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## ANALYSIS OF THE IMPACT OF EXTREME FLOOD EVENTS ON RICE PRODUCTIVITY AND WELL-BEING OF FARMERS IN BARANGAY BUCAYAO AND PANGGALAAN, CALAPAN, ORIENTAL MINDORO

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### ABSTRACT

The study analyzed the impact of extreme flood events on rice productivity and well-being of registered rice farmers of Barangay Bucayao and Barangay Panggalaan, Calapan City Oriental Mindoro for the basis of a mitigation plan. The study used a mixed-method research design to provide a comprehensive understanding of the impact of extreme flood events on rice production and the wellbeing of rice farmers of Barangay Bucayao and Barangay Panggalaan for the basis of the mitigation plan. The quantitative data provides insights into the profile of the rice farmers, while the qualitative data is used to measure the impact of the extreme flood events on rice production and the well-being of rice farmers of two barangays. The data analyses were used to develop a mitigation plan to help rice farmers minimize the impact of future extreme flood events. Results of the study show that extreme flood events caused the total destruction of rice fields implicating a severe impact on rice production and a high impact on the well-being of rice farmers both positive and negative. Rice farmers learn to develop response mechanisms and adapt the mitigation strategies utilized by their barangay to minimize the impact of extreme flood events. However, immediate response to ongoing and future extreme flood events is a must. Rice farmers, though have second thoughts about the possible outcome of the implementation of a mitigation plan, they are willing to hold on for the security of their livelihood.

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**Keywords:** *extreme flood events, farming system, mitigation plan, rice productivity, well-being*

## Introduction

Rice serves as the staple food for more than half of the global population. However, climate change-induced extreme weather events including floods pose a great risk to different agricultural communities worldwide. Under the impacts of climate change, the seriousness of floods would increase as they become more intensified, deeper, and longer, consequently, the loss they would cause to rice production would increase significantly (Giang et al., 2019). Likewise, the increasing frequency and severity of these events will pose a significant threat to millions of rice farmers who depend on the crop for their livelihood and food security. This will create an impact as rice farming is a source of income and employment for millions of farmers and their family members in Asia.

The province of Oriental Mindoro is dubbed as the Rice Granary of MIMAROPA with 35% of rice production in the region. However, the province is also extremely vulnerable to floods due to tropical storms and monsoon rains devastating major crops like rice, corn, and banana. In fact, the Department of Environment and Natural Resources has identified the province as one of the top ten most flood-prone areas in the country. Barangay Bucayao and Barangay Pangalaan, in Calapan City, were barangays with massive river channels resulting in frequent floods almost yearly where rice farmers were greatly affected. These rice farmers face significant challenges in sustaining their livelihood and well-being when exposed to these recurring flood events.

The general objective of the study is to analyze the impact of extreme flood events on the rice productivity and well-being of the rice farmers in Barangay Bucayao and Barangay Pangalaan, Calapan City, Oriental Mindoro for the basis of a mitigation plan. The study

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recommends a mitigation plan to minimize the impact of extreme flood events on the rice productivity and well-being of the rice farmers in the two barangays. The following are the specific objectives of the study: (1) Analyze the profile of rice farmers in Barangay Bucayao and Barangay Pangalaan in terms of socio-demographic and socio-economic characteristics (2) Describe the rice production system of farmers in both barangays. (3) Determine the impact of extreme flood events on rice productivity and the well-being of farmers in the two barangays. (4) Identify the adaptation and mitigation plan employed by farmers to cope with extreme flood events.

## Review of Literature

Flooding is the overflowing of large amounts of water beyond its normal limits, especially on normally dry land.

According to Nott (2006), the causes of floods can be divided into physical factors, climate and human influences such as vegetation clearing and urban development. The most common causes of flooding are related to climate, especially rainfall.

Prolonged rains are the most common cause of flooding worldwide. These events are usually associated with continuous rainfall over several days, weeks, or months. Human impacts on river basins influence flood behavior. In particular, changes in land use have a direct impact on the intensity and behavior of floods. Deforestation leads to increased runoff and often reduces channel capacity due to increased sedimentation rates.

According to Doreen (2003), human activities such as deforestation also lead to a decrease in the stability of hilltops to geological factors. She added that a combination of topographic, geological and climatic factors such as heavy rainfall is responsible for the flooding.

On the other hand, Antonio (2006) argues that flood disasters are directly related to human activities due to population pressure and urbanization, along with the degradation of

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environmental use, causing areas more vulnerable to natural disasters. The tendency to occupy floodplains has been a serious concern over the years.

According to Théodore and Simon (1967), in areas with frequent occurrence of measurable events such as hurricanes and tornadoes, floods occur more frequently with more devastating effects and the possibility of the river is not enough to accommodate large currents on either side from the upper river basins after heavy rains leading to flooding.

Bankoff (2003) states that in the Philippines, flooding is not a recent hazard, but one that has occurred throughout recorded history.

Borrows and De Bruin (2006) point out those floods are caused by the overflow of rivers, rivers can overflow their banks and this happens when there is more water upstream than normal and it flows downstream to adjacent low-lying areas and water infiltrates land.

In 2008, thousands of people were affected after flash floods engulfed hundreds of hectares of farmland in the northeast region after floods displaced hundreds of families in the area. Farmlands including some 1,200 pieces of farmland have seen their livelihoods and food security disrupted (Irin 2008).

More so, in the last decades, extreme weather has been responsible for widespread economic and social damages on a global scale. Between 1980 and 2019, extreme weather caused the death of 1.15 million people, with droughts being the event causing the highest number of deaths (around 50% of fatalities due to climate extremes), followed by storms and floods (Cesarani et al. 2021). Weather and climate have always been strictly linked with agricultural productivity. Climate variability accounts for roughly a third of yield variability globally, while in the substantial areas of the global breadbaskets, more than 60% of yield variability can be explained by climate variability (Ray et al. 2015).

Agriculture is particularly vulnerable to natural hazards too. Over the 2000–2018 period in low- and middle-income countries, agriculture alone absorbed 26% of the overall impact

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caused by medium- to large-scale natural disasters. Losses in agriculture relative to the combined industry, commerce, and tourism sectors in the same period accounted for 63% of the whole losses from natural disasters (FAO 2021). Even in high-income countries such as the European ones, agricultural losses due to extreme events are relevant. As an example, historical drought and heat waves in Europe reduced cereal yields on average by 9% and 7.3%, respectively, while non-cereal yields declined by 3.8–3.1% during the same set of events (Brás et al. 2021).

The increase in both the number and frequency of extreme events observed over the past years poses a significant challenge to agriculture, compromising global food security (Chavez et al. 2015). Climate change is expected to increase the frequency and severity of weather-related extreme events such as floods, droughts and storms (IPCC 2022), and therefore, the losses that the agricultural sector is going to experience in the next years are expected to increase (Cammalleri et al. 2020).

The quantification of danger severity alone is insufficient for developing risk management techniques (Bachmair et al. 2017). Because vulnerability is an important component of the risk chain (Wu et al. 2021), understanding crop susceptibility to both extreme weather events and climate change is critical for developing appropriate adaptation measures to successfully reduce yield losses. The usage of vulnerability curves, also known as vulnerability functions, stage damage functions, or damage curves, is a conventional way to assessing the detrimental impacts of extreme events (Dutta et al. 2003; Michel-Kerjan et al. 2013; Tarbotton et al. 2015).

To comprehend vulnerability (or damage) functions (or curves), it is necessary to define the idea of vulnerability adequately. (Adger 2006) defines "vulnerability" as "the degree to which the system is susceptible to and unable to cope with adverse effects of change." The United Nations International Strategy for Disaster Risk Reduction (UNISDR 2009) defined vulnerability as "the features and circumstances of a community, system, or asset that make it vulnerable to the damaging effects of a hazard." This concept incorporates several

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dimensions of vulnerability resulting from physical, social, economic, and environmental variables (e.g., poor building design and construction, inadequate asset protection, and a lack of public information and awareness, among others). According to this definition, vulnerability is a feature of the element at risk that is independent of its exposure to any hazard. However, the word vulnerability is frequently used more widely to incorporate the element's exposure in the quantitative assessment of the risk associated with a given hazard.

On the other hand, it is also becoming increasingly important to pay attention to the welfare of farmers, as floods not only cause physical property damage but also create high levels of stress that can have serious effects on health.

Flooding is a serious environmental threat in many parts of the world, with the potential to have harmful consequences on human life, health and livelihoods. The frequency and severity of floods are increasing in many parts of the world as land-use planning processes and climate change are expected to increase rainfall intensity (Smith et al., 2014). ; Watts et al., 2015 ). For example, recent estimates of increased flooding due to development, land management, and climate change have contributed to increased concern about the impact of future flooding in the United Kingdom (Committee on Climate Change, 2015).

A substantial body of evidence has established that floods have direct health impacts such as the risk of death and injury, disease outbreaks, such as gastroenteritis, and water quality issues (Alderman et al., 2012). But floods are also a deeply traumatic experience for those affected. Multiple studies highlight higher occurrences of mental health issues (such as anxiety, depression, and posttraumatic stress disorder) in populations that have experienced flooding (Ahern et al., 2005, Carroll et al., 2009, Stanke et al., 2012, Alderman et al., 2012, Fernandez et al., 2015). Research further documents some of the factors that exacerbate the mental health consequences of flood experience, such as the flood duration, the economic and social consequences of recovery, and the emotional labour involved (Fordham and Ketteridge, 1995, Medd et al., 2015, Tapsell et al., 2002, Tapsell and Tunstall, 2001, Tapsell and Tunstall, 2008, Whittle et al., 2012). Although the socio-psychological health

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impacts of floods have long been established, most empirical studies have focused on the analysis of single outcomes or particular factors that affect psychological health. Less attention has been given to analysis of how multiple factors and processes combine to contribute to wider wellbeing outcomes.

Furthermore, floods can impact societies in multiple ways, ranging from the loss of life, injuries, and mental health effects to the destruction of assets (Bubeck, Otto, & Weichselgartner, 2017), which results in flooding being considered the most significant natural hazard to affect humanity (UNISDR, 2011). Asia is especially prone to flood impacts – for example, a typhoon in November 2017 resulted in around 110 deaths and a monetary loss of 650 million USD across the Philippines and Vietnam (Munich Re, 2018). Moreover, while the impacts of floods are large today, flood impacts are projected to increase due to socio-economic development and climate change. The effects of socioeconomic develop and climate change could result in more people and assets being susceptible to harm (IPCC, 2014). To counteract the increasing threat posed by flooding a range of effective adaptation strategies are needed.

In addition, flood severity has traditionally been considered as one of the main factors that can lead to mental disorders in people experiencing flooding. Many authors consider water depth as an indicator of flood severity. For example, Lammond et al. [2015], Paranjothy et al. [2011], and Tunstall et al. (2006) found that the prevalence of mental health symptoms increased with flood water levels. Another factor that characterizes the severity is the speed of the flow. The role of this factor has only been studied in physical health, e.g. mortality and injury [Foudi et al., 2015; Jonkman and PenningRowsell, 2008; Penning-Rowsell et al., 2005] and infrastructure [Kreibich et al., 2009; Thielen et al., 2005], but no effect on mental health. According to the Department of Environment, Food, and Rural Affairs [2006], the degree of danger that floods pose to people depends on both the depth and speed of the flood water. Based on a combination of speed and depth, the Ministry of Environment, Food

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and Rural Affairs [2006] classifies the potential physical health effects of flood hazards into different hazard categories: low, moderate, significant and extreme.

Overall, it is important to be attentive to the interconnections between different factors underlying wellbeing impacts, as the research highlights that it cannot be fully understood in isolation. For example, the negative impact of evacuation on residents' well-being stemmed from a combination of a sense of powerlessness, a lack of community support, the long-term stress of being away from home and having to rebuild homes, as well as continued concerns about future flood risk. It is only by understanding the ways that these different social dimensions interact in affecting and constituting wellbeing that interventions can counteract the detrimental impacts on wellbeing from floods and other environmental hazards.

## The Conceptual Framework

The conceptual framework illustrates the relationship between Independent Variable and Dependent Variable.

The independent variable is extreme flood events.

The dependent variables are rice productivity and well-being of rice farmers of Barangay Bucayao and Barangay Pangalaan.

It is also observed that the two type of variable is connected through broken single-headed arrow lines which denotes the mitigation plan in minimizing the impact of extreme flood events on rice productivity and well-being of the rice farmers in two (2) barangay.

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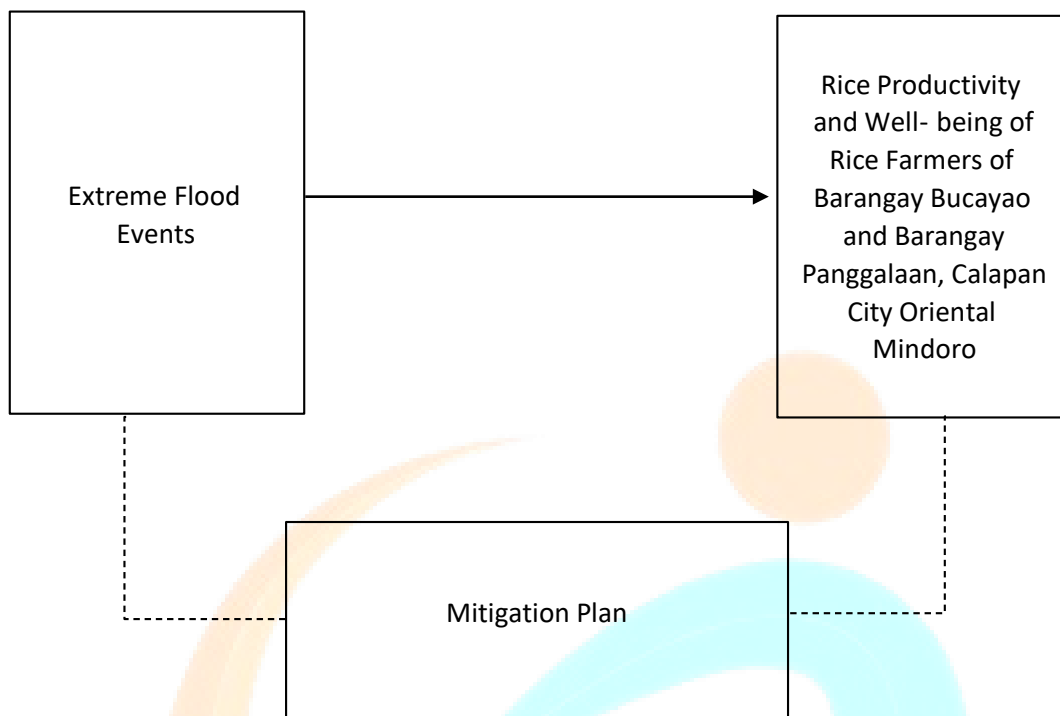


Figure 1. The Conceptual Framework of the Study

## METHODOLOGY

### Locale of the Study

The study was conducted in Barangay Bucayao and Barangay Panggalaan, Calapan City Oriental Mindoro, located in a third-class component city in the First Congressional District in the Province of Oriental Mindoro, Region IV-MIMAROPA.

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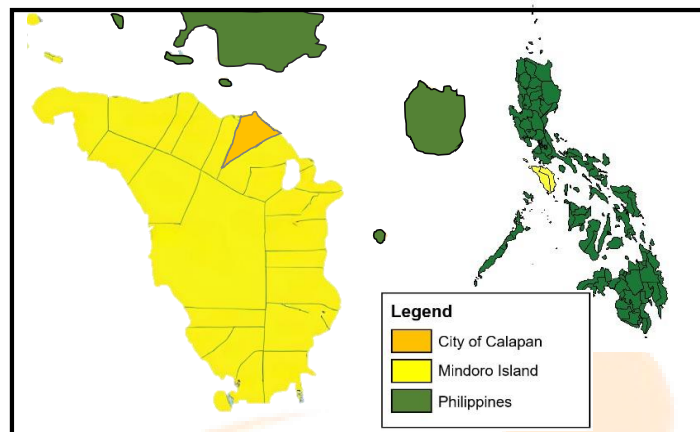


Figure 2. The location map of Calapan City, Oriental Mindoro

## Research Design

The study used a mixed-method research design to provide a comprehensive understanding of the impact of extreme flood events on rice production and the well-being of rice farmers of Barangay Bucayao and Barangay Panggalaan. The quantitative data provides insights into the profile of the rice farmers, while the qualitative data is used to measure the impact of the extreme flood events on rice production and well-being of rice farmers of Barangay Bucayao and Barangay Panggalaan. The analyses of data were used to develop a mitigation plan to help rice farmerS minimize the impact of future extreme flood events.

## Respondents and Data Collection

The respondents of this study are one hundred fifteen (115) registered rice farmers where sixty- one (61) are from Barangay Bucayao and fifty- four (54) from Barangay Panggalaan. The list was provided by the President of the Farmers' Association. For the focused group discussion, ten (10) participants were gathered, composed of Farmers' Association Officials, farmer barangay officials, eldest farmers, and rice farmers.

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The study used both secondary and primary data. Secondary data were gathered from the related literature. The primary data were taken from the in-depth interviews with registered rice farmers through person-to-person interviews and focus group discussion.

### Method of Data Analysis

Descriptive statistics were used to analyze the relationship between extreme flood events and rice productivity and well-being of rice farmers.

## RESULTS AND DISCUSSION

### I. Profile of Rice Farmers in Barangay Bucayao and Barangay Pangalaan

#### 1. Socio-Demographic Characteristics of Rice Farmers

##### 1.1 Age Distribution

Fifty-six (56) or 49% of registered rice farmers from Barangay Bucayao and Barangay Pangalaan ages 55 and above, thirty-seven (37), or 32% ages 43- 54, and twenty-two (22), or 19% ages 31- 42. This indicates that most registered rice farmers from the two barangays are near to senior citizens.

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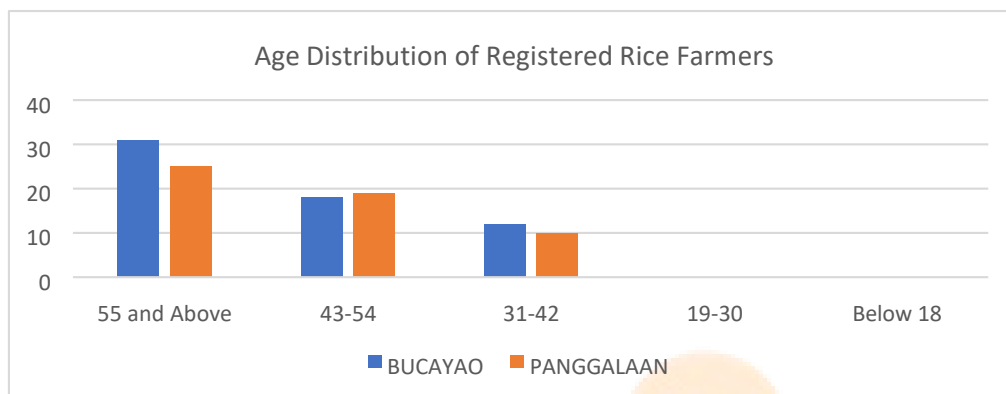


Figure 1.1. Age Distribution

### 1.2 Gender Distribution

Eighty-four (84) or 73% of registered rice farmers in Barangay Bucayao and Barangay Panggalaan are male and thirty-one (31) or 27% are female. This indicates that most registered farmers in the two barangays are male.

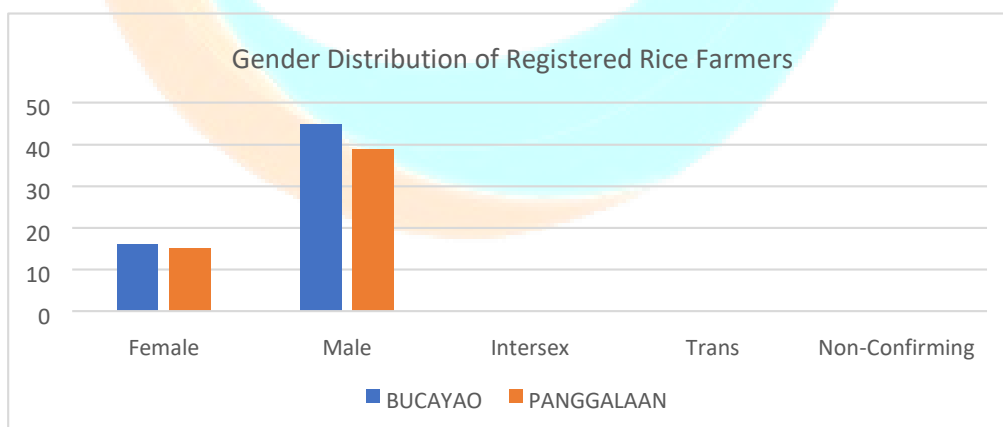


Figure 1.2. Gender Distribution

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### 1.3 Civil Status

Ninety-four (94) or 82% of registered rice farmers of Barangay Bucayao and Barangay Panggalaan are married, eight (8) or 7% are widowed, six (6) or 5% are living with a partner, five (5) or 4% are never been married, and two (2) or 2% are separated. This indicates that most registered rice farmers of two barangays are living together with their spouse.

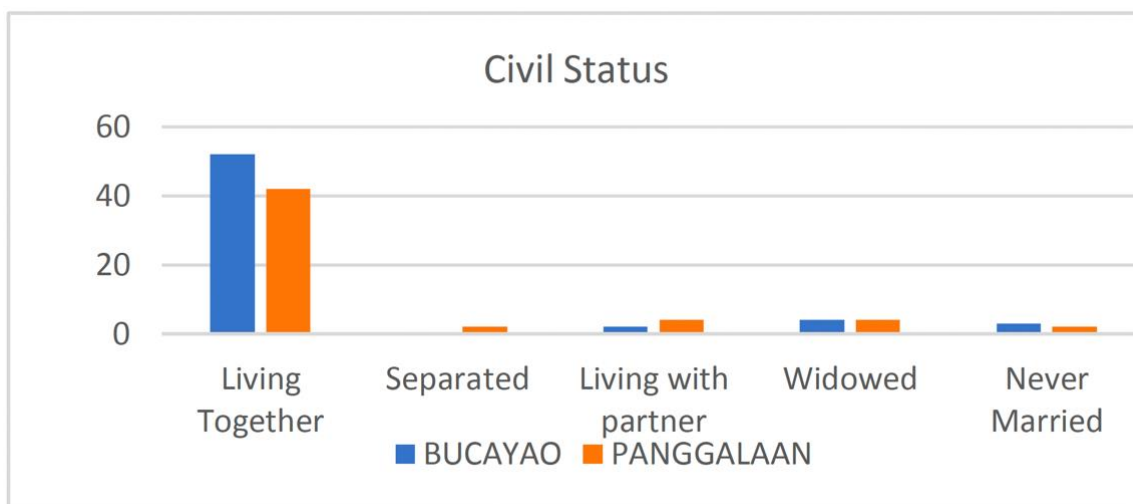


Figure 1.3. Civil Status

### 1.4 Ethnicity

One hundred fifteen (115) or 100 % of registered rice farmers from Barangay Bucayao and Barangay Panggalaan do not belong to in ethnic group. This indicates that all registered farmers from the two barangays do not belong to any minority group.

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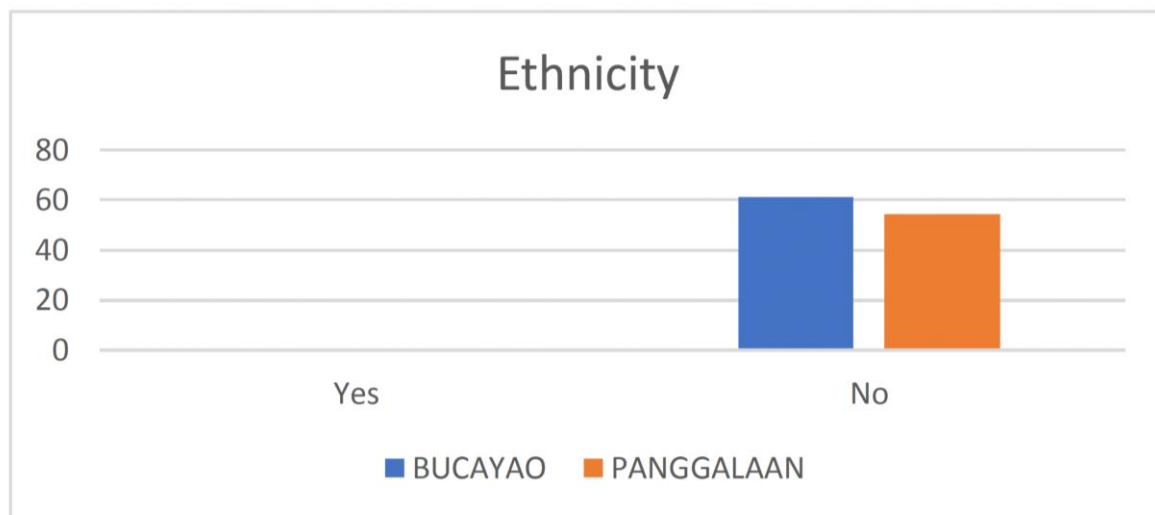


Figure 1.4. Ethnicity

## 2. Socio-Economic Characteristics of Rice Farmers

### 2.1 Educational Background

Forty-eight (48) or 42% of registered farmers in Barangay Bucayao and Barangay Panggalaan attained secondary level, forty-two (42), or 37% attained primary level, nineteen (19), or 17% attained tertiary level, five (5) or 4% attained graduate study, and one (1) or less than 1% has no education. This indicates that most of the registered rice farmers from the two barangays have formal education.

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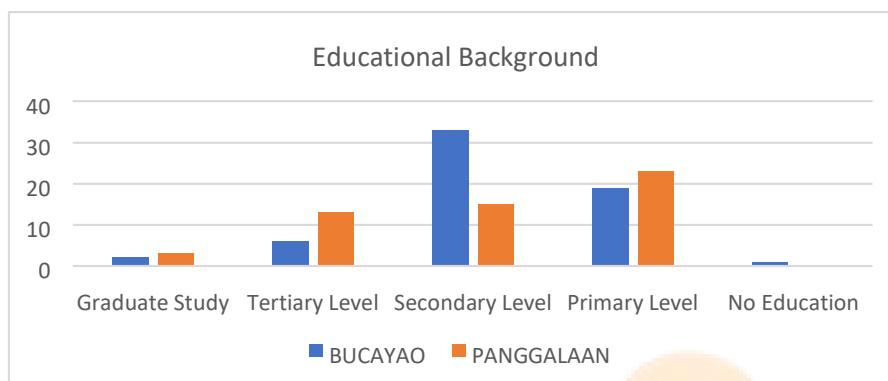
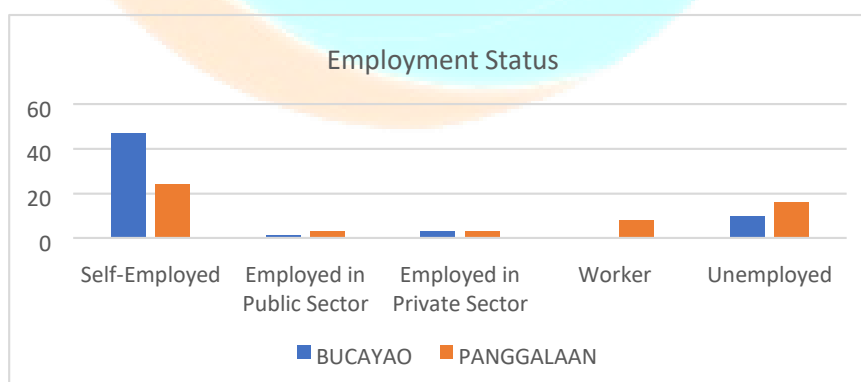


Figure 2.1. Educational Background

## 2.2 Employment Status

Seventy- one (71) or 62% of registered farmers from Barangay Bucayao and Barangay Panggalaan are self- employed, twenty- six (26), or 23% are unemployed, eight (8), or 7% are workers, six (6), or 5% are employed in private sector, and four (4) or 3% are employed in public sector. This indicates that most of the registered rice farmers in the two barangays is self-employed.



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Figure 2.2. Employment Status

### 2.3 Household Monthly Income

Forty- seven (47) or 41% of registered rice farmers of Barangay Bucayao and Barangay Pangalaan earned ₱ 5,001.00- 13, 000.00 in a month, thirty- two (32), or 28% earned below ₱ 5,000.00, twenty- eight (28) or 24% earned ₱ 13, 001.00- 21, 000.00, and both four (4) or 3% earned ₱ 21, 001.00- 29,000.00 and ₱ 29,001.00 and above.

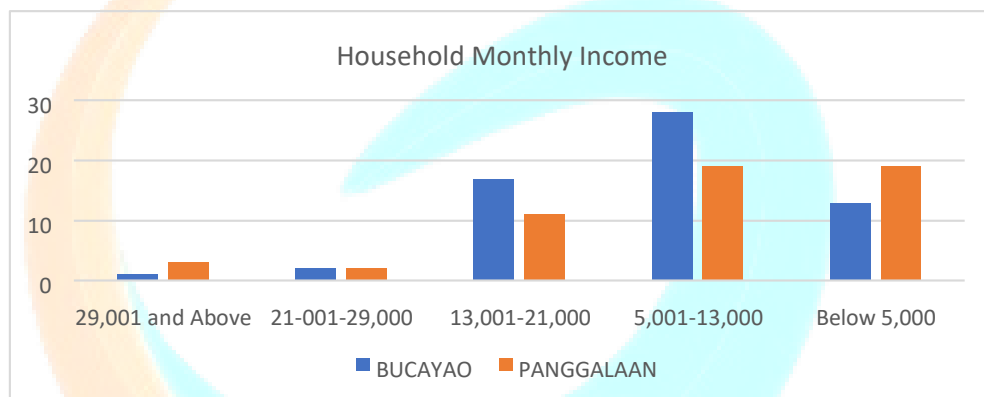


Figure 2.3. Household Income

### 2.4 Social Assistance

Forty-nine (49) or 43% of registered rice farmers from Barangay Bucayao and Barangay Pangalaan have no assistance received from public or private sector, thirty- four (34), or 30% received social assistance worth less than ₱ 1,000.00 in a month, eighteen (18) or 16% received ₱ 1,501.00- 3, 000.00 in a month, thirteen (13) or 11% received ₱ 4,501.00 and above in a month and one (1) or less than 1% received ₱ 3,001.00- 4,500.00 in a month.

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This indicates that most of the registered rice farmers from two barangay have social assistance either from the public or private sector.

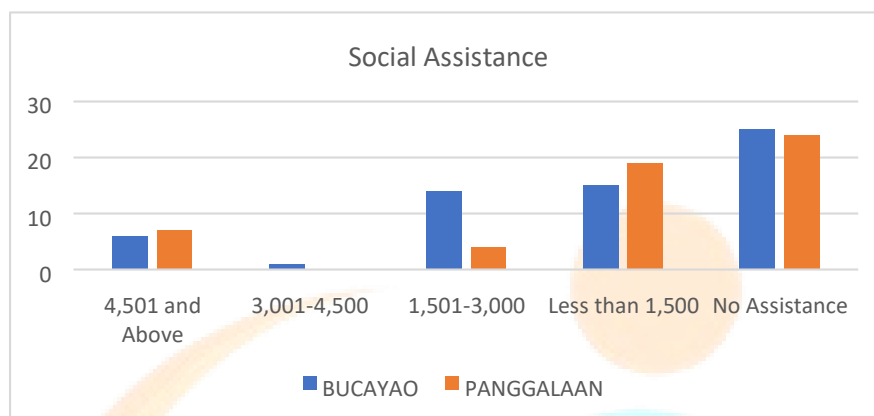


Figure 2.4. Social Assistance

## 2.5 Household Monthly Expenses

Fifty- seven (57) or 50% of registered rice farmers from Barangay Bucayao and Barangay Panggalaan spent ₱ 5, 001.00- 13, 000.00 every month, twenty- seven (27) or 23% spent below ₱ 5,000.00 every month, twenty- one (21) or 18% spent ₱ 13, 001.00- 21, 000.00 every month, five (5) or 4% spent ₱ 21, 000.000 29, 000.00 the same as ₱ 29, 001. 00 and above every month. This indicates that half of the registered rice farmers of two barangay spent below the average monthly expenses of a Filipino family.

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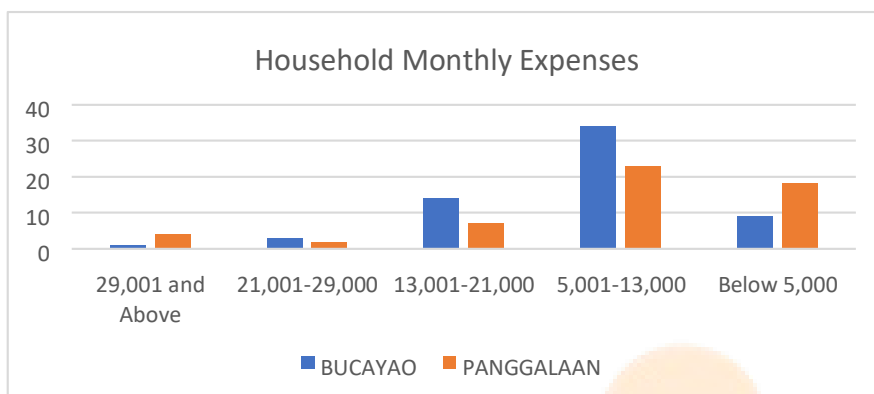


Figure 2.5. Household Monthly Expenses

## 2.6 Sense of Community Belongingness

Thirty- eight (38) or 33% of registered rice farmers from Barangay Bucayao and Barangay Panggalaan have an emotional connection to their community, thirty (30) or 26% see themselves as members of their community, twenty- five (25) or 22% influenced their compatriot, twenty- one (21) or 18% fulfilled the needs of their community, and one (1) or 1% has no community belongingness. This indicates that most registered rice farmers have a sense of community belongingness.

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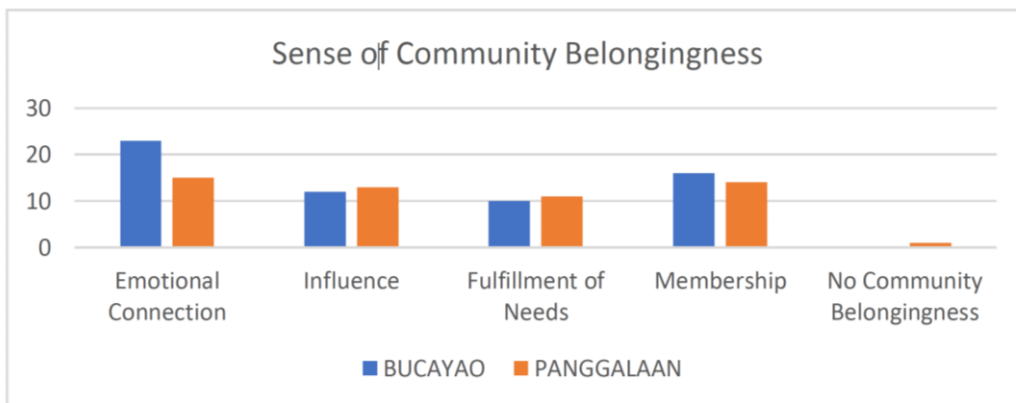


Figure 2.6. Sense of Community Belongingness

### 3. Understanding on Extreme Flood Events that Affect Rice Farmers In Barangay's Farming System

Eighty-two (82) or 71% of registered rice farmers of Barangay Bucayao and Barangay Panggalaan associated extreme flood events to "Heavy and Torrential Rainfall", twenty-five (25) or 22% were associated with "Rainfall above Normal", six (6) or 5% associated to "Normal Rainfall", and two (2) or 2% associated to "La Niña". This indicates that more than half of registered rice farmers believe that extreme flood events were caused by heavy and torrential rainfall.

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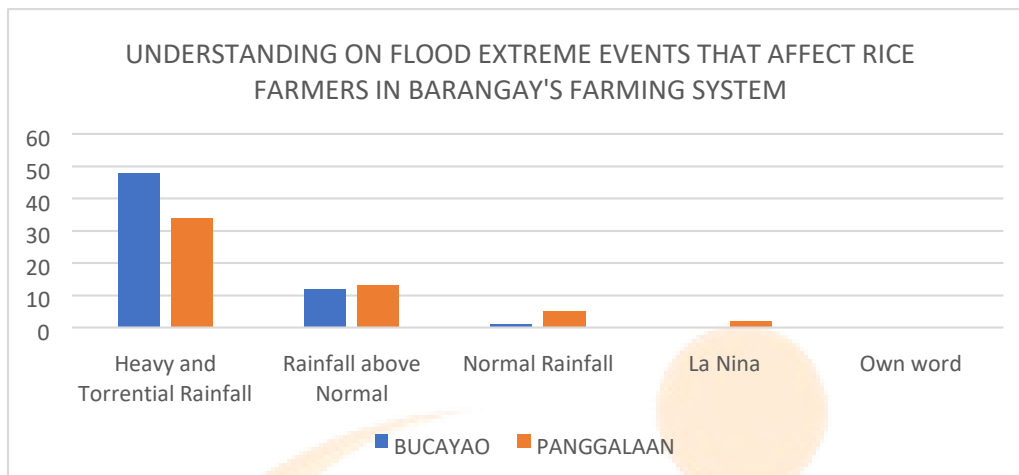


Figure 3.1. Understanding on flood extreme events.

#### 4. Level of Awareness of Rice Farmers in Extreme Flood Events

Seventy (70) or 61% of registered rice farmers in Barangay Bucayao and Barangay Panggalaan got a "Very High Level of Awareness on Extreme Flood Events, thirty- two (32) or 28 % got a "High

Level of Awareness on Extreme Flood Events", ten (10) or 9% got "Average Level of Awareness on Extreme Flood Events", two (2) or 2% got "Very Low Level of Awareness on Extreme Flood Events", and one (1) or 1% got "Low Level of Awareness on Extreme Flood Events". This indicates that more than half of the registered rice farmers of two barangays have a very high level of awareness of extreme flood events.

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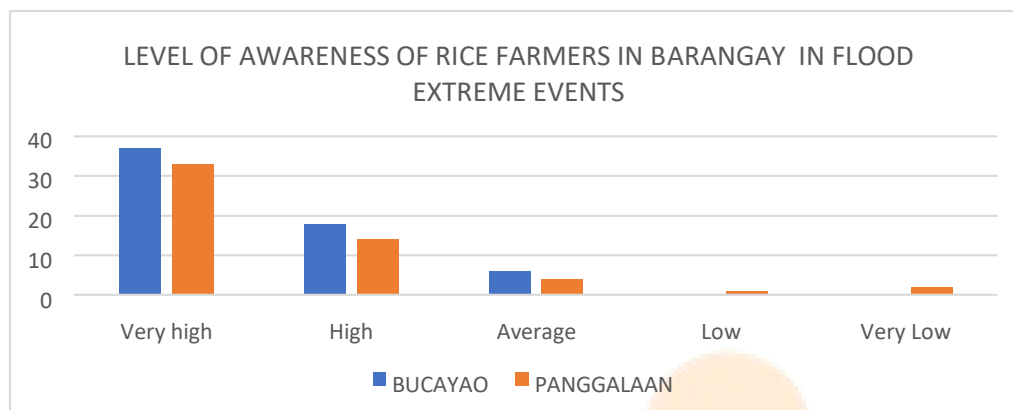
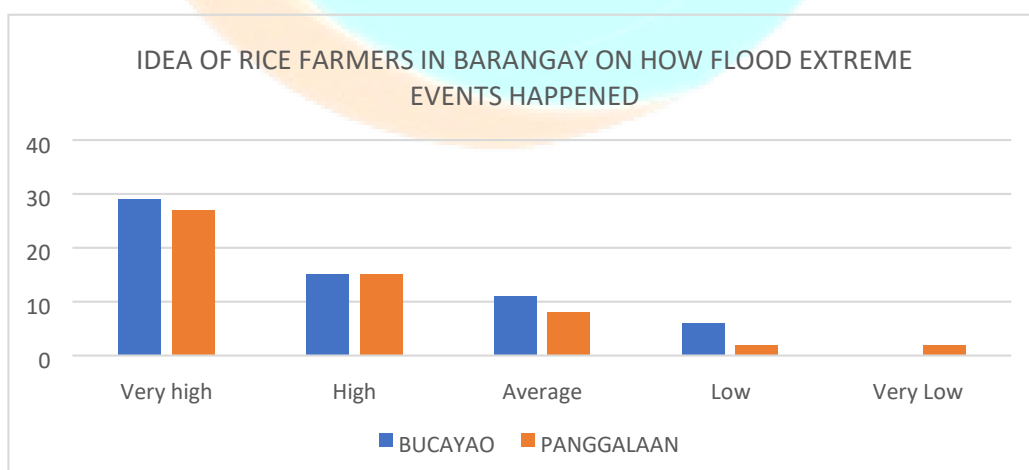


Figure 4.1. Level of awareness on flood extreme events

### 5. Idea of Rice Farmers on How Flood Extreme Events Happened

Fifty- six (56) or 49% of registered rice farmers in Barangay Bucayao and Barangay Panggalaan got "Very High" in the idea of how extreme flood events happened, thirty (30) or 26% got "High", nineteen (19) or 17% got "Average", eight (8) or 7% got "Low", and two (2) or less than 2% got "Very Low". This indicates that almost half of the registered rice farmers from two barangays have a very high idea of how extreme flood events happened.



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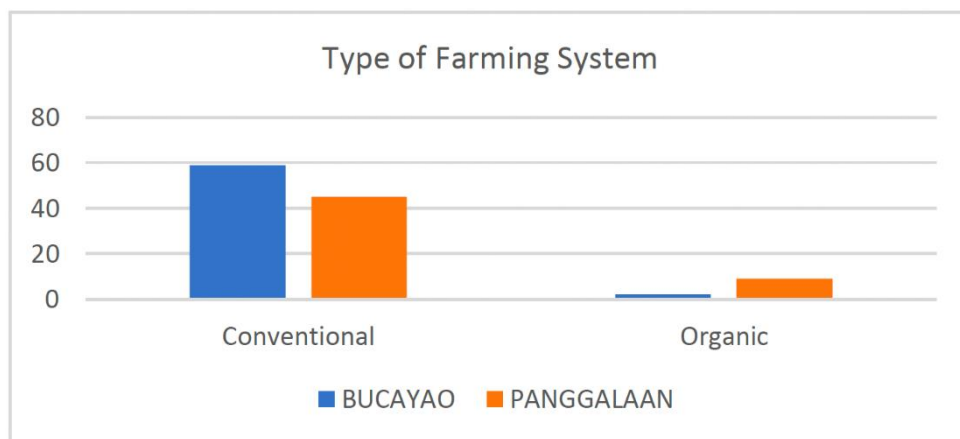
Figure 5.1. Idea of farmers on flood extreme events

## II. Rice Production System

### 2.1. Farming System

#### 2.1.1. Type of Farming System

One hundred and four (104) or 90% of registered rice farmers use a conventional type of farming system and eleven (11) or 10% use an organic type of farming system. This indicates that almost of registered rice farmers from two barangays ensure food security.



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Figure 2.1.1. Type of farming systems

## 2.2. Farm Size

Eighty- eight (88) or 77% of registered rice farmers from Barangay Bucayao and Barangay

Panggalaan have 1-5 hectares farm size, nineteen (19) or 17% have 0.6- 1-hectare farm size, six (6) or 5% have less than 0.5-hectare farm size, one (1) or less than 1% has 5.5 – 10 hectares farm size, and one (1) or less than 1% has more than 10 hectares farm size. This indicates that most of registered rice farmers from two barangays cultivate 1- 5 hectares farm size.

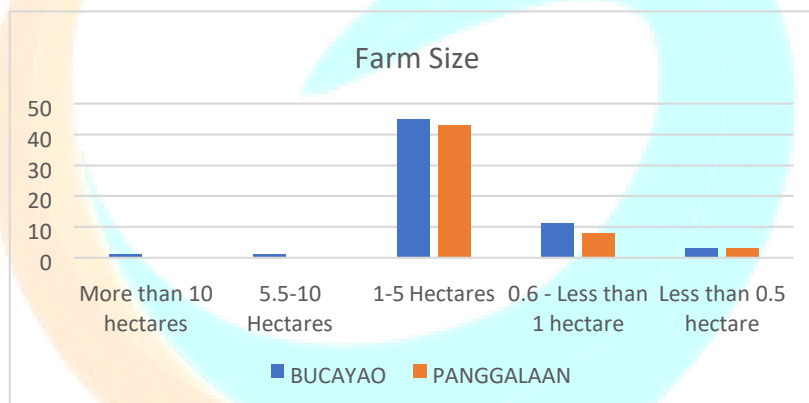


Figure 2.2. Farm size

## 2.3. Topography

Seventy-six (76) or 66% of registered rice farmers' fields in Barangay Bucayao and Barangay Panggalaan are floodplain topography, thirty- one (31) or 27% are river topography, five (5) or 4% are upland topography, two (2) or 2% are rolling topography,

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 and one (1) is hilly topography. This indicates that more than half of registered rice farmer’s farms from two barangays are at risk of flood.

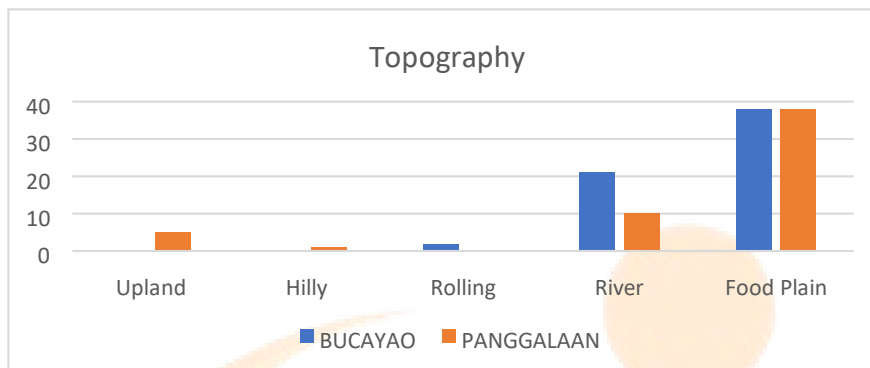
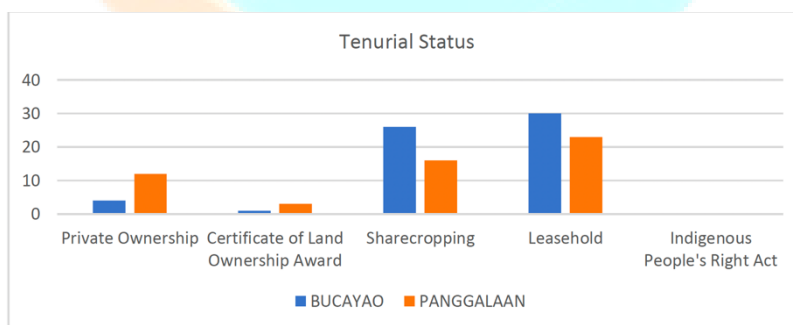


Figure 2.3. Topography

## 2.4. Tenurial Status

Fifty-three (53) or 46% of registered rice farmers from Barangay Bucayao and Barangay Panggalaan are leaseholders of farms, forty-two (42) or 37% are sharecropping, sixteen (16) or 14% own their farms, and four (4) or 3% received Certificate of Land Ownership Award. This indicates that most of the registered rice farmers of two barangays are tenants for long-term periods.



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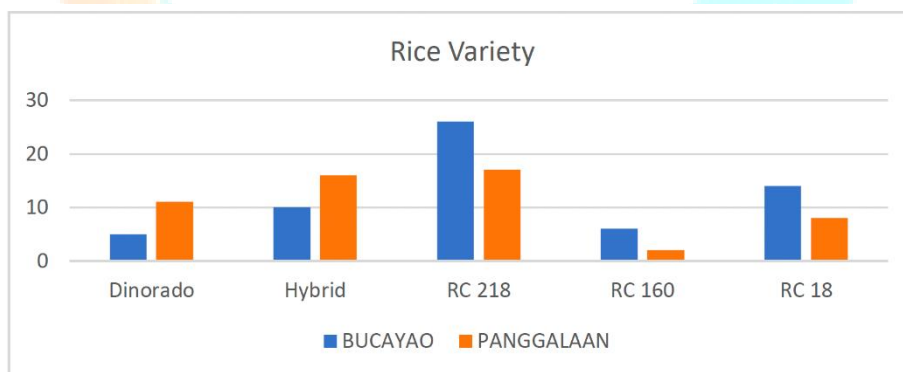
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Figure 2.4. Tenurial Status

## 2.5. Wet Season

### 2.5.1. Rice Variety

Forty- three (43) or 37% of registered rice farmers of Barangay Bucayao and Barangay Panggalaan used RC 218 as rice seed in the wet season, twenty- six (26) or 23% used Hybrid, twenty- two (22) or 19% used RC 18, sixteen (16) or 14% used Dinorado, and eight (8) or 7% used RC 160. This indicates that most of the registered rice farmers used RC 218 in wet season.



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Figure 2.5.1. Rice Variety

### 2.5.2. Water Sources

Fifty- two (52) or 45% if registered rice farmers from Barangay Bucayao and Barangay Pangalaan used groundwater as water irrigation during the wet season, thirty- eight (38), or 33% used rainwater, fourteen (14), or 12% used surface water, and eleven (11) or 10% used Municipal Water System. This indicates that most of the registered rice farmers from two barangays used groundwater for water irrigation during wet seasons.

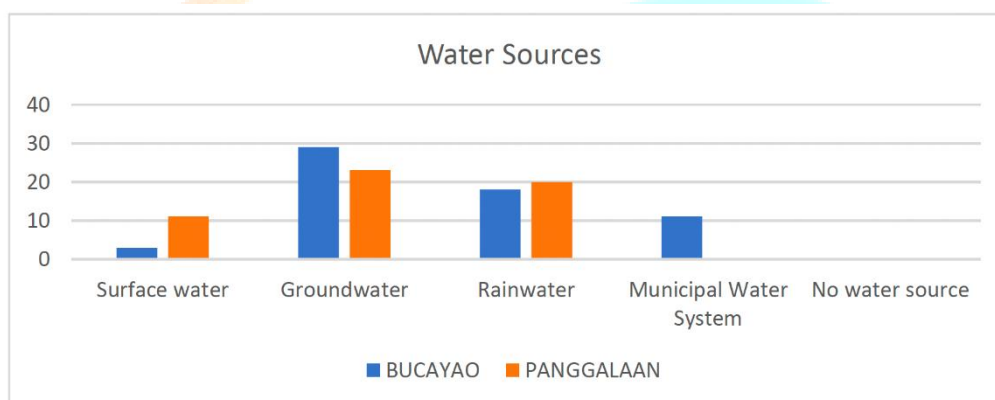


Figure 2.5.2. Water Sources

### 2.5.3. Number of Days from Planting to Harvesting

Sixty- one (61) or 53% of registered rice farmers of Barangay Bucayao and Barangay Pangalaan harvested rice after 111- 120 days during wet seasons, fifty- two (52), or 45% harvested rice after 110 days or below, and two (2) or 2% harvested rice after 121- 130

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days. This indicates that more than half of registered rice farmers harvested rice within 111-120 days during wet seasons.

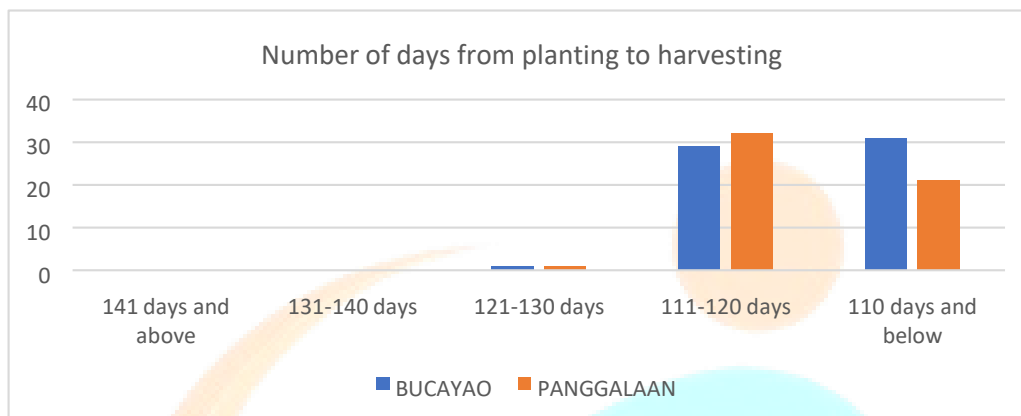


Figure 2.5.3. Number of days per crop season

## 2.6. Dry Season

### 2.6.1. Rice Variety

Thirty- three (33) or 29% of registered rice farmers of Barangay Bucayao and Barangay Panggalaan used RC 218 as rice seed during dry seasons, twenty- eight (28) or 24% used Hybrid, twenty- (21) or 18% used Dinorado, nineteen (19) or 17% used RC 160, and fourteen (14) or 12% used RC 18. This indicates that most of the registered rice farmers in two barangays used RC 218 during dry seasons.

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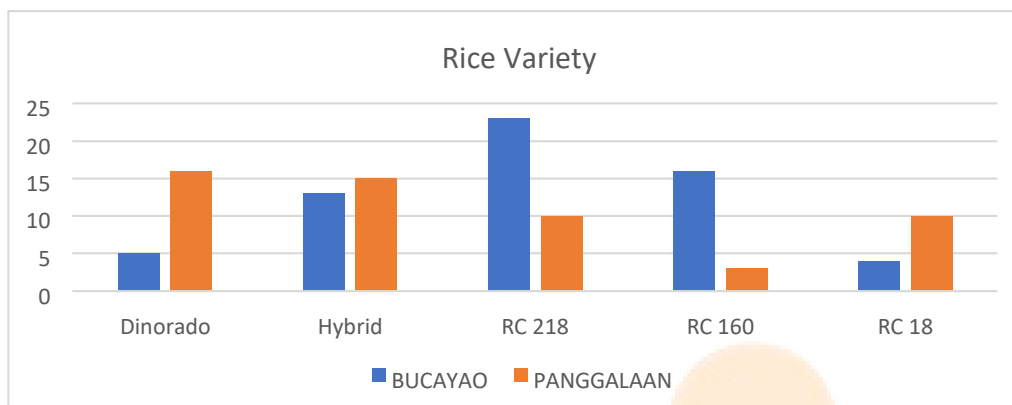


Figure 2.6.1. Rice Variety

## 2.6.2. Water Sources

Seventy (70) or 61% of registered rice farmers of Barangay Bucayao at Barangay Panggalaan used groundwater as water irrigation during dry seasons, twenty-three (23) or 20% used rainwater, twelve (12) or 10% used surface water, and ten (10) or 9% used Municipal Water System. This indicates that more than half of the registered rice farmers of two barangays are used groundwater as water irrigation during dry seasons.

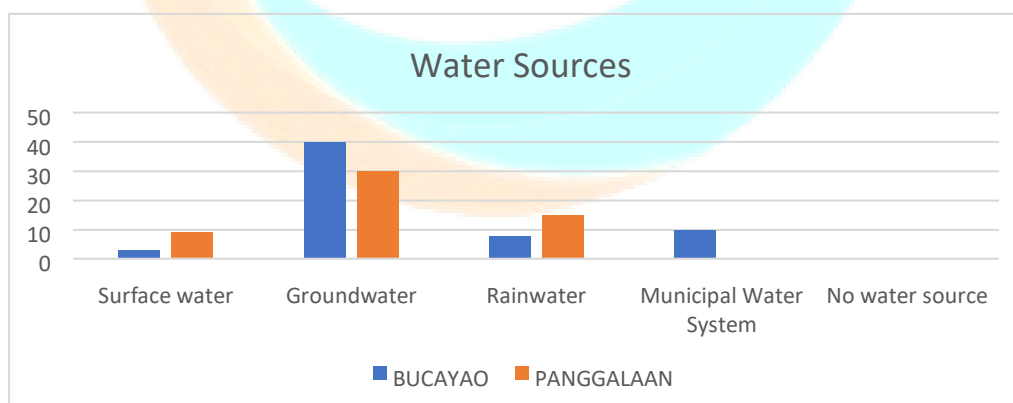


Figure 2.6.2. Water Sources

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### 2.6.3. Number of Days from Planting to Harvesting

Seventy-seven (77) or 67% of registered rice farmers of Barangay Bucayao and Barangay Panggalaan harvested rice after 110 days or below during dry seasons, thirty-five (35) or 30% harvested rice after 111- 120 days, and three (3) or 3% harvested rice after 121- 130 days. This indicates that more than half of the registered farmers from two barangays harvested rice after 110 days or below during dry seasons.

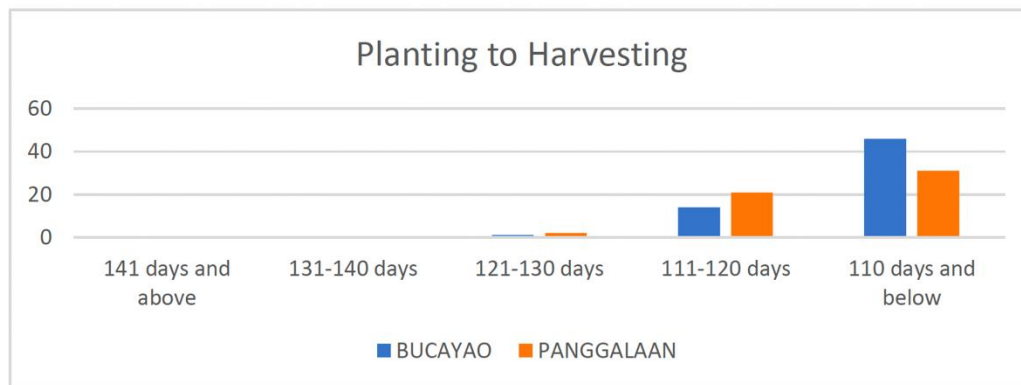


Figure 2.6.3. Number of days per cropping season

### 3. Cultural Practices

Results from the Focus Group Discussion (FGD) showed that rice farmers prepare their land by plowing, harrowing, and leveling. Labor was daily amounting to around P 350.00 to P 400.00 requiring 3 to 4 laborers per hectare working alternately. Some farmers tend to rent hand tractors with a contract of P 2,500.00, this was for the tractors only and an additional P2,500 was used for the crude oil.

According to the farmers, the variety of seeds depends on the seed provided by the City Agriculture Office, some of them were free and some were subsidized. 2 bags with 40 kilos

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each were being utilized per hectare. Transplanting and broadcasting rice seedlings were the forms of planting.

The labor was provided by the farmer and their family members.

In terms of fertilizer, farmers use urea (46-0-0) and complete (14-14-14). After 10 days of planting, complete fertilizer was applied then will be followed by urea after a month. The cost of the fertilizer was around P7,400. These fertilizers were procured from the local agricultural store.

According to the farmers, manual weeding and the use of herbicides were needed to protect growing rice plants from unwanted weeds. Herbicides were mixed in water in a sprayer. For labor, farmers spend P 50.00 per gallon in which 8 gallons were needed per hectare. On the other hand, some are on a contractual basis at a rate of P 400.00 for a day.

With regards to the pest, common pests were snails and rice black bugs. For a hectare, farmers consume 10 full sprayers of insecticides and spend P 50.00 per sprayer. Damage incurred by these pests depends on the growth stage.

According to the result of the FGD, farmers used harvesters on a contractual basis of P5,000.00 to P5,500.00 per hectare for the harvesting of rice. Farmers spend an additional P20.00 per sack for the transport of rice from the rice field to the rice warehouse or storage area. In favorable weather conditions, 80-120 sacks of rice can be harvested per hectare with an estimated weight of 50 kilograms per sack. Some of them sell their rice to rice traders and others are directly rice millers. Rice traders and millers buy this rice depending on its quality which ranges from P 17.00 to P20.00 per kilo.

### III. Impact of Extreme Flood Events on Rice Productivity and Well-being of Rice Farmers in Barangay Bucayao

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1. *Impact of Extreme Flood Events on Rice Productivity of Rice Farmers in Barangay Bucayao and Barangay Panggalaan*

Barangay Bucayao and Barangay Panggalaan experienced total destruction from typhoon Dinang, 1981; Southwest Monsoon, 1993; and Super Typhoon Nona, 2015. The damage covered the parameter of both barangays. However, the height of flood and extent of damage in Barangay Bucayao is higher than in Barangay Panggalaan. This indicates that the impact of extreme flood events on rice production of rice farmers in both barangays is severe.

Table 1. Impact of Extreme Flood Events on Rice Productivity of Rice Farmers in Barangay Bucayao

Year	Extreme Flood Event	Flood Height of Flood	Cost of Damage	The extent of Damage (hectares)
1981	Typhoon Dinang	8-14 ft	Total destruction	(Whole Barangay) 168 Hectares
1993	Southwest Monsoon	8-10ft	Total destruction	(Whole Barangay) 168 Hectares
2015	Super Typhoon Nona	8-10ft	Total destruction	(Whole Barangay) 168 Hectares

Table 1. Impact of Extreme Flood Events on Rice Productivity of Rice Farmers in Barangay Panggalaan

Year	Extreme Flood Event	Flood Height of Flood	Cost of Damage	The extent of Damage (hectares)
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1981	Typhoon Dinang	3-4 feet	Total	destruction(Whole Barangay)
			(Cost unidentified)	143 hectares
1993		6 feet		
	Southwest		Total	destruction(Whole Barangay)
	Monsoon		(Cost unidentified)	143 hectares
2015	Super Typhoon	6 feet	Severe	destruction(Almost the Whole
	Nona		(Cost unidentified)	Barangay)
				Less than 143
				hectares

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## 2. *Impact of Extreme Flood Events on the Well-being of Rice Farmers in Barangay Bucayao and Barangay Panggalaan*

Barangay Bucayao had excessive fatigue and skin conditions, experienced severe stress, anxieties, fear, and trauma, and felt uncertainty and insecurity after extreme flood events. However, their resiliency, faith, and mental health increased positively. They learned from their experiences and adapted mitigation plans for future floods.

Barangay Panggalaan lost not only homes but some lives of their family. Also, anxieties, trauma, and fears were felt once the rain comes. They found comfort in their faith and the unity and cooperation of their compatriots. However, they think the government has no concrete plan to solve the challenges they encountered in extreme flood events and to stop illegal logging.

This indicates that the impact of extreme flood events on the well-being of rice farmers from two barangays is high.

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Table 3. Impact of Extreme Flood Events on the Well-being of Rice Farmers in Barangay Bucayao

Aspects of Well-being	Impact of Extreme Flood Events on the Aspects of Wellbeing
Physical	Result in excessive fatigue and the occurrence of some skin conditions
Emotional	Increased stress, anxiety, or fear during and after flood events. Emotional trauma caused by the loss of belongings and home. Feelings of uncertainty or insecurity regarding future flood events.
Social	Increased reliance on social support systems during and after flood events. Searching for meaning or purpose after the floods have occurred.
Spiritual	Find strength through spiritual activities or by connecting with others.
Intellectual	Increased awareness and understanding of flood risks and the need for preparedness. Learning from past experiences to develop better strategies for flood management.

Table 4. Impact of Extreme Flood Events on the Wellbeing of Rice Farmers in Barangay Pangalaan

Aspects of Well-being	Impact of Extreme Flood Events on the Aspects of Wellbeing
Physical	Destruction of homes

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Emotional	Anxiety, trauma, and fear before, during, and after the typhoon and flood. Feelings anxious when it rains because it might flood. There was unity and cooperation
Social	Blaming politicians for the lack of assistance and their involvement in illegal logging.
Spiritual	Finding comfort in spirituality.
Intellectual	None

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### *3. Mitigation Measures and Response Mechanism to Minimize the Impact of Extreme Flood Events on Rice Farmers in Barangay Bucayao and Pangalaan*

Barangay Bucayao prepared supplies and emergency kits, created emergency plans, and participated in disaster preparedness training as one's self-response in extreme flood events. Moreover, the government prepared evacuation centers for the barangay, led rescue operations, and disseminated relief goods. Barangay Bucayao constructed dikes, repaired and maintained the existing dikes, rechanneled the river to prevent the recurrence of massive flooding, and elevated the base of houses for flood control as their adaptation and mitigation strategies.

Barangay Pangalaan adjusted the period of planting rice based on climate, repairing their homes, and farms as their response mechanism. On the other hand, the government supplied relief goods, and financial assistance, and provide rescue operations. The citizens elevated their homes as their adaptation and mitigation strategies.

This indicates that the altitude and heights of houses in two barangays are the common adaptation and mitigation strategies in extreme flood events.

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Table 5. Mitigation Measure and Response Mechanism to Minimize the Impact of Extreme Flood Events on Rice Farmers in Barangay Bucayao

Year	Extreme Flood Event	Response Mechanism		Adaptation and Mitigation Strategies
		From own self	From Government and other sectors	
1981	Typhoon Dinang	Preparation of essential supplies and emergency kits.  Creation of personal emergency plans.  Participation in disaster preparedness training.	Evacuation of affected residents to safer areas.  Provision of emergency relief supplies.  Coordination of rescue operations.	Construction and repair of existing dikes for flood control.  Rechanneling of Bucayao River to prevent the recurrence of massive flooding.  Elevation of the base of houses.

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1993 Southwest Preparation of Evacuation of Elevation of the base  
Monsoon essential supplies affected residents of houses.  
and emergency to safer areas  
kits.

Provision of  
emergency relief  
supplies

Coordination of  
rescue operations.

2015 Typhoon Preparation of Evacuation of Maintenance and  
Nona essential supplies affected residents repair of existing  
and emergency to safer areas dikes for flood  
kits. control.

Provision of  
Creation of personal emergency relief Elevation of the base  
emergency plans. supplies of houses.

Participation in Coordination of  
disaster rescue operations.  
preparedness  
training.

Table 6. Mitigation Measure and Response Mechanism to Minimize the Impact of Extreme Flood Events on Rice Farmers in Barangay Pangalaan

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Year	Extreme Event	Response Mechanism	Adaptation and Mitigation Strategies
		From own self	From Government and other sectors
1981	Typhoon Dinang	Rise up and start a new one.  Fixing of homes and farms.	Relief supplies and financial assistance  Search rescue operations.  Providing seminars
1993	Southwest Monsoon	Adjusting the planting of rice based on the climate  Fixing of homes and farms.	Relief supplies and financial assistance  Search rescue operations.
2015	Typhoon Nona	Adjusting the planting of rice based on the climate  Rise up and start a new one.	Relief supplies and financial assistance  Search rescue operations.

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Fixing of homes and Providing seminars  
farms.

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#### *4. Idea to Mitigate the Impact of Extreme Flood Events on Rice Farmers in Barangay Bucayao and Barangay Pangalaan*

Ideas of farmers from Barangay Bucayao to mitigate the impact of extreme flood events are to improve flood control infrastructure (dike), implement early warning systems to alert residents, conduct regular maintenance and cleaning of the waterway, implement reforestation programs, and provide education and training on flood preparedness and response.

Ideas of farmers from Barangay Pangalaan to mitigate the impact of extreme flood events are to adjust the planting of rice based on the climate, improve flood control infrastructure, and plant trees.

This indicates that the common idea of two barangay in mitigation of the impact of extreme flood events is to improve flood control infrastructure and implement reforestation programs.

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## IV. Ecosystem-Based Disaster Risk Reduction and Management to Prevent and Mitigate Extreme Flooding in Barangay Bucayao and Barangay Pangalaan

Barangay Bucayao and Barangay Pangalaan declared their support to be part of forest restoration or sustainable forest management for risk reduction or supporting measures to mitigate flooding. They are willing to give 5kg of rice every season of rice production, on condition that the collection will be facilitated by the Farmers' Association (FA).

### Summary

The study was conducted in Barangay Bucayao and Barangay Pangalaan Calapan City, Oriental Mindoro to analyze the impact of extreme flood events on rice production and farmers' wellbeing to create a mitigation plan. Based on the farmer's profile, most of the respondents are near senior citizens with an age of 55 and above. Most of the registered farmers are male and others are female. The study conducted shows a large number of residents are living together with their spouses. Some are widowed, living with a partner, never been married and a few of them are separated. The registered farmers from both barangays were not belong to any ethnic or minority group. In terms of socioeconomic characteristics, most of the registered rice farmers from the two barangays have formal education and only a few of them have no formal education which includes farmers with a primary level of education. In terms of employment status in both barangays, some of the registered farmers are selfemployed and some are employed in public and private sectors. Hence, most of the registered farmers earned 5,000-13,000 in a month, some of them earned below 5,000, and a few of the farmers with their lands earned 21-000-29,000 and above. A percentage of both barangays have no assistance received from the public or private sector, some received social assistance worth less than 1,000 in a month, and less than 1% received 3,000-4,500 in a month. In terms of household monthly expenses, half of the registered rice farmers of two barangays spend below the average monthly expense of a Filipino family. Most spend 5,000-13,000 every month,

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some spend below 5,000 in a month, and a small percentage spend 29,000 and above every month. According to registered rice farmers from two barangays, they farm 1-5 hectares of land, and half of the registered rice farmers' farms are at risk of flooding because most of the farm fields are in floodplain photography and some in river topography.

Floods have significant negative effects on rice production. Most of the registered farmers from Barangay Bucayao and Panggalaan are leaseholders of the farm, some are sharecropping, owners of their farms, and others received the Certificate of Land Ownership Award. The two barangays used the same variety of seeds such as RC 218, Hybrid, RC 18, Dinorado, and RC 160 for the wet season and dry season. Similarly, more than half of the rice farmers from two barangays used groundwater for water irrigation during wet seasons and dry seasons and harvested rice after 110 days or below during dry seasons.

Mitigation measure and response mechanism on the impact of flood with the mentioned extreme events of rice farmers in Barangay Bucayao and Barangay Panggalaan includes preparation of essential supplies and emergency kits, creation of personal emergency plans, an adjustment in the planting of rice based on the climate, participation in disaster preparedness training, rise and start a new one by fixing of homes and farms. Farmers also need help and response from the government and other sectors including evacuation of affected residents to safer areas, provision of emergency relief supplies, coordination of rescue operations, financial assistance, and seminars. The farmers come up with adaptation and mitigation strategies, like, construction and repair of existing dikes for flood control, rechanneling of Bucayao River to prevent the recurrence of massive flooding, elevation of the base of houses, maintenance and repair of existing dikes for flood control.

The idea to mitigate the impact of flood extreme events on rice farmers in Barangay Bucayao and Barangay Panggalaan includes improving flood control infrastructure (dike), implementing early warning systems to alert residents, conducting regular maintenance and cleaning of the waterways, implementing reforestation programs like tree planting, providing

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education and training on flood preparedness and response, adjust the planting of rice based on the climate

## Conclusion

The study concluded that massive flooding greatly affects the rice production and the wellbeing of the registered farmers in Barangay Panggalan and Barangay Bucayao of Calapan City Oriental Mindoro. This extreme flooding is caused primarily by deforestation and different weather phenomenon. According to the farmers, the damage caused by extreme flood events ranges from severe to total destruction of rice fields of two barangay measuring hundreds of hectares. The farmers' emotional, physical, social, intellectual, and spiritual health were also affected during this kind of event. They feel exhausted, stressed, and suffered from anxiety, however, they also find strength, resiliency, and awareness to cope with this kind of situation. Several plans were given by the farmers based on the past years of experiencing massive flooding. They come up elevating their houses based and shifting on the times of farming where weather might be good for them. They also suggested to have maintenance, repair, and construction of flood control infrastructure in their areas, alert warning signals, planting trees, implementing reforestation programs, and educational training for flood preparedness and response mechanism.

## Recommendations

The study recommends a concrete and long-lasting solution to prevent massive floods in the two barangay that will lessen the effect on rice production and farmers' well-being. Construction and upgrading enough flood control infrastructures such as dikes, waterways, and re-channeling of rivers should be prioritized by the sector of government. Conducting

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several activities such as planting trees, flood preparedness and response program would be beneficial to all barangay residents. Elevating the houses based in response to extreme flooding was also suggested. In terms of rice production, it was also recommended to adjust the planting season according to the climate.

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