

# Coping Mechanism of Farmers at Catagbacan, Goa, Camarines Sur in Extreme Weather Condition

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**Abstract---**The case study on the coping mechanism of farmers in extreme weather conditions was conducted to evaluate the coping mechanisms of farmers from Catagbacan, a rural community in the province of Camarines Sur, Philippines. Farmers from the study area had been affected by typhoon, extreme heat, extreme rain, prolonged rain, prolonged heat, early onset of rainfall and delay onset of rainfall with typhoon as the most frequent. These extreme weather conditions have brought negative impacts to crops such as crop damage, stunted growth and drying of plants in extreme and prolonged heat, decaying of plants during extreme and prolonged rain and pest infestation during extreme heat and typhoon and the deterioration of soil quality during the occurrence of typhoon, early onset and delay onset of rain. Farmers then suffered from low productivity and low income resulting to poverty. The coping mechanism of farmers depend on the kind of extreme weather conditions that affected them. The use of modern and indigenous technologies were adopted by farmers to cope with these weather variability. There is little that they can do to avoid economic losses and sustenance of soil quality during the occurrence of extreme weather conditions.

**Keywords---**Coping mechanism, extreme weather conditions, farmers

## I. INTRODUCTION

Climate change is a global natural phenomena that greatly affects the various activities of the farmers particularly those in the watershed area. Climate change is a natural event that humans have no full control of its occurrence. Climate change experts anticipate more extreme weather events but their severity and location are difficult to predict. Increases are expected in flash flooding, landslides, as a result of intense rainfall or flood water, storm surges, man-made floods, such as breaches of embankments and areas not previously prone to flooding, such as urban areas. [1]. Climate change is one of the most serious environmental challenges facing the world according to Greenpeace, the world's largest environmental organization. [2]. What is certain is that climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. [3]. It is projected that in 2020 and 2050, future climates in the Philippines will be greatly influenced by the past greenhouse gas emissions already there and this will make the Philippines warmer, more so in the relatively warmer summer months. [4].

The Bicol region is not an exception to the vulnerability of extreme climatic conditions. Just like the other parts of the country, the Bicol Region is at grave risk every time a calamity strikes. Goa, Camarines Sur is one of the municipalities in the Bicol Region, Philippines that is vulnerable to climate change. This municipality, is considered as a 2nd class municipality and is classified as partly urban. It occupies an area of 20618 km<sup>2</sup> and home of 54,035 residents. Administratively, the municipality of Goa is subdivided into 34 barangays. [5] One of which is Catagbacan, the chosen venue for this case study. This was chosen because of its variation in topography representing both the lower and upland portion of Mt. Isarog. It also presents a variety of farmers with multiple experience in extreme weather conditions and has long range of experience in farming. Barangay Catagbacan has a total land area of 1,528.88 hectares and is classified as urban area among the 34 barangays of Goa. It is made up of 7 zones namely: Zone I, Zone II, Zone III, Zone IV, Zone V, Zone VI and Zone VII and is approximately 3 kilometres away from Goa proper [6]. There is diversity in the crops raised in the different zones of the barangay. Zones 1, 2, 3, 4 and 5 which belongs to the lower portion of Mt. Isarog grows rice, vegetables, corn and root crops. While Zones 6 and 7 which are located in the upper portion of Mt. Isarog abounds abaca and coconut, root crops and vegetables. The poor economic condition of the residents in the locality can be worsen in the advent of severe climatic changes such as the typhoon, la Nina, el Nino, drought and many other calamities caused by climate change. Looking at the impact of extreme climatic condition in the locality and how they adapt to this climatic changes is worth analysing. The assessment on the impact of climate change to the locality and adaptation strategy assessment will serve as an aid in developing a strategic planning to mitigate the negative impacts of climate variability.

## II. OBJECTIVES OF THE STUDY

The main purpose of the study is to determine the coping mechanisms of the farmers from Catagbacan, Goa, and Camarines Sur, Philippines. In particular, it aims to describe the profile of the farmers living in the community, determine the extreme weather experienced by them and the impacts of climate change to the three dimension of farming which are the crops, income and soil quality. Further, the study was conducted to determine the coping mechanisms adopted by farmers in various climatic changes that hit their locality.

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### III. RELATED STUDIES AND LITERATURE

Farmers employ different combinations of ex ante and ex post drought coping strategies to minimize the impact of drought. Ex ante coping strategies include careful choice of rice varieties, planting date, crop establishment methods, and weeding and fertilization practices to minimize the effects of drought. In addition, farmers also make temporal adjustments in cropping patterns based on the timing of drought occurrence. Overall, farmers do not seem to have much flexibility in making management adjustments in rice crop in relation to drought. [7]. The study conducted by Yang [8] on the absence ex-post income risk coping mechanisms such as risk pooling in social networks and inter-temporal consumption smoothing mechanism, farmers depend heavily on ex-ante mechanisms to cope with income risk during extreme heat, the conservative production strategy and the diversified strategy play the most important role in farmers' reducing income fluctuations but it causes the low efficiency and widens the income gap between the poor and the rich. Farmers from Tamil Nadu, India, who are vulnerable to frequent drought, reported reduced yields and revenue linked, as well as quick evaporation of soil moisture, soil erosion and changing seasonal patterns, and were adapting through the adoption of technological coping mechanisms as well as shifting from agriculture to other professions. Other coping mechanisms included mixed and intercropping planting techniques, integrated farming systems, changes in cropping patterns, changes in livelihoods, loans, and livestock sell-offs, and crop insurance. [9]. Socio-economic characteristics, maize farming characteristics as well as farm location determine the decision to adjust the agricultural calendar. Consequently, providing farmers with climate related information could ensure a rational and time-efficient management of the agricultural calendar. Moreover, research and extension institutions should help in establishing and popularizing clear agricultural calendars while taking into account the driving forces of behaviors towards the adjustment of farming practices as a climate variability response. [10] El Niño brought various effects that were favorable behavior manifestations like planting of forest land fruit trees by farmers and the existence of *bayanihan*, community expenses and social obligations were reduced. The test of relationship of variables revealed a highly significant relationship of socio-demographic characteristics with level of awareness; highly significant and positive relationship between levels of awareness and attitude formation, and highly significant relationship between attitude and decision to allocate resources. [11]

### IV. METHODOLOGY

The focus group discussion was conducted among the key farming sectors in the study area representing the farmers in the different zones of the community to identify the different impacts of climate variability to the three dimensions of farming. The focus group discussion is a group interview of approximately six to twelve people who share similar characteristics or common interests. But in this case, 14 participants were involved to represent the 7 zones

of the barangay to have two participants per barangay. The farmers were then classified into different farming sectors and were asked questions on the impacts of extreme weather conditions to their crops, income and soil quality. They were also asked questions on their coping mechanisms. Their responses were then tallied whether the impact and coping mechanisms adopted by the farmers are positive or not. Their coping mechanisms were also classified in time frame whether the coping used was done before, during or after the advent of extreme weather. Based on their responses, the benefits that they will derive from their coping mechanisms were evaluated and come up with a possible solution or strategies that will help farmers address the issues on the impact of extreme weather conditions to them as farmers and to the community. Interview with farmers and key officials of the barangay was also conducted and farm visits were done to validate responses by farmers during the focus group discussion.

### V. RESULTS AND DISCUSSION

**A. Profile of the respondents.** Based on the survey conducted, the profile of these respondents shows that the average age of the respondent is 57 with 82 years as the oldest and 34 years old the youngest. This means that they are experienced farmers and had been there for a long period of time. A high percentage of farmers (78%) are male, mostly (57%) are tenants and the rest (43%) are land owners. A larger percentage of the farmers (64%) are farming a small land area less than 1 hectare and 36% of them are farming a land area between 1 to 5 hectares as tenants. Some farmers are engaged in multi cropping which means that they farm a combination of rice and vegetables. There are also farmers who plant rice only, coconut only or corn only. It also shows that 42.86% are rice farmers, 64.29% are vegetable. Mostly of the farmers reside at Zone 7 and this is the poorest area and residents there live below the poverty line.

**B. Extreme Weather Conditions Experienced by Farmers.** Farmers have experienced variability in extreme weather conditions. All of them have experienced typhoon, 64.29% have experienced extreme heat and extreme rainfall, 21% have experienced prolonged rain, 42.86% have experienced prolonged heat and 35.71% of the farmers have experienced early and delay onset of rainfall. This means that extreme weather conditions are already affecting farmers and that they have done some form of coping mechanisms to address issues on extreme weather conditions. The Bicol region is frequently hit by typhoon with Typhoon Reming the fastest and strongest among them with a maximum sustained wind speed of 320 kph and the latest is typhoon Glenda with a speed of 86 kph. For the year 2014, the highest recorded temperature is 31°C that hit Bicol Region last May and June. [12]

#### **C. Impact of extreme weather conditions to farming.**

Farmers in the community have varied experiences whenever a change in climatic condition strikes their locality. The impact of the different extreme weather were disclosed by the farmers during the focus group discussion.

**Impact to crops.** Based on the focus group discussion, the extreme weather conditions have negative impacts to crops. Extreme heat results to drying of rice and pest infection arise in the form of “*tungro*” (when rice is infected by virus carried by grasshopper). Extreme rainfall results to the delay of planting and if already planted, plants decayed because of so much water. During typhoon, crops are toppled down and some of them were totally destroyed particularly rice, corn, vegetables, abaca, and coconuts. Root crops like sweet potato and cassava are not totally damaged and are readily recovered. The early onset of rainy days also result to the delay of the preparation of seedlings which eventually result to the delay of the planting of crops. This means a delay in harvest and production. Plants are unhealthy during the delay onset of rainy days. The lack of water needed by plants for growth and development accounts for this slow growth due to the poor distribution of nutrients to plants. As explained by Wang, [13], the early onset of rainfall or delay onset of rainfall also affects the crop production. The variability of monsoon rainfall have serious consequences on the human, financial, infrastructure. Acidity deteriorates the quality of soil for it kills the microorganisms responsible for the degradation of decayed plants and animals and convert them to important micro and macro nutrients needed by plants for its growth and development. The data implies that extreme weather conditions will not give good effect to the different dimensions of farming particularly to crops, economy and soil quality. The effect of extreme weather conditions are interactive and interdependent to each other. Absence of water means unavailability of nutrients resulting to poor growth, poor harvest, low income, and food shortage, high cost of farm produce and low productivity of farmers. This explains why farmers in the upper portion of the barangay are suffering from food shortage and why they have a very low poverty index. Most of these farmers lack the technology on how to adapt to extreme weather conditions. This kind of coping mechanism is beneficial to farmers for it guarantees the availability of food and productivity of farmers during El Nino. Based on this observation, farmers can still survive amidst climate variability but their productivity is not enough to support the food demands of the community and food security of the region [14]. In the past, during extremely hot days, a similar circulation anomaly occurred and these circulation changes decrease moisture flow over the land, and longer periods without rain, along with hot conditions can no longer be distinguished [15]. With these, there’s a need for adaptation strategies in agriculture, including increased investments in water storage, drought-tolerant crops, crop diversification, and early warning systems [16].

**Impact to income.** The occurrence of extreme weather conditions has only one common impact to farmers and this is loss of income. The delay onset of rainfall delays the preparation of the seedlings which then will lead to the delay of farming and harvesting. Return of investment is therefore delayed and affects the farming pattern. Loss of income means loss of capital to farm the land and this can lead to food shortage and to poverty. The loss of income is due to

poor production or low crop yield or no yield at all. This means less food is available on the table and eating pattern of the farmers is altered. Loss of income also means another capital for the next planting season is required.

**Impact to soil quality.** Extreme weather conditions gave different impacts to soil quality. Extreme heat caused soils to crack which make it unfavourable to farming due to its hardness and lack of water supply. Whereas, heavy rainfall results to poor soil quality. This is so because much of the nutrients have been carried away downhill most especially in the upland portion of the municipality. Fertilizers applied to farmlands are also carried away by rain and flows through a nearby river, the Rangas River. Typhoon, delay onset of rainfall and early onset of rainfall gave no significant impact to soil quality. La Nina or prolonged rain makes the land softer resulting to landslide and carry away crops or cover other crops hit by landslide. Landslide turns up lower part of soil exposing sub soil with lower amount of nutrients making the land surface less fertile and not good for farming. One has to wait for a longer period of time before the land affected by landslide to recover its fertility. The prolonged heat or El Nino caused the soil to be more acidic. Acidity deteriorates the quality of soil for it kills the microorganisms responsible for the degradation of decayed plants and animals and convert them to important micro and macro nutrients needed by plants for its growth and development. The data implies that extreme weather conditions will not give good effect to the different dimensions of farming particularly to crops, economy and soil quality. The effect of extreme weather conditions are interactive and interdependent to each other. Absence of water means unavailability of nutrients resulting to poor growth, poor harvest, low income, and food shortage, high cost of farm produce and low productivity of farmers. This explains why farmers in the upper portion of the barangay are suffering from food shortage and why they have a very low poverty index. Most of these farmers lack the technology on how to adapt to extreme weather conditions.

#### **E. Coping Mechanisms of Farmers in Extreme Weather Conditions**

It is interesting to note that farmers have various adaptation strategies towards their crops whenever extreme weather conditions strikes in their locality. Some of them are negative but a majority are positive and beneficial to farmers in sustaining their farming system.

**Coping mechanisms of farmers to crops.** Focus group discussion further revealed that farmers use crop rotation, in between cropping and planting alternative crops like sweet potato, cassava and monggo in acclimatizing extreme heat or weather. These strategies are positive and beneficial during typhoon, when all the crops have been destroyed, farmers can do nothing but to plant again. This activity requires additional capital to defray the cost of farming and looking for financial support in crisis such as typhoon is a very difficult situation most especially if farmers are just tenants and have no extra capital to start new planting. It has been observed, that in the advent of typhoon, crops that are ready

for harvesting, are already harvested before the typhoon arrives in the locality. In this way, losses is minimized and capital used for farming are returned but not profit is incurred. This is better than having a total loss of the capital and the profit. For crops like vegetables, farmers used typhoon breakers by pulling down their crops down to the ground to prevent heavy damage by strong winds and rain. In the case of abaca, farmers cut down all the damaged crops and convert them into fibres and then plant again. In the case of coconuts, farmers gather all the coconut that had fallen and convert them into copra and sell them to the *comprada* (store for agricultural products) and then wait for the coconuts to bear fruits again. Typhoon is short lived and happens only in one to three days in a locality. Thus coping up with typhoon is easier than any other extreme climatic events. Somehow typhoons leave farmers goods to start with and losses is bad but not as bad when extreme heat, heavy rainfall, La Nina and El Nino strikes in the locality. The fact that typhoons can be forecasted, farmers have the chance to protect their crops against strong winds and heavy rainfall

The early onset of rain is beneficial to farmers for it allows them to farm earlier than expected. This means that they will harvest earlier and return of capital and generation of income or profit will be earlier. During the delay of the onset of rain farmers use water pump to irrigate their farm lands and this is not beneficial because source of underground water is deep and requires high cost of energy to power their pumps in extracting water from the underground. Catagbacan is endowed with a watershed and it is a potential source of water to irrigate their farmlands. Thus, harnessing the Rangas River as source of water supply during extreme heat and El Nino requires special kind of engineering and technology. Funding is also required which can be provided by the Local Government Unit, the National Irrigation Administration or the Department of Agriculture.

During La Nina, farmers fix their irrigation system to direct the flow of water to farmlands with excessive water supply. Some farmers plant *gabi* and *kangkong* in areas with sufficient water supply. Such kind of crops can provide them extra income and ensures that they have foods to eat to fill their stomach. Letting the time pass by, means that farmers will just wait for the La Nina to end before they will start to plant new crops. It means waiting for plants to decay and to farmers, this is another sign of their helplessness in moments of disaster caused by extreme weather conditions. During prolonged heat, farmers plant crops that are tolerant to extreme heat like corn, mongo and peanuts. They also plant root crops like cassava, sweet potato and *gabi*. All these are resistant to heat and requires less water in order to survive.

#### **Coping mechanisms of farmers towards their income.**

Further, the focus group discussion, showed that farmers can cope up with their income during typhoons. In other extreme weather conditions, they have no alternative means of increasing their income such as loans, financial assistance or crop insurance. It should be noted that extreme weather conditions lead farmers to incur a lot of losses and low productivity. Somehow, the strategies used by farmers such

as intercropping, planting of alternative crops suitable to different weather conditions will help them cope up with their losses. During typhoons, farmers tend to harvest remaining goods from their farmland and sell them at higher cost. Coconut farmers, for example, would gather fallen coconuts and convert them into copra which they can sell and provide them income after the typhoon. After the typhoon, they will wait for another harvest season. In the case of abaca farmers, they would harvest fallen abaca trunks and convert them into abaca fibres and sell them to market. In the case of rice and corn farmers, farmers would harvest their crops even before the arrival of the typhoon, especially if they are matured enough for harvest. In this way the farmers can prevent losses and still gain income from their crops. Thus, in extreme weather, farmers still have their alternative sources of income but not as much as when their crops are not affected by extreme weather.

#### **Coping mechanisms of farmers towards soil quality.**

It is a notable practice for farmers to allow their crops to decay during extreme rainfall. According to them, this practice would convert the decayed plants into fertilizers and conditions the soil, thus improving its quality and increase its productivity. It is also noted that farmers have no coping mechanisms in extreme weather conditions like extreme heat, extreme rainfall, and delay onset of rainfall, early onset of rainfall, prolonged heat and typhoon. The reason is that farmers find no impact on soil especially during typhoon, delay onset of rainfall and early onset of rainfall. Farmers are not much aware of soil quality and has less knowledge on how to measure soil quality and understand its alkalinity and acidity. But they can relate soil quality to crop yield and applying inorganic fertilizers and allowing plants to decay will help improve the soil quality, increase crop yield and income. Climate change can risk soil quality. Once soil is damaged or contaminated it can be extremely difficult, if not impossible, to restore [17]. Good soil management is therefore essential to maintain and improve soil quality and farmers should be trained on soil management and must know how to sustain the quality of soil in their farmlands, particularly its soil fertility. Other nutrients, like boron and manganese, plants only need in very small amounts. In high-quality soil, nutrients are available at rates high enough to supply plant needs, but low enough that excess nutrients are not leached into groundwater or present at high levels toxic to plants and microbes [18]. These extreme weathers have brought negative impact to crops such as crop damage, drying or decaying of plants and pest infection. All of these results to low productivity and loss of income. Extreme weather conditions also result to poor soil quality and makes land to crack in extreme heat, acidic during prolonged heat. Extreme rainfall can carry away fertilizers resulting to poor soil quality and prolonged rain makes the land soft causing landslide affecting also the soil quality.

Farmers do have positive and negative coping mechanisms in the advent of extreme weather conditions in their locality. Mostly of their coping mechanism is done before but in some cases coping mechanism is done after the occurrence of extreme weather. Farmers have no coping mechanisms to address the impact of extreme weather to

income except during typhoon when they can still convert crops to money or by harvesting their crops before the coming of the typhoon. To cope up with the soil quality, farmers simply allow their crops to decay during prolonged rainfall and serve a soil conditioners. In other extreme weather conditions, farmers have not adopted any coping mechanisms to address the impact to soil quality or because some of the extreme weather do not also give negative impact to soil quality particularly during typhoon and during the delay and early onset of rainfall. To address the impacts of extreme climate conditions in the barangay, farmers can establish and strengthen farmers organization, adoption of agricultural intensification and innovative farming methods, more trainings on livelihood, agriculture technologies, soil management. The local government of the barangay can expand their credit facilities and crop insurance system.

## VI. CONCLUSION AND RECOMMENDATION

Farmers in the community have been affected by different extreme weather conditions with the typhoon as the most experienced calamity that hit the locality. These extreme weathers have brought negative impact to crops such as crop damage, drying or decaying of plants and pest infection. All of these results to low productivity and loss of income. Extreme weather conditions also result to poor soil *quality* and makes land to crack in extreme heat, acidic during prolonged heat. Extreme rainfall can carry away fertilizers resulting to poor soil quality and prolonged rain makes the land soft causing landslide affecting also the soil quality. Farmers find no impact to soil quality in the event of typhoon, early onset or delay onset of rainy days. Farmers do have positive and negative coping mechanisms in the advent of extreme weather conditions in their locality. Mostly of their coping mechanism is done before the occurrence of extreme weather but some are done after the occurrence of extreme weather.

To address the impacts of extreme climate conditions in the barangay, farmers can establish and strengthen farmers organization, adoption of agricultural intensification and innovative farming methods, more trainings on livelihood, agriculture technologies, soil management. The local government of the barangay can expand their credit facilities and crop insurance system.

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