and recovering caused by natural disasters and occurrences, particularly droughts and floods, as the effects of climatic change will exert a substantial influence on agricultural production. The report's conclusion outlines mitigation as well as adaptation tactics that may serve as workable solutions regarding the ramifications of climate change. Public, private, and civic associations could advocate for the authorities to adopt or enforce these policies.

The more adaptable rice farmers are to climate change, the higher the yield and productivity. The need for rice producers to comprehend how climate change and variability will affect rice yield and output is growing. Rice producers have responded to the mitigation of the impact of climate change on rice output and yield. Farmers have changed their rice-growing techniques and procedures to better respond to climate change.

Improved water management and perhaps soil fertility will be required in addition to gradually changing current types for higher temperature seasons, which is how rice producers should gain from climate change. Rice producers should decide that staying with present varieties will have a detrimental impact on rice yields due to climate change, while adopting varieties with higher temperatures and keeping up with the growing season's shorter growing time will have favorable impacts. More studies are required on how rice is grown in extremely hot or cold climates, as well as on adaptation strategies such changing the date of sowing.

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