JOURNAL OF Management and Development Studies
University of the Philippines Open University

COPING MECHANISMS TO EXISTING CLIMATE HAZARDS IN THE AGRICULTURE SECTOR OF BARANGAY MARAVILLA, NAGCARLAN, LAGUNA, PHILIPPINES

Marianne R. de Luna[1]*, Ma. Rosary T. Tesorero[2] , Janet L. Saturno[3], Joan P. Sadoral[4], Bordeesorn Phumrungruang[5], Abigail P. Daria[6], Ajaree Sikhandakasamita[7], Rowena DT Baconguis[8]

[1] University Researcher II, College of Agriculture and Food Science, UP Los Banos, Laguna, Philippines
[2] Science Research Associate, Aklan State University, Banga, Aklan, Philippines
[3] Assistant Professor IV, Central Luzon State University, Nueva Ecija, Philippines
[4] Associate Professor II, University of Southern Mindanao, Kabacan, North Cotabato, Philippines
[5] Subject Matter Specialist, Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, Thailand
[6] Instructor, Cavite State University - Main Campus, Cavite, Philippines
[7] University Agricultural Extensionist, Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, Thailand
[8] Professor, College of Public Affairs and Development, University of the Philippines Los Baños

*Corresponding Author: mrdeluna@up.edu.ph

ABSTRACT – The study wanted to identify coping mechanisms of farmers to existing climate hazards and to recommend possible solutions to the identified problems in agriculture. Farmers from Barangay Maravilla, Nagcarlan, Laguna, Philippines were interviewed using Participatory Rural Appraisal (PRA) tools like Village/ Resource Map, Timeline, Seasonal Calendar, Venn Diagram, and Problem and Alternative Trees. Results showed that climate hazards such as typhoons and flooding and the occurrence of pests and diseases had affected their major crops like coconut, banana and lanzones. The farmers' coping strategies included inter-cropping of cash crops, use of integrated pest and disease management and engaging in non-farm activities. These coping mechanisms were adopted despite absence of external assistance. The farmers realized the need to organize themselves into an association and be recognized by the local government to have access to agricultural programs. Organizing will entitle them access to government programs which will help them overcome the damages brought by the climate hazards. The barangay officials promised to support the farmers' organization to ensure food security and sufficiency in their community.

Keywords: coping mechanism, climate hazards, PRA

To cite this paper: De Luna, M. R., Tesorero, M. R. T., Saturno, J. L., Sadoral, J.P., Phumrungruang, B., Daria, A. P., Sikhandakasamita, A. & Baconguis, R. DT. (2019). Coping Mechanisms to Existing Climate Hazards in the Agriculture Sector of Barangay Maravilla, Nagcarlan, Laguna, Philippines. Journal of Management and Development Studies Volume Number 8 Issue 2, 16-36.

INTRODUCTION

Climate Change

The Philippines is endowed with humid equatorial climate. It is characterized by relatively high temperature, high humidity, and abundant rainfall. According to the National Climate Change Action Plan (2011-2028), the Philippines being archipelagic, ranked highest in the world in terms of vulnerability to tropical cyclone occurrences, third in terms of people exposed in seasonal events and sixth as extremely vulnerable to climate change based on Climate Change Vulnerability Index (CCVI).

Agriculture

Agriculture is a key economic sector in the Philippines, contributing to approximately 12% of the country's gross domestic product (GDP). Agriculture is practiced by roughly 5 million farmers in the Philippines, the large majority of whom operate at the subsistence or small-scale level (Dikitanan, et al, 2017). Small-holder farmers are described as those marginal and sub-marginal farm households that own and/or cultivate less than 2.0 hectare of land (Singh, et al., 2002).

A large proportion of damages from disasters, which are generally climate-related, are experienced by the agricultural sector each year. The agriculture sector is vulnerable to natural hazards that resulted in significant losses every year. Although the sector is an important source of both output and livelihood, relatively few measures appear to have been adopted to mitigate their impact (Benson, 1997).

Adaptation to Changes in Climate

Adger (2003) noted that adaptation is a response mechanism that involves a wide range of stakeholders at different levels. He also mentioned that adaptation is a “dynamic social process and the ability of societies to adapt is determined, in part, by the ability to act collectively".

The onslaught of climate change has brought the risks of natural hazards even higher. Academic researchers on climate change and disaster risks could help generate theoretical attention and promote realistic participatory strategies for policymakers and practitioners (Mercado, 2016). Differing knowledge on effective adaptation strategies and resilience indirectly calls for better education and capacity building efforts across all engaged institution levels to local community members (Zalameda, 2015).

Lasco, et al. (2008) studied the implementation of Albay in Action on Climate Change (A2C2), which included the Albay Integrated Agricultural Rehabilitation Program (AIARP) where farm clusters assist farmers and fisherfolks in their needs. One lesson they learned is that the frequency and severity of climate hazards in an area determined the knowledge and responsiveness of stakeholders to adaptation efforts.

Predo (2010) recorded the actual experiences and planned adaptation to flooding brought by extreme climatic events of the communities and selected municipalities in Ormoc, Leyte and along Cabalian Bay in Southern Leyte. They found out that the respondents implemented adaptation strategies which are accessible alone at the household level (evacuation measures, reconstruction of houses) rather than those that required community cooperation (usually engineering work, like construction of dikes/ canals).

Perras et al (2008) documented the various adaptation practices employed by farmers in Pantabangan-Carranglan watershed area to reduce the impacts of climate variability. The

study highlighted the importance of bottom-up assessment and planning and participatory processes in research. They suggested that there should be further research on the limitations and challenges to adaptation in the household and societal levels.

Coping mechanisms

Local coping strategies in the Philippines are encouraged like changing cropping schedules or adjusting the cropping calendar according to water availability; maximizing the use of available water during abundant periods by constructing reservoir-type projects; and introducing other water-saving techniques.

Use of PRA tools

The primary objective of the PRA approach is to gather basic information through close cooperation with the local community and immediately analyze and evaluate information on rural conditions and local knowledge (Hussain and Mohyuddin, 2014).

The PRA tools were used in responding to needs of communities and target groups and utilized to help local people analyze their own conditions and communicate with outsiders (Townsley, 1996). These tools were employed in this study to determine the farming practices, issues and concerns in the area as well as other factors that affect their lives, particularly on livelihood. The discussion about coping mechanisms practiced by farmers to climate hazards were conferred.

Research gap

While there is information on expected impacts of climate change on agriculture and on adaptation measures that could help minimize impacts, information that specifically assess the vulnerability of smallholder farmers to climate change is very limited (Donatti, et al., 2018). Empirical research about the climate-related losses and damages across the world are also very limited (Van der Geest and Warner, 2015).

There is a need to address the risks and formulate coping mechanisms to ensure food sufficiency and sustainability especially in an agricultural country. Addressing climate hazards consists of several issues and studies that will serve as a baseline to formulate applicable and useful coping mechanisms. We need data with basic attributes that provides the basic foundation in the local planning and in policy making that can be instrumental to our local leaders, hence, this study was formulated.

Despite the potential area for agriculture, Barangay Maravilla in Nagcarlan, Laguna was not spared from the effects of climate change. Effects of these may lead to yield reduction, thereby affecting the livelihood of the farmers. Thus, we need to identify farmers' coping mechanisms and help them develop appropriate/ innovative strategies to address the existing climate hazards.

The objectives of the study are: (1) to determine the agricultural practices and problems experienced by farmers due to climate hazards; (2) to discuss coping mechanisms employed by farmers to the existing climate hazards; and (3) to recommend possible solutions to the problems identified by the agriculture sector of Barangay Maravilla.

Scope and Limitation of the Study

The study focused on identifying problems and coping mechanisms in agricultural activities employed by the local farmers dealing on crops and fruit tree production, poultry and backyard swine raising. However, results were only limited to the understanding of farmer-participants as identified by the members of the barangay council.

METHODOLOGY

This study used qualitative research design through Focused Group Discussion (FGD) and workshops. In conducting the FGD, the Participatory Rural Appraisal (PRA) tools such as Village/ Resource Map, Timeline, Seasonal Calendar, Venn Diagram, Problem and Alternative Trees were used to analyze the agricultural situation amidst climate hazards.

Selection of participants

Prior to the conduct of the workshops, ocular visitation to the community and personal interview with the members of the Barangay Council were conducted to gather preliminary data on the current situation in the area particularly in agriculture. A visit to the Municipal Agriculture Office of the Municipality of Nagcarlan was done to obtain relevant secondary data of Barangay Maravilla.

The FGD and workshops were conducted on May 6 and May 13, 2017. A total of 16 (out of the 54) farmers or 28% in Barangay Maravilla participated. They were identified and selected by the members of the Barangay Council. Farmers who were directly involved in crop and animal production (coconut, rice, bean, banana, charcoal maker, crab fisherman) were selected as participants since the focus of the study is on farming practices as a source of livelihood affected by climate hazards.

The discussions focused on identifying problems and coping mechanisms in agricultural activities employed by the local farmers dealing on crops and fruit trees production, poultry and backyard swine raising in Brgy. Maravilla.

PRA tools

1. Village/Resource Map

The Village and Resource mapping were used to visualize the community's physical features and its natural resources which can be used for future development in the area and to identify areas of concern, potential changes (desired or needed) or important additions that would improve the community.

A barangay map was prepared by the team containing only the boundaries and other pertinent features such as rivers, creeks, bridges, railroads and highways. The participants were asked to identify the location of different structures which they consider important in the community and in their daily activities such as schools, market, barangay hall, etc. They were also asked to put all their resources particularly in agriculture. Prepared cut-outs of different fruit-bearing trees and vegetables available in the area were used and placed on the village/resource map.

2. Timeline

The timeline, as another tool, is a graphical method used to show perceived changes or events taking place over time; and to generate important events, data and information. It is a group-based analysis that identifies and promotes critical reflection of possible causes and impacts of change that have occurred in or affected a community over an extended period. It can be used for understanding and analyzing a current problem by looking for its causes in the past.

A timeline from secondary data was prepared before the workshop. It was used as an aid for recall of farmer-participants. During the workshop, farmer-participants were asked about the important events, situations and incidents which occurred over the years wherein they experienced drastic changes that affected their community.

3. Seasonal Calendar

The Seasonal Calendar was used to illustrate schedules of various household activities, events, farming variables or climatic conditions over a particular time frame, usually one year. A calendar in table format was prepared by the team.

Farmer-participants were asked to identify the three most important commodities in their area that served as a source of living for their family. Major poultry and livestock animals that the farmers raised were identified. Time schedules for crop and animal production activities like land preparation, planting, fertilization, spraying of pesticides, weeding, harvesting, breeding and weaning were determined.

The average yield per crop, time of pest and disease occurrence, water availability, labor intensity and peak and lean months of the year were determined. A sticker was placed under each month to indicate relative amounts, abundance or intensity of each variable. The result was discussed and analyzed with the participants.

4. Venn Diagram

The Venn Diagram was used to identify organizations or institutions which have helped the barangay during climate hazards. It also wanted to see their relationships and the impact of their intervention to the area. It aims to identify farmers' coping mechanisms in times of calamities.

The participants were asked to list down the names of organizations within and outside the barangay that have provided assistance during calamities; identified the impact of their help by writing the organization's name in colored cartolinas of different sizes. The bigger the size used, the greater the organization's impact in the Barangay.

Afterwards, the participants were asked to "position" the cartolinas near or away from the center of the manila paper which represents the Barangay. The proximity of the organization from the center revealed their relative distance to the Barangay.

5. Problem Tree Analysis

The Problem Tree as a tool was utilized in developing ideas that would serve as a basis in future project planning and development. This analysis precedes the design of logical framework. This tool is illustrated by a tree where the trunk represents the core problem, while the roots and branches represent the causes and effects, respectively. An alternative tree analysis, on the other hand, describes the future situation that will be achieved by solving the problem identified.

During the workshop, farmer-participants were asked of their core problem. The causes and effects of such problems were determined. Results were analyzed and discussed together with the participants.

6. Logical Framework

The Logical Framework (Logframe) served to analyze the existing situation during the project preparation. It establishes a hierarchy of objectives, identifies potential risks of achieving objectives, and what should be monitored and evaluated by the participants themselves.
A table on logical framework was prepared in Tagalog. The participants were asked to identify the goal, purpose, objective, outputs and activities that they can do as a group within a given timeframe. They also discussed objectively the verifiable indicators, means of verification and assumptions on each component of the logframe.

The team prepared open-ended questions for free-flow discussions for the workshop and FGD activities. The gathered data were analyzed and discussed by the team and recommendations for possible solutions to the identified problems were drawn. Results were only limited to the understanding and experiences of 16 farmer-participants.

RESULTS AND DISCUSSION

A. Study Site

Nagcarlan is a municipality in the landlocked province of Laguna (Figure 1). It is located 103 kilometres (64 mi) south of Manila. The municipality has a land area of 78.10 square kilometers which constitutes 4.07% of Laguna's total area. Nagcarlan has an elevation of 229.0 m. It has a tropical monsoon climate with clean flowing rivers, gushing waterfalls, calm lakes and lush hills and mountains.

Figure 1. Map of the Philippines
(Source: https://www.worldatlas.com/maps/philippines.html)

Nagcarlan is a second-class municipality in the province of Laguna (Figure 2). In 2015, the poverty incidence was recorded at 5.6%. Its population, as determined by the 2015 Census, was 63,057. This represented 2.08% of the total population of Laguna province, or 0.44% of the overall population of the CALABARZON region. It is subdivided into 52 barangays.

Figure 2. Map of Laguna (Source: https://laguna.gov.ph/province/province)

Barangay Maravilla is located in the Municipality of Nagcarlan, Laguna (Figure 3). Its population, based on the 2015 Census, was 1,217, which represented 1.93% of the total population of Nagcarlan. In 2010, the population was 1,216, so the annual growth rate from 2010 to 2015 is only 0.02%.

Based on the community profile, it has a total area of 295.42 hectares with 100 has as agricultural land, 150 has residential land and 45.42 has commercial land.

Figure 3. Map showing Barangay Maravilla in Nagcarlan, Laguna
Source: https://www.openstreetmap.org/#map=12/14.1694/121.3313

B. Socio-economic Profile

Based on the Barangay Integrated Development Plan (BIDP) of Barangay Maravilla for 2014-2016, its population comprises 742 male and 695 females. It has 348 households, with an average family size of 4. The average length of stay of residents in the barangay was 37 years.

Maravilla has 944 total numbers of labor force. 111 of the households are squatters and 200 families have income below the poverty threshold. In terms of educational attainment, 105 of the population were college graduates, 331 were high school graduates and 140 of them were elementary graduates.

In terms of ownership of residential area, 118 families own the land, 108 resides in government property, 40 households occupy land for free but with consent of the owner, 33 families were caretakers, while the remaining were either rented, being amortized, owned by family and were being occupied without the owner's consent.

Regarding the sources of income (Table 1), residents of Barangay Maravilla were mostly laborers and unskilled workers (36%), farmers, forestry workers and fishermen (15%), officials of the government, etc. (14%), while others were plant/ machine operators/ assemblers, crafts/ trade workers, professionals and service workers.

Table 1. Sources of Income in Barangay Maravilla (2014).

Sources of Income	Frequency	Percentage
Clerks	26	6.82
Crafts and related trade workers	33	8.66
Farmers, Forestry workers and fishermen	58	15.22
Laborers and unskilled workers	138	36.22
Officials of government, special-interest organizations, corporate executives, managers, managing proprietors and supervisors	55	14.44
Plant and machine operators and assemblers	45	11.81
Professionals	14	3.67
Service workers and shop and market sales workers	12	3.15
Total	381	100.00

C. Existing Resources

Using the Village/ Resource Map (Figure 4), the study found that most of the houses in Barangay Maravilla were located beside the railroad. The most important structures such as schools, churches, day care center, police outpost, market, barangay hall and plaza were identified. The market was threatened to be demolished due to road widening, while the barangay council has yet to identify another location for their market.

The barangay was bounded by mountains which were dominantly planted with fruit bearing trees such as lanzones, coconut and banana. Most of the households have backyard gardens planted with various vegetables. The farmers also practiced integrated and organic farming to augment their daily living while waiting for the harvest season of their fruit trees. This served as their coping mechanism to earn a living during lean months.

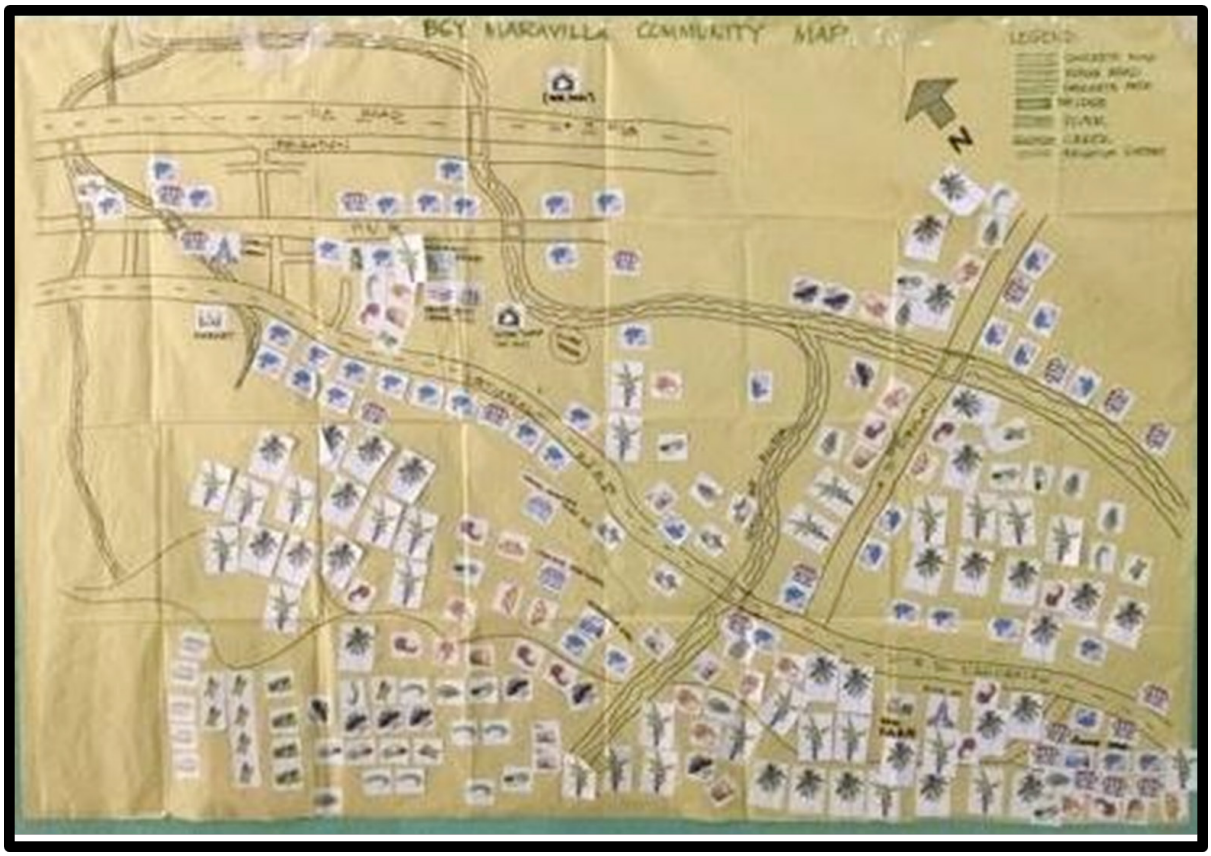

Figure 4. Actual Village/Resource Map of Barangay Maravilla

The waterways like the rivers and creeks were abundant sources of irrigation water for their crops. Farmers used the water resources for their domestic use (laundry, cleaning, etc.). Two springs were identified within the barangay but cannot be utilized for drinking due to possible contamination. Thus, they opted to buy purified water from nearby grocery stores for their family's consumption.

According to the Barangay Captain, there was one instance wherein a portion of the barangay experienced flooding because of the overflowing of the river. This has prompted the council to seek help from their Congresswoman to fund the construction of a bridge that will control the flow of water during heavy rains and prevent flooding to residential areas.

The participants confirmed that they have not experienced landslides in their area despite being near the mountains. This may be attributed to the barangay ordinance prohibiting the cutting of trees and doing slash-and-burn farming ("kaingin").

D. Significant Events related to Climate Hazards

Using the timeline (Figure 5), the major responses of participants relative to the important events that occurred in their area over the years were the occurrence of strong typhoons and severe flooding. The said events affected their community, particularly the fruit crops, vegetables, houses and other infrastructures. Coconut scale insect (CSI) infestation also damaged their coconut farms and selected fruit trees.

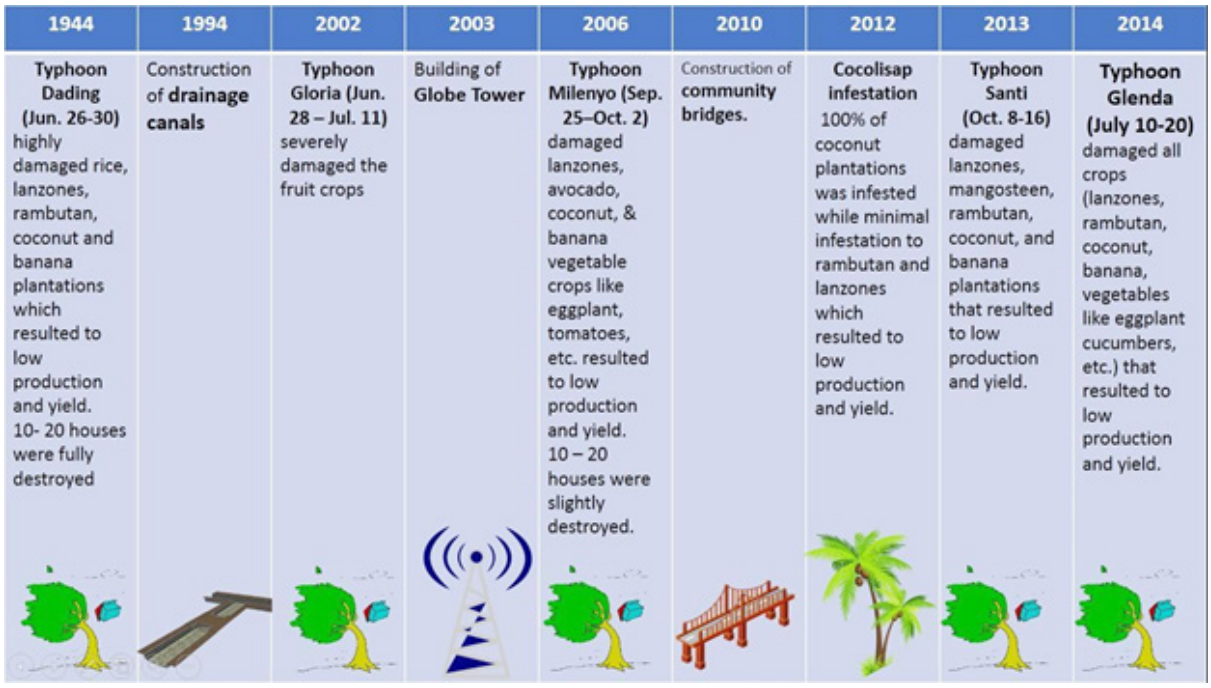

Figure 5. Timeline produced by the farmers during the PRA workshop

Moreover, the participants identified eight (8) significant years (1964, 1994, 2002, 2003, 2006, 2010, 2012, 2013 and 2014) where the incidence of strong typhoons, flooding, CSI infestations and constructions of relevant infrastructures (drainage canals, telecommunication tower and bridges) occurred. However, the farmers noted that Typhoon Glenda had greatly contributed to the reduction of CSI infestation.

E. Agricultural Production

Using the seasonal calendar (Figure 6), participants identified the three most important commodities in the area that greatly helped them in their living. They are the following:

1. Coconut

Engaging in coconut production requires several management practices to obtain high yield. Fertilization, cleaning or weeding and harvesting of mature nuts were some of the usual activities done by coconut farmers.

Fertilizer was applied to coconut trees during the month of May which coincides with the onset of the rainy season. Five kilograms of salt (sodium chloride) per tree was applied once a year. Salt fertilizer[1] was given free by the Philippine Coconut Authority (PCA) to help farmers increase their production.

Weeding of the areas was done during the month of July. Farmers also start to establish crops like string beans, eggplant, bitter gourd, ladies' finger, cucumber, squash, corn and papaya under coconut trees during the said period. Produce from intercrops helped augment family income as well as source of food. Harvesting of mature coconut was done at 45 days interval, thus starting from September, the next harvest was conducted in November and then 45 days thereafter.

[1] The use of sodium chloride (NaCl) or common salt as fertilizer is a practical means of increasing coconut production. Salt is the cheapest and best source of chlorine to increase copra yield.

2. Banana

Production activities for bananas include de-leafing, de-suckering, weeding and harvesting. Activities were done all year-round as planting of such commodities is continuous. Several cultivars such as latundan, bungulan, cardaba, señorita, bangga and tundok were grown by many farmers. Bacterial and fungal infections in banana were high throughout March to April and during the rainy season (September), respectively.

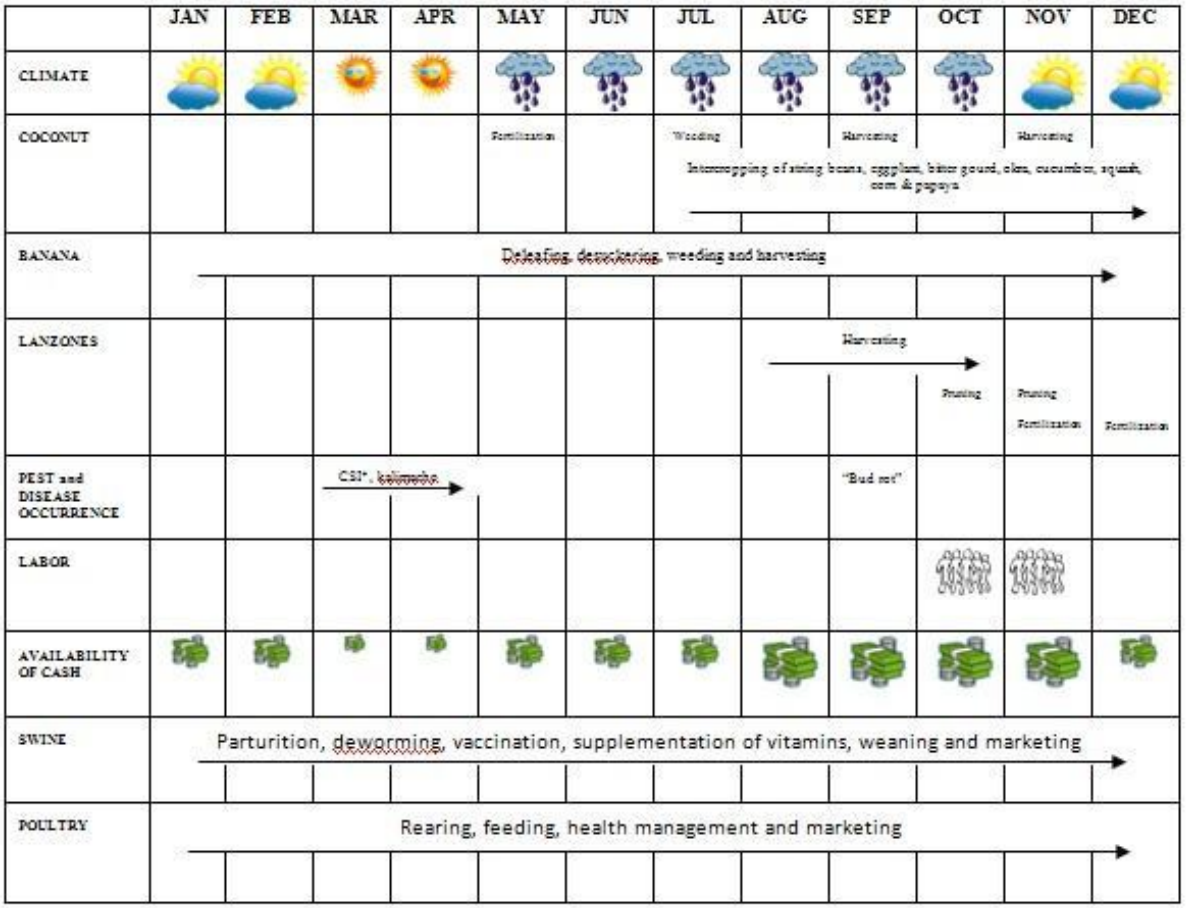

Figure 6. Seasonal calendar for climate and farming activities, labor and cash availability of Barangay Maravilla, Nagcarlan, Laguna.

3) Lanzones

The peak of harvest starts in the month of August and ends in October. There is abundant supply of lanzones in the area during the said period. The produce was sold to middlemen that supplied fruits in neighboring areas. Pruning and fertilization were conducted after the fruiting season. Pruning was done during the months of October and November while application of dried chicken manure was carried out from November to December. Fertilization enhanced the growth and development of lanzones trees.

4) Swine

Backyard swine raising is common in the area. At 45 days after parturition, piglets were sold to a viajero. If the parturition period falls in January, weaning and marketing of piglets happens in mid- to late-March of the same year. Prior to marketing, piglets were castrated, dewormed and supplemented with vaccines, antibiotics and vitamins.

Swine were infected with foot-and-mouth disease (FMD) with high prevalence during April and May. Aside from raising and marketing piglets, few farmers were engaged in hog-raising for fattening purposes. Hog fattening is all year-round.

5) Poultry

Farmers were engaged in small scale poultry production of broiler/ meat type chicken, all year-round. From a day-old chick, it will take 45 days before it reaches the marketing age. Chicken was also produced as a source of food for family consumption, especially during special occasions (Christmas, Barangay Fiesta, etc.).

6) Labor services

High demand for labor services in Barangay Maravilla falls during the month of October until November which coincides with the harvest season for lanzones and coconut. Other maintenance activities in the farms also took place during these months. Several workers such as harvester, picker, dehusker, hauler and pruner are in demand during such periods.

Lean months were experienced by the farmers during March and April. During such times, availability of cash in the household was limited due to expenses incurred either in providing needs for the family or in the farm. Farmers don't have any income from his farm, thus, they resorted to other sources of living such as working as hired laborers to other farms, becoming a house helper or laundry woman, small entrepreneur (such as cooking and selling native delicacies or buy and sell of animals particularly goat) and a vegetable farmer.

Identified Constraints in Crop Production and Coping Mechanisms

There were several problems encountered by coconut farmers in the area. In 2012, the coconut trees were infested with CSI which was prevalent during dry months of the year (March and April). High infestation can be attributed to several factors such as high temperature, relative humidity, planting density and wind direction (Manohar and Velasco, 2014).

Despite the threat brought about by CSI infestation, coconut farmers managed their farms through employing several control measures such as the release of biological control agents (predator), application of used oil to the coconut trees and spraying of soap on the infested trees as well as utilization of chemicals by stem injection.

Another problem encountered by coconut farmers is low production. Such was attributed by the existence of senile coconut trees. Old trees are usually susceptible to biotic and abiotic stresses and most often produce less number of nuts as compared with the newly developed high yielding varieties.

Low production also emerged as a constraint in banana production. This might be due to poor management practices employed by the farmers. Fertilization was not practiced and management of disease was not employed seriously or even not a priority.

Lanzones trees were infested by scale insects which resulted in low crop yield. Despite farmers' awareness on the infestation, no control management practices were employed by them in their respective farms.

F. Linkages/ Networks

Using the Venn Diagram (Figure 7), the participants identified four organizations (Figure 6) who extended help to them during the typhoons/ flooding in Barangay Maravilla, to wit:

1. Barangay Council of Maravilla, Nagcarlan, Laguna. The council distributed relief goods from the Municipal Mayor's office/ Governor's office/ Department of Social Welfare and Development (DSWD) to community members. They also identified/ prioritized recipients of relief goods if supply is limited.

2. Office of the Municipal Mayor of Nagcarlan, Laguna. They informed/ provided relief goods from DSWD to the barangay council of Maravilla.

3. Office of the Provincial Governor of Laguna. They informed/ provided relief goods from DSWD to the Municipal Council of Nagcarlan, Laguna.

4. Department of Social Welfare and Development (DSWD). Provided relief goods which usually consists of noodles and canned goods to typhoon victims all over the Philippines.

The participants shared that only the barangay council directly offered help to them after each typhoon and the LGU officials accessed help from their local government counterparts like the Office of the Mayor (of Nagcarlan) and the Office of the Governor (of Laguna).

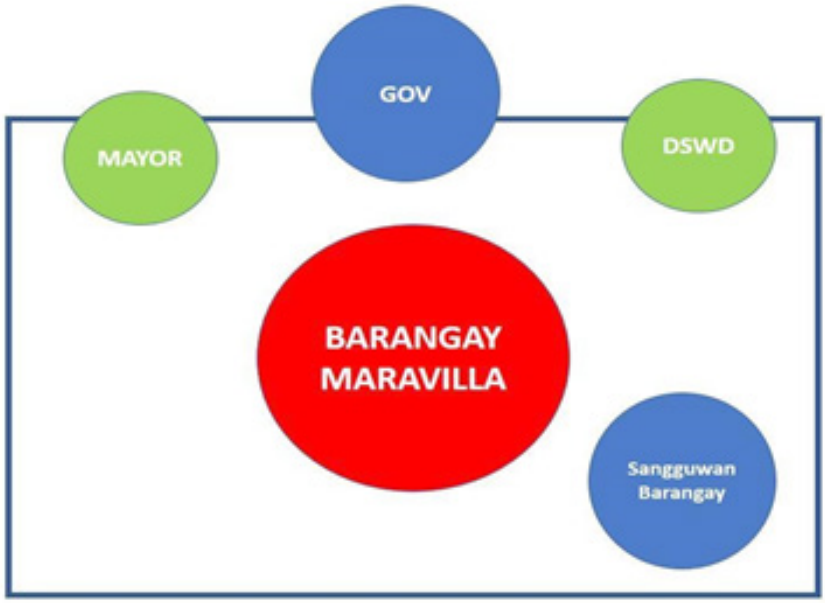

Figure 7. Venn Diagram

Surprisingly, external support was not evident in the community particularly during calamities as testified by the participants. This might be attributed to the absence of accredited farmers' organizations in the area where most of the support for funding and equipment, as well as credit assistance for agriculture, were coursed through.

As a result, agricultural damages brought by calamities were all shouldered by the farmers because of non-accessibility to crop insurance and other support institutions. As a coping mechanism, farmers just borrow money either to private persons with relatively high interest or to relatives with no or minimal interest.

G. Problems encountered by the agriculture sector

Based on the data gathered from the barangay, the problems related to climate hazards identified by the farmers include: a) the destruction of crops and farms due to typhoons and other calamities; and b) the destruction of fruit and coconut trees due to insect infestation brought about by climate change.

The BIDP of Barangay Maravilla, on the other hand, identified the following problems and needs: sustaining the health of livestock, lack of community gardens, lack of additional capital for livelihood and inadequate source of vegetables for families.

Analysis of the Problem tree (Figure 8) showed that lack of organized groups emerged as the core problem of farmers in Barangay Maravilla. No organization existed in the area and because of this, some community members opted to join organized groups in nearby barangays.

Several causes were identified by participants that contributed to the emergence of the core problem. These are the following:

1. ***Lack of time to attend an organizational meeting.*** Though there were previous attempts to organize an association, it didn't succeed because farmers were hesitant to respond to the invitation. They do not attend meetings because they are not interested in joining the group.

   It was found out that farmers' apathy in joining the organization was due to their tenurial status. Majority of them do not own the land they till. They don't have lands where seeds or seedlings can be planted, in case that the agricultural support is in line with the provision of quality planting materials. That's why even if an organization will be formed, they believe that the benefits that such a group could extend will not be enjoyed by them.

2. ***Absence of organizer.*** Farmers could not identify a person or a group who is willing to take the lead in forming an organization. Although previous attempts were made, the persistence of the one who took the initiative didn't last.

3. ***Lack of capital in organizing an association.*** Creating an organization would entail considerable costs particularly in the registration process. Farmers don't have much financial resources to allocate for some contributions that are required by an association.

4. ***Lack of capital in farming.*** Farmers don't have the capital for the sustenance of their farming needs. Credit facilities/ institutions do not exist in the barangay where farmers can supposedly access loans for their production needs.

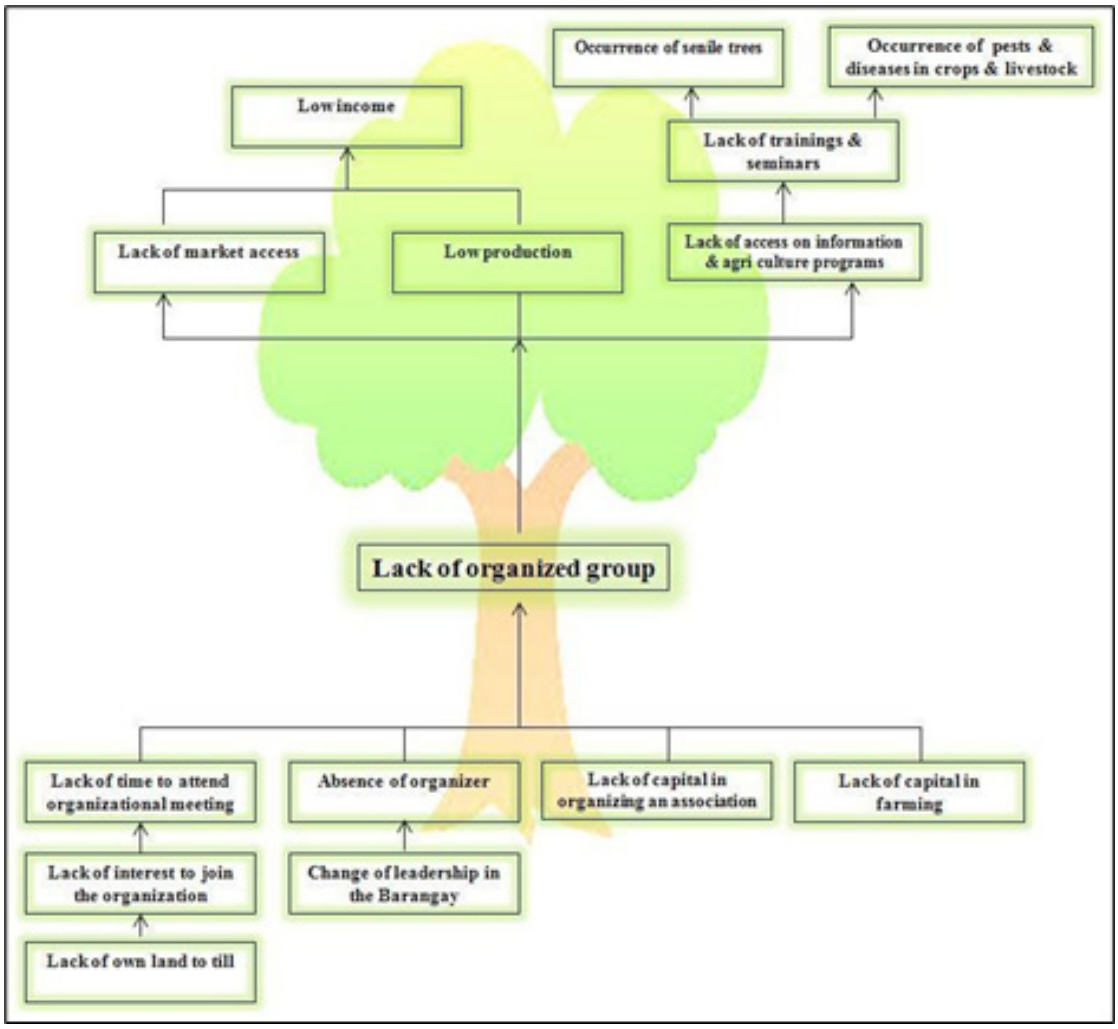

Figure 8. Problem tree analysis among farmers of Barangay Maravilla, Nagcarlan, Laguna.

Furthermore, the emerging problems in the area have led to several effects such as:

1. *Lack of market access.* Since farmers were not organized into groups, most often they sold their produce individually. They do not have any option to select a buyer that will give them higher prices as they are just selling in small volume. As a result, farmers obtained low income which is often not enough to support the needs of their family.

2. *Low production*. This happens when farmers fail to obtain the potential yield of his crop. This resulted in low income of the farmers.

3. *Lack of access to agricultural information and programs*. Due to the non-existence of an organization, farmers have no access to agricultural information and programs implemented by the government. Support of the government to the farmers is usually extended through an accredited organization. Thus, farmers who do not belong to a recognized group may have limited chances to benefit from agricultural programs.

   Insufficient information was due to farmers' lack of training and seminars particularly on crop and animal production. This further resulted to the existence of senile trees, particularly for coconut, and the occurrence of pests and diseases affecting crops, poultry and livestock animals.

F. Alternative Tree Analysis

Figure 9 describes the future situation that will be achieved by solving the problem identified. Lack of organized groups among farmers was determined as the major problem in the area. Thus, to achieve the objective of organizing an association, farmers must attend meetings; an organizer that will initiate the creation of the group must be present; and capital that will be utilized for organizing as well as for farming must be availed by the farmers.

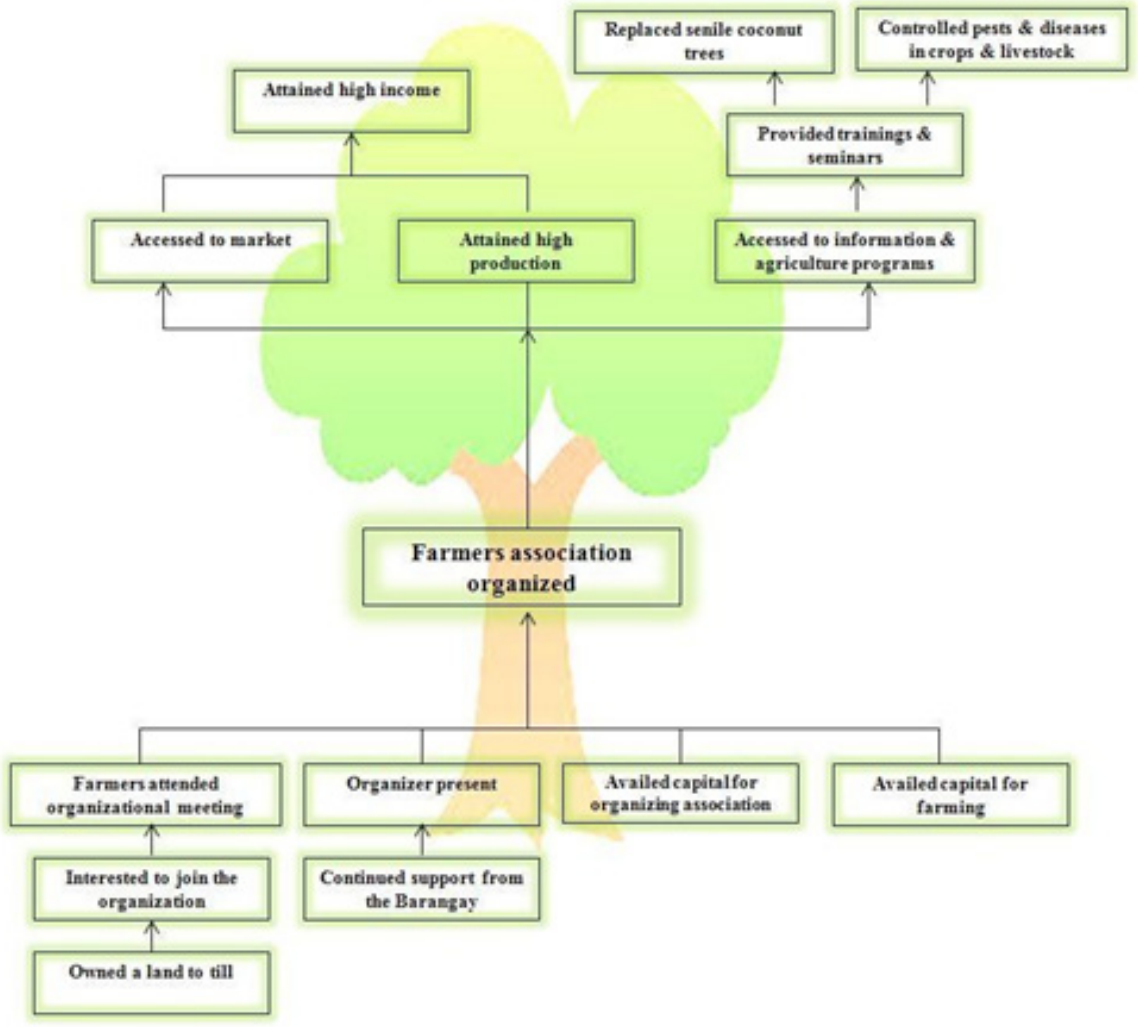

Figure 9. Alternative tree analysis among farmers in Barangay Maravilla, Nagcarlan, Laguna.

Presence of an organizer that will take responsibility in leading the group will be made possible through the continuous support of the Barangay Local Government Unit (BLGU). Also, the creation of an organized group among farmers will lead to increased production and having access to market, information and agricultural programs being implemented by the government. Access to market and high production can lead to high income of the farmers that could greatly help them in supporting their family and improving their living standard.

Having insights on the existence of agricultural programs intended for the farmers will lead to provision of necessary training that will enhance their skills on crop and animal production. With the knowledge obtained from such trainings, senile trees will be replaced with modern, early-maturing and high-yielding varieties. Pest and disease occurrence that caused detrimental effects on crops and livestock will be controlled through appropriate management strategies.

H. Planning using Logical Framework

The participants opted to respond to the need for an organized farmers' association in their logical framework activity (Table 2). During the workshop, they realized the importance of having an organized farmers' group in the barangay.

Table 2. Logical framework of farmers of Barangay Maravilla, Nagcarlan, Laguna.

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Assumptions
Goal Improved crop production practices.	Increased production and supply of coconut, lanzones and banana by 20% in 3 years.	Production data from Barangay Maravilla and the MAO of Nagcarlan.	Farmers applied the proper production practices in their farm.
Objective To access training and seminars to improve knowledge and skills on proper crop production practices.	100% of members of the farmers' association attended at least two trainings and seminars on proper crop production in 3 years.	• Invitation letter/s for training/ seminars • Certificate of Attendance/ Participation • Attendance • Photos	Availability of farmers. Availability of training/ seminars from LGU/ MAO.
Output Organized farmers' association of Barangay Maravilla.	Accredited farmers' association in Barangay Maravilla within 1 year.	• Certificate of Accreditation from LGU-Nagcarlan • Copy of organization's Constitution and By-Laws • List of activities to be accomplished by the organization	Met the minimum requirement to become accredited by the LGU.
Activities			
1) Emergency meeting of Barangay Council	Emergency meeting of the Barangay Council was held. Schedule of the assembly meeting was finalized.	• Attendance • Minutes of BC meeting • Photos	Availability of Barangay Council officials
2) General Assembly meeting of farmers of Barangay Maravilla.	General assembly meeting of farmers was held. Names of farmers who wanted to become members were listed.	• Attendance • Minutes of BC meeting • Photos	Availability of farmers

Table 2. Logical framework of farmers of Barangay Maravilla, Nagcarlan, Laguna (cont'd...)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Assumptions
3) Formation of farmers' association in Barangay Maravilla.	Farmers met and agreed to form an association in Barangay Maravilla. Accomplished required documents for LGU- accreditation.	• List of official members • Minutes of farmers' meeting • Photos • List of required documents for LGU- accreditation	All farmers are willing to become members of the association

The chairman of the Committee on Agriculture informed the group that the Barangay Captain plans to call an emergency meeting for the council to discuss the organization of farmers of Barangay Maravilla.

The local officials wanted to call for an assembly meeting of all the farmers of the barangay to present results of this workshop, emphasize the need and to encourage them to join the farmers' association.

With the initial agreement from the workshop, participants will participate in the meeting and become part of the farmers' association, the barangay councilor is confident that they will meet the minimum requirement for accreditation to the LGU of Nagcarlan, Laguna within one year.

After accreditation, the group envisions that they will have access to training/ seminars being offered by the government, specifically the OMA of Nagcarlan, Laguna. Thus, they hope that all members will be able to attend at least two training activities on crop production practices within three years.

With the new knowledge and skills learned from training attended, their goal is to improve their crop production practices which will lead to a 20% increase in production/supply of major crops like coconut, lanzones and banana within a three-year period. This can be verified by the production data which can be accessed from the Barangay and from LGU-OMA of Nagcarlan.

CONCLUSION AND RECOMMENDATIONS

This study looked at the coping mechanisms employed by farmers of Barangay Maravilla, Nagcarlan, Laguna, Philippines to deal with climate hazards (like typhoons and flooding) in the agriculture sector.

The problems identified by the farmers related to climate hazards include: a) the destruction of crops and farms due to typhoons and other calamities; and b) the destruction of fruit and coconut trees due to insect infestation brought about by climate change.

The coping mechanisms employed by farmers to the existing climate hazards include:

On low crop yield due to typhoon damages - They intercropped coconut with vegetables to help augment family income and to have a steady source of food.

On low income due to agriculture damages brought by calamities - Farmers engaged in non-farm activities to sustain their livelihood or borrow money either to private persons with relatively high interest or to relatives with no or minimal interest, because of non-accessibility to crop insurance and other support institutions.

On farmers' control measures for coconut infestation – Farmers adopted integrated pest and disease management like use biological control agents (predators), applied used oil to the infected coconut trees and sprayed soap on the infested trees as well as utilized chemicals through stem injection.

However, such coping mechanisms were not enough to help improve their production that will eventually lead to the upliftment of their living conditions. The PRA activities have made the farmers realize the need to organize themselves into an association and be recognized by the local government. This should enable them to have access to information and agricultural programs offered by the government and the private sector in order to enhance their farm productivity and improve their lives, even with the onset of climate change. The local government of Barangay Maravilla promised to support the farmers' organization and provide them all the help that they will need to ensure food security and sufficiency in their community.

The Barangay Integrated Development Plan (BIDP) cum Disaster Risk Reduction and Climate Change Adaptation of Barangay Maravilla (2014-2016) validates that the 1,438 population is at risk in terms of hazards of typhoons and flooding. As a response, they have assigned three evacuation centers (Barangay Operations Center, Barangay Chapel and Barangay Day Care Center) in case of calamity.

The study recommends that farmers of Barangay Maravilla, Nagcarlan, Laguna commit to their plan as stated in their logical framework. The committee chair on agriculture of the barangay council, has to be fully motivated and committed to organize farmers in the area. Organizing farmers will entitle them to benefits of access to government programs, like provision of seeds and fertilizers and training, which will help them overcome damages that may be brought by climate hazards.

The study also suggests that the LGU of Nagcarlan should develop an action plan to address the concerns of the farmers, specifically of Barangay Maravilla. It also recommends that the local government establishes an outlet to ensure a market for the agricultural products of the farmers in the area.

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