TERMINAL REPORT

Understanding Food Security Response Strategies of Disaster Victims: The Case of Taal Volcano Eruption

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List of Acronyms

BATSTATEU	Batangas State University
BFAR	Bureau of Fisheries and Aquatic Resources
CBPR	Community Based Participatory Research
CLCP	Community Life Competence Process
CLUWP	Comprehensive Land and Water Use Plan
COVID-19	Corona Virus Disease 2019
CVAP	Community Visioning and Action Planning
DOST	Department of Science and Technology
DOST-CALABARZON	Department of Science and Technology – Cavite, Laguna, Batangas, Rizal and Quezon
DOST IV-A	Department of Science and Technology Region IV-A
DSWD	Department of Social Welfare and Development
ENIPAS	Expanded National Integrated Protected Area Systems
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GCQ	General Community Quarantine
IATF	Inter-Agency Task Force for the Management of Emerging Infectious Diseases
ISAAD	Institute for Sustainable Agri-Fisheries and Development
KII	Key Informant Interview
LGU	Local Government Unit
MECQ	Modified Enhanced Community Quarantine
NGA	National Government Agency
NIPAS	National Integrated Protected Area Systems
PAR	Participatory Action Research
PCAARRD	Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PSA	Participatory System Analysis
PUNLAD	Pungla sa Pag-unlad
RA	Republic Act
SERD	Socio-Economics Research Division
TVPL	Taal Volcano Protected Landscape
UPLB	University of the Philippines Los Baños

EXECUTIVE SUMMARY

The Taal Volcano eruption in January 12, 2020 exposed vulnerabilities of the Taal Lake community who has not seen a major eruption since 1977. This study will look on the adaptive response strategies, with focus on food security, of the population directly affected by the Taal Volcano eruption. It is in the hopes of this study that future projects be created that would improve resilience of the population surrounding Taal Lake.

The onset of the COVID-19 pandemic and its corresponding heath protocols restricted the onsite surveys and community interviews. Community Scoping and Key Informant Interviews were conducted in lieu of large scale surveys and community integration. The selected communities identified to best represent the area were the towns of Agoncillo, San Nicolas and Talisay. The data derived from the above data gathering method was used in the creation of the 10 Key Elements and Success Metric using the Participatory Systems Analysis (PSA) method. The PSA method was used instead of the more familiar SWOT analysis as food security is a metric that cannot be pinned down in a single element such as availability of food during disasters. Interestingly, the PSA results showed that availability of food during a disaster was found to be only a buffer solution to the problem of food security.

The result of the PSA method showed several key elements that would address food security concerns with the greatest impact. The following crucial elements were institutional partnerships with other government agencies and institutionalized responses to recurring disasters. While the elements with the greatest effect on food security, known as movers in the PSA method, were adequacy of funds, adequacy of manpower, and institutional partnerships with donors and other development agencies.

Cross referencing with other existing projects in the area showed that institutional partnerships with donors and other development agencies are thriving and thus have a strong positive effect on the Taal Lake community. However, a few opportunities were found that are not being addressed by any other agencies. The Taal Lake community is foremost a fishing community and their livelihood is directly tied to the lake. It has also been repeatedly established that food security is in parallel with the livelihood of individuals.

With these information, the team has identified 3 promising projects that would greatly impact the Taal Lake Community. 1. Creation of a Disaster Evacuation Playbook and Drills, 2. Establishment of Tawilis seeding programs of Taal Lake, and 3. Creation of a Marine Protected Area within the Taal Lake.

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TERMINAL REPORT

A. BASIC INFORMATION

1. Project Title: **Understanding Food Security Response Strategies of Disaster Victims: The Case of Taal Volcano Eruption**

2. Proponent(s): **Department of Science and Technology Region IV-A (DOST IV-A)**

3. Implementing Agency

   3.1. Lead Agency: **DOST IV-A**
   Head of Agency: **Ms. Emelita P. Bagsit, Regional Director**
   Contact Details: **(049) 536-4497**

   3.2. Collaborating Agencies: **Batangas State University** (BatStateU)
   Institute for Sustainable Agrifisheries and Development (ISAAD)

4. Project Duration: **15 months**

   4.1 Start Date of Implementation: **01 July 2020**

5. Project Site(s)

   5.1 Province: **Batangas**

   5.2 City/Municipality: **Agoncillo, San Nicolas, Talisay**

6. Project Funding

   6.1. Total Approved Budget: **PhP 2,802,182.16**

   6.2. Agency Counterpart: **PhP 655,000.00**

7. Target Beneficiaries/Users: **Local government agencies, local executives, researchers, affected communities**

B. TECHNICAL DESCRIPTION

Rationale/Introduction

Lakes are important aquatic resources in the Philippines covering about 200,000 ha nationwide (BFAR, 1994). Majority of these lakes provide livelihood to surrounding communities but generally have been over exploited. The existing open access policy of the government as provided for in **Presidential Decree 704** further exacerbated the problem. Taal Lake is the third largest lake in the country. Fishing is an important economic activity of the surrounding population. The exploitation of the lake has been intensifying while poverty among its lakeshore communities has been increasingly becoming evident. The major reasons cited for this include a) **low educational attainment of marginalized lakeshore inhabitants**, almost 50% only reached elementary level (UPLB Foundation, Inc. 1996), limiting their opportunities to obtain better employment elsewhere; b) **limited livelihood opportunities around the lake**; and c) **proximity to major tourist and commercial centers likewise limited the attractiveness of the communities to investors, negatively affecting the economy of lakeshore barangays**. During the last decade it seems that fish cage development was the only one which flourished but this has been overcrowding the lake bringing about conflicts between municipal fisherfolk and fish cage operators in addition to negatively affecting water quality and the ecological health of the lake.

In response to the growing problems in the lake, the Taal Volcano Island National Park, was established in 1967. It was later restructured to the Taal Volcano Protected Landscape (TVPL) under the National Integrated Protected Areas System (NIPAS) Act (RA 7586) by virtue of **Presidential Proclamation 923** issued in 1996. When the Expanded National Integrated Protected Areas System (ENIPAS) Act or RA 11038 enacted in 2018, the TVPL was permanently classified as a National Park covering an area of 62,292.16 hectares and surrounds the Taal Volcano Island, Taal Lake, and 37 tributaries of thirteen municipalities and three cities. A portion of Pansipit River, which serves as Taal Lake's only outlet to Balayan Bay in the West Philippine Sea, can also be found inside the TVPL.

Lake Taal is an interesting freshwater ecosystem to study.[1] The fisheries in the lake have become integral to the way of life of households in the communities surrounding the lake and have sustained them for hundreds of years. However, the biodiversity of Lake Taal has been threatened by extensive aquaculture activities. This eventually led to poorer water quality and alteration of species' structure. Also, the presence of the world's lowest active volcano provides an interesting array of challenges that households have learned to adapt to.

[1] Papa, RD. 2016. Lake Taal: Sustaining native biodiversity in the face of aquaculture, climate change, and non-native species

Taal Volcano is one of the 24 active volcanoes in the Philippines and ranks as the second most frequently erupting volcano with 35 identified historical eruptions since 1572. The nature of the eruptions was either phreatomagmatic, phreatic or strombolian. Another large magnitude eruption in the future threatens the lives and livelihoods of about two million people living within a 35-km radius in Batangas Province alone including those living within the Taal Caldera and Taal Volcano Island. The communities around Taal Lake and Taal volcano face the most risk from future eruptions of the volcano. A major reason for this is because these communities are home to poor population who are less able to respond to natural hazards and related threats exacerbated by their lack of access to resources - financial and institutional and limited capacities. It is therefore imperative to increase resilience of households in these communities. Increasing resilience, however, often involve household and community adaptation. This can be through protection and insurance which and can be done either privately, as with **autonomous household adaptation**, or as local government or public led initiatives, as with **planned adaptation strategies**.

With the recent eruption of Taal Volcano, physical rehabilitation, and evacuation have been foremost in the agenda of both local and national governments. The eruption and the resulting chaos on how risks are perceived highlighted several issues and challenges that the affected communities and households face and must contend with. It also highlighted the need for a deeper understanding of the adaptation behavior and risks perception of the affected population.

Natural disasters like a volcanic eruption have direct impacts on food security of the affected communities. Nutritional quality of food is also affected by the significant influence of disasters on crops, livestock and fisheries. The eruption of the Taal volcano primarily affected the agriculture and fisheries sector. According to the Department of Agriculture (DA), financial cost of losses and damage was estimated at PhP 3.06B with the fisheries sector accounting for about half of the losses. The eruption also led to displacement of affected residents to evacuation or relocation centers, and dependence, initially, on assistance provided by the local government and private sectors. Their properties, sources of food and livelihood were affected when Taal volcano erupted.

The study focused on autonomous adaptation of households in addressing food security in the three most affected communities (Agoncillo, San Nicolas, and Talisay) by the recent Taal volcano eruption. Results of the study provide valuable information for addressing the effects of volcanic eruptions in other areas within and outside of Batangas and identify the constraints faced by poor households in vulnerable areas and the possible interventions that could be pursued by LGUs. This study also provides evidence-based information that can refocus rehabilitation strategies where it matters and can be sustainable over time. Results can serve as DOST's and PCAARRD'S contribution to the rehabilitation efforts. A more thorough and deeper understanding of the sociology of the affected households can help

explain why households behave the way they do and could guide policy formulation, prioritization, and implementation of the interventions that are being planned in the affected areas. The household's guided and objective perception of the risks and hazards they face and the strategies they employ to ensure their food security can support LGUs in providing appropriate assistance to the households and strengthen the communities' resilience to natural hazards and risks such as those brought about by the volcanic eruption.

Review of Literature

There are already numerous empirical studies on adaptive behavior of rural households. Ramirez, et al. (2016) for example, assessed the effect of climate change perception on adaptation of farmers in Batangas, Palawan and Misamis Oriental. On the other hand, Deressa et al. (2008) looked at the effect of climate change perception on adaptation of farmers in the Nile Basin of Ethiopia. In the study, the interest was more on climate change as manifested by temperature and rainfall change instead of the impacts of hazards associated with climate change. Like most studies, the study used univariate techniques in analyzing adaptive behavior. Nhemachena and Hassan (2007) recognized the shortfall of using univariate techniques in analyzing adaptation choices. According to the authors, univariate approaches may be prone to biases as the models ignore common factors that might be unobserved and unmeasured but might affect different adaptation measures. They instead used a multivariate approach to analyze the determinants of farmer adaptation against long term temperature and precipitation changes. They considered the simultaneous use of various adaptation strategies in agriculture-based households. Similarly, Seo and Mendelsohn (2007) looked at the effect of climate change variables such as temperature and precipitation changes and recognized the issue of simultaneous choice of livestock portfolio for households in Africa.

It is surprising, however, that despite the more pronounced risks in coastal and lakeshore communities, there has been very little empirical study on the adaptive behavior of households in these communities. Most studies have focused on adaptive behavior of communities in terrestrial ecosystems as described earlier. Francisco et al. (2011) considered the effects of an extreme climate event for some coastal communities in China, Philippines, Thailand, Indonesia, and Vietnam. However, the focus was mostly on terrestrial systems with minimal coverage of coastal communities. They adapted a Multinomial logit to study the determinants of proactive and reactive adaptation. Jarungrattanapong and Manasboonphempol (2009) focused on Thailand coastal communities' adaptation strategies to address coastal erosion and flooding. Like those common in the literature, the study however, was mostly descriptive in nature.

In analyzing adaptation options in the affected community, one needs to recognize the uniqueness of lakeshore ecosystems. Unlike communities in terrestrial ecosystems, lakeshore

and coastal communities face a confluence of geophysical hazards. Among these are coastal erosion, flooding/typhoon, and saltwater intrusion. Thus, the issue of autonomous adaptation and household resilience should be analyzed within the context of multiple hazards. There is still a dearth of literature that studied why some households self-protect and self-insure against multiple but interrelated natural hazards. This study is closest to that of Mahmud and Barbier (2011) in that they considered joint adaptation decisions to self-insure and self-protect against storm damages in southwest Bangladesh.

Another aspect overlooked in adaptation behavior is the psychological impact of these disasters. Mental, emotional and spiritual recovery from a traumatic event is an ongoing process (Rothschild, 2000; van der Kolk, McFarlane & Weisaeth, 1996). Research suggests that psychological recovery from a disaster varies between individuals and is dependent on multiple factors (Barlow, 2001; Rothschild, 2000). These include the internal variables such as personality as well as external variables, such as social support (Barlow, 2001; Nathan & Gorman, 2002). Research indicates that when an individual receives social support and encouragement towards recovery, including having people to listen and talk with, psychological recovery is more likely. When members of a community begin to act on their concerns and support each other, the recovery process can be enhanced (Boss, 2006).

Natural disasters and food insecurity are directly interconnected (Tirivangasi, 2018). According to FAO (2015), disasters directly impact agricultural livelihoods, food security and nutrition. Natural hazards like floods, typhoons and volcanic eruptions, consequently affect market access, trade and food supply, reduce income and employment, and increase food prices. Natural disasters create poverty which successively increases the prevalence of food insecurity and malnutrition. According to Hidayat et al. (2021), natural disasters affect food security due to low production in the affected areas, so that securing food is a top priority when a disaster occurs. In developing countries, the agriculture sector absorbs about 22% of the total damage and losses cause by natural hazards (FAO, 2015).

Food security, according to the Food and Agriculture Organization (FAO), exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. To accomplish its sustainability, four major and crucial components or dimensions of food security are identified: (1) availability, (2) access, (3) utilization, and (4) stability.

All these dimensions of food security are affected whenever natural disasters occur. Reddy et al. (2019) described these components as follows:

1. Food availability refers to the constant availability of food in adequate quantities.

   It pertains to adequate amount of food with appropriate quality which can be obtained through domestic production or import. It refers to food supply which is

physically at-hand at any given time. In the household level, this includes stock of rice and food, backyard garden, poultry and livestock that may be used for consumption when needed. In the macro level, this refers to food available for distribution or for sale in the community.

2. Food access is determined by people's initial ability to produce their own food or their purchasing power.

   There must be adequate resources or so-called entitlements which come from direct or own production (such as backyard gardening), source of income to buy food from the markets, gathering of wild foods, community support (such as food sharing or food aid), and other means.

3. Food utilization refers to the metabolization and positive nutritional impact on people.

   This dimension pertains to use of available and accessible foods by considering dietary requirements needed to have an active and healthy life. Nutritious foods, clean water, sanitation in food preparation, storage and hygiene practices are among these requirements.

4. Food stability is the ability to procure food over time, through production and/or food transfer.

   Stability refers to maintaining availability and access to adequate and nutritious food at all times, even when there are economic or climatic crisis and cyclical or seasonal events. This means that a stable food-secured household is able to maintain a constant level of food supply throughout the year without being affected by natural calamities and other disasters.

Project Objectives[2]

The project's **research** objectives include:

1. To identify, document and analyze the reasons for the choice of autonomous adaptation strategies for enhanced food security by households in the volcano eruption affected sites;

2. To determine the most significant factors affecting these adaptation strategies; and

[2] During the inception meeting, the evaluators suggested that the team identify and separate the research objectives from the development objectives given the expected output of the project indicated in the approved project document.

3. To identify and recommend policy options to enhance resilience of volcano eruption affected communities.

Considering the nature and topic of the research, however, the project also has its own **development objectives**[3]:

1. To provide training and capacitate partner researchers on participatory action research, community life competence process approaches as well as participatory system analysis.
2. To further enhance the capacity of local executives to more efficiently and effectively respond to impacts of natural calamities and hazards like volcanic eruptions.
3. To identify and develop scientific papers for submission to both local and international journals; and
4. To identify and recommend specific plan of action to enhance the resilience of communities amidst natural calamities and other hazards that threaten food security in the communities.

Methodology

Study Sites

The study covered three municipalities in the Province of Batangas significantly affected by the eruption of Taal Volcano in January 2020. These are the municipalities of Agoncillo, San Nicolas and Talisay (**Figure 1**). Local executives of each municipality were initially informed thru writing about the project and to secure their support and cooperation. Meetings with the local executives were conducted to discuss specific activities to be undertaken, purpose of each activity as well as seek support for all the activities. Protocols regarding public health standards being implemented in each municipality were also discussed. After the meetings with the LGUs, the study sites selected were Barangay **Subic Ilaya in Agoncillo**, **Barangay Bancoro in San Nicolas** and **Barangay Aya in Talisay**. The criteria used in selecting the barangays are the following:

a. Accessibility
b. Population
c. Peace and order condition
d. Presence of networks, and other projects that could be accessed by the team

[3] This was the suggestion of the evaluators of the project during the inception meeting on 9 July 2020.

e. Previous experience and familiarity with the community

f. Presence of other institutions and relevant government agencies

g. Extent of damage and rehabilitation required

h. Socio-economic and demographic profile of the community (population, income, development challenges and sources of employment)

i. Representativeness of the barangay of the conditions in other barangays in the municipality

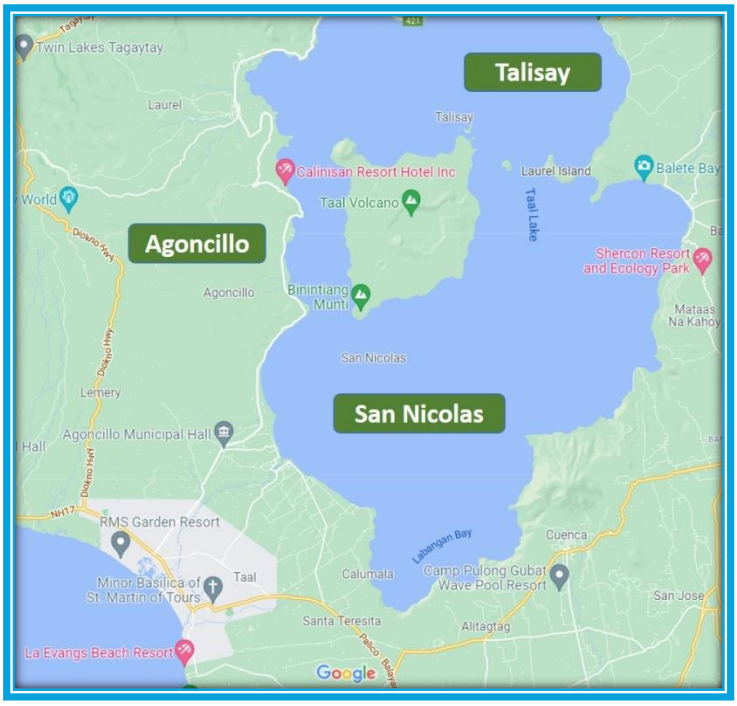

Figure 1. Location of the three project sites

Conceptual Framework

The conceptual framework of the project is shown in **Figure 2**. Communities with their inherent assets and liabilities face a confluence of challenges and threats. How they react or adopt to these challenges is a function of individual (autonomous) adaptation strategies and planned or community led (public) strategies. The critical part of the analysis was identifying the levers that could drive the transformative change to establish resilience of the community and households and lead to sustainable impulses or interventions to address the food security problems of both the households and communities. These challenges and impulses were documented as these could assist the LGUs in addressing similar or different threats in the future.

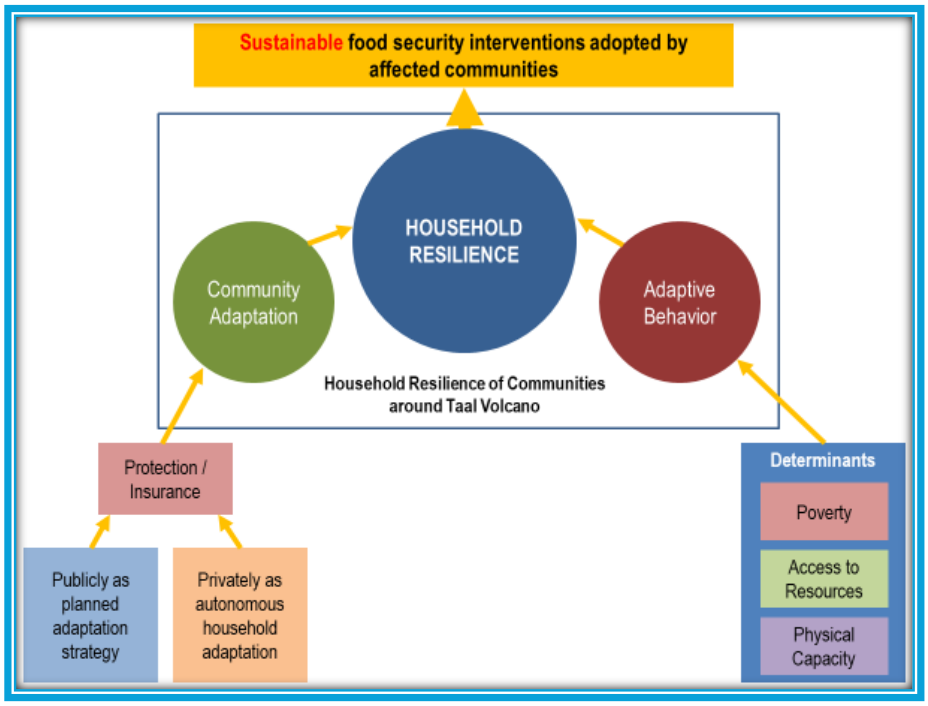

Figure 2. Conceptual framework for the project

Analytical Framework

The analytical framework used in the study is shown in **Figure 3.** The study used qualitative data to achieve the objectives of the project.

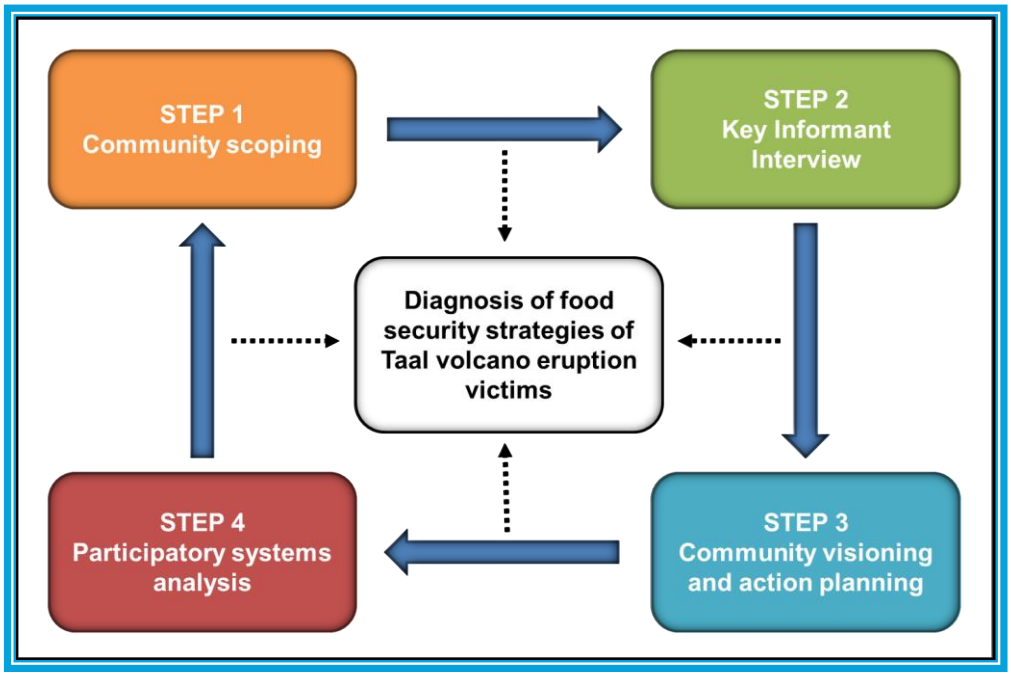

Figure 3. Analytical framework used in the study

STEP 1: Community Scoping

Community scoping activities were conducted in each study site. Courtesy calls were conducted to the local executives of the three barangays to introduce the project and its objectives and to inform them of the activities to be conducted in the barangay. The effects of the Taal volcano eruption in their barangay and the evacuation process done were discussed with barangay officials. Key economic activities and sources of employment in the area as well as development challenges faced by the community were identified. Transect walks were done to observe the physical effects of the eruption as well as the local dynamics including the general way of life in the community. Insights from the community visits and data gathered from data mining were used in completing the community profiles of the project sites.

STEP 2: Key Informant Interview (KII)

With the help of the local executives, six (6) sectors were identified for each barangay. At least five (5) key informants per sector identified were interviewed. As approved by the local executives, face-to-face interviews were conducted (**Figure 4**). A total of 94 individuals were interviewed. **Table 1** shows the list of the different sectors from each municipality and the number of KIs per sector who participated. To facilitate the interviews, guide questions for KII were prepared. Results of the KII were utilized to identify the effects caused by the eruption (on properties and source of income), their perception on food security, and the adaptation strategies employed by households especially with regards to food security, and perception on food sufficiency.

Figure 4. Conduct of KIIs at the covered court of Barangay Bancoro. Use of face masks and social distancing was observed in compliance with the Inter-Agency Task Force (IATF) guidelines for group gathering during the COVID-19 pandemic.

Table 1. Total KII participants per sector per barangay

Sector	Subic Ilaya	Bancoro	Aya	Total
Barangay Workers	7	5	5	17
Government Employees	5	5	5	15
Fishers	5	5	5	15
Farmers	5	5	5	15
Hog Raisers	6	-	-	6
Poultry Raisers	6	-	-	6
Poultry & Livestock Raisers	-	-	5	5
Senior Citizens	-	5	-	5
Tricycle Drivers	-	5	-	5
Dressmakers	-	-	5	5
TOTAL	**34**	**30**	**30**	**94**

STEP 3: Community Visioning and Action Planning (CVAP)

CVAP is part of the Community Life Competence Process (CLCP) which facilitates actual actions towards issues faced by the community. Detailed process can be found **here**. CVAP was used in this study to facilitate the identification of the perceived needs of the communities affected by the Taal volcano eruption and ways to address these needs. The five (5) representatives per sector who participated in the KII were also engaged in the CVAP. Initially, each participant was asked to draw their personal dreams for their community. The participants then shared their personal dreams to the group (sector) and drew the sector's dream for their community. The selected sectoral representatives convene to create a community dream (**Figure 5**). Their drawing was a representation of what their vision is for their community. The representatives then assessed themselves where their community is, in relation to their dream. Priorities were identified and actions plans were developed. The action plans include priority practices and current level of the community, target level for these priorities within 1 year, specific actions they need to undertake to reach target level, resources needed to reach target level and time frame within which the community will reach target level per priority practice.

Figure 5. Sectoral representatives prioritizing community needs as part of CVAP in Barangay Subic Ilaya, Agoncillo.

STEP 4: Participatory Systems Analysis

The detailed process of PSA can be found **here**. PSA is a tool utilized in the analysis of problem. For the project, PSA was used to identify the critical factors/areas that need to be acted upon. These critical areas when addressed will make the community's response to volcanic eruption, in relation to food security, effective. First, a success metric was framed. Factors/elements were then identified which were perceived to have an impact on the success metric. Influences and cross-influences among the factors were examined using the rating system and the PSA matrix (**Figure 6**). Active sum, passive sum and degree of influence were calculated and results were plotted on the PSA quadrant (**Figure 7**). After plotting, the elements/factors were identified as motor/lever, crucial/critical, buffer and symptom.

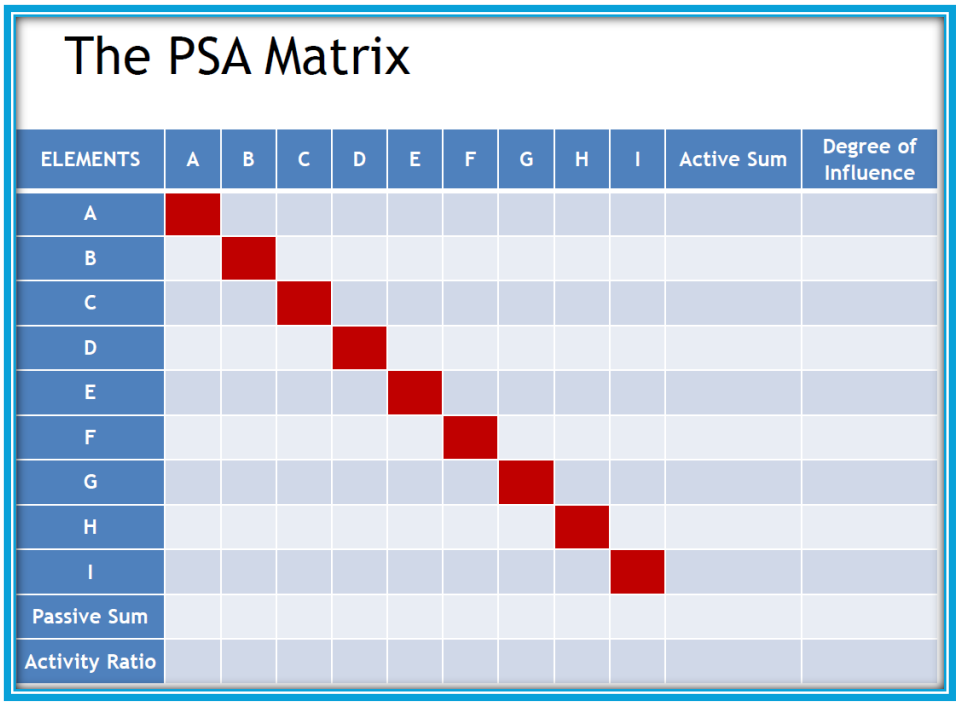

Figure 6. The PSA matrix

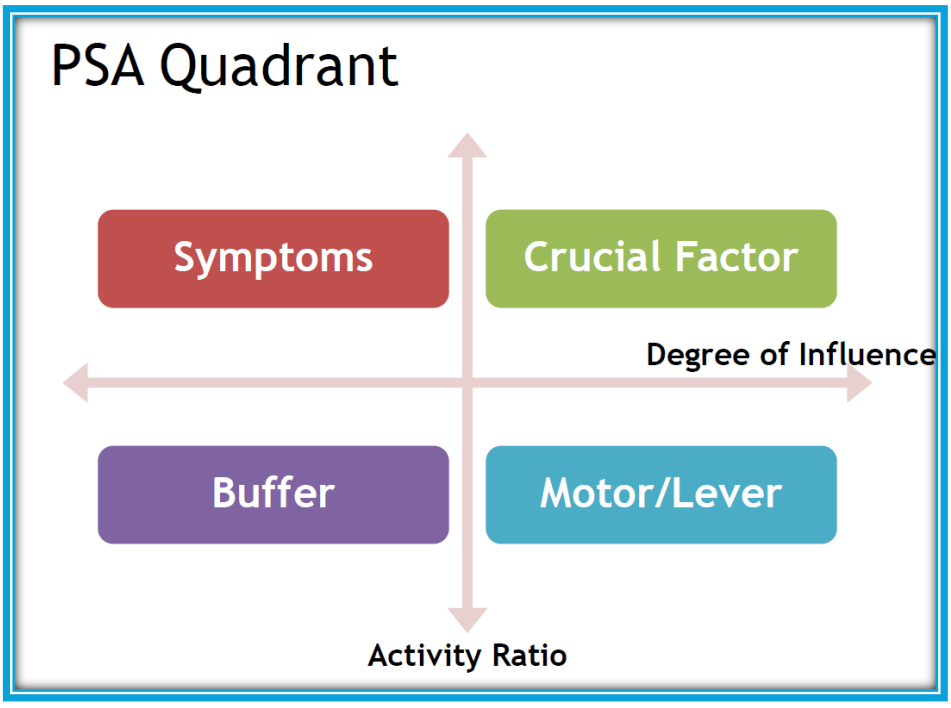

Figure 7. The PSA quadrant

Results and Discussion

1. Results from Community Scoping Activity

The research team visited the project sites to observe and document the effect of the Taal volcano eruption more than a year after it happened. Preliminary assessment of the effect of the eruption and of existing adaptation strategies was done by the team.

1.1. Agoncillo

The municipality of Agoncillo is a 4th class municipality with 21 barangays and a population of 38,059 (PSA, 2015). It has a total land area of 49.96 square kilometers which constitutes 1.60% of total are of Batangas. Agoncillo is bounded by Taal Lake on the east, Municipality of San Nicolas on the south, Municipality of Laurel on the north and Municipality of Lemery on the west.

According to the 2020 Comprehensive Land and Water Use Plan (CLUWP), Agoncillo is highly dependent on agriculture, producing coconuts, bananas, cassavas, corn, mangoes, rice, sugarcanes and vegetables. Livestock and poultry raising are also present in the municipality. Fishing is the main livelihood for the locals of Agoncillo.

Development constraints identified in the 2020 CLUWP include:

- Weak implementation of the solid waste management system
- Limited access to transportation
- Unstable electricity
- Inadequate water supply
- Intermittent telecommunication signal.

On the other hand, development opportunities identified are in the area of tourism businesses and investments, and agriculture (crops production and fisheries).

Barangay Subic Ilaya is one of the coastal barangays of Agoncillo. It has a total population of 3,833 which accounts for 10% of the total population of Agoncillo (PSA 2015). Subic Ilaya is identified by PHIVOLCS as one of the barangays susceptible to Taal volcano base surge (100%), volcanic tsunami (19%) and ballistic projectile (65%).

According to the barangay officials, majority of the residents of Subic Ilaya were placed in evacuation centers when the volcano erupted. The barangay received

overwhelming support through the relief goods distribution. Residents who have relatives working overseas or who have other sources of income was able to immediately rebuild their damaged houses or put up new ones. The local government also provided assistance to families with the most devastated houses by providing housing repair materials such as hollow blocks and galvanized roofs. The Department of Social Welfare and Development (DSWD) coordinated and collaborated with the LGU to provide financial assistance for the affected families.

Adverse effects of the Taal volcano eruption are still evident in Subic Ilaya. Lake waters crept inland resulting to many houses submerged in water (**Figure 8**). Displaced families in these areas availed of relocation at Barangay Talaibon in Ibaan where most evacuees are situated.

Figure 8. Houses still submerged in lake water in Barangay Subic Ilaya

According to the barangay captain, one of the developmental challenges in Subic Ilaya are abrupt natural disasters such as storm and typhoons, earthquakes, and volcanic eruption, as these events destroy properties and infrastructures, and their effects are devastating to the environment, economy, and public health. Another developmental challenge identified is the high financial capital for fish cage operation. Fishing is the primary livelihood in the Subic Ilaya. Most fish cages in the area are owned by non-resident financiers as an estimate of at least PhP 1M is needed to put up one fish cage. With this, the residents preferred to work as caretakers of fish cages. But some non-resident financiers preferred bringing in their

own caretakers which is contrary to the municipal ordinance stating that caretakers and laborers of fish cages are limited to the locals.

Most of the houses in Sitio Hillside and Sitio Manalao are submerged by flood because they are adjacent to Taal's coast and experienced successive tropical storms. Displaced families availed a relocation site at Barangay Talaibon in Ibaan, where most Taal evacuees are situated. Most people residing in Sitio Manalao and Hillside are not locals in the area. The compelled reasons for resettling are the source of employment and marital status.

Damaged roadways (**Figure 9**) were observed in Agoncillo. The volcano's seismic activity and recurrence of calamities resulting in the displacement of soil destroyed many roadways. Because of the disturbances of the road network, they created an alternative route connecting Agoncillo to Talisay. These roads are under construction and maintenance to avoid risks of accidents and increase traffic safety.

Figure 9. Damaged roadways in Barangay Subic Ilaya, Agoncillo

1.2. San Nicolas

San Nicolas is a 5th class municipality from the 3rd district of Batangas. It is bounded on the north by Taal Lake, on the south by the Municipality of Taal, on the east by the Municipality of Sta. Teresita and on the west by the Municipality of Agoncillo. It is the smallest municipality in Batangas with a total land area of 14.37

square kilometers which constitutes 0.46% of Batangas' total area and includes half of the Taal Volcano Island. Total population as of 2015 was 22,623.

Economic activities are basically anchored on agriculture. A large segment of the population is engaged in agricultural activities such as land cultivation, fishing, livestock and poultry raising. Food crops raised in the municipality are rice, corn, root crops, sugarcanes, vegetables and fruit trees. San Nicolas has 18 barangays, 12 of which are coastal, thus are mainly engaged in fishing. Other activities that augment household income are employment (generally out of town), small scale businesses and some are overseas workers.

Local residents claim that San Nicolas which is blessed with a scenic view over-looking Taal volcano is the real gateway to Taal volcano since it is closer to the volcano island (three to four kilometers from the mainland) than any other lakeshore municipality. Hence, the municipality focused on tourism as a priority agenda because they see the lake and the volcanoes' potential to attract tourists and thus becoming one of the eco-tourism destinations in Batangas.

The municipality faces major challenges to growth and development namely:

- Increasing poverty despite the intensive exploitation of Taal lake.
- Limited livelihood opportunities around the lake. Fish cage development has been overcrowding the lake resulting to conflicts between the local fishermen and the absentee fish cage operators.
- Depletion of indigenous fishery resources, particularly the *tawilis* (*Sardinella tawilis*), *maliputo* (*Caranx ignobilis*) and other migratory fish species.

Barangay Bancoro is one of the coastal barangays of San Nicolas with a total population of 2,648 (PSA, 2015). This represents 11.70% of the total population of San Nicolas. Bancoro is included in the list of barangays prone to Taal volcano base surge (100%) and volcanic tsunami (50%) according to PHIVOLCS.

The barangay officials disclosed that houses suffered only minor damages such as cracked walls or ceiling from the constant earthquakes and damaged roofs due to the hardened ashfall that accumulated on rooftops. Since these were considered minor damages, most of these were unreported. Among the barangays in San Nicolas, Bancoro suffered the least since there were only five reported cases of totally damaged houses.

Fishing is the primary source of livelihood in Bancoro. But compared to other coastal barangays, there are no fish cages in the vicinity of the barangay. But some residents are caretakers of fish cages located in other barangays. They were the ones

affected by the eruption as the fish cages were destroyed. Fishing method used are mostly with the use of net, hook and line, and spear. Some fishers are also gillnet makers (**Figure 10**) since they find it cheaper to make their own nets.

Figure 10. Gillnet making is a common sight in Barangay Bancoro

Farming and land cultivation is another source of income in the barangay. Main crops in the barangay are cassava and corn. Due to the ashfall from the volcanic eruption, the soil became acidic thus limiting the type of crops that can be planted in the area. It can be observed during the transect walk that a number of households have their own backyard gardens (**Figure 11**). Vegetables grown in the garden are usually for their own consumption but excess are peddled on the streets.

Figure 11. Some of backyard gardening observed in Barangay Bancoro

According to the barangay officials, the major challenges in their community are the availability of work in their community so that there will no need to work in other barangay or town. Also, there is need for livelihood initiatives. The barangay officials wanted to Bancoro to be known for a specific product. Although there are many cassava farmers in the barangay, there is no market for processed cassava products and some of the growers are already old.

1.3. Talisay

The municipality of Talisay is a third class municipality located in the north-central area of Batangas. It is bordered in the north by Tagaytay, west by Laurel, east by Tanauan, and south by Taal Lake. The municipality has a total land area of 28.20 square kilometers accounting for 0.90% of the total area of Batangas. Talisay consists of 21 barangays with a total population of 45,301 as of 2015. Talisay prides itself as the seedling bowl of the country. Thus a major festival in the municipality is called "Punla sa Pagunlad" (PUNLAD) Festival held every February.

The most common sources of income of the residents come from agriculture, livestock raising, fishing, forestry and aqua farming of milkfish, *maliputo*, *tawilis* and arroyo tilapia. Other sources come from artificial flower making especially in Brgy. Banga and plant nursery/plant propagation. Business establishments are present and located along the national highway. Tourism activities are also present in the municipality. However, majority of the income earners are employed outside Talisay – mostly in Tanauan, Sto. Tomas and in Metro Manila.

Some of the most pressing development issues and challenges identified include:

- Political conflict (additional allocation of ponds to increase employment rate)
- Presence of active volcano (Taal Volcano)
- Declaration of "no human settlement"/"permanent danger zone" in Taal Island
- Lack of alternative livelihood sources for displaced families
- Relocation of the residents of Brgy. Pulo declared permanent danger zone
- Fish kill in many fish cages which have become congested causing pollution (PhP1.6 B)
- Absence of trading post for fish catch
- Lack of hatchery for common fish species farmed in the area

Barangay Aya is one of the coastal barangays of the municipality of Talisay. It has a population of 6,215 which represents 13.72% of the total population of Talisay. The barangay has a total land area of 4.30 square kilometers which 15.24% of the total land area of Talisay. According to PHIVOLCS, barangay Aya is susceptible to Taal volcano base surge (66%) and volcanic tsunami (13%).

Although the eruption only caused minor damages to houses, the agricultural land has been devastated. A few farmers resumed tilling their lands due to the ash fall that piled up and covered the top soil. Other sources of livelihood were also observed

along the way. There were seedling growers of guyabano and other fruit bearing trees.

Majority of the residents in Brgy. Aya are engaged in fishing in Taal Lake (**Figure 12**). The fisherfolks in the community are slowly returning to their normal lives since majority of them rely on the lake fish grow-out. According to a local fisher, the Talisay area was most affected when Taal volcano erupted. All of the cages in the part of Talisay sunk due to the piling up of mud and ashes that came from the volcano. All of the fishes from the cages escaped leading to profit loss.

Figure 12. Fish cage caretakers in Barangay Aya as they leave to feed tilapia

2. Effect of the Taal Volcano Eruption

The dominant effect of the Taal volcano eruption identified by the respondents was physical damages to properties and crops, and loss of livestock and poultry. Furthermore, respondents also identified emotional and mental effects of the volcanic eruption which include fear, anxiety and depression.

Effects on properties **–** Properties damaged by the eruption include houses, piggeries, chicken coop, fish cages and boats, Majority of the houses have slight damages (i.e. cracks on walls, damage on roofs) while some houses totally collapsed. These physical effects were mainly due to two factors: (1) the incessant earthquakes and (2) the heavy

ashfall experienced by the surrounding municipalities of the Taal volcano and even neighboring towns.

Those who have extra money were able to shoulder the cost of house repairs while others whose house suffered only slight damages opted to put off repair. As one teacher commented, she would rather spend her salary on food instead of paying monthly loan amortization for house repair. For those who took loans to be able to save their houses from further damage, their take home pay was reduced. Only a few residents received the P3,000 subsidy for house repair because only those who reported property damages to the barangay has been included in the list of recipients.

For those who continued with fishing and livestock raising, they suffered further losses due to the cost of repairs and replacement of boat and fishing equipment, chicken coop and piggeries.

Effects on sources of income –Some respondents who were from the barangay worker and government employee sectors stated that the eruption has no effect on their source of income as their salary or honorarium is continuous. This is also true for some senior citizen respondents who receive monthly pension.

For the fishing sector (including those who fish as alternative source of income or for consumption), majority responded that fishing operation was affected by the eruption but was continued after the eruption. The eruption affected the fishing industry due to damage to fish cages, boats and nets, low price of tilapia and fear of buyers/residents to consume tilapia as they believe that it can cause poisoning. Fish cages were badly damaged in the three project sites. Majority of the fish cages are owned by financiers and residents are employed as care takers of the fish cages. For Bancoro, fish cages are located near the Taal volcano island. Fishers from mainland Bancoro use gillnets for fishing.

The farming operations were also affected by the eruption. Crops mostly affected by the eruption were bananas, cassava and various vegetables. Farmers however continued their farming practices but with difficulty. This is due to the presence of ash as according to some, it made the soil "hot" hence not suitable for growing vegetables and other crops. Thus, there were some respondents who were unable to plant anything with the ashfall-covered soil while those who were able to grow vegetables found that the quality of harvested crops is not suitable for selling. As one farmer lamented, "*Dati nakakakuha ng isandaang sako, ngayon eh nakakakuha ng kinse, beinte, nakupo, lugi pa ako…Yung kamote lumago, lumaki ang tangkay eh ang hina naman ng laman ng kamote. Maliit ho, tangkay ang lumaki*." [Before we could harvest up to 100 sacks of camote; now we could only get fifteen or twenty sacks. I had no profit at all. Only the leaves grew, the camote

were small and its inside is loose.] Because of this, harvests were mostly for personal consumption only while those sold were marketed at lower prices.

Quantity of crops harvested were greatly reduced thus farmers suffered losses from continued farming, similar to what this farmer complained, "*Nakakapagbenta po ng mga saging na tanim. Sa halip po na 100 piraso ang bunga na anlalaki eh naging treinta, paliit pa ng paliit ang mga bunga*" [We were able to sell bananas but instead of 100 pieces which used to be large, we only harvested thirty pieces. The size of harvested bananas keep on getting smaller.]

Like the fishing and farming industries, the livestock and poultry raising operation was also affected. Although some raisers responded that they totally stopped operation, majority continued operation. Mortality of livestock and poultry were mainly due to hunger and damaged cages while some were eaten by stray dogs. Some respondents admitted that they went back to their barangay even if they were not yet allowed so that they can feed the animals. They shared that in order to avoid checkpoints, they rode motorcycles and took lesser known routes in order to go back to their houses. When they were able to return to their barangay, most of the raisers decided to sell their livestock and poultry even if the price is low to ensure that they would get something back. They fear that their animals, especially the pigs, might die and they would not be able to sell it.

For the dressmakers and tricycle drivers, their livelihood was affected by the eruption as operations briefly stopped during and immediately after the eruption. For tricycle drivers, they were able to continue once the roads were cleared of ashfall and damages were repaired. Dressmakers were able to accept sewing jobs when they returned to their municipalities.

Some respondents shared that they looked for additional livelihood by provision of goods (selling of various products) and services (laborer, delivery) but some changed their sources of income. A number of respondents have alternative source of income which were continued after the eruption. This includes services like carpentry and plumbing, and selling of goods (sari-sari store, canteen, peddling).

3. Compounding Effect of COVID Pandemic

During the interview, it is apparent that the constraints brought about by the pandemic has influenced the responses of some residents regarding their current quality of life, their sources of income, strategies for their household to be food secured and perception on food sufficiency of their community.

Back then, during the community quarantine, movement of people outside their residences were allowed only for obtaining food and other essential goods and services.

To avoid spreading the virus, operation of non-essential businesses, manufacturing and public transportation were halted.

Sectors which participated in the KII which was directly affected by the lockdown include the tricycle drivers and dressmakers. Tricycle drivers who had no other livelihood resorted to borrowing money, getting financial help from relatives and taking odd jobs such as carpentry to earn a living. Meanwhile, dressmakers who earned on piece-rate basis were left with nothing to do as garment operation was suspended since textile clothing cannot be delivered for sewing. They considered it a big loss since they no longer have extra money to buy other food necessities such as coffee and bread. One respondent shared that she resorted to cooking meals for sale to neighbors just to earn.

While the pandemic has no direct effect on fishing, farming and livestock raising, these sectors also felt the constricting effect of lockdown as family members who used to work out-of-town came home to stay because operations were discontinued. Thus, there were more heads to feed whereas family income was greatly reduced. Likewise, the number of their buyers was reduced because the latter were also undergoing financial difficulty.

In terms of financial stability, it would seem that the sectors belonging to barangay workers and government employees were not affected since they continued to receive their fixed salary. However, their workload increased as barangay workers were given other tasks to help out in enforcing quarantine restrictions while government employees were involved in logistics for the distribution of financial subsidies, food and goods to affected households. Teachers were also burdened by extended hours and additional work that on-line and modular classes entailed.

Senior citizens interviewed were those who continued to receive their monthly pensions *i.e. GSIS, SSS, SPIF, 4Ps*. While on lockdown, relatives and sometimes barangay officials helped them claim their pensions and assisted them in procuring groceries and medicines. Their main complaint was lack of mobility which prevented them from getting their exercise from walking around the neighborhood or the baywalk.

However, some senior citizens also belong to the fishing, farming and livestock sectors. Thus, they were also affected by the compounding effect of pandemic on their reduced income due to the damages of volcanic eruption on their crops and livestock.

4. Perceived Quality of Life Before and After Volcanic Eruption

Majority of the respondents perceived that their quality of life was better before the eruption. The reasons for this perception are (1) availability of livelihood opportunities or other sources of income before the eruption, and (2) better farming condition before the eruption. For some respondents from the government employee sector, barangay worker

sector and senior citizen sector, their perception is that their quality of life before and after the eruption is the same. This is due to their continuous source of income (salary, honorarium, pension). Thus, although there are difficulties in living, they are still able to buy the same things.

5. Perception on Food Security

The perceptions of the respondents on food security varied. Responses can be clustered into frequency, food availability, food access, and type of food they consume.

The dominant response of respondents was food security equates to frequency of food consumption. They considered themselves food secure if they eat at least three times a day. For some, the quality and quantity of food they consume do not matter as long as they are able to eat their breakfast, lunch and dinner.

The second dominant response was on the availability of food supply. It is important for them that there is adequate amount of food that they can obtain. According to the respondents, they may have the money to spend but if there is no available food to buy, they will not be able to secure food for their family. Also, for some respondents, as long as they have a vegetable garden in their backyard or they can fish in the lake, they are food secured.

The next dominant response was on the accessibility of food. For the respondents, they are food secured if they have the money to spend on food. According to the respondents, there can be available supply of food in the market but they will not be able to consume the food that they want without money to spend. Also, for them, if they have money to spend on food, they can somehow choose. This can enable them to prepare nutritious food for their family.

Same number of respondents answered that they consider themselves food secure if they eat nutritious and/or balanced food and if they have rice to eat. Consumption of nutritious food is important for some respondents especially to the senior citizens sector and other senior citizen respondents. It is also important for some who have small children. The availability of rice to eat is important to some respondents. According to them, they can eat rice even without any viand. For some, as long as they have rice to cook and eat, they will not go hungry.

6. Perceived Food Sufficiency in the Community

Their perception on food sufficiency in their barangays was based on how their immediate neighbors and siblings from other households managed their food acquisition.

Their responses showed that most of them considered themselves food secured for the following reasons: (1) they eat three times a day, (2) there is fresh fish available to catch or buy when they need it, (3) there are vegetables and other food within reach, either from their backyard or the mountain, which could be obtained for free such as malunggay, papaya, or snails. Even when the volcano erupted, whether in evacuation or back in their household, they still had available food to eat thanks to the abundance of relief goods given to them by both LGU and private sectors.

One respondent shared that in their barangay, only a few are indigents and they were taken care of their barangay chairman. Another respondent said that his basis for saying there is enough for everyone comes from the low incidence of crime rate in their barangay. Moreover, as an agricultural area, they believed no one would go hungry if everybody worked hard. Many residents echoed the same principle that this respondent quipped "*Basta po masipag ay hindi po magugutom. Madami naman po mapagkukuhanan diyan.* [As long as one is hardworking, no one will get hungry here. There are many sources of food around.]"

7. Adaptation Strategies of Households for Enhanced Food Security

7.1. Reasons for Choice of Autonomous Adaptation Strategies

The choice of autonomous adaptation strategies to ensure food security employed by households affected by the Taal volcano eruption was mainly influenced by two factors: (1) availability of food, and (2) availability of fund.

7.1.1. Availability of Food

During the Taal volcano eruption, the dominant strategy of respondents to ensure food security was reliance on food assistance provided by the LGUs and, later on, by private sectors. There was an overwhelming response from private sectors that most evacuees recounted that they were able to bring home relief goods. Some even shared that they were able to bring home 2 sacks (25 kg) of rice. This is why some respondents claimed that they still relied on food assistance to ensure they have enough food even when they have already returned to their homes. In the evacuation centers, food assistance given was not limited to uncooked food (rice, canned goods, noodles, fresh vegetables) but LGUs and private sectors were also able to provide cooked meals to affected households in evacuation centers.

Evacuees who stayed with family/relatives or friends also experienced the same support. Their host LGU was able to provide them with food assistance. Some

respondents shared that they were also able to receive food assistance from private sectors even if they were staying with relatives.

The spirit of bayanihan with which Filipinos are known for is also present for those staying with several families in one house. For those subsisting on food packs, they gathered whatever they received and cooked it in portions for the group. Those who do not prefer communal sharing exchanged what they have with other family evacuees. For instance, tilapia was exchanged for squash vegetable. This way, they were still able to eat nutritious foods. Sometimes, families who were not able to obtain relief goods from the local barangay where they stayed got help from neighbors.

Also, some respondents shared that when they were already allowed by authorities to enter their municipality to visit their houses and check on their animals, some respondents took this opportunity to catch fish. Since there was abundance of fish in the lake due to damaged fish cages, they were able to bring their catch to the evacuation centers where they were staying. Other respondents disclosed that some residents regularly returned to their community to continue fishing for consumption and/or to sell their catch.

Respondents also reported that upon return to their houses they tried to grow vegetables for consumption. Poultry and livestock raisers continued with what was left of their cows, hogs or poultry. Some also returned to fishing to be able to provide food for their family.

7.1.2. Availability of Funds

Although majority of the evacuees relied on food assistance during the eruption and even when they returned to their homes, availability of funds was the main reason why they were able to augment the food items they received from the LGUs and private sectors. They were able to buy food items which were not usually part of the food packages they received like fresh meat and vegetables.

Availability of funds while in evacuation came from different ways. Those from the employed sectors continued to receive their salaries. Others have savings they could use. Some respondents also claimed that family and relatives sent financial help when the volcano erupted.

Those who have livestock sold some of their animals so that they will have so-called pocket money while staying in evacuation. Some fishers who were able to go

back regularly (either thru checkpoints or other routes) tried to catch fish to sell some of their catch so they would have money for other food necessities.

Those staying with other families in one house pitched in whatever amount they could contribute so they could all eat fresh and nutritious foods. This also enabled them to buy other food that their children prefer to eat such as bread or hotdogs.

Some respondents have stock of food good for at least a week up to one month thus they had food available during and immediately after the eruption. This strategy continued to be employed even after the eruption. Some respondents also claimed that they budget their income and prioritize procurement of food. These are the dominant strategies for those with regular source of income although some respondents from other sectors also practice these strategies.

A few respondents shared that after the eruption, they realized that they need to ensure that they have extra money for them to be able to buy food. Thus, they need to be thrifty or they pursued other means to generate additional income. Some respondents ventured to selling goods and cooked meals while some looked for other jobs like carpentry, plumbing and the likes.

7.2. Proactive vs. Reactive Adaptation Strategies Employed by Households

7.2.1. Proactive Adaptation Strategies

Compared to other disasters like typhoon and flooding, adaptation strategies to volcanic eruption are limited. Since it takes decades between major eruptions, insights from historical data are not sufficient basis to form strategies. Thus, the common proactive adaptation strategy employed by households is the storing or stocking of food (especially rice) in preparation for a natural disaster. Another proactive strategy is budgeting their finances and prioritizing food procurement. Some respondents claimed that they used their savings to buy food. Thus saving money can also be considered as a proactive adaptation strategy. This is also present for those who stayed with their family/relatives or friends and not in evacuation centers.

7.2.2. Reactive Adaptation Strategies

For the reactive adaptation strategies, the most common is the reliance on food assistance. Both the LGUs (their own LGUs and their host LGUs) and the private sectors provided food assistance to residents affected by the Taal volcano eruption.

Other reactive adaptation strategies are planting/replanting of vegetables for consumption, fishing for consumption (for those who are not fishers), and pursuing other means to generate additional income. People have also reported breaking into the danger zone to recover household belongings or feed their livestock left behind.

7.2.3. Expected adaptation strategies that were not found

While backyard gardening and small scale farming were prominent before the eruption, it was largely absent immediately after the eruption. Only subsistence fishing was present. This can be largely attributed to the lack of access to their residences immediately after the eruption. Another aspect observed is that gardening and farming could not immediately be restarted even after residents returned to their households. This is due to the effect of the ashfall on their lands. It was only after heavy rains washed away the ashfall were the land arable enough to start planting. Even then, several reported that their harvests were not up to par compared to before the eruption. Several studies have supported this as ashfall can take up to 30 months before it can support vegetation.

A key sentiment that keeps repeating is: **"If anything happens, we can always rely on fishing to survive."** This sentiment is most prevalent in towns of Agoncillo and San Nicolas where other sources of income are less available.

8. Community Level Adaptation Strategies

Based on the results of the KII, money/source of money is the most significant factor needed to attain food security. Thus, the lack of financial resources or the inability to have access to it is the biggest constraint that any household would face, especially in the aftermath of a volcanic eruption. The availability or accessibility of financial resources should therefore be foremost in any community action planning to help households to easily adapt to difficulties that another eruption would cause.

This need for money or the resources with which to acquire it is also reflected in the survey where KII respondents were asked about the assistance they got or still expect from LGUs and other agencies. By collating and clustering their responses, their needs to adapt to the difficulties caused by the volcanic eruption were categorized into four areas, three of which are financially-related as follows:

(1) Assistance of financial nature such as cash grants and borrowing capital – Most did not indicate what they would use the money for but some mentioned that it will be used as capital for livelihood or purchasing livestock or for buying parcel of land for farming.

(2) Assistance in kind which pertains to things they need to continue their livelihood – Generally, fishers prefer to receive fishing equipment; farmers want free seedlings, fertilizers and pesticides while livestock raisers want free livestock, feeds and vaccination. As one respondent remarked whose husband is into farming, "*Pag pera, magagastos pa, eh pag iyang binhi isinaksak sa lupa, siguradong may aanihin*." [If cash, it will just be spent on something else, but seeds given when planted on soil, would surely result to harvests.]

However, one dilemma faced by the aforementioned sectors was that only those who belong to registered associations were qualified to be recipient of LGU dole-outs.

(3) Extra or alternative livelihood to augment or replace existing source of income – Some respondents would rather be given opportunities to engage in additional or new livelihood for their sector or to find jobs within their municipality. They do not prefer cash grants because they find it hard to manage.

One respondent who was able to briefly capture the concern of others on managing cash grants shared that "*Minsan, hindi mo rin masisi kasi kahit sabihin mong pangkabuhayan eh pagka wala ka na bang pagkain eh masasabi mo ba mauuna mo pa ang pangkabuhayan kung wala ka pagkain? Syempre, mababawasan na ng mababawasan iyan*." [Sometimes you can't blame them because even if they are told that the cash is for livelihood purpose, would they still prioritize it when they have no food to eat? Of course, the money would continue to be diminished (as they continue to deduct their food expenses from said cash grant)]

During the CVAP, the same KII respondents discussed among their sectors what they want their municipality to be within the next five years (**Figure 13-15**). The culminating activity was an action planning that the representatives from each sector identified as the **top three priorities** (**Table 2**) from among all sectoral dreams in their respective barangays.

Snap shots of the sectoral representatives as they prioritize their community dreams (Figure 13), assess their capabilities vis-à-vis desired target level (Figure 14) and develop action plans (Figure 15).

Figure 13. CVAP in Barangay Subic Ilaya

Figure 15. CVAP in Barangay Aya

Figure 14. CVAP in Barangay Bancoro

Table 2. Top three (3) priority dreams per barangay

Barangay Subic Ilaya, Agoncillo	Barangay Bancoro, San Nicolas	Barangay Aya, Talisay
1. Build Fish Port 2. Construct a Dump Site 3. Establish a Cooperative	1. Establish a Cooperative 2. Improve agriculture (farming and livestock) 3. Improve barangay health center	1. Construct Senior High School building 2. Improve barangay health center 3. Create livelihood or employment

Creation of Cooperatives as Long-Term Adaptive Solution

The result of action planning resonate the need of residents for financial resources, *i.e. creation of cooperative for Brgy. Subic Ilaya and Bancoro while creation of livelihood for Brgy. Aya*. Although the need for a cooperative was also identified by one sector of Brgy. Aya, the rest are more interested in setting up livelihood and other job opportunities for its residents.

The creation of multi-purpose cooperatives is perceived differently by the residents who want to form it. Some sees this as a bridge that will facilitate release of institutional assistance that can only be given to registered groups while some sees this as "middle man" that will help reduce costs of farming and fishing equipment and supplies that need to be purchased. For most, this is seen as a readily available source for borrowing money. This is the fastest and most convenient way for them to acquire money at times of calamities since members need not produce so many documents to qualify.

Although this was identified as a communal dream instead of a coping mechanism against volcanic eruption, this could be considered a long-term proactive adaptation strategy since this will be in place even before another volcanic eruption occurs, thus readily available to serve the financial needs of its members at a time when their capacity to earn and engage in livelihood activities are restricted by the damaging effects of volcanic eruption.

9. Results of the Participatory Systems Analysis (PSA)

The responses obtained from various questions given to the participants are almost similar in content, hence seemingly repetitive. However, this indicates consistency in their perception based on their own experiences at the household level and exposure to others' experiences in the community level. This increases the reliability of the conclusion we would obtain from incorporating common themes derived from the KII results in the PSA which the project team conducted on behalf of the community.

Due to the restrictions brought about by COVID-19, it was decided to conduct PSA with the members of the project team. From the discussions, the success frame/metric was agreed upon as follows:

The local government units (LGUs) have an effective and efficient system that guarantee a nutritious and affordable supply of food accessible to everyone including the poor and marginalized members of the community affected by volcanic eruption.

Then the participants identified and agreed on ten (10) factors or elements that could seriously affect or impact the success metric, namely:

1. Adequacy of funds
2. Availability of adequate food for distribution
3. Clear guidelines and protocols on food distribution
4. Efficient network of relocation/evacuation centers
5. Institutional partnerships with other government agencies
6. Institutional partnerships with donors and other development agencies
7. Adequacy of manpower
8. Effective and operational focus for rehabilitation after the volcanic eruption
9. Sustainable community-level or household-level farming practices
10. Institutionalized responses to recurring disasters

Using the PSA matrix, the influences and cross-influences among the factors were discussed and examined, and the participants were asked to rate the degree of influence of one factor over another using the prescribed rating system (based on group consensus):

No Influence (Nil) : 0.1
Weak Influence : 0.5
Moderate Influence : 1.0
Strong Influence : 2.0

After the ratings were inputted in the causality matrix, the active sum, passive sum, degree of influence and activity ratio were computed and inputted into the matrix. The computations are as follows:

Passive sum – is the vertical sum of the ratings of each element
Active sum – is the horizontal sum of the ratings of each element
Activity ratio – is the quotient of the active sum and the passive sum
Degree of influence – is the product of the passive sum and active sum

Figure 19 below shows the fully filled up causality matrix.

Once the causality matrix was filled up, results were plotted using the PSA Quadrant. First, the vertical and horizontal axes values were determined using the formula below:

Horizontal (X) axis = highest degree of influence/2 +30
Vertical (Y) axis = activity ratio = 1

The results of the casualty matrix were then plotted in the PSA Quadrant (**Figure 20**).

Table 3. Fully filled up causality matrix

Elements	Adequacy of funds	Availability of adequate food for distribution	Clear guidelines and protocols on food distribution	Efficient network of relocation/ evacuation centers	Institutional partnerships with other government agencies	Institutional partnerships with donors and other development agencies	Adequacy of manpower	Effective and operational focus for rehabilitation after the volcanic eruption	Sustainable community-level or household-level farming practices	Institutionalized responses to recurring disasters	Active Sum	Degree of Influence
Adequacy of funds		2	0.5	2	0.5	0.5	1	2	0.5	1	10.00	90
Availability of adequate food for distribution	1		2	0.5	0.1	0.5	0.5	2	0.5	1	8.10	81.81
Clear guidelines and protocols on food distribution	1	1		1	1	1	0.5	0.5	0.1	2	8.10	73.71
Efficient network of relocation/evacuation centers	2	1	2		0.5	0.1	0.5	1	1	1	9.10	113.75
Institutional partnerships with other government agencies	1	2	0.5	2		1	1	2	0.5	2	12.00	103.2
Institutional partnerships with donors and other development agencies	1	1	0.5	2	2		2	1	1	0.5	11.00	72.6
Adequacy of manpower	0.5	0.1	1	1	0.5	0.5		2	0.5	2	8.10	61.56
Effective and operational focus for rehabilitation after the volcanic eruption	1	0.5	0.5	1	1	1	1		2	1	9.00	112.5
Sustainable community-level or household-level farming practices	0.5	0.5	0.1	1	1	1	0.1	1		0.5	5.70	40.47
Institutionalized responses to recurring disasters	1	2	2	2	2	1	1	1	1		13.00	143
Passive Sum	9	10.1	9.1	12.5	8.6	6.6	7.6	12.5	7.1	11	94.10	892.6
Activity Ratio	1.1	0.8	0.9	0.7	1.4	1.7	1.1	0.72	0.80	1.18		101.5

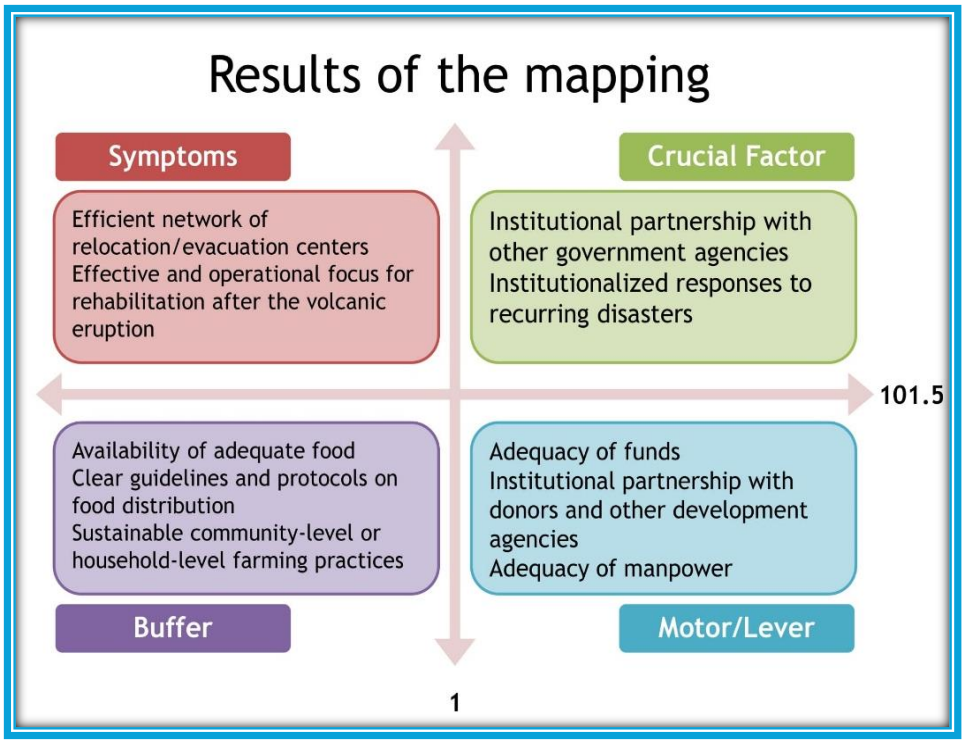

Figure 16. PSA quadrant with results

9.1. Interpretation of the result map

9.1.1. Buffers

- Availability of adequate food for distribution
- Clear guidelines and protocols on food distribution
- Sustainable community-level or household-level farming practices

Interpretation:

The KII interviews support the results above. There were little problems encountered with the availability of food during the evacuation and after the eruption. This was surmised by plenty of responses that they had sufficient food supply months after the evacuees returned home. Even evacuees who lived among their relatives and not at evacuation centers were able to adequately receive relief goods. Farming and backyard gardening had to be put on hold until ashfall were removed from their fields and took several months before any harvest from gardening and farming were felt. One outlier that was not addressed is livestock maintenance and subsistence fishing. The main cause of livestock death during a volcanic eruption is starvation. Residents had to sneak into the danger zone to

regularly feed their livestock. Areas with strict containment like the volcano island experienced massive expiration of their livestock.

Assessment:

Gardening and farming assistance will not have an immediate effect on the food security of the residents. Long term projects for farming and gardening will help, but the scale of farming in the Taal Volcano area is not as extensive as the fishing industry.

9.1.2. Symptoms

- Efficient network of relocation/evacuation centers
- Effective and operational focus for rehabilitation after the volcanic eruption

Interpretation:

There were few concerns found in evacuation centers. The few complaints were being forced to move twice from the 1st evacuation center to another as the first location was still part of the 14km danger zone and the 2nd evacuation center became overcrowded. This is mostly due to established evacuation plans set for typhoons which were still in the volcano danger zone. Rehabilitation also started immediately after residents were allowed to return. More than half the KII respondents also reported that their livelihood were not greatly affected as they were on regular employment. The key finding is that with the exception of permanent residents of Taal volcano island, residents were eager to return to their homes for immediate rehabilitation and return to livelihood activities.

The immediate need to return to their homes greatly shows that evacuation centers relief is only a symptomatic solution for the people affected by the volcanic eruption.

Assessment:

Efficient evacuation systems can be improved and rehabilitation assistance can be given. This will help on the mental and physical health of the evacuees but does not greatly affect the food security of the residents

9.1.3. Crucial

- Institutional partnerships with other government agencies
- Institutionalized responses to recurring disasters

Interpretation:

The lack of Living Memory of the last Taal volcano eruption in the early 1970's created a lax attitude of the severity of a volcanic eruption and the dangers it poses to people living within the vicinity of the Taal volcano.

The crucial factors mapped during the PSA found that preparedness for an eruption is a critical factor in ensuring food security for the residents of the Taal Volcano vicinity. Government agencies like the military, the DSWD, and the LGU were key to proper evacuation and security of the evacuees during the eruption and after the residents were allowed to return. Residents have been advised to prepare GO BAGS as early as September 2019 which most residents complied with. A recurring result in the interviews found that residents tended to relax when the alert level was dropped to Level 1 and unpacked their Go Bags. Unfortunately, the January 12 eruption escalated from level 1 to level 4 within a matter of hours. This resulted in many residents not having a GO BAG ready when they needed to evacuate. Another crucial element naturally found by LGU's was to announce, through social media, specific pick up points and key personnel in case a new eruption were to occur. This was not prevalent prior to the January 2020 eruption.

Assessment:

Institutionalized responses are critical to the safe evacuation of the residents. The January 2020 eruption has proved that though there were lapses among residents and the LGU, they were mostly prepared and was able to adapt to changing real time conditions. An institutionalized response system which will include "Eruption Drills" akin to "earthquake drill" among the various LGUs will greatly improve these responses.

9.1.4. Motor/Lever

- Adequacy of funds
- Adequacy of manpower
- Institutional partnerships with donors and other development agencies

Interpretation:

The result of the PSA for movers was the biggest surprise for the team. And this part of the PSA was the most consistent among the several iterations conducted. While adequacy of funds was mainly focused on the LGU, it also reflected with the adequacy of personal funds of each evacuee. Many were satisfied with their food security upon receiving relief goods. This also highlights the perception of food

security of a majority of the interview results that having food to eat is the definition of food security.

A good number of evacuees who had enough accessible funds also opted to go out of evacuation centers to purchase fresh goods which were largely absent from the relief goods. The manpower to distribute the goods was also a prime mover, but was fortunately, largely satisfied. Only a few reports of evacuees not receiving enough relief goods were present, and mostly for individuals who chose not to stay at evacuation centers and instead to move in with other family members not affected with the eruption. And finally, institutional partnerships with donors and agencies were found to be the greatest mover for food security on this aspect. A reliance on the private sector is key to providing food security to affected residents both during the eruption and during rehabilitation.

Assessment:

In the context of food security in an eruption, the calamity funds and the private sector are the key. While providing easy access to fresh produce around or near evacuation centers would greatly improve nutrition. The fresh produce need not be relief goods but can be sold at subsidized prices for people or even barangay LGUs with adequate funding. Funds are also deeply tied with livelihood, this resulted in evacuees immediate need to return to their homes even in the uncertainty of another eruption.
Both for short term and long term food security; provision or access to funds and livelihood opportunities for residents and evacuees of any disaster is the greatest mover for food security.

10. Projects in Taal Lake After The Taal Volcanic Eruption

Based on article released by GMA news in March 3, 2021, *a year after the Taal volcanic eruption in January 2020*, the National Economic and Development Authority (NEDA) thru its assistant regional director for Calabarzon (Gina Gacusam) dislosed that there were 1,347 projects with cumulative worth of P41.902 billion that aimed to assist in the rehabilitation of Taal Lake's agriculture and fisheries, tourism and livelihood, housing and settlements and physical infrastructure. However, only 88 projects were completed with 75 on-going while the rest still need proposal for funding.

Some of the projects that were reported online/through social media are the following:

Project Shelter (not long-term rehab but emergency relief)
January 2020/ July 2021

Pilipinas Shell used some of its fuel stations as evacuation centers for displaced residents. It also served as a hub for accepting relief goods which they repacked and distributed to other evacuation centers. For those staying in the Shelter Stations, they provided drinking water, food packs and canned goods, sleeping and hygiene kits, first aid kits and free mobile charging services.

Ash for Cash Program
January 2020

Ash for Cash is a livelihood program launched by Batangas Governor Hemilando Mandanas so that residents get paid by selling the ash they collected either to the provincial government or government-assisted cooperatives. The accummulated ash would be mixed with cement to produce hollow block so this would be offered to cement manufacturers or construction companies.

Artificial Propagation of Sardinella Tawilis
April 2020

The Sardinella Tawilis thrives in the zero-salinity environment of Taal Lake. However, this fish was already designated as endangered specie in 2017. The recent volcanic eruption is therefore a threat to its survival. The volcanic ash that fell in the lake resulted to short-term physical and chemical changes in water quality, especially dissolved oxygen, nitrate and phosphate. The project which will be handled by BFAR-Inland Fisheries Technology Center in partnership with BFAR IV-A and NFRDI-Freshwater Fisheries Research and Development Center aims to induce breeding, conduct nursery larval rearing, and to determine the bio-physio-chemical water condition appropriate for breeding and culture of tawilis.

Php54.4 Million Intervention from the Department of Agriculture
October 2020

On October 13, 2020, the Department of Agriculture (DA) gave away carabaos including feeds, vitamins, antibiotics and wound spray to farmers in San Nicolas. It also distributed certified seeds, fertilizers and planting materials for rice and high-value crops to farmers in Laurel. Together with the Bureau of Fisheries and Aquatic Resources (BFAR), it conducted lake seeding of maliputo and ayungin fingerlings. BFAR also distributed tilapia and bangus cages to fishers in San Nicolas and Laurel. Other municipalities which benefitted were Mataas na Kahoy which was given vacuum pack sealer, cassava grater and fertilizer bags for its Corn Program and Agoncillo where Participatory Coconut Planting Project beneficiaries were given cash incentives.

Various Projects under the **Community Empowerment thru S&T (CEST) Program for Disaster-Stricken Areas in Batangas Province** which are all funded by the Department of Science and Technology (DOST). Project commenced on June 2020 upon MOA signing.

The "**Bangon Taal: Breeding Affected Niches Geared on Needs-based Technology Application for Alternative Livelihood of Taal Volcano Eruption Victims**" is a CEST project implemented in the municipalities of Agoncillo, Laurel, San Nicolas and Talisay. This is an on-going project pertaining to establishment of bricks/hollow block production facility using ashfall as one of its materials.

In the municipality of Laurel, an additional CEST project called "**Establishment of Plastic Blocks Production Facility using DOST-ITDI developed Plastic Densifier Technology**". The plastic shredder and plastic densifier have already been delivered as of 23 June 2021.

In San Nicolas, the selected livelihood CEST program is the "**Upgrading of Street Food Vending**" which are used along the Baywalk primarily to cater to tourists. DOST o facilitated the fabrication of street food carts which were delivered to San Nicolas last 06 August 2021 after a series of food sampling in 21 July 2021 from the five vendor recipients of the food carts.

In Talisay, the CEST project is referred to as "T**echnology Support Intervention for Fisheries Sector Affected by Taal Volcano Eruption**" where 60 fishers were identified to be given bottom set gillnet (BSGN). 21 of the target recipients have already received the BSGN as of 24 June 2021.

Fish Ark Project for Taal Lake: Direction for Conservation of the Endemic Freshwater Fish *Sardinella tawilis*
March 2021

The DOST-PCAARRD commissioned the University of the Philippines Los Banos – Limnological Station to save the tawilis which is endemic to the Taal Lake from possible extinction due to potential massive volcanic eruption. So far, it succeeded in transporting and rearing the tawilis away from its natural habitat.

Php30-Million Taal Rehabilitation and Recovery Program of DHSUD
April 2021

In line with the BALAI program or Building Adequate, Livable, Affordable and Inclusive Filipino Communities of the Department of Human Settlements and Urban Development (DHSUD), it has identified 15 cities and municipalities that were heavily affected by the

volcano eruption to be its recipient of Php2-million cash grant each. Said grant would be used to acquire safe, resilient and suitable resettlement sites where they can begin to form sustainable communities.

Bangon Batangas Project
June 2021

The "Bangon Batangas" project is an S&T-based intervention to Taal Volcano's Internally Displaced Population (IDP) which was funded by DOST-PCAARRD. Its target beneficiaries consists of 151,386 families from the municipalities of Talisay, Laurel, Agoncillo, San Nicolas, and Balete who were dispersed across provinces of Batangas, Quezon, Laguna, and Cavite. This project is spearheaded by the Batangas State University (BatStateU) which is in charge in studying damages to high value crops such as coffee while its partner, the Laguna State Polytechnic University would look into damages to aquaculture and fisheries. The project's initial studies showed a need for sustainable livelihood interventions as well as science-based soil treatment for farmlands affected by ashfall.

11. Executive Summary of Results and Discussions

- The PSA results mirror the sentiments of the qualitative interviews that food security perception is about having enough food to eat.
- There was enough food available immediately after the eruption.
- Evacuation procedures and centers can be improved as most systems are set for other disasters like typhoons and not volcanic eruptions.
- Existing plans for a volcanic eruption was not a "top of mind" action and most were improvised during evacuation. (Plans have been implemented since)
- Availability of funds is the prime mover for food security in the area.

Recommendations

Existing programs mentioned in the previous section already cater to some immediate concerns of food security of Taal lake residents. The Ash for cash and the rehabilitation program answers the immediate need for funds while the DA intervention provides long term livelihood for farmers and fishers in the Taal Lake community.

The following Policy or research recommendations based on the PSA results. Some recommendations are derived from community visioning sessions conducted within the study along with KII interviews.

1. **Disaster Evacuation Playbook and Drills**

While policies and commands are given by the NDRRMC and the LGU during a natural disaster, no such playbook exists to our knowledge and the knowledge of the town officials we interviewed. The routine actions and policies in place are mostly geared to typhoons, which is the country's most occurring natural disaster. The creation of the playbook may be conduction by DOST along with the NDRRMC and the LGU. This playbook can include annual volcano eruption drills for the LGU in the same manner national earthquake drills are regularly conducted. Taal Volcano is the only volcano with permanent residents numbering to almost 500,000 within its 14 km danger zone. This makes the Taal Lake community unique in the immediate threat of a volcanic eruption. Implementing a volcano eruption drill to the community will establish a behavior of preparedness for a volcanic eruption to the residents in the vicinity.

2. **Tawilis seeding of Taal Lake**

Project Fish Ark of PCARRD, fish seeding programs of DA (which includes Taal Lake among others) and artificial propagation of Tawilis Project by BFAR will prove beneficial to the livelihood of Taal Lake residents.

Project Fish Ark has already proven that tawilis can be reared away from Taal Lake. A study can be done in producing tawilis fingerlings in fish tanks or fish ponds can prove beneficial as controlled conditions and lack of predation would ensure the survival of the fingerlings. This can also be done offsite in other provinces. Tawilis fingerling propagation offsite, and Taal Lake seeding can be a viable process of repopulating Taal Lake with tawilis while giving livelihood to hatcheries that are not lake based.

3. **Marine Protected Area**

The DENR already implements a Temporary Fishing ban of Tawilis period during March and April. The DILG has implemented a No Man's Land Policy on Taal Volcano Island in the foreseeable future. The map above shows radial proximity of the Taal Lake from the Taal Volcano Main Crater. As can be seen in the map (**Figure 17**), the southeast shore of Taal Volcano island is within the 3 km Danger Zone and no man's land. This region can be studied and established as a Marine Protected Area or "No Fishing Zone" within the Taal Lake.

A search on marine protected areas in the Philippines shows several inland areas in Cagayan, Sibuyan Island and SBMA. However, there are no Marine Protected Areas

in Taal Lake primarily due to economic utility of Taal Lake. A study of establishing a Marine Protected Area in Taal Lake can take advantage of 2 other existing policies in Taal; the no man's land policy of the DILG and the temporary fishing ban of DENR. In both the context of human safety and fish biodiversity, a Marine Protected Area can be established around the Taal Volcano Island or even just within the 3km danger zone on the southeast shore. Another possible area is directly on top of the underwater crater of Taal Volcano as can be seen in Figure 17. The existing policies already being implemented at the Taal Volcano area would help blunt most political concerns of establishing a Marine Protected Area in the Taal Lake.

In the future event that tourism is once again allowed in the Taal Volcano Island, these Marine Protected Areas will also serve as tourist attractions.

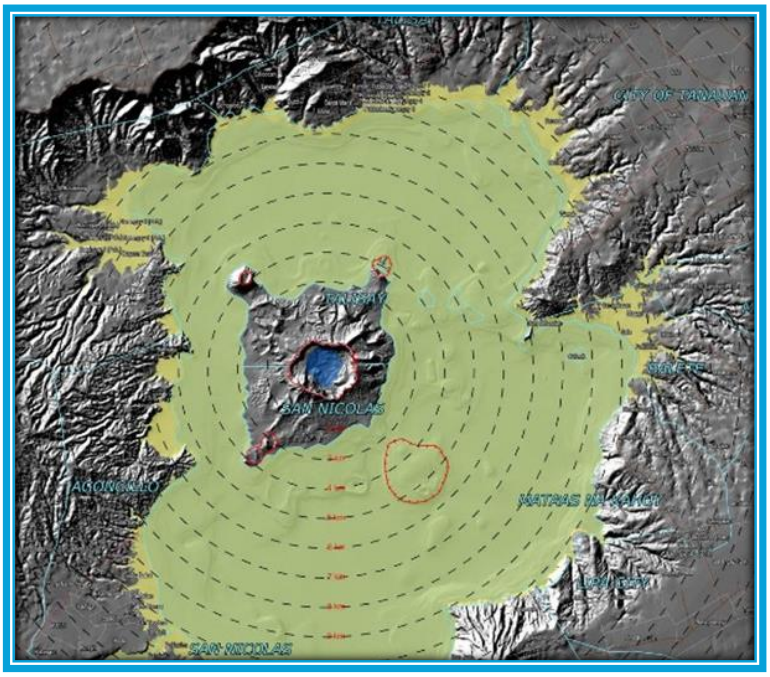

Figure 17. Scope of marine protected area

Conclusions

Disaster resiliency has often been a narrative of Filipinos, and the Taal Volcano eruption appears to show the same story. However, the effect of a major Taal Volcano eruption will be far longer and affect more people than any other natural disaster, such as typhoons, that the Philippines experience. Coupled with the overuse of the Taal Lake for fishing can compound the long term adaptation of residents of the area. The attitudes and behaviors of the residents must be changed in order to establish food security of the residents on a regular basis, much more if a major volcanic eruption occurs.

Creating a volcano evacuation plan and drills to Taal communities will establish a preparedness mindset unique to Taal area. As well as implementing policies and programs on Taal lake fish biodiversity specifically, but not limited to, tawilis population and harvest.