Intra-household Impacts of Climate Hazards and Autonomous Adaptation in Selected Coastal Areas of Zamboanga del Norte

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Front cover photo: Fleet of artisanal fishing boats with outriggers, locally known as pump boats secured from coastal hazards lined along the creek of Purok Laoy, Barangay Olingan in Dipolog City, Zamboanga del Norte, Mindanao, Philippines. Photo by Leocadio Sebastian

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EXECUTIVE SUMMARY

This study described the implications and issues of coastal hazards on the internal dynamics of decision making within the household. Flooding and typhoon were recognized as the common hazards in the communities. Adaptation strategies within households of male and female decision makers were also identified during the survey. Community plans to adapt to specific coastal hazards were also laid down in village-level discussions.

We identified six coastal barangays from the three local government units in Zamboanga del Norte that were most prone to hazards. These are San Pedro and Polo in Dapitan City, Galas and Olingan in Dipolog City, and San Antonio and Tuburan in Katipunan. Resources mapping, hazard mapping, and historical timeline were conducted during focus group discussions. Household decisions makers and key informants were also interviewed.

The impacts of flooding and typhoon in all study sites are predominantly in the forms of damage to houses and loss in income from fishing. Olingan households reported the highest amounts for both, being the highest paid hired fisher workers across study areas. Polo households reported losses in aquaculture production; San Antonio households, which are mostly into fishing and farming, reported losses in agricultural production in addition to the latter's damages to houses and losses in income from fishing. In Barangay Galas where economic activities are more widespread, the residents narrated loss of income from retailing and service business. It is the livelihood of husbands that is most affected by flooding and typhoon in all six barangay. The income that the women get from offering laundry services or nipa thatch making decreases with more time devoted for hours for house chores after occurrences of flooding or typhoon. In terms of health impacts, waterborne diseases after flooding and typhoon were recorded in puroks with high population densities but with low income such as Polo, San Antonio, and Tuburan. The 25–65 age groups had the highest adaptation participation rate within households, which tallies with the adaptation participation rates for each age and gender cohort by barangay.

Common household adaptations employed by local residents aim to protect family members. The second priority is to save acquired assets or to prevent income loss. Packed food, lighting, and clothes for the children are prepared before the occurrence of any coastal hazard. During typhoons, assets are protected. Sources of livelihood, like domesticated animals and early harvest of aquaculture products, were also considered by inhabitants before any coastal hazard. The residents of the most-affected areas create defenses to protect their assets from destruction. Community adaptations include activities that raise awareness of people before any disaster, actual evacuation during occurrence of hazards, and distribution of food and relief items after any damaging events. The local government units (LGU) and volunteer groups in the barangays implemented the programs and activities. Different barangays vary in their community adaptations, depending on the extent of damage and frequency of hazards. Barangay San Antonio in the municipality of Katipunan requires the most help and adaptive strategies. Meanwhile, women in the barangay show greater participation in adaptation activities within the household and even in the community. These should be recognized through plans and programs of the BDRRM (Barangay Disaster Risk Reduction and Management) activities that will be initiated by the women themselves and could pave the way for women empowerment.

1.0 INTRODUCTION

1.1 Overview of Climate Change in Zamboanga Peninsula

The coastal areas of Zamboanga del Norte province seat along Murcielagos Bay, Dipolog Bay, and Sindangan Bay. In 1998–2009, there were 25 marine protected areas (MPA) recorded in the three bays covering an area of 410.83 ha. Live coral species, seagrasses and mangroves provide an important ecosystem that serves coral reef fishes and 15,228 households relying on fishing as their major source of livelihood.

Reports in the Zamboanga Peninsula Regional Development Plan 2011–2016 identified its three component provinces—Zamboanga del Norte, Zamboanga del Sur, and Zamboanga Sibugay—as highly susceptible to typhoons, storm surges, sea level rise, earthquakes, tsunamis and volcanic hazards, and extreme weather conditions such as El Niño and La Niña.

At least five major hydrologic hazards displaced 90 to 4,000 households in the region from February 2012 to February 2013 despite being located generally outside the typhoon belt. In terms of land area, the Zamboanga Peninsula ranks second-most vulnerable to a one-meter rise in sea level, with 40 of its 67 municipalities susceptible to submergence due to sea level rise. There are actual accounts of 90 families in almost 2,000 households who were displaced in four of the towns due to tropical depression Auring and flooding in January and February of 2013.

The Zamboanga Peninsula provinces comprising Region 9 are included in the top 20 provinces vulnerable to a one-meter rise in sea level (NEDA Region 9 2010b). Zamboanga del Norte, with a total of 1,057 ha of coastal area, ranks 19th among the top 20 provinces in the country vulnerable to a one-meter sea level rise (GTZ-DENR 2010). Sea level rise is seen to inundate biodiversity-rich coastal habitats such as mangroves and beach vegetation, affect seagrass beds and mangroves, and cause saltwater to intrude into groundwater, lakes, and rivers (GTZ-DENR 2010).

Climate trends in the province from 1971–2000 showed that there is a statistically significant decrease in number of hot days and warm nights but an increase in the number of cold days and cool nights (PAGASA 2011). Average annual rainfall in Zamboanga del Norte is 1,750–2,450 mm and the typhoon frequency is once in 12 years. Specifically, a maximum rain period occurs from October to December in Dipolog (Concepcion 2004).

Some indications of upwelling like cooler temperatures and elevated chlorophyll *a* are also observed off the coast of Zamboanga Peninsula. A time series analysis of sea surface temperature reveals interannual variations in upwelling, with weakening during the 2007/2008 La Niña and strengthening during the 2006/2007 El Niño. Interannual variations in upwelling, phytoplankton productivity, and sardine catch suggest that interannual El Niño-Southern Oscillation variations can affect the small Zamboanga Peninsula pelagic fishery (Villanoy et al. 2011).

Climate change and climate variability adversely affect the biodiversity in the marine and coastal communities. The production output of the commercial fisheries sector in Zamboanga Peninsula dropped slightly by 4.96% or 17,730.99 MT in 2010, which is lower compared to the same period in 2009. The El Niño phenomenon affected the fishing industry, in which most of the pelagic species went to deeper fishing ground due to the intense heat (NEDA Region 9 2010a).

1.2 Objectives

This study systematically studied the intra-household implications and issues of climate-related shocks or hazards. In particular, the internal dynamics of decision making within the household, as well as how the joint adaptive action of household members (principally the husband and wife) affect outcomes/risks for different groups and individuals within the household itself were looked into. The specific objectives of the study included the following:

1. To describe the role of men and women in decisions related to adaptation against various climate hazards in coastal communities;
2. To describe and identify the various adaptation strategies employed by husband and/or wife for different climate-related hazards;
3. To measure the physical and monetary damages in terms of health, individual assets, and labor allocation (time cost) incurred by individual members of the household from climate-related hazards (i.e., intra-household impacts of climate hazards);
4. To identify community cultural and social norms that affect the degree of women's participation in adaptation decision making and action;
5. To describe and measure how intra-household dynamics (i.e., women's participation in decision making both for adaptation and general decision spheres) result in intra-household impacts from different climate hazards; and
6. To explore and identify emerging issues in the intra-household study of adaptation decision making and action.

The internal dynamics of intra-household decision making is shaped by social norms and cultures which are, in turn, affected by levels of socioeconomic and political development. For instance, more westernized cultures, better educational systems, and higher economic growth afford more opportunities for women and can therefore alter decision making within households.

2.0 CONCEPTUAL FRAMEWORK AND SOME RESEARCH HYPOTHESES

2.1 Impacts, Hazards, and Adaptation: The Standard Framework

The common analytical framework for analyzing climate change impacts posits that risk or impacts are a function of the degree of the climate-related hazard, exposure of the household, and the adaptation strategies of households (Figure 1). Impacts or risk from climate change emanate largely because of the attendant hazards associated with it. One aspect that differentiates coastal communities is that they are facing a confluence of hazards. These hazards, which were the focus of this study, include typhoons and flooding, coastal erosion and storm surges, and saltwater intrusion. These hazards have different implications because of their characteristics in terms of frequency and permanence of impacts. Typhoon and flooding are often extreme weather events that occur with uncertain regularity. The impacts may be passing, as in the case of flooding events that do not inundate communities. Saltwater intrusion and coastal erosion, on the other hand, are slow and "creeping" events that occur and are felt slowly by coastal communities. The impacts of these two hazards, however, are permanent.

Figure 1. Standard framework for climate change adaptation and impacts

Hazards or covariate risks have differential impacts on households in a community because of the different levels of exposure and mitigating actions or adaptive strategies employed by households. Levels of exposure can differ because of factors like location, such as in cases where houses are located in danger zones or are located near sources of hazards. This can be classified as physical or geographic exposure. An indirect source of exposure is the degree to which a household is dependent on an income source that is affected directly by hazards. This is common in fishing communities that depend largely on the resource base for fishing. The impact of covariate risks (such as climate-related hazards) is larger on these households than on those with more diversified income sources. We call this economic exposure.

Adaptation, on the other hand, reduces or mitigates the effects of hazards and exposure. Although hazards and exposure are exogenous to the household to some extent, adaptation options or strategies (or the lack of it) are choices made by households or are endogenous. These are actions done either before (proactive adaptation) or after (coping mechanisms or reactive adaptation) a hazard. For instance, a household can diversify income prior to a climate-related event, thus reducing its exposure level. The household can, on the other hand, react or "cope" with an event by diversifying or looking for alternative sources of income after an event. We delineate between deciding on what adaptive strategies to take and the action of implementing these strategies. Household members may decide on a specific adaptation strategy, but its implementation may differ.

The impacts felt by the household are the net effects of hazards, exposure, and adaptation strategies. Often, such impacts are measured through household vulnerability. Impacts can also be measured as the vulnerability to expected poverty (VEP) or the probability that households or individuals will move into poverty in the future or fall below minimum consumption threshold level given certain shocks (Chaudhuri, Jalan and Suryahadi 2002). However, as discussed earlier, the innovation in this study is that the impacts were measured both at the household and intra-household level.

2.2 Impacts, Exposure, and Adaptation in an Intra-Household Framework

We extended the common framework by introducing intra-household dynamics. The collective household model is the basic intra-household model and is illustrated by a labor supply in the presence of covariate shocks. The basic intuition behind the model is that household members, particularly the household head and the spouse/husband, have varying degrees of control over household resources; therefore, they have different degrees of influence and participation in household decision making. The household member that has more control over the resources has a greater say in decision making. It deviates from the usual model of a unitary household, in which incomes from different members of the household are pooled and the household is representative of its members; hence, according the unit of analysis to the household.

The standard climate change framework was modified to accommodate the assumption of a collective household (Figure 2). At the outset, this would mean that power dynamics within the household could influence outcomes. In particular, control of resources and bargaining power can lead to different outcomes for the household and, possibly, for individual members of the household. Husband and wife, for instance, may decide and implement different adaptation strategies. These internal dynamics and differences can lead to differential impacts or risks at both the household and intra-household levels. For instance, if women have control of household resources and assets, then their preferences would be more fully represented during decision making activities within the household. This can mean lower economic exposure to covariate climatic risks if, for instance, women are more actively engaged in non-fishery income activities because they have more bargaining power and control over the use of their time. It can also mean better health outcomes for children if women have more control over household expenditure, and their preference dictates higher expenditure on child immunization and health supplements (instead of spending it on alcohol or wine, for instance). In this case, household expenditure toward improved child health becomes an ex-ante or proactive adaptation in anticipation of health consequences of climate hazards.

The previous discussion points out that one natural way to analyze climate within an intra-household framework is to incorporate dynamics of intra-household decision making and accounting for variables or factors that increase the bargaining position of individual household members especially between the husband and wife. In the context of climate change/hazard adaptation, this can be in the form of increasing the women's assets. These assets can be in the form of productive assets (or physical capital), such as offering them more livelihood opportunities. It can be informational assets, such as tailoring training programs on disaster risk response to suit women's capabilities and concerns. Informational assets can also be in the form of highlighting aspects of the climate change problem that affect women more. Through their effects on household and intra-household exposure and adaptation activities and choice of individual household members, these assets can affect outcomes or the level of risks both at the level of the household and among individual household members.

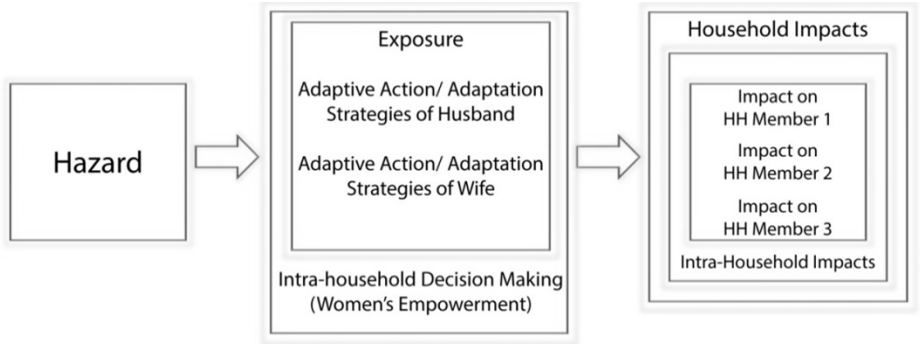

Figure 2. Climate change adaptation and impacts in intra-household framework

2.3 Outcome Variables and Some Research Hypotheses on These Variables

In our research, we considered intra-household and the household impacts/risk of climate hazards as our outcome variables. The key characteristic of these intra-household outcome variables is that they should be easily measurable at the level of the individual household member (or demographic groups within the household). For instance, the intra-household consumption as an impact or outcome variable was measured but the "shared bowl" problem makes it harder to measure. To wit, we identified the following outcome variables:

1. *Intra-household incidence of major diseases and health endpoints after a climate hazard event*. This is one of the easier variables to measure since health of individuals within the household is readily observable and is variably affected by climate events. The hypothesis is that children are most affected, and thus bear the brunt of the cost. This is, however, tempered by anticipatory health expenditures on children that make them more resistant. An ancillary hypothesis is that the higher these anticipatory health expenditures are, the greater the asset position. Thus, it can be a measure of the bargaining power of women within the household.
2. *Intra-household asset damage*. This is possible if individuals or groups of individuals within the household own separate or specific assets. The hypothesis is that women-owned assets are more relatively affected and damaged by climate hazards if they have less bargaining power within the household.

3.0 METHODOLOGY

In this section, a methodology that meets the research objectives through a series of steps is outlined. It starts by describing the specific study sites and the dominant climate-related hazards in these sites. The sampling strategy of the study is described, then ends with an outline of the quantitative methodologies used to measure the key outcome variables and attribution of differences in outcomes to intra-household decision making.

3.1 Study Sites

The coastal barangays as study sites were identified based on existence of significant climate change hazards and vulnerability of the various sectors and economic activities. Table 1 presents a summary of the sites and some preliminary information that were gathered. The list of study sites were finalized during the actual scoping activities, and then further narrowed down to the barangay (village) and purok (zone) level.

Table 1. Summary of Zamboanga del Norte study sites, hazards, and vulnerabilities

Site	Philippines
Province	Zamboanga del Norte
Municipality/City	Dapitan City, Dipolog City, Katipunan municipality
Barangay	San Pedro and Polo (Dapitan City), Galas and Olingan (Dipolog City), San Antonio and Tuburan (Katipunan municipality)
Potential climate change hazards	Typhoon, flooding, coastal erosion, strong waves, saltwater intrusion, storm surge, a combination of the hazards, earthquake and landslide
Vulnerable sectors/ Economic activities	Livelihoods related to fish pond operations, oyster farming, nipa thatch making Fishing and its marketing, gleaning, dried fish processing, hard boiled fertilized duck egg making, raft making, coconut farming and tuba gathering; Infrastructure and houses, commercial buildings and establishments (e.g., resorts, cottages)

3.2 Data Sources

Data were collected at the community and household levels. Community-level data were collected through focus group discussions (FGDs), while household-level data were based on the results of a household survey. The next subsections detail the data collected from each source.

3.2.1 Community-level data

FGDs were used to document narration and experiences of six hazard-prone barangays and puroks (Table 2) in three of the municipalities/cities of Zamboanga del Norte. The FGD used is a general participatory tool and a crosscutting tool in participatory climate change adaptation assessment. Specific tools used were community resource mapping, hazard mapping, mobility mapping, historical timeline, and vulnerability assessment and capacity matrix. Each barangay was represented by an average of 26 sector representatives.

Table 3 shows the specific associations and representatives present during the participatory discussion. The conduct of FGDs provided the project team initial information on the extent of identified hazards within the different puroks of the barangay and a basis for the random selection of respondents for the household survey.

Table 2. Distribution of population in Zamboanga del Norte study sites

LGU	Population (2010)	No. of HH (Coastal Puroks Only)	No. of FGD Participants
Dapitan	**77,441**		
San Pedro	1,817	259	20
Polo	3,115	235	46
Dipolog	**120,460**		
Galas	14,713	418	18
Olingan	11,857	605	18
Katipunan	**43,339**		
San Antonio	2,356	544	24
Tuburan	1,568	347	30

Source: NSCB (2010)

Table 3. Sector representatives during the FGDs

Project Site	Organization	Position of Participant
City of Dapitan		
Barangay San Pedro	Local government unit	Barangay Chairman, Councilor and Secretary, Barangay Health Worker, Barangay Nutrition Scholar, Purok President, Purok Secretary
	San Pedro Minagsoon Multipurpose Cooperative	Chairman
	Parents Teachers Association	President
	Talaba Association	President
	Senior Citizen Association	President
	Habal-Habal Association	President
	Women's Association	President

Table 3 continued

Project Site	Organization	Position of Participant
Barangay Polo	Local Government Unit	Barangay Chairman, Councilor, Secretary, *Tanod**, Purok President, Purok Secretary
	Fishermen's Sector	Member
	Biblical Sectoral Council	Chairman
	Youth/ Worship	Secretary
	Women's Association	President
	Fish Vendors' Association	Member
	Senior Citizen Association	President
City of Dipolog		
Barangay Galas	Local Government Unit	Barangay Chairman, Councilor, Secretary, Tanod, Purok President, Purok Secretary, Sitio President
	Galas Multipurpose Cooperative	Secretary
	Galas Feeder Port Laborers Association	President and Secretary
	Women's Association	Member
	Senior Citizen's Association	Member
Barangay Olingan	Local Government Unit	Barangay Chairman, Councilor, Secretary, Tanod, Purok President, Purok Secretary
	Senior Citizens' Association	Member
	Elementary Schools: Laoy, Sta. Cruz, and Olingan	Master Teacher and Teacher
	Organized Radio Assistance and Communication Information Services	President, Member
	Youth Association	President
Municipality of Katipunan		
Barangay Tuburan	Local government unit	BDRRMC Chairman and Councilor, Secretary, Tanod, Purok President, Treasurer, Purok Secretary, Parent Leader, Barangay Health Worker
	Community Health Team	Member
	Women's Association	President
	Bantay Dagat Association	Member
	Sea Kaunlaran Association	Member
	Tuburan Savers Association	Member
Municipality of Katipunan		
Barangay San Antonio	Local Government Unit	BDRRMC Chairman and Councilor, Secretary, Tanod, Purok President, Treasurer, Purok Secretary, Parent Leader, Barangay Health Worker, Daycare Worker
	Christian Children Foundation	Member
	Parents Teachers Association	Secretary
	Women's Association	Representative
	Hawak Kamay	Member
	Cooperative Fisher Folks	Member

Note: (1) * A *barangay* tanod is a village police officer. It is the lowest level of law enforcement officer in the Philippines.
(2) BDRRMC = Barangay Disaster Risk Reduction and Management Committee

3.2.2 Household-level data and sampling strategy

A household survey was administered to 300 households to answer the key research questions. The respondents were identified through stratified random sampling. Coastal communities—i.e., those within a kilometer from the coastline—were first identified. Through the participatory community-based hazard mapping described previously, these communities were delineated into hazard and non-hazard zones. The target number of respondents in each study site was distributed proportionally according to the fraction of the coastal population living in the identified hazard and non-hazard areas. Table 4 shows the distribution of households for the survey by barangay and by purok.

Table 4. Distribution of households in coastal puroks by barangay

Site	No. of HH	No. of Respondents
Barangay Polo, Dapitan City		
Alimango	18	3
Anduhaw	72	10
Bangus	33	5
Locon	42	6
Pasayan	70	10
Tanguigue	130	19
Barangay San Pedro, Dapitan City		
Bakhaw	42	0
Kawayan	59	0
Nipa	53	8
Naga	53	8
Talisay	73	11
Pasil	38	5
Piape	59	0
Sanga	47	0
Barangay Galas, Dipolog City		
North Baybay		
Bangus	100	8
Kamunggay	100	15
Romblon	70	6
South Baybay		
Cory	30	4
Eco-5	30	4
Locon	30	4
Mabolo	30	4
Mauswagon	28	4
Barangay Olingan, Dipolog City		
Central		
Corales	60	9
Farmer	–	–
Morning Star	–	–
Palayan	–	–
Parpagayo	50	7
Sampaguita	16	2
De Oro	100	6
Mangga (Portion)	14	2

Table 4 continued

Site	No. of HH	No. of Respondents
Everlasting	62	9
Ofisco	290	5
Riverside	13	2
Barangay San Antonio, Katipunan		
Purok 1	46	7
Purok 2	49	7
Purok 3	52	8
Purok 4	60	9
Purok 5	55	8
Purok 6	75	11
Purok 7	72	10
Purok 8	86	12
Purok 9	49	7
Barangay Tuburan, Katipunan		
Purok 1	145	22
Purok 2	55	9
Purok 3	51	8
Purok 4	60	9
Purok 5	36	0

A multipurpose household questionnaire was designed to gather data, which included the following information:

1. Household demographic information;
2. Consumptive and non-consumptive expenditure of households;
3. Assets of husband and wife as well as their assets brought into marriage;
4. Income sources of individual household members;
5. Occurrence, damages, and impacts of flooding/typhoon, saltwater intrusion, and coastal erosion/storm surges;
6. Adaptive strategies implemented by husband and wife;
7. Participation of husband and wife in decision-making activities, including choice of adaptive strategies;
8. Time allocation of household members before and after an extreme weather event;
9. Incidence of disease as well as sickness and treatment expenditure after an extreme weather event; and
10. Awareness of husband and wife on climate change issues and adaptation choices.

Portions of the questionnaire were administered separately to the husband and wife.

3.3 Analytical Methods

This section discusses the analytical methods that were used to answer the research questions of the study. Analyzing the data within the conceptual framework yields the following general train of causality:

outcome = f (adaptation (women's participation in decision making), hazard, exposure, women's participation in decision making)

The causality, as illustrated, is tempered by the interaction of these variables with how decision making is determined within the household, particularly women's participation in this activity. Thus, analytical methods should address the measurement of the outcome variables listed previously, women's participation, and the choice of adaptation strategies as influenced by women's participation in adaptation decision making. Finally, causality between these variables and the outcomes were shown using matching methods.[1]

3.3.1 Measuring women's participation in decision making: Women empowerment index

A major determinant of outcomes is the degree of women empowerment in household decision making. In order to measure women's level of participation in various household decision making spheres, including the choice of adaptive strategies, we used the concept of women empowerment index (WEI), which is computed as follows (Paris et al. 2008):

$$WEI_i = \frac{\sum_i x_i}{d}$$

where:

WEI = women's empowerment index for identified activities of each respondent,
x = value of decision making on the i^{th} activity and has the following values:

x_i =
- 1 the husband solely makes the decision
- 2 the husband dominates the decision
- 3 the husband and wife make joint decision
- 4 the wife dominates the decision
- 5 the wife solely makes the decision,

d = total number of decisions given by the respondent, and
I = is the i^{th} decision-making activity.

A higher index or score indicates that the woman in the household is more empowered or has greater participation in a decision making activity. The total number of decisions (*d*) given varies among respondents because some questions may not be applicable to certain households. In cases where either the husband or the wife is not available (i.e., deceased, abroad, etc.), the husband was replaced by an adult male who is involved in household decision making, such as the grandfather or the brother. Similarly, an adult female who is involved in the household decision making replaced the wife in case of her absence. The WEI was used as an explanatory variable in the succeeding regressions. Note also that the formula can be extended to include weights for major and minor activities within the household. Giving equal weights to all activities can be misleading. It may be that the WEI is high but the activities women are deciding on are just minor concerns within the household. In this case, the study could not say that women are empowered since they are left to decide on relatively minor decision making spheres. To remedy this, major and minor decision making spheres based on the FGDs were delineated.

[1] Quasi-experimental methods such as instrumental variable (IV) regressions can also be used to show causality between outcomes and adaptation and women's participation. We are also contemplating on using regression discontinuity methods.

4.0 RESULTS AND DISCUSSION

4.1 Site Description

4.1.1 Dapitan City

Dapitan City is situated on the northwestern coast of Mindanao in Zamboanga del Norte, one of the three Zamboanga Peninsula provinces. Its geographical coordinates are 8°50′ north latitude and 123°30′ east longitude, and it is about 650 km^2 southwest of Manila, Philippines. Dapitan is bounded on the north by Sulu Sea, on the south by the municipalities of Mutia and La Libertad, on the east by the municipalities of Sibutad and Rizal, and on the west by Dipolog City, the provincial capital that is 14 km away.

Dapitan is a second-class city with a level to rolling land area of 390.53 km^2 devoted mainly to agriculture (74.4%), as shown in Table 5. A large portion of swamps and marshes that have been developed into fishponds lies along one of the major rivers, Liboran River. In a 2011 survey of 100 fishermen-headed households, poverty index registered at 38.06%.

Dapitan City has 50 barangays classified into 27 interior, 13 coastal, 8 urban, and 2 island barangays. The average elevation range is 60–120 meters above sea level. Coastal areas are generally plain except in the northern coastlines. Mangroves, seagrasses, coral reefs and reef fishes are present in the area.

Along the 13 coastal barangays, fishing is the second source of livelihood. Marginalized fishermen use motorized and non-motorized boats. Fishes found in the area include *tuloy* (sardines), oceanic bonito, *bulinaw* (anchovies), round scad, *bilong-bilong* (moon fish), *sawasid* (halfbeaks), yellow fin tuna, *barongoy* (flying fish), slip mouths, mackerel, and herring.

The 27 interior barangays sit on largely arable land. Dapitan is a coconut-producing community, with bananas often intercropped under the coconut trees. Rice and corn are also grown. Backyards generally lend to livestock- and poultry- raising purposes.

The main seaport of the province is the Pulawan Wharf in Barangay San Vicente, about 9 km from the *poblacion* (town proper). One of the oldest bridges in Mindanao links Dapitan to its component city of Dipolog. Another steel bridge connects the poblacion to the northern part of the city.

Table 5. Land use in Dapitan City

Land Use	Area (ha)	% of Total
Residential	429.5844	1.10
Commercial	124.9700	0.32
Industrial	257.7506	0.66
Agricultural	29,055.5263	74.40
Forestland	7,127.1956	18.25
Tourism	827.9263	2.12
Parks and Open spaces	859.1688	2.20
Area priority development	39.0531	0.10
Total	**39,053.1267**	**100.00**

Source: OCPDC Dapitan City (2010)

In February 2012, Dapitan River overflowed which resulted in flashfloods affecting 13,052 individuals. Reports showed that prolonged rainfall in two of the coastal barangays, Polo and San Pedro, would result in a one-meter sea level rise (GTZ-DENR 2010).

Ordinances on Dapitan City coastal management are Dapitan City Fisheries Ordinance of 2002, Ordinance No. 2008-222 and Ordinance No. 2008-228. These established the Strategic Agriculture and Fisheries Development Zone and also created a City Fisheries and Aquatic Resources Management Council that regulates the installation of fish corals, stationary basnigan, fish cages from the mouth of Liboran River in Polo to Bakong Hill and the use of compressors in the extraction of marine products.

Fishes like *barla, tarugho, bansi, baro-baro, bugkanon, koldeso, katambak, kitong, liplipan, managhoy, molmol, nokos, salawasid, solid*, and *tanigue* are caught through varying fishing methods in Dapitan City. Fishing methods include multiple hook-and-line (*palangre*), spear fishing (*pana*), surface set (*pukot*), encircling gill net (*pangsulid*) and hook and line (*pasol*).

People's Organizations in Dapitan include Barangay Aliguay Fisherfolks' Association, Baylimango, To-od, Cavite, Tabasan Mananagat, Carang Fisherfolks' Farmers Association, NAKASKAS Women Workers Association, Selinog Island Dapitan Fisherfolks Association, Sidlak Organization ZANFESSI, Lando Barangay Indigents, Polo Fishpond Operators and Buyers Association, San Pedro Integrated Farming Association, Active Vendors Association Bangus Processors, Purok Mangga Vendors Association, Pulauan Porters Association, Shrine Women's Organization, United Fisher Folks Association, Prime Movers for Peace and Progress Association, Sicayab-Bucana Fisherfolks Association, and Zamboanga del Norte Livelihood and Econetwork Association (Banks and Leadbitter 2010).

4.1.2 Dipolog City

Dipolog City is the provincial capital of Zamboanga del Norte. With a population of 120,460 residing in 136.28 km^2 (PSA 2010), Dipolog is a third-class city comprised of 21 barangays with more than 97.87 km^2 devoted to agriculture (Table 6). Its five coastal barangays are Barra, Minaog, Sicayab, Olingan, and Galas. Flooding, coastal erosion, and storm surges are felt in the barangays of Barra, Minaog, Sicayab and Olingan (GTZ-DENR 2010). In the Local Sustainable Action Plan of Dipolog City for 2013/14 drafted by the heads of LGU Offices, Barangay Biasong is included in the list of coastal barangays classified as urban centers; Galas, Olingan, Minaog, and Sicayab are suburban centers of Dipolog City.

Table 6. Land use in Dipolog City

Land Use	Area (ha)	% of Total
Agriculture	9,787.0375	25.06
Forestland	6,77.0000	1.73
Shrubland	329.8735	0.84
Residential	1,920.0000	4.92
Commercial	200.0000	0.51
Institutional	827.9263	2.12
Parks and recreation	56.6300	0.15
Transport and utility zone	69.2200	0.18
Planned unit development	15.0000	0.04
Open spaces	153.7190	0.39
Total	**39,053.1267**	**100.00**

Galas inhabitants experience localized flooding (GTZ-DENR 2010). Barangays Olingan and Galas are the most populous barangays in Dipolog. The political hierarchy in Galas is slightly different from those of the other 20 barangays in Dipolog, as the 14 sitios have a sitio president governing the purok presidents.

Topography in Dipolog City is gentle to rugged, while Linabo Peak and a portion of Mt. Malindang form part of the moderate to steep slopes in other areas. The central and eastern sections have flat to gentle terrain set apart by coastal and flood plains. The southern part has hilly areas. Dipolog River, along with other waterways, drains toward Sulu Sea.

A study of 102 out of 1,746 Dipolog fishers showed that they barely attended elementary school, and their average monthly income ranges from PHP 5,001–10,000. The poverty index among these fishers is 23.15 % (Banks and Leadbitter 2010).

4.1.3 Municipality of Katipunan

The municipality of Katipunan is situated 15 km south of the Zamboanga del Norte provincial capital, Dipolog City. A third-class municipality with a land area of 255.20 km^2 devoted mainly to agriculture, Katipunan is home to 43,339 people (PSA 2010) residing in 30 barangays. Five of these are coastal barangays: Barangays Uno, Dos, New Tambo, San Antonio, and Tuburan. These coastal communities experience frequent flooding, storm surge, and coastal erosion. The highest coastal hazard in Katipunan is recorded in Barangay Tuburan, while an entire purok in Barangay San Antonio is affected by the hazards (GTZ-DENR 2010).

Based on a survey of 50 fisherfolk, Katipunan registered a poverty index of 58.87%, the highest among the coastal municipalities of Zamboanga del Norte. About 32% of the fisherfolk in the municipality earn less than PHP 3,000 each month, far below the province's per capita income of PHP 9,114. This sector barely attended elementary education (Banks and Leadbitter 2010). Indications of poverty among fishers in the same study showed that majority of the settlers have nipa or cogon roofing (42%) and use firewood gathered from around (100%). Of those interviewed, 74% live without toilet facilities, and only 39% have electricity connections. Basic fishing methods are used among fishers in Katipunan. Common fishing gears used are surface set gill nets (*panulot*) that are also locally called *pamo*, fish traps, drift gill net (*kurantay*), bottom set long line (palangre), and hook-and-line (*tonton*), which is also locally called *pasul*. Among the fishing gear, *palangre* is mostly used.

4.2 Qualitative Results: Resource Mapping, Hazard Mapping, and Historical Timelines

4.2.1 Barangay Polo, Dapitan City

Barangay Polo has a total land area of 253.5 ha and has the largest population among the 13 coastal barangays. There are 3,115 inhabitants in the area distributed in nine puroks, with Purok Tanguinge having 74 households, the most number of households located along the shorelines of Dapitan Bay.

Polo has the densest population of mangroves among coastal barangays. *Rhizophora apiculata* (locally known as *bakhaw-laki*), *Rhizophora mucronata* (*bakhaw-baye*), *Sonneratia alba* (*pagatpat-laki*), and *Sonneratia ovata* (*pagatpat-baye*) thrive in abundance as full-grown trees, seedlings, and saplings along Dapitan Bay and other aquaculture systems.

Resource mapping showed that Purok Alimango is rich in mangroves, nipa, and fish pens; it is home to about 18 households. The hazard maps developed by the female participants revealed that flooding had been experienced in Purok Alimango. Nipa thatch making is suspended during flooding. Male participants also confirmed that Purok Alimago is indeed prone to flooding. Purok Anduhaw is bounded by the national highway, where the barangay hall, health center, a water refilling station, and the Assembly of God Church are located. This purok ranks second in terms of number of households and has a high number of children. Crabs are the main produce of the area. Both female and male groups said that houses had also been flooded in Purok Anduhaw. In 1970, typhoon caused the collapse of the old Rizal Bridge, which was the only entrance to Dapitan City.

Purok Bangus is the barangay's center of commerce, and fish and vegetable vendors line along Polo Rotunda to sell their produce to buyers going north to the remote barangays, or from the poblacion of Dapitan City. The purok has a Roman Catholic chapel, funeral homes, and a number of coconut trees. Purok Locon has large nipa and fishpond areas. Inland flooding is experienced during strong typhoon with heavy rains. In one instance, the water in the ponds and in the river adjacent to an inland barangay (Barangay Sulangon) rose and then overflowed toward the streets and reached Purok Bangus of Barangay Polo. Milkfish and tilapia swarmed the streets during the incident.

Purok Pasayan has a basketball court and fishponds, and is the third most populated purok in Polo. Purok Tanguigue is the most populated purok in the barangay with 130 households and the highest number of children among other puroks. This is the purok that partly faces a parcel of the shorelines of Dapitan City, and to its east is the mouth of Dapitan River. Coastal erosion was commonly identified by both female and male groups as the hazard of the purok. Typhoon occurrences aggravate eroded areas, while coconut fruits are blown and river water reaches the houses when it rises.

The female group mentioned that flooding has been experienced in all puroks, and they also reported flooding in the houses. However, male participants described flooding in only two puroks: Purok Bangus and Purok Anduhaw. Both groups of male and female agreed that Purok Tanguingue has experienced coastal erosion.

The historical timelines (Figures 3 and 4) show the identified hazards based on the extent of the damage caused to either the community in general (according to the male group) or just within homes and houses (according to the female group). Such damages were the bases of participants, as they rated intensity of typhoon (black), flooding (brown), earthquake (violet), storm surge (blue), strong winds (orange), coastal erosion (green) and big waves (red). Typhoon, storm surge, and earthquake were the common hazards identified by both groups. Based on the hazard mapping at the purok level (Figures 5 and 6), flooding, and storm surge were the only hazards causing damages to livelihood, households, and properties.

Only the male group regarded flooding with a perceived intensity of six. However, it was the female group who described flooding in all puroks of the barangay including inland flooding caused by Sulangon River. The male participants specifically identified two puroks as being more affected than any other area in the barangay. Coastal erosion came out in the historical timeline of the female group and the same hazard was described to have affected one purok in Barangay Polo.

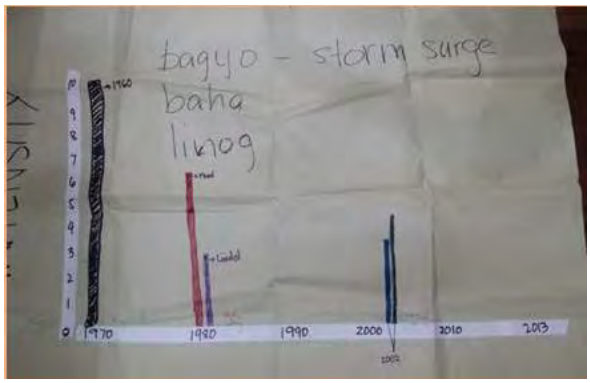

Figure 3. Polo historical timeline (male)

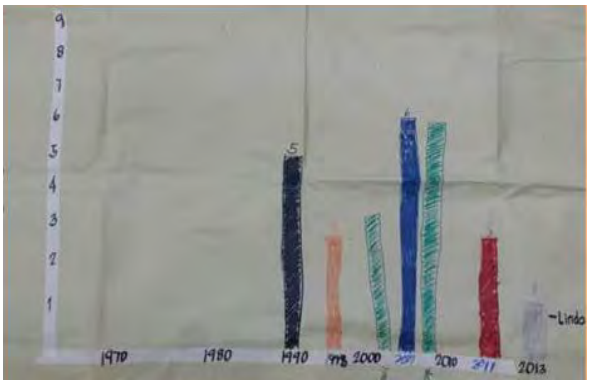

Figure 4. Polo historical timeline (female)

Figure 5. Polo hazard map (male)

Figure 6. Polo hazard map (female)

4.2.2 Barangay San Pedro, Dapitan City

Barangay San Pedro has a total land area of 290.1 ha. There are 1,817 inhabitants in the area distributed in eight puroks, with most of the households settled either along Antipolo River or along the shorelines of Dapitan Bay. The eight puroks are Talisay, Piape, Kawayan, Nipa, Pasil, Bakhaw, Sanga, and Naga. Hazard-prone puroks are Talisay, Naga, Nipa and Pasil.

San Pedro alone grows different types of mangroves but has few in terms of trees, saplings, and seedlings. These are *Avicenniarumphiana* (local names: *apil-apil* and *bungalon*), *Xylocarpusgranatum* (*tabigi*), *Ceriopsdecandra* (*baras-baras* and *malatagal*), *Ceriops tagal* (*tangal* and *tungog*), and *Kandelia candel* (*tangal*). Physical resources in Barangay San Pedro include a 30-ton cold storage facility, a barangay hall, a bridge, a national highway, unpaved barangay roads, two chapels (i.e., Bible Baptist Church and Assembly of God Church), two schools, a basketball court, a warehouse made of concrete hollow blocks and construction materials, and gasoline stations. Natural resources are Antipolo River, Owaon Creek, Dapitan Bay, mangrove, bamboo, backyard swine, and nipa. Barangay San Pedro is the only source of cultured oyster in Dapitan City and even in Dipolog City.

Both female and male participants in the FGD mentioned that the frequency and intensity of coastal hazards in their barangay depend on the presence of typhoons passing through the province of Zamboanga del Norte. Geographically, the land mass of Barangay San Pedro lies along the shore of Dapitan Bay and at the mouth of Antipolo River. A creek called Owa-on Creek also drains into Antipolo River then into Dapitan Bay.

Inhabitants in Purok Naga and Nipa had been flooded, as drawn and narrated by the FGD participants. Based on the mapping by purok (Figures 7 and 8), Purok Naga and Nipa residents live at the foot of the moderately sloped and steep parts of the barangay, and thus rainwater would plunge among residences, which leads to flooding in the area. These puroks lead to Pulawan Wharf of Dapitan City. Purok Pasil is flooded during typhoon occurrences and inhabitants experience coastal erosion. Actual interviews were also conducted among middle-class residents in Purok Pasil. The sea walls that they constructed in front of their houses could not restrain coastal erosion and, in rare cases, big waves. Purok Bakhaw inhabitants and properties were affected by storm surges, according to the male FGD participants. Purok Talisay inhabitants were flooded due to the heavy volume of water carried along Antipolo River which drains toward Dapitan Bay. Another male FGD participant narrated that in 2004, a whirlwind had made landfall in an interior barangay of Dapitan after passing along the river, which consequently made the water rise, thereby flooding Purok Talisay.

During weekdays, most women engage in fishing and gleaning to earn a living. During weekends, washing clothes are the alternative means of livelihood. Most men earn from driving pedicabs from Pulawan Wharf to Dipolog. Another source of income is from harvesting and selling oysters or talaba every day. Oyster is sold either fresh from the shell or bottled. San Pedro has a wide area for gleaning during low tide. They sell their fish and shells at the Dipolog City market everyday and on Sundays as well as in the poblacion during the weekly Tabó Day.

As shown in the hazard maps and historical timelines (Figures 9 and 10), occurrences of typhoon (black) in Barangay San Pedro brought flooding (brown), storm surge (blue), and coastal erosion (green) in four of the eight puroks. Women and men described the intensity of hazards resulting from typhoon occurrences based on the damage to their properties and livelihood. Inhabitants in Purok Naga and Nipa were flooded, as drawn and narrated by both male and female FGD participants.

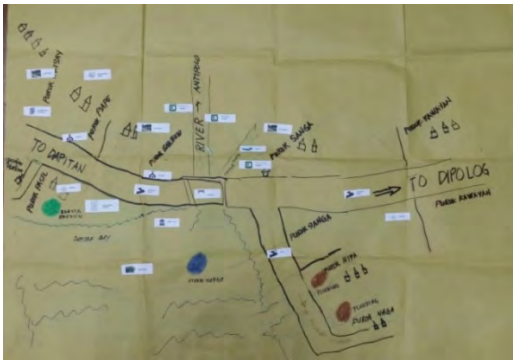

Figure 7. San Pedro hazard map (male)

Figure 8. San Pedro hazard map (female)

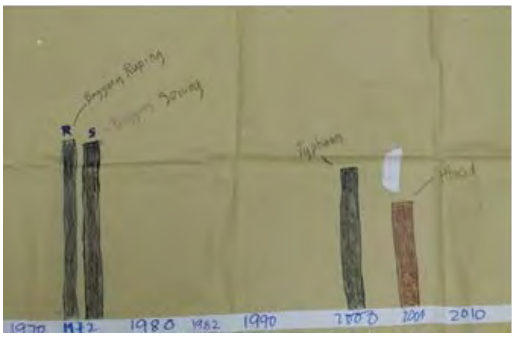

Figure 9. San Pedro historical timeline (male)

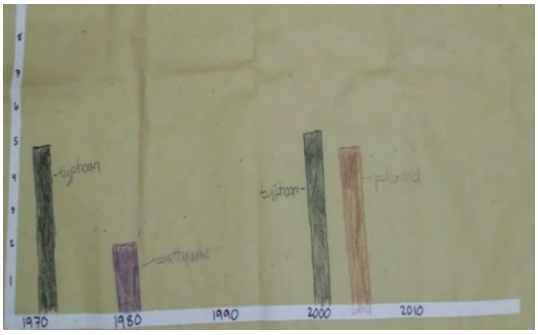

Figure 10. San Pedro historical timeline (female)

4.2.3 Barangay Galas, Dipolog City

The entire province of Zamboanga del Norte was placed under public storm signal number 3 as typhoon Pablo swept many parts of the Philippines in December 2012. In January 2013, tropical depression Auring brought heavy rains and caused flooding, which affected about 90 families. The continuous rains in February 2013, caused 1,855 residences and 422 ha of agricultural land in Dipolog City and in the nearby municipality of Katipunan to be flooded.

From June to July of the same year, coastal erosion and strong waves, which were sometimes accompanied by a typhoon, were prominent in the sitio of North Baybay. The unfinished feeder port in North Baybay is evidence of the coastal hazards. Historical timelines show (Figures 11 and 12) that in the 1940s, coconut trees were eroded. The 1960s and 1970s had strong waves. The 1980's saw the narrowing of the mouth of South Baybay due to the accumulation of soil and sand, but this is now part of the sea. Female participants declared that the playing field they once had in their younger years no longer exists today. Flooding in North and South Baybay were often a result of heavy rains in the upland.

A female participant who has resided in Galas since 1946 remembered typhoon Titang from December 1976 as the most destructive. Typhoon Titang carried along strong winds and heavy rains that drowned one of the inhabitants in the Municipality of Polanco where one of the waterways in Galas exits. Even with its deceleration, the typhoon still flattened houses in many puroks. Hazard mapping for both male and females groups revealed the affected puroks (see Figures 13 and 14).

Figure 11. Galas historical timeline (male)

Figure 12. Galas historical timeline (female)

Figure 13. Galas hazard map (Male)

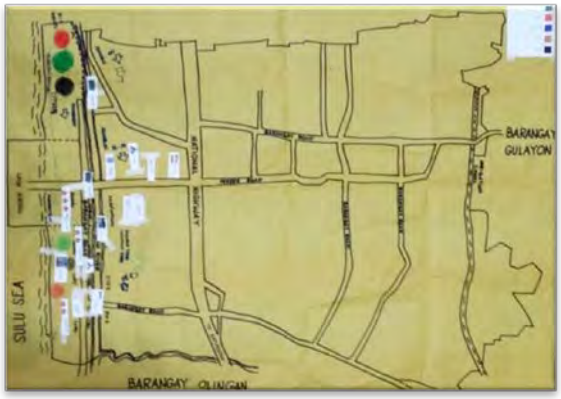

Figure 14. Galas hazard map (Female)

Typhoons Neneng, Rosing, and Ondoy were the storms in the history of Galas, as recalled by the male participants. There was also coastal erosion, and the earthquake that doomed Bohol was also felt by the Galas residents although it did not cause much damage. Flooding and flashfloods were experienced during the aforementioned typhoons. Commercial areas such as rice fields were the most affected during these calamities.

According to an account of a key informer in Purok Cory located near the coast line, typhoons Ondoy and Sendong brought strong waves, floods, and coastal erosion that devastated the house of the informer's brother, washing it out and driving it into the open sea. The informer also described the shoreline to be 50 m away 10 years ago; it is only 8 m now. After the feeder had been built, they started experiencing sudden strong waves and coastal erosion in their area.

Based on another account of a key informant from Eco 5, typhoon Ruping struck the area, and floodwater rose up to their elevated floor. Typhoon Ruping, which lasted from November 10–14 in 1990, was the most costly typhoon in Mindanao; it left damages amounting to PHP 10.846 billion. Meanwhile, the nipa trees in Eco 5 are able to protect the houses and households from the strong winds and waves that might devastate the barangay during typhoon occurrences in Zamboanga del Norte.

A couple interviewed also reported that there has been no evacuation in the area since they moved there in the 1980s. Mangroves and mahogany trees are now visible in the purok. Presently, a narrow and shallow creek in Purok Eco 5 becomes a source of flood. The barangay had organized excavation of the accumulated soil in the creek as a flood protection measure, but key informants still lamented the presence of the unfinished feeder port in Sitio North Baybay.

The Galas Feeder Port is a project of the Department of Transportation and Communication. The infrastructure facility intended to serve as a catalyst for commercial development within the city, to support industrial development in the southern portions of the region, and to provide a transshipment point that would complement the existing wharf and seaport of the province in the nearby city and municipality. Settlers within the area, however, blame the project for causing the adverse coastal hazards being experienced in the locality.

In terms of risk reduction and disaster management, the local government of Dipolog has 51 evacuations centers, early warning device system, and ready emergency response team.

4.2.4 Barangay Olingan, Dipolog City

The male FGD participants identified typhoon, flood, earthquake, drought, and storm as the hazards that had been experienced so far in Barangay (Figures 15 and 16). The earthquake occurred in 1977, while flooding is a yearly hazard in the barangay affecting rice fields in Purok Central. Participants also remembered experiencing a drought in 1994, which had dried up nearly all the water in the area. Waterways along Purok Parpagayo also dried up.

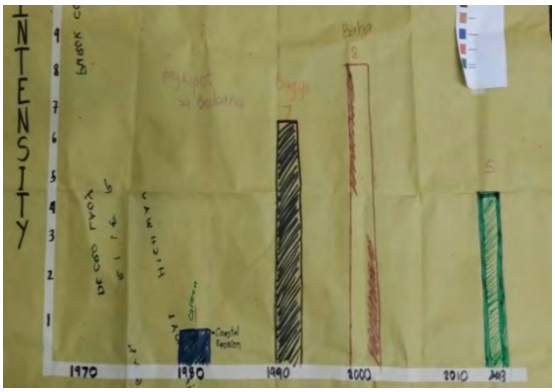

Figure 15. Olingan historical timeline (male)

Figure 16. Olingan hazard map (male)

In 2007, a storm surge was observed by severely affected coastal settlers in Purok Corales and the fishermen's village in Purok Ofisco. Big waves, high tide, and the overflowing of Olingan River added to the storm surge, and damages were most felt in Purok Ofisco. This was further clarified during a key informant interview (KII), when a participant recalled how Typhoon Unsang damaged the purok. High tide was also present during typhoon Unsang, while another male participant mentioned that typhoon Titang resulted in flooding.

As reflected in Figure 17, the female FGD participants remembered occurrences of storm surge, typhoon, flood, and coastal erosion over the span of 50 years in the barangay. The narrowing of creeks was vividly described by female participants, and they agreed that it resulted in the overflowing of creek water, which flooded their elementary and secondary schools as well as the Technical Education and Skills Development Authority building situated in Purok Riverside (Figure 18). The marine biologist facilitator explained during the FGD that the type of mangrove planted in the swamp areas of the barangay could be causing the accumulation of soil along waterways. Flooding within the purok was worse in 2000, when the place experienced continuous rains.

The female participants recalled that in 2011, coastal purok inhabitants' houses in Purok De Oro had been washed to shore. The lady barangay captain and medical doctor noted the lack of a drainage system in De Oro, and thus rainwater from the national highway would find its way to the purok as well as Purok Parpagayo, Purok Everlasting, Purok Mangga, Purok Sampaguita, Purok Riverside, and Purok Central. Purok Central and a large portion of Purok Mangga are more than 100 m from the shore. Purok Everlasting, Mangga, and Central settlers have been experiencing inland flooding for more than 30 years now.

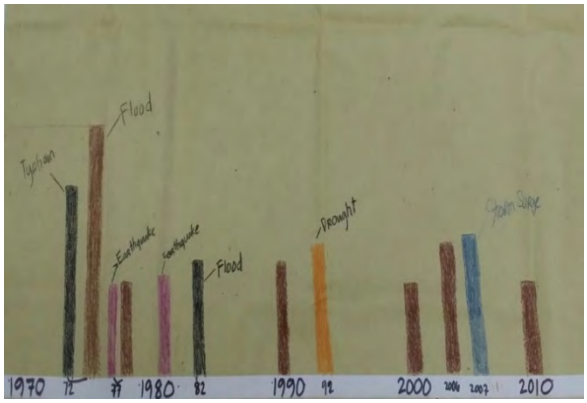

Figure 17. Olingan historical timeline (female)

Figure 18. Olingan hazard map (female)

4.2.5 Barangay San Antonio, Katipunan

As can be gleaned from Figures 19 and 20, occurrences of typhoon (black) in Barangay San Antonio brought out flooding (brown), storm surges (blue), strong waves (red), and coastal erosion (green), which devastated many properties and livelihoods and engendered fear and learning among inhabitants (Figures 19 and 20). Puroks along the coasts have also experienced saltwater intrusion. Other occurrences like drought and cyclone, although having minimal effects, were also remembered by the FGD participants. Their stories allowed them to embrace the scenarios that had stricken their barangay again. Female participants had more vivid narrations of their experiences and specific roles during the events.

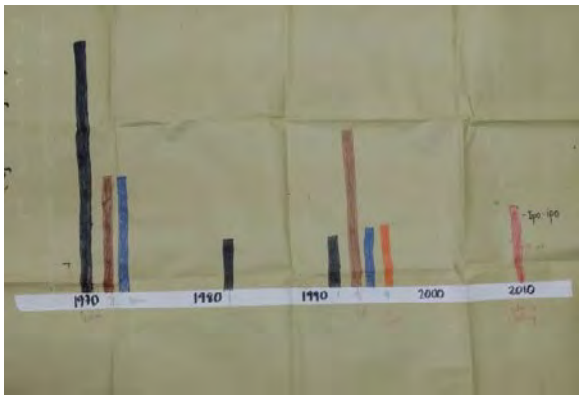

Figure 19. San Antonio historical timeline (male)

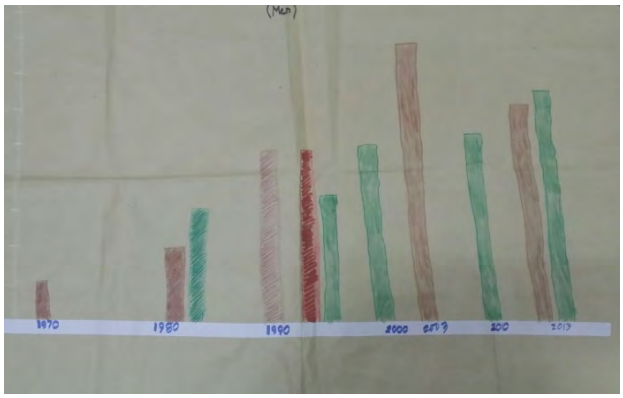

Figure 20. San Antonio historical timeline (female)

The male participants remembered typhoon "Titang" as the most hazardous event in the history of San Antonio. In Barangay San Antonio, strong waves that accompanied typhoon Ruping were equally devastating, washing out almost all assets in the 9 puroks at that time. The bridge in Dikayu River was also almost unpassable.

The 13 FGD participants remembered well the damage brought about by typhoons. On the other hand, the 11 female participants remembered the intensity of the hazards based on the losses that they incurred. These include eroded land masses where their homes were erected since the 1980's and a police officer's death while rescuing a child in the 2003 flooding.

Coastal erosion has been visible in Purok 1 since the 1980s. The extent to which the soil eroded has been evident in the gradual sinking of their houses. However, they continue to build new ones only to see their houses gradually sink again.

Flooding or layas is a yearly occurrence in San Antonio. In December 2003, Dikayu and Liburan rivers overflowed extremely such that floodwater reached the national highway. Floodwater went through three-fourths of the land area in Purok 6, and then overflowed toward Puroks 7 and 8. The remaining puroks were unaffected by the flood, but inhabitants along the coastal areas were trapped and left waiting for rescue.

The participants also remembered experiencing a little tornado or *ipo-ipo* in 2010 and drought in 1998, but their effects did not adversely affect the community compared to the losses from flooding and coastal erosion caused by typhoons. The hazard maps of both the male and female participants showed the affected puroks (Figures 21 and 22). The typhoons that resulted in flooding and strong waves in San Antonio ravaged the properties, livelihood, health, institutional services, and lives of settlers. Floodwater washed out houses in Puroks 6, 7, and 8. Note that the consumption of almost half of the number of households are propelled by activities in these areas.

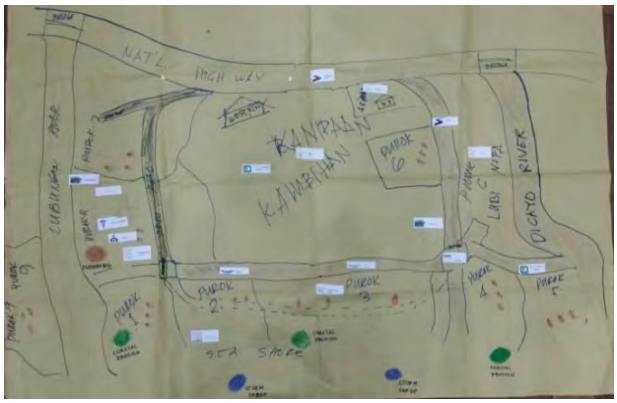

Figure 21. San Antonio hazard map (male)

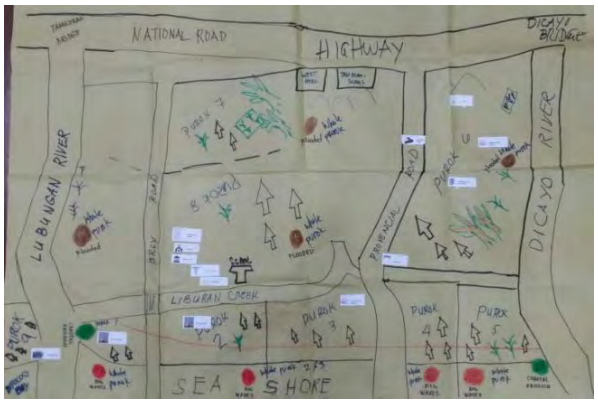

Figure 22. San Antonio hazard map (female)

A concrete barangay bridge serves as the main link between Puroks 3 and 6. When it got destroyed by a flood, the inhabitants replaced it temporarily with makeshift bridge made of bamboo. It could be inferred that during strong waves, the inhabitants in Puroks 1, 2, 3, 4, 5, and 9 needed to evacuate immediately from their dwellings.

4.2.6 Barangay Tuburan, Katipunan

The male FGD participants in Barangay Tuburan remembered that they had been frequently hit by typhoons (black) (Figure 23). On the other hand, the female FGD participants remembered frequent flooding (brown) in the barangay (Figure 24). The women narrated that the barangay gets flooded every three years, which causes death and damage of properties. For instance, whenever the Minang and Ibo-an creeks overflow, it affect the many families that live alongside them.

According to the female participants, the barangay gets flooded due to the heavy rains that typhoons cause and due to high tides. Landslides are also common occurrences in the barangay. On the other hand, the male participants identified earthquake as a hazard that is destructive to many of their domesticated animals.

Figure 23. Tuburan historical timeline (male)

Figure 24. Tuburan historical timeline (female)

The Sindangan-Cotabato Fault is found nearest to the municipality of Katipunan, and thus medium-scale earthquakes can be felt. The male participants believed that Barangay Tuburan lies along this fault line, more than any other barangay in the municipality of Katipunan. Meanwhile, male FGD participants clearly remembered the PAGASA-named typhoons from 1972 to 2009. Of these, typhoon Unsang was remembered to be the most damaging while typhoon Ondoy was narrated to be the second most damaging. These were followed by typhoons Ruping and Titang.

The maps drawn by the FGD participants (Figures 25 and 26) showed that the northernmost part of the barangay is along the coast. On the east is the Minang Creek that cuts across the national highway leading to Zamboanga City, while Ibo-an Creek divides Purok 1 and Purok 2. Minang Creek and Ibo-an Creek line the 145 households from other puroks in the barangay. During typhoons with heavy rains or continuous rains, the two creeks swell and overflow to majority of the land areas in Purok 1. The coastal area of Purok 1 experiences strong waves, coastal erosion, saltwater intrusion, and storm surge during typhoon and tropical storms.

Figure 25. Tuburan hazard map (male)

Figure 26. Tuburan hazard map (female)

Purok 2 experiences strong waves, coastal erosion, saltwater intrusion, and storm surge. Purok 3, on the other hand, is prone to flooding, according to both the male and female participants. The male group added that the coastal portion of Purok 3 experiences the same coastal hazards as those in Purok 2. Likewise, big waves, coastal erosion, saltwater intrusion, and storm surges happen in Purok 4 due to the typhoons and storms that pass the province of Zamboanga del Norte before exiting the country.

Table 7 shows the summary of resources that have been affected in the six hazard-prone barangays of Zamboanga del Norte. The resources are generally classified as property, livelihood, health, people's organizations, and institutional services. In some cases, coastal hazards may cause loss of life.

In Barangay San Pedro, the properties and livelihoods of the inhabitants are the ones that have been mostly affected. The typhoons and other coastal hazards that have occurred have mostly destroyed the residents' homes. Swine, hogs, oyster and aquaculture products were also affected. The elderly and children often get sick after a coastal hazard occurs, as reported by the FGD participants. In Barangay Polo, damages are more felt whenever public infrastructure is affected. Whenever their sources of primary livelihood are affected, the outcome becomes detrimental to the community. In Barangay Galas where economic activities are more widespread, the residents narrated loss of income from retailing and service business. Houses and public infrastructure have been both affected by combined coastal hazards.

Table 7. Resources affected due to hazards

	Typhoon	Flooding + Big Waves + Whirlpool + Storm Surge + Coastal Erosion
A. Barangay San Pedro, Dapitan City		
Property	Nipa roofs blown by strong winds Damaged houses Swine and hogs manifested unusually Dikes soften and become deformed due to rising water in fish ponds	Dike of fishpond have been damaged Oyster aqua farm gets flooded Private sea wall gradually collapse while other parts have been totally destroyed
Livelihood	Fishermen are unable to fish, thus nothing to buy rice with Without fish catch and aquaculture harvested, women have nothing to sell in Dipolog market Backyard vegetable garden are destroyed Shrinkage of meat for live oyster Early harvest of milkfish, prawn, and tilapia	
Health	The elderly and children get sick	

	Typhoon	Flooding	Storm Surge	Coastal Erosion	Earthquake
B. Barangay Polo, Dapitan City					
Property	Old Rizal Bridge collapsed (1970s) Several houses in Purok Pasil destroyed	Basketball court is constantly flooded Houses in Purok Anahaw, Alimango, and Tanguigue flooded		Eroded half a hectare of Purok Tanguigue	Cracked earth barangay road
Livelihood	Women unable to glean Fishers without catch means women have nothing to peddle Coconut fruit were blown Fish cages entirely destroyed	Fish ponds flooded Bangus, tilapia, prawn, crabs flow out from the pond Women unable to glean Unable to gather for barnacle or tagimtim Fishers without catch means women have nothing to peddle Work stoppage for nipa thatch making	Women unable to glean Fishers without catch means women have nothing to peddle		
Health		Skin diseases common after flooding in the barangay			

Table 7 continued

	Typhoon + Big Waves + Storm Surge + Coastal Erosion					
C. Barangay Galas, Dipolog City						
Property	Dwelling places of Purok Cory and Eco 5 Commercial areas Dipolog Feeder Port					
Livelihood	Fish and vegetable vendors Suspended business operations e.g., bars, cottages, resort, function halls Fisherman unable to fish Coconut farmers Duck raisers					
Health	The elderly and children get sick					
People's Organization	Vendors Association					
	Typhoon	Flooding	Storm Surge	Coastal Erosion	Earthquake	Drought
D. Barangay Olingan, Dipolog City						
Property	Dwelling places	Houses in Puroks De Oro, Parpagayo, Mangga, Ofisco, and Corales affected Carabao, cow clinic affected		Houses in Purok Ofisco and Corales affected		
Livelihood	Fishing, rice farming, mangoes pesticide applicators Dried fish processing Hard boiled fertilized duck processing	Fish pond operation, rice farming Mangoes pesticide applicators Dried fish processing Hard boiled fertilized duck processing	Fishing Dried fish processing Raft making	Dried fish processing Raft making	Fishing	Rice farmers
Institutional Services		Schools, TESDA, School of Fisheries				
People's Organizations		ORPO Bakeshop				Irrigators Association

Table 7 continued

	Typhoon	Flooding	Coastal Erosion	Earthquake	Strong Waves	Saltwater Intrusion	Little Whirl-pool	Land-slide
E. Barangay San Antonio, Katipunan								
Property	Flooding and strong waves	Dwelling places in Puroks 6, 7, and 8	Started in 1980s		Washed out 35 houses	Undrinkable water in Puroks 3, 4, 5, and 9	Houses	
		Concrete bridge	Left 70%of the total land area in the coastal puroks Other Puroks with coastal erosion were Puroks 3, 4, and 5		Waves were higher than inhabitants' kitchen	Left 1% of the total number of coconut trees		
			Houses gradually shrunk to the ground		Fish drying areas were destroyed	Devote gas expense every day to fetch water from other barangays		
					Micro businesses like convenience store, internet cafes, videoke houses were washed out			

Table 7 continued

	Typhoon	Flooding	Coastal Erosion	Earthquake	Strong Waves	Saltwater Intrusion	Little Whirl-pool	Land-slide
E. Barangay San Antonio, Katipunan								
Livelihood		Backyard vegetable garden in Purok 6		Resulted in 5 months of almost no fish catch	Fishermen were unable to fish			
		Wild ducks and fruit bearing trees			Suspended business operations for videoke bar operators, computer café owners, wild duck raisers			
		Manangguete, mango sprayer,						
		1 kg of rice for five to seven children in all meals for the day Children have no fare nor allowance and are thus unable to go to school						
		Fishermen tried to be at sea though water is still muddy brown						
Health		Eight in every ten children are malnourished						
Life		Death of a rescuing police officer						

Table 7 continued

	Typhoon	Flooding	Coastal Erosion	Earthquake	Strong Waves	Saltwater Intrusion	Little Whirl-pool	Land-slide
E. Barangay San Antonio, Katipunan								
Institutional Services		Paralyzed services of the government institutions Schools, barangay hall, church are packed with mud						
		Church from Purok 1 rebuilt in Purok 8						
		Classes were temporarily suspended						
	Typhoon		Flooding		Earthquake		Landslide	
F. Barangay Tuburan, Katipunan								
Property	Houses were blown away Destroyed portions of some houses		Washed away household items and domesticated animals Other families lost their carabao, cow River reached Minang Bridge		Pregnant animals damaged Appliances were broken			
Livelihood	Destroyed rice fields Strong winds blew corn		Irrigated rice field filled with flood Destroyed corn		Eggs in poultry farm cracked		Destroyed rice fields Eroded root crops and backyard vegetables	
Health	Cough, fever, colds, skin disease caught mostly by children		Cough, fever, colds, skin disease caught mostly by children					
Life			Children were carried along flood water in Minang River					

Note: ORPO = Olingan Relocation People's Organization, TESDA = Technical Education and Skills Development Authority,

In Barangay Olingan, the fisher and farmer FGD/KII participants also reported work stoppage with coastal hazards. Organized micro bakers and irrigators were adversely affected. Government offices and roads were also reportedly flooded.

It is in Barangay San Antonio that coastal hazards like typhoon, flooding, strong waves, and saltwater intrusion occurred. The inhabitants even felt earthquake and saw landslide within the barangay. The entire nine puroks were affected. In Barangay Tuburan, selling in schools and offices, rice farming and gardening, and poultry were major sources of livelihood. Flooding affects more sectors of the barangay than any other coastal hazards.

4.3 Qualitative Assessment of Autonomous and Community Adaptation

4.3.1 Barangay Polo, Dapitan City

The women found it impossible to generate the usual amount of income they get from their usual thrice-a-week gleaning when a typhoon hit Barangay Polo and consequently flooded the barangay due to the heavy rains and overflow of Dapitan River. Likewise, inhabitants of Purok Anduhaw get no income from nipa thatch making whenever the purok gets flooded. Both male and female groups agree that flooding, typhoon, and soil erosion are the common hazards in Polo (Figures 27, 28 and 29). The males distinctly identified that storm surge have also affected their barangay. Both groups also agreed that reforestation should be the topmost priority among the adaptation options to address flooding. However, the male participants dominated the discussion and decisions for the remaining options. The second plan was waste management, which was also suggested by the men. Seminars and trainings to stop illegal logging were ranked third and fourth, and were recommended by the females.

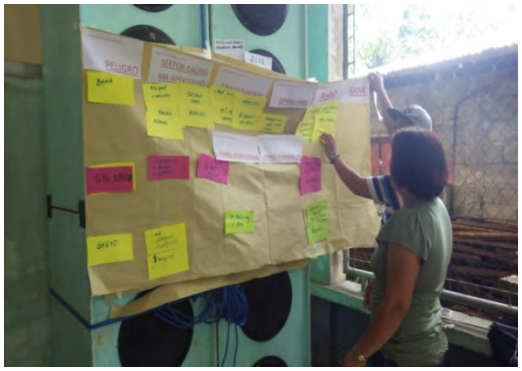

Figure 27. Vulnerability Assessment Matrix (VAM), Polo (male)

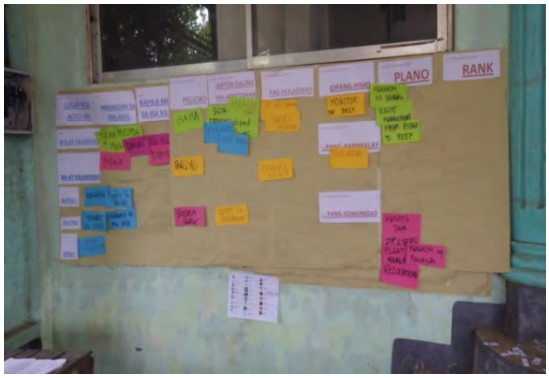

Figure 28. VAM, Polo (female)

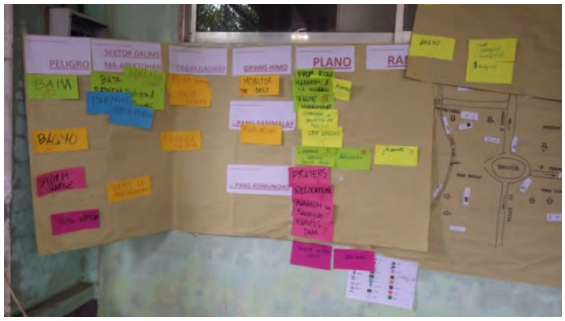

Figure29. VAM, Polo (synthesis)

4.3.2 Barangay San Pedro, Dapitan City

One female participant narrated that during the first few years after she settled in Barangay San Pedro, she had to harvest milkfish earlier than ideal due to a coming typhoon. This meant smaller fish sizes, and reduced selling price compared to a harvest of fully-matured stock. Other female participants, particularly mothers, were aware of the basic predisaster activity to pack rice, clothing, and underwear. They also emphasized adding lighters or a box of matches.

The female participants grew excited when they recalled and shared how it had been in the early morning when strong waves occurred in Dapitan Bay. Shells were washed to shore, and since this occurrence was coupled with low tide, women had a bigger harvest from gleaning compared to ordinary gleaning days. Some also stood along the Antipolo River banks waiting for drift coconuts. Gathered nuts were dried into copra and sold to buyers nearby. Men remembered leading prayers in the family during typhoons, while others transferred their hogs and swine.

The inhabitants of San Pedro, based on the narration of FGD participants, planned a number of preparations, adaptations, and mitigations to start with the government mandate to create a BDRRM Committee (Figures 30, 31 and 32). The initial plan would be to organize a Barangay Disaster Risk Reduction and Management Committee (BDRRMC). The FGD in this study was conducted six months after the local election, and there was still no committee organized. Their second plan was to increase mangroves in the barangay. Discussion followed on regarding the rampant cutting of mangroves to be used for building fish pens. Proper waste management was also suggested by the female participants. The president of the Senior Citizens suggested that the practice of zero-burning should be adopted by inhabitants. Further discussion was made when one woman participant emphasized on informing inhabitants of the necessity of each plan.

Figure 30. VAM, San Pedro`(male)

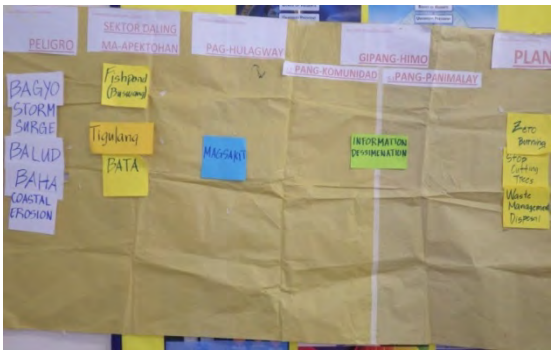

Figure 31. VAM, San Pedro (female)

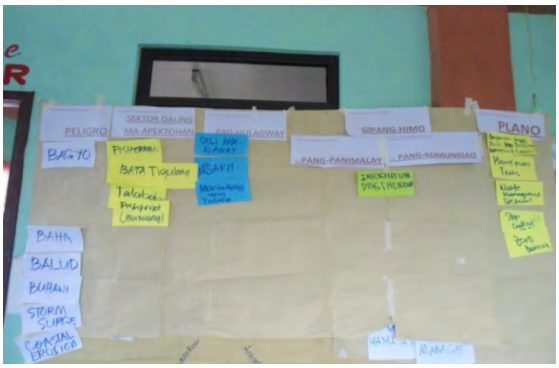

Figure 32. VAM, San Pedro (synthesis)

During the separate discussions of the men and women groups with regard to the enumeration of hazards, the women enumerated more types of hazards than did the men while describing their experiences. The male group identified fishing as directly affected by the occurrence of typhoon. Flooding would immediately follow, affecting their cultured oysters. The female group believed that typhoon occurrence brought flooding, storm surge, big waves, and coastal erosion. They also believed that typhoons cause flooding and other hazards, which destroy their dikes, overflow their pond, and pose health risks to elderly and children. However, both groups agreed that the typhoons primarily brought flooding. Thus typhoon was ranked first among the hazards. The male participants detailed the impacts of flooding on their fishing, and on oyster and shells gathering. Other hazards enumerated by females were ranked accordingly.

Coastal erosion was ranked last. A male participant explained that the mangroves in Barangay San Pedro have prevented the damages that could have come from coastal erosion. Evidence of this is the concrete barangay hall erected within the waters of Dapitan Bay, which is surrounded with mangroves. This was confirmed by other participants.

Both groups agreed that typhoon frequently passes San Pedro. However, flooding was believed to cripple livelihood and lives. The barangay captain admitted that the barangay must initiate other DRRM plans. The presence of the BDRRM Committee is the first step to introducing interventions needed by the barangay. Organizing the BDRRM Committee ranked first among other plans. Since mangroves continued to propagate in San Pedro, the male group believed in and discussed the need to continue planting mangroves. Mangrove reforestation was ranked second. Female participants also said that trees have to be secured, and thus the practice of cutting mangroves for fish pens has to stop. The elderly participant of the Senior Citizen sector reiterated the other observed cause of flooding in San Pedro. He explained the proper practice of solid waste management and the need to stop their burning practices. Though many knew the existence of the ordinance on solid waste management and proper disposal, the elderly participant took the opportunity to disseminate it during the discussion held. The proper solid waste management and zero-burning community plans were ranked fourth and fifth, respectively.

4.3.3 Barangay Galas, Dipolog City

The male group identified the hazards affecting not only coastal areas but also the upland areas (i.e., North Galas) (Figure 33). The presence of the President of the Senior Citizen facilitated the enumeration of hazards. These hazards were typhoon, flash flood, whirlpool, big waves, and storm surge. One sitio president explained that despite of these hazards, these were not as intense and frequent as those in the five barangays. The occurrence of flash flood, whirlpool, big waves, and storm surge depends mainly on the occurrence of typhoons. The hazards jeopardize the livelihoods of farmers and laborers in the Galas Feeder Port and cause illnesses among children and the elderly. The enumerations of planned adaptations were generally on preparations for typhoon since it will result in other hazards. The community adaptations were relocation of households, construction of evacuation center and sea wall, planting of trees in North Galas, and planting of mangroves in the coastal part.

The women's group—composed of a first-term councilor, the president of the Vendors' Association in Galas, a staff of the councilor also from Galas and a resident of a coastal purok in North Baybay—did not identify storm surge as a coastal hazard based on personal experiences (Figure 34). Unlike the female participants in the other study areas, these women either worked in the office of the LGU or attended to their convenience store located along the national highway. The women FGD participants from other barangays stayed at home for most of the day or sold fish before the sun rises.

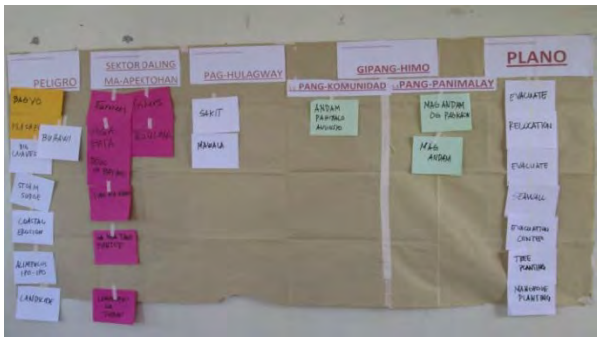

Figure 33. VAM, Galas (male)

Figure 34. VAM, Galas (female)

Later in the discussion with the women's group, the Vendors' Association president recalled an incident when inhabitants had been warned of a tsunami after several earthquakes shook Dipolog City and other parts of the Visayas and Mindanao. They were told to vacate their homes and live in the covered court.

A key informant in Purok Cory observed the practice of preparing his family during strong typhoons. Each of his family members has prepared packed bags filled with rice, clothing and canned goods in case of evacuation. However, there has been no instance of evacuation that occurred in Purok Cory. They had experiences of house posts inundated with seawater. The Purok Cory president encouraged his fellow settlers to concretize the footing of their houses. His brother, whose family and house were washed out to sea, had a house with a tree trunk for a post, unaware that it was just arm-sized at the base. He and a few settlers built concrete bases for some houses, but many others still have none. They had tried planting mangroves and once had tall coconut trees, but these were now eroded and were not rehabilitated.

During the combined group discussion, men and women agreed that typhoons brought along other natural hazards in coastal and upland Galas. A primary plan of the community is to ultimately control big waves, coastal erosion, and flooding due to typhoons (Figure 35).
They initially thought of high-profile projects like building sea wall and a relocation center, among others. They also agreed that tree planting is the best option to prevent the ruthless damage to property caused by overflowing creeks, flashfloods, and coastal erosion.

Figure 35. VAM, Galas (synthesis)

One councilor shared that they have life jackets, hose, hard hats, and life boats for use during disasters, but they lack trained personnel to execute preparations for this kind of disasters. They are open to organizations that can train their people in the community against disasters and hazards that may occur in the future. The female participant who suggested the provision of financial and in-kind aid to victims added that if there were training and equipment to be prepared, there should also be funds or goods after the occurrence of hazards. The shared discussion of men and women led to the agreed decision that the BDRRM plan must be strengthened in preparation for typhoons in Galas. Building a sea wall and an evacuation center will also be included in the BDRRM plan. Tree planting and mangrove plantation were also identified.

4.3.4 Barangay Olingan, Dipolog City

The president of the Organized Radio Assistance and Communication Information Services (ORACIS) and a retired Coast Guard shared much during the discussion for the men's group during the FGD. During ordinary days when there is no flood or typhoon, settler-members of civic organization ORACIS conducts a daily monitoring routine. During calamities in the nearby municipality of Katipunan, members of ORACIS were in rescue operations and distributed relief assistance after.

The discussion among male participants was largely revolved around the environmental degradation that spills over to many puroks due to the increasing number of inhabitants who were from another barangay in the city but are now living in relocation sites (Figure 36). Although typhoons with heavy rains also resulted in overflowing rivers that flooded clinics, schools, and offices located in the area, man-made activities were also observed to cause frequent flooding. One of the male participants related that expanding nipa plantations in some areas thwart waterways and cause water to overflow in many puroks. Likewise, fish pens also thrive in numbers that provide consumption and added income to fishers but impede water passages along creeks and the Olingan Creek. The ORACIS president recalled several instances of sea turtle or pawikan sightings. Last July 2013, a sea turtle weighing more than a 100 kg was found and then returned to the sea. The shores of Dipolog, from Barangays Miputak to Olingan, seem to be a new breeding ground for sea turtles. The participants also believed that the presence of other marine life and their natural habitat should be conserved and protected from human activities. Indirectly, flooding will be prevented in the area and no harm would affect households and their assets when storm surges or typhoons occur.

Figure 36. VAM, Olingan (male)

The male group believed that Olingan has the potential to be declared an MPA. Declaring it as such can prevent inappropriate waste disposal and promote coordinated planting and growing of nipa and mangroves. This intention to protect the area was included in a plan. The men's group thought of an MPA plan to be promulgated in the barangay of Olingan as one clear-cut plan. The negative consequences of the plan were also enumerated. First, the plan will mean displacing many of the relocated families to other barangays in Dipolog City. Removing the nipa trees that have accumulated soil in the river and creeks will also mean displacing the inhabitants who rely on nipa thatch making as an alternative income source. One of the male participants related that expanding nipa plantations would thwart waterways and would cause water to overflow in many puroks. Likewise, fish pens also thrive in numbers that provide food for personal consumption and added income to fishers; however, they also obstruct water passages along creeks and the Olingan Creek. Waste management will be incorporated in the MPA plan.

The lady barangay captain led the planning of the women's group regarding mitigations and adaptations to climate change hazards. Flooding also came out as a devastating hazard in Olingan. The lady barangay captain mentioned floodwater in their clinic, while teachers who also participated in the FGD described how the classrooms and their surroundings got flooded (Figure 37). The discussion led to the human causes of flooding like clogged canals, propagations of mangrove and nipa along creeks, and practices of throwing waste along creeks. The barangay captain then mentioned the needed toilets and proper waste disposal in some puroks of the barangay, especially now that the barangay is the relocation site for residents who were originally from Barangay Barra, from the area called Tabuk Barra.

The FGD facilitator brought back the discussion to addressing coastal hazards, although interventions for man-made hazards were also recognized as equally important and has to be attended to by the community. This resulted in ranking the adaptations that would address both coastal and man-made hazards.

Flooding affects crop farmers, fish pond owners, and proprietors of rice mill. The planned interventions that were enumerated and ranked accordingly were dredging canals, elevating the road in Purok Farmer, building drainage canal, and building toilets. The overlaying of the national highway almost every year and the present improvement of the same further elevated the national highway. This means a basin will need to be created among the hazard-prone puroks in order to lead the collected water due to heavy/continuous rains back toward the sea. Based on this, the women's group believes it would be wise to elevate barangay roads simultaneously with nationally funded road improvements and maintenance. Typhoon was the other hazard mentioned by the women's group, and dredging was suggested as an intervention since typhoons bring heavy rains, especially during high tide, which result in flooding.

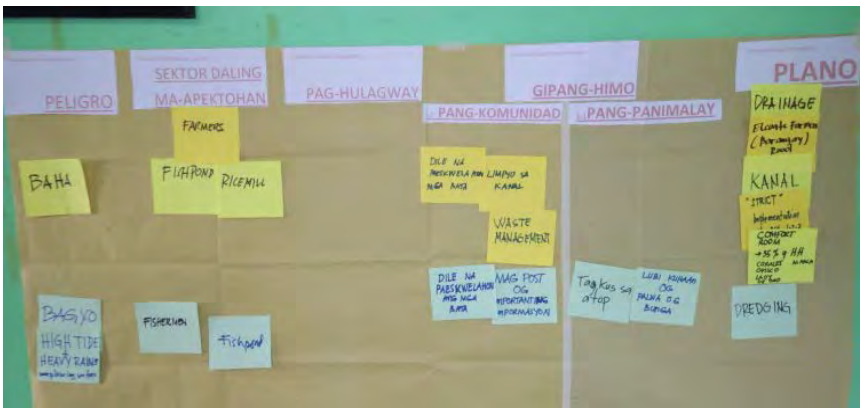

Figure 37. VAM, Olingan (female)

Meanwhile, the planned interventions enumerated by the Olingan FGD participants initially tackled coastal hazards, but they found out that man-made hazards contributed to flooding in the barangay. This resulted in plans that include future solutions to correct the adverse practices of many inhabitants (Figure 38). Discussions during the plenary were initiated by the ORACIS president, who was insistent of their group plan. Building a drainage canal was ranked as the most urgent intervention. Other interventions were strict implementation of the city ordinance, drafting of an MPA plan in Olingan, dredging of river basin, and elevation of the road in Purok Farmer.

Figure 38. VAM, Olingan (synthesis)

4.3.5 Barangay San Antonio, Katipunan

As household heads, the fisherfolk reflected on how autonomous adaptation strategies will yield benefits in the long run by keeping their families safe while allowing them to stay close to the sea (Figure 39). Men also reported constantly checking typhoon updates even during the hazard. They keep an eye on indications of possible rise in water level along rivers, sea waves, and storm surges. After every hazard, households face financial difficulties, just like in the other days. Heads of every family will go out of the barangay to look for individuals or lending institutions from whom or which to borrow money. Wives are left waiting for relief goods to be distributed or for assistance to come. Others would look around for useful materials and resources to meet their basic needs for the day and to think of their next move as the days come.

In spite of the impoverished situation of San Antonio families, it could be deduced that they are highly resilient. The women in Barangay San Antonio, who manifest courage in looking for alternative resources that are readily and easily available after coastal hazards, are present in the nine puroks. The women considered the Nipaan in five puroks to be source of alternative livelihood as nipa thatch making enables them to earn temporarily while their fisherman husbands are at the mercy of the sea during typhoons, strong waves, or coastal erosion. Husbands drive around the municipality to earn a living from "habal-habal" (passenger tricycles). Women making thatch or *pawud* out of nipa leaves is a useful livelihood alternative, but remains insufficient to earn enough to buy food for a day. Drift coconuts are also found to be very useful as copra and charcoal can be sold in the local public market, the nearest of which is 4 km from the barangay. The inhabitants also noted the usefulness of driftwood as either useful debris for house repairs or firewood that could be sold.

According to the account of a female participant who is also a daycare worker, her husband is just like other fishers who are forced to be at sea in spite of turbid water (Figure 40). Stories such as this illustrate the difficulties that the local community faces after extreme weather events.

Figure 39. VAM, San Antonio (male)

Figure 40. VAM, San Antonio (female)

Subregions in Mindanao have the largest area of coconut-bearing trees. Thus, inhabitants near the rivers or the coasts usually wait and collect for coconuts that have drifted along the waterways from the mountains after and (even) during typhoon/flood events. Nuts are dried and sold as copra, whereas coconut shells are made into charcoal. However, the average nut yield in this traditional coconut region of the country is lower compared than that in the rest of Luzon (DA-BAS 2008). Coconut production in the region also went down by 1.82% in 2010 due to the long and dry spell brought about by El Niño.

The meaningful ringing of the church bell is a traditional indication of what to do that is still being used significantly (Figure 41). Evacuations will be signaled through handheld sets, megaphones, and sounds from police cars. The barangay *tanod* (barangay police officer) and officials hold the handheld set and megaphones.

The once-concrete-bridge was repaired using bamboo materials since this is the immediate escape path of coastal puroks. Nails, together with relief goods, were also distributed to affected puroks. Female participants had personal reflections on who qualify as beneficiaries. They termed the availment of relief goods as "color-coding" to refer to the political affiliation of inhabitants as basis to qualify for relief assistance.

Figure 41. VAM, San Antonio (synthesis)

Middle-class families outside Barangay San Antonio willingly lend their trucks and sports utility vehicles to transport stranded families during unfavorable events. In some cases, a 10-wheeler truck of the local government and 6 x 6 military trucks transported assets and people from San Antonio. The female participants narrated how they carried along pots, clothing, sleeping mats, and canned goods and noodles. They also held *pintakasi* or cooperative clean-up drives targeting institutions such as the church, schools, daycare center, and covered court. In extreme cases, speed boats from the provincial and municipal government were used to rescue inhabitants. During these times, saving lives are the priority.

4.3.6 Barangay Tuburan, Katipunan

The male participants agreed that the construction of the Ibo-an River Control and planting trees will mitigate flooding in Tuburan (Figure 42). Occurrence of big waves was identified as second-most damaging to inhabitants. The participants believed that a relocation area for coastal puroks should be prioritized by the government. Puroks that are eroded must be filled or inhabitants must be relocated.

The barangay nutrition scholar participant narrated that during her stay in Tuburan, there had been strong typhoons and massive flooding, but a number of motor boats and non-motorized fishers from Olingan and Sindangan took refuge from the turbulence in Barangay Tuburan (Figure 43). With regard to the flooding felt by the residents of Purok 2 (which is adjacent to Ibo-an Creek), the women's group planned to construct a cemented canal along the creek. However, this was opposed by one official who stated that a thorough feasibility study on this has already been done but there was no financial backing for its implementation. When the same idea of cemented canals was brought up with the male participants, the rice farmers disagreed since this would destroy their rice fields and many livelihoods.

Figure 42. VAM, Tuburan (male)

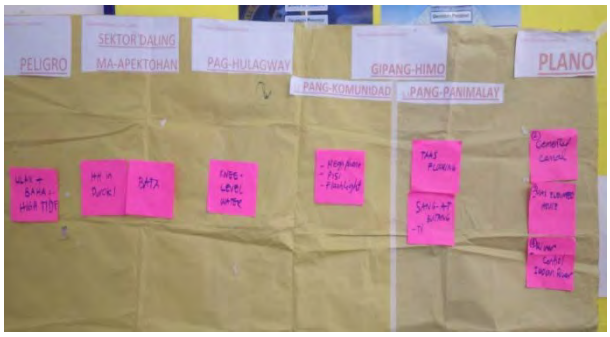

Figure 43. VAM, Tuburan (Female)

The political affiliations of sector representatives' surfaced during the synthesis of the consolidation of the vulnerability and capacity matrices of the male and female groups, which were accordingly spelled out in the final discussion (Figure 44). A former barangay councilor initially raised the idea of mitigating flooding in the barangay through continued tree planting in the upland area of Tuburan (Purok 5). The participant explained the benefits that the trees will provide in the future, and majority of the FGD participants agreed to this proposal.

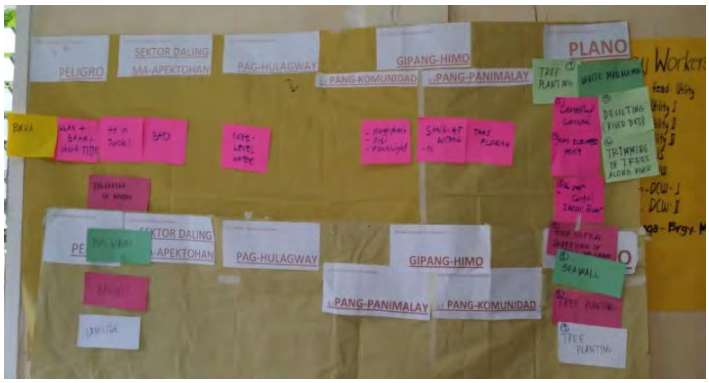

Figure 44. Tuburan Synthesis of VAM

On the one hand, the BDRRMC coordinator and barangay councilor insisted on implementing waste management from the beginning in order to prevent frequent flooding in the area. The BDRRMC coordinator inferred that water passages overflow due to the drift bamboo poles and plastics in creeks that clog waterways. This scenario was observed in both creeks. On the contrary, the female purok president of Purok 5 (upland purok) disagreed and reasoned that they have not been dumping solid waste in waterways, and thus overflowing creeks should not blamed on upland inhabitants. The discussion was resolved with a plan to plant trees and to promulgate a waste management plan in the barangay, to which everybody agreed.

Table 8 summarizes the local residents' common household adaptations, which primarily aim to protect family members. The second priority is to save acquired assets or to prevent income loss. Packed food, lighting, and clothes for the children are prepared before the occurrence of any coastal hazard. During occurrences of typhoons, assets are protected. Sources of livelihood, like domesticated animals and early harvest of aquaculture products, were also considered by inhabitants before any coastal hazard. The residents of the most-affected areas create defenses to protect their assets from destruction.

Table 8. Household-level adaptation

Hazard		Household Adaptive Strategies
Barangay San Pedro, Dapitan City		
Typhoon	Women	Conduct early harvest of milkfish in ponds Buy 5 kg rice, lighter, or box of match Family members counted and kept intact Pack clothing and underwear
	Men	Pray Transfer hogs and swine
Flooding + Big waves + Whirlpool + Storm surge + Coastal erosion	Women	Gleaning is better after big waves with shells washed to shore Stand along Antipolo River and Owa-on Creek to pick up drift coconuts and wood Private sea wall constructed in Purok Pasil
	Men	During night time, men light torches to gather shrimps and crabs along rivers and shores

Table 8 continued

Hazard		Household Adaptive Strategies
Barangay Polo, Dapitan City		
Flooding	Women	Look for drift coconut along rivers
	Men	Prepare flashlights, candle Pack rice, canned goods, noodles Family members stay at home
Typhoon	Men	Prepare flashlights, candle Packe rice, canned goods, noodles Family members stay at home Monitor typhoon updates from TV and radio Households evacuate to nearby barangays, Sulangon and San Pedro
Storm surge	Women	Private sea wall constructed by some residents in Purok Tanguigue
Coastal erosion	Women	Private sea wall constructed by some residents in Purok Tanguigue Pile sacks of sand by some residents
Barangay Galas, Dipolog City		
Typhoon + Big waves + Storm surge + Coastal erosion	Men	Monitor from TV and radio Move fishing equipment to a safer place Pack relief goods, clothing Warn other neighbor Set house posts in cemented Observe sea level rise
	Women	Pack relief goods Families along the creek look for drift wood and nuts
Barangay Galas, Dipolog City		
Flash floods (Upland Galas)	Women	(Was not identified by coastal female participants as a hazard)
Whirlpool or "buhawi" + Landslide (Upland Galas)	Women	(Was not identified by coastal female participants as a hazard)
Barangay Olingan, Dipolog City		
Flooding	Women	Keep dried firewood Monitor radio, TV Remove drift wood and coconut along creek and river
Typhoon	Men	Pack drinking water and instant food
	Women	Monitor from radio, TV Elevate appliances Pack clothing, flashlight, noodles, rice Place used wheels on roofing Tie roofing
Storm surge	Women	Pray
Earthquake	Women	Monitor radio, TV

Table 8 continued

Hazard		Household Adaptive Strategies
Barangay San Antonio, Katipunan		
Typhoon	Men	Read from internet Monitor TV, radio After hazards, find where and from whom to borrow money for food, schooling of children
	Women	Vigilant in community announcements/warnings and on what typhoon could bring e.g., flooding, strong waves, erosion
Flooding	Men	Carry their chicken, rooster, wild duck
		Push their motorcycles Carry their old and sick household members
	Women	Find opportunity for alternative livelihood through collecting coconut shell and mangrove, mud clam, or *tuway* to be sold in municipal market Pack canned goods, some clothing and flashlight for evacuation Each household shouts to the neighborhood for warning Observe rise in the level of water Carry their children first (others with 7 children) 4Ps beneficiaries clean church, covered court, barangay hall Elevate their fishing paraphernalia
Saltwater intrusion	Men	Drive motorbikes to fetch water from deep well in Purok 7 and nearby barangay (Brgy. Daanlungsod)
	Women	Filter and boil water from within the Purok to drink Those who could not afford water connections buy water from neighbors
Coastal erosion	Men	Head toward LGU to report
	Women	Filled soil to the eroded portion of their land right where houses are erected Report to the municipality the situation
Barangay San Antonio, Katipunan		
Strong waves	Women	Elevate *banca* and net as main source of livelihood then their other assets
Earthquake	Men	Experienced no fish catch, and thus drive "*habal-habal*" and other alternative ways to earn
Storm surge	Men	Observe sea level rise Initiate praying in the family
Drought	Men	Barter between fishers' catch with whatever harvest there is from upland farmers
Barangay Tuburan, Katipunan		
Flooding	Men	Prepare clothing, canned goods, Charge flashlight and batteries
	Women	Elevate houses

Community adaptations include activities that raise awareness of people before any disaster, actual evacuation during occurrence of hazards, and distribution of food and relief items after any damaging events (Table 9). The LGU and volunteer groups in the barangays implemented the programs and activities. Different barangays vary in their community adaptations, depending on the extent of damage and frequency of hazards. Barangay San Antonio in the municipality of Katipunan requires the most help and adaptive strategies.

Table 9. Community-level adaptation measures

Hazard	Community/Local Government Adaptive Strategies
Barangay San Pedro, Dapitan City	
Typhoon	Monitor reports from media Information dissemination through flyers Recent activity of the LGU was train barangay tanod and officials on disaster preparedness (after the FGD was conducted)
Barangay Polo, Dapitan City	
Flooding	Use of 17 handheld radios and one base among selected purok presidents and councilors to inform residents
Typhoon	Use of 17 handheld radio and one base among selected purok presidents and councilors to inform residents
Barangay Galas, Dipolog City	
Typhoon + Big waves + Storm surge + Coastal erosion	Peace and Order Committee, BDRRMC of the LGU warn the public using megaphones Barangay LGU talk to coastal puroks on being vigilant for possible big waves LGU pack relief goods to prepare for impending hazard Police officers warn the public ahead of impending hazard Drills in schools
Flash floods (Upland Galas)	Tree planting
Whirlpool + landslide (Upland Galas)	Tree planting Mangrove planting
Barangay Olingan, Dipolog City	
Flooding	Warnings and disaster preparation posted on church bulletin board Barangay officials roam around barangays to give warnings Bell used as warning device House-to-house warnings of ORACIS, LGU
Typhoon	Warnings and disaster preparedness posted on church bulletin board Bell used as warning device Flyers on disaster preparedness and management distributed among inhabitants by ORACIS
Earthquake	Earthquake drill conducted by teachers
Barangay San Antonio, Dipolog City	
Typhoon	Church bell used as warning device to signal evacuation Handheld set distributed among three barangay tanod and few barangay officials Use of megaphone by purok presidents and barangay officials in giving warning to household members Police officers use their car sirens to provide warning LGU distributes relief goods LGU gives nails for house repairs Improvise the bamboo-made bridge in lieu of damaged bridge in barangay "*Pintakasi*" is the term for *bayanihan* on the aftermath, which includes cleaning of government offices like the barangay hall which is filled with mud that goes up to higher than the knee. Immediate *bayanihan* is required so that the mud could be washed away before it hardens. Middle-class residents along the national highway drive their trucks and cars to transport residents in Barangay San Antonio to the JRMSU-Katipunan Campus Gymnasium or other high grounds

Table 9 continued

Hazard	Community/ Local Government Adaptive Strategies
Flooding	Speedboat used for rescue in three of the nine puroks Ten-wheeler truck used by the LGU to carry people and movable properties Purok 8 is a government-proposed government evacuation site Gym of JRMSU Katipunan Campus is an evacuation site about 3.5 kilometers from the barangay Middle-class households living along the highway made cars and trucks available for rescue Evacuate LGU provided nails for house repairs after flooding
Saltwater intrusion	Connect to LGU water pipes and pay to the barangay unit
Coastal erosion	DSWD respond through assistance
Strong waves	Church bell used as warning device to signal evacuation. Handheld set distributed among three barangay tanod and a few barangay officials Use of megaphone by Purok Presidents and Barangay Officials in giving warning to household members Police officers use their car's sirens to provide warning Middle-class residents along the national highway drive their trucks and cars to transport residents in Barangay San Antonio to the JRMSU-Katipunan Campus Gymnasium or other high grounds
Barangay Tuburan, Katipunan	
Flooding	Warning device like megaphones are used to make announcements around puroks Rope for rescue operations in flooded areas and flashlights are made ready in the barangay
Typhoon	During strong typhoons, residents in houses that directly face the sea and houses that are along creeks are advised to evacuate LGU coordinators inform residents of warnings and the signal number of typhoon Rope for rescue operations in flooded areas and flashlights are made ready in the barangay
Landslide	Warning devices like megaphones are used to make announcements around puroks
Earthquake	Warning devices like megaphones are used to make announcements around puroks

Table 9A. Consolidated plans

Hazard	Plans
Barangay San Pedro, Dapitan City	
Typhoon	Organize Barangay Risk Reduction Management Council (BDRRMC) Plant more trees Employ proper waste management Stop cutting trees Practice zero burning
Flooding + Big waves + Whirlpool + Storm surge + Coastal erosion	(Occurrences of these hazards resulted from typhoon and are arranged as ranked by participants)
Flooding	Plant trees (e.g., mangroves, bamboo, and other trees) Employ waste management Conduct seminars and trainings on rescue operations and information dissemination Stop illegal logging
Typhoon	Plant mangrove Increase the number of warning devices available in the barangay Consider relocation Put up an evacuation center
Storm surge	Pray Go to relocation area Plant bamboos to be used in making raft Each family to pack relief items Make a raft
Coastal erosion	Employ waste management Construct sea wall
Barangay Polo, Dapitan City	
Flooding	Plant trees (e.g., mangroves, bamboo, and other trees) Employ waste management Conduct seminar and training on rescue operations and info dissemination Stop illegal logging
Typhoon	Plant mangrove Increase the number of warning devices available in the barangay Consider relocation Go to evacuation center
Storm surge	Pray Go to relocation area Plant bamboos to be used in making raft Each family to pack relief items Make a raft
Coastal erosion	Employ waste management Construct sea wall
Barangay Galas, Dapitan City	
Typhoon + Big waves + Storm Surge + Coastal Erosion	Strengthen disaster management plan Consider relocation, evacuation Construct sea wall Pass barangay resolution to increase financial aid for calamity affected families Increase in-kind assistance

Table 9A continued

Hazard	Plans
Flash floods (Upland Galas)	Tree planting
Whirlpool + Landslide (Upland Galas)	Tree planting Mangrove planting
Barangay Olingan, Dapitan City	
Flooding	Begin drainage construction Consider strict implementation of City Ordinance No. 123 Draft an MPA plan Dredge the narrow creek Elevate the barangay roads
Barangay San Antonio, Katipunan	
Typhoon	(Considered by FGD participants as cause of the succeeding hazards, i.e., flooding, coastal erosion, storm surge, and strong waves and thus, hazards are addressed one by one)
Flooding	Institute river control Consider relocating to higher ground Plant production trees and coconut Construct evacuation center Look for employment
Saltwater intrusion	Increase water systems to reach those without water connections
Barangay San Antonio, Katipunan	
Coastal erosion	Consider relocation Plant Mangrove Conduct land filling in Purok 8 since it is a flood-prone proposed relocation site Institute river control
Storm surges	Pray Heighten awareness and knowledge of inhabitants
Strong waves	Consider relocation Employ sea wall/wave reflector Heighten awareness and knowledge of inhabitants; conduct safety drills
Earthquake	Implement earthquake drill in the barangay
Barangay Tuburan, Katipunan	
Flooding	Employ tree planting and waste management Construct cemented canal along Ibo-an Creek Increase ground floor elevation of houses Construct river control in Ibo-an Creek Conduct creek desilting (river bed) Trimming trees along creeks
Coastal erosion	Stop sand and gravel quarry
Typhoon	Construct sea wall
Strong waves	Conduct tree planting
Earthquake	Conduct tree planting

4.4 Results Based on Household Survey

4.4.1 Profile

The study interviewed 300 households. Most of the respondents were male-headed households (287 male household heads or 96%). Female household heads were both older (average of 52 years old) and farther in birth order (5th) than the male heads, whose average age was 44 years old and were usually 3rd from the eldest among their siblings. The educational level of almost every household head was limited to seven years of schooling or early years in high school. This translates to having jobs that are primarily related to labor, unskilled work, and trades. Common secondary jobs were plant and machine operation and assembly among men as well as vending and nipa shingles making among females (Table 10).

Table 10. Socioeconomic profile of household heads

Characteristics	Female-Headed HH (n = 13)	Male-Headed HH (n = 287)	Whole Sample (N = 300)
Age (mean)	51.85	43.64	44.00
Birth order (mean)	5.31	3.43	3.51
Years of schooling (mean)	7.62	7.56	7.56
Marital status	Widowed, Separated	Married	Married
Common primary occupation	Laborers and unskilled workers (fisher, nipa shingles maker, laundry woman)	Traders and related workers	Traders and related workers
Common secondary occupation	Traders and related workers (vendor, hired labor in nipa shingles making)	Plant and machine operators and assemblers	Plant and machine operators and assemblers

4.4.2 Farming characteristics

Most of the respondents involved in farming activities in the six barangays were either tenants or hired workers (Table 11). About 20% of Galas and Tuburan households that were into farming cultivate their own land, while 22.22% owned a parcel of land cultivated in San Antonio. Coconut remained the major crop in the province. Among farm owners, Galas farmers gained the highest profit (PHP 14,790) from the latest coconut cropping. Corn farm owners in Tuburan simply produced for consumption, while those who were hired to help in corn production were paid an average of PHP 225 weekly. Tenants in Olingan received the highest share in the last cropping.

Table 11. Farming characteristics of study sites

Study Site	% Owned	% with Tenure	Major Crop Grown	Production of Major Crop (kg)	Farm Profit (PHP)	Income from Shareholding (PHP) (n = 15)	Income as Hired Labor (PHP) (n = 17)
Polo (n = 2)	0.00	100.00	–	0	0	1,500	300
Galas (n = 5)	20.00	80.00	Coconut	855	14,790	943	1,157
Olingan (n = 11)	0.00	100.00	–	0	0	4,778	1,106
San Antonio (n = 9)	22.22	77.78	Coconut	302	8,038	3,615	819
Tuburan (n = 10)	20.00	80.00	Corn	45	0	2,366	225

4.4.3 Fishing characteristics

Many of the fishers interviewed were engaged in fishing activities (Table 12). Goat fish and spotted sardinella were their major catch. Goat fish was sold for more than PHP 100/kg by retailers in the province, and thus a bigger catch on an ordinary day among Polo and San Pedro fishers leads to better profit. Other barangays rely mostly on spotted sardinella. In San Antonio, 50 households were into fishing activities. They had the highest average volume of fish catch per trip among the sites covered. They also owned motor boats and fishing inputs. Renters of fishing paraphernalia who generate the highest income were regular renters from Purok Corales in Barangay Olingan. Among barangays, payment for hired labor in fishing was highest in San Pedro.

4.4.4 Gleaning characteristics

Gleaning is not a financially rewarding activity, as reflected by the meager profits reported by households and summarized in Table 13. The profit depends on the frequency of gleaning—i.e., some families do it twice a week while others consider it as a daily activity. Based on the accounts of those interviewed, part of the catch becomes food for the family. Stories of gleaning in the area were plentiful before but they seemed rare today given the volume of harvest for burnay, sihi, and batutol across barangays. Studies show that in other municipalities such as Roxas and Manukan of Zamboanga del Norte, the bivalve clam Paphia Textile used to be abundant. Presently, these have been depleted mainly due to unsustainable harvesting practices especially in the municipality of Manukan (Argente and Estacion 2014).

Table 12. Fishing characteristics of study sites

Study Site	% Owned	% Renter	% Hired	Major Fish Catch	Major Fish Catch (kg)	Fish Profit (PHP)	Income from Renter (PHP) (N=11)	Income as Hired Laborer (PHP) (N=26)
Polo (n = 22)	50.00	9.09	40.91	Goat Fish	2.00	74.40	105.60	562.00
San Pedro (n = 8)	87.50	0.00	12.50	Goat Fish	3.38	130.63	160.31	875.00
Galas (n = 3)	100.00	–	–	Spotted Sardinella	35.00	720.00	1,400.00	–
Olingan (n = 13)	53.85	7.69	38.46	Spotted Sardinella	80.00	1,485.00	2,400.00	2.00
San Antonio (n = 50)	72.00	8.00	20.00	Spotted Sardinella	83.00	1,573.56	1,770.75	1.48
Tuburan (n = 19)	47.37	21.05	31.58	Spotted Sardinella	59.90	1,140.00	1,198.00	1.84

Table 13. Gleaning characteristics of study sites

Study Site	Frequency of Gleaners	Major Species Gathered	Total Catch of Major Species (kg)	Profit (PHP)
Polo	17	Burnay	2.2	42.39
San Pedro	1	Burnay	4.0	100.00
Galas	1	Top Shell or *Sihi*	1.0	10.00
Olingan	4	Burnay	3.0	30.00
San Antonio	2	Top Shell or *Sihi*	1.0	20.00
Tuburan	1	Batutol	2.0	30.00

4.5 Characteristics of Male and Female Decision Makers

4.5.1 Other income sources of female decision makers

Women in the six coastal areas of the province have diverse sources of additional income. The largest amount that the women have received is a cash grant from the government for basic household spending. Table 14 shows that 65% of female household heads receive government cash grant averaging PHP 1,182.31 per month. Other female household heads boost their household income by engaging in sales or making nipa shingles. Direct selling activities alone generate an average income of PHP 356.76 per day. About 8% of the women respondents occasionally sell nipa shingles and earn an average of PHP 875, while 11% of female household heads receive additional income from other household members or relatives residing outside the province who are gainfully employed or moonlight as drivers. About 3% receive their pension and retirement pay via monthly payment transfers amounting to PHP 14,333.33. Another 1% earn an average of PHP 958.33 per month from their net share in the agricultural, livestock, and poultry produce of other households. Other sources of extra income that the women respondents identified are income from laundry and house help services. Additional income earned from laundry and cosmetology services such as manicure or haircut is at PHP 653.95 a week.

Table 14. Income of women decision makers from other sources

Income Source	% of Women Decision Makers Receiving Income from this Source	Mean Income (PHP)
Salary and wages (of all household members) from government or private employment	11.00	7,699.09
Wholesale and retail trade including market vending, sidewalk vending and peddling, selling groceries, beverages, snacks, and farm products, etc.	34.00	356.76
Net share of crops, fruits and vegetables produced or livestock and poultry raised by other households	1.00	958.33
Transportation, storage, and communication services such as operation of tricycle, jeepneys, pedicabs; storage and warehousing activities, messengerial services, telephone rentals, etc.	1.00	4,500.00
Selling forest and other timber and non-timber products (including coconut lumber, mangrove lumber, nipa shingles etc.)	8.00	875.00
Other cash receipts, gifts, support, relief and other income from abroad including pensions, retirement, workmen's compensation, dividends from investment, etc.	3.00	14,333.33
Cash and in-kind receipts from disaster/ calamity relief operations	1.00	60.00
Cash receipts, support, assistance and other income from domestic sources, including assistance from government and private sources (4Ps)	65.00	1,182.31
Other sources not classified elsewhere	19.00	653.95

4.5.2 Other income source of male decision makers

Compared to the female heads, the male heads have more diverse sources of additional income. Table 15 shows that their major sources of extra income are salary of other household members (25%), income from driving tricycles for those near the city or habal-habal for those in remote barangays (24%), wage income from occasional carpentry work (31%), and income coming from other sources but mostly from selling coconut wine or tuba (45%). The service sector, which includes transportation, storage and communication, and trade and repair contributed more to the economic growth of Zamboanga Peninsula than agriculture, fishery, and forestry. Retail or service sector wage earners in Region 9 are right behind non-agriculture wage earners in terms of salary, earning a minimum of PHP 260 per day (DOLE Region 9 2013).

Table 15. Income of male decision makers from other sources

Income Source	% of Men Decision Makers Receiving Income from this Source	Mean Income (PHP)
Salary and wages (of all household members) from government or private employment	25.00	3,275.60
Wholesale and retail trade including market vending, sidewalk vending and peddling, selling groceries, beverages, snacks, and farm products, etc.	9.00	281.11
Working on other agricultural farms (off-farm work)	3.00	1,500.00
Net share of crops, fruits, and vegetables produced or livestock and poultry raised by other households	1.00	200.00
Net sale of livestock and livestock by-products	5.00	1,731.00
Net sale from other processing activities (salt making, seaweeds, wine making etc.)	7.00	194.57
Transportation, storage, and communication service such as operation of tricycle, jeepneys, pedicabs; storage and warehousing activities, messengerial services, telephone rentals, etc.	24.00	277.92
Rental of agricultural/fishing assets (e.g., farming, fishing equipment, rental of boats, rental of tiller, etc.)	1.00	300.00
Selling forest and other timber and non-timber products (including coconut lumber, mangrove lumber. nipa shingles etc.)	5.00	742.00
Mining and quarrying activities such as mineral extraction like gold mining, gravel, sand and stone quarrying, etc.	1.00	160.00
Construction like repair of houses, building or and structure	31.00	12,699.36
Remittances from overseas contract workers	1.00	800.00

Table 15 continued

Income Source	% of Men Decision Makers Receiving Income from this Source	Mean Income (PHP)
Other cash receipts, gifts, support, relief, and other income from abroad including pensions, retirement, workmen's compensation, dividends from investment	2.00	9,500.00
Cash receipts, support, assistance, and other income from domestic sources, including assistance from government and private sources (4Ps)	2.00	1,550.00
Pension and retirement, workmen's compensation and social security benefits	2.00	9,900.00
Net winnings from gambling, lotteries, and other games of chance	1.00	500.00
Other sources not classified elsewhere	45.00	1,842.84

4.6 Impacts of Climate-Related Hazards

4.6.1 Flooding and typhoon damages of households

Flooding and typhoon were the common coastal hazards identified by households in all study sites based on results of FGDs and household surveys. The impact of flooding and typhoon in all study sites is predominantly in the form of damage to houses and loss in income from fishing (Table 16). Olingan households reported the highest amounts for both, with damage to houses costing PHP 1, 106.73 on average and income loss from fishing amounting to PHP 486.36 on average. However, as already mentioned in previous discussions, Olingan fishers are the highest paid hired workers across barangays.

Polo households reported distinct damages in the form of losses in aquaculture production, and these are also reflected in the resource mapping. San Antonio households, which are mostly into fishing and farming, also reported loss in agricultural production amounting to PHP 156.36 during the last cropping season. This is in addition to the damages to their houses and loss in income from fishing which they also reported.

4.6.2 Coastal erosion damages of households

Results of the FGDs showed that coastal erosion was visible in the barangays of Polo, Olingan, San Antonio, and Tuburan. In the survey, damages were declared by respondents from Barangays San Antonio and Tuburan in the municipality of Katipunan, as presented in Table 17.

Table 16. Distribution of asset damages and loss in income due to flooding and typhoon by study area

Damage/Loss	Dapitan City		Dipolog City		Katipunan		Whole Sample (n = 156)
	Polo (n = 27)	San Pedro (n = 15)	Galas (n = 12)	Olingan (n = 22)	San Antonio (n = 55)	Tubu-ran (n = 25)	
Damage/Loss to house (mean in PHP)	513.52 (686.20)	3,800.00 (4,708.66)	352.50 (495.97)	1,106.73 (3,213.45)	593.27 (1,347.50)	623.20 (2,002.75)	946.49 (2,380.01)
Loss in agricultural production (mean in PHP)	0.00	0.00	0.00	0.00	156.36 (825.91)	0.00	55.13 (493.22)
Loss in fishing income (mean in PHP)	231.48 (367.99)	16.67 (64.55)	258.33 (458.17)	486.36 (1,398.74)	293.64 (533.69)	56.00 (160.93)	242.63 (242.63)
Loss in aquaculture production (mean in PHP)	18.52 (96.53)	0.00	0.00	0.00	0.00	0.00	3.21 (40.03)
Others (Mean in PHP)	0.00	100.00 (387.30)	0.00	0.00	40.00 (270.53)	12.00 (60.00)	25.64 (201.25)

Note: Standard deviations in parentheses

Table 17. Distribution of damages or loss due to coastal erosion by barangay

Damages/Losses	Katipunan		Whole Sample (n = 4)
	San Antonio (n = 3)	Tuburan (n = 1)	
Damage/Loss to house (mean in PHP)	120.00 (207.85)	0	90.0 (180.0)
Loss in fishing income (mean in PHP)	700.00 (1212.44)	0	525.0 (1,050.0)
Damage to fishnets (mean in PHP)	83.33 (144.34)	0	62.5 (125.0)

Note: Standard deviations in parentheses

4.6.3 Gender-differentiated damages

All six barangays reported that it is the livelihood of husbands that is most affected by flooding and typhoon (Table 18). Foregone income among husbands in Tuburan amounted to an average of PHP 1,638.80 during the recent typhoon and flooding. The whole sample posted an average income loss of PHP 345.51 due to a recent typhoon or flooding.

Among the barangays, the two located in the municipality of Katipunan showed the most evidence of gender-differentiated damages. Although there were no declared damages among wives in Polo, San Pedro, and Olingan, wives in San Antonio and Tuburan reported being affected in terms of damages to their appliances and livestock as well as foregone income. Wives in barangays who did not declare any damages work mostly as house help of their neighbors, a kind of work that is not necessarily exposed to coastal hazards. The case is different for wives in San Antonio, as they live below the poverty threshold and have diverse but irregular livelihoods such as nipa thatch making, peddling the fish catch of their husbands, processing dried fish and selling snacks—activities that are put on hold during flooding and typhoon.[2] Based on the survey, there are 55 wives in similar scenarios. There are a number of possible reasons for this. First, wives in San Antonio have limited livelihood options in their immediate environment and are left to stay at home during typhoon or flooding. Second, flooding in San Antonio are more intense compared to those in other study areas, and thus result in damages to appliances and livestock. Two women even highlighted losing a possible average income of PHP 680 from their pigs due to flooding. Likewise, husbands also declared losing fighting cocks and native chickens amounting to PHP 533.33 during the recent typhoon and flooding.

4.6.4 Health Impacts[3]

Respondents were also asked about waterborne diseases affecting household members after the latest flooding or typhoon event (Table 19). A total of 68 households had different members suffering from typhoid fever, diarrhea, dengue, worms or helminthes infection, and skin diseases, among others. Typhoid fever, for instance, affected 22 household members from the different study areas.

Incidence of waterborne diseases in the study sites was recorded in puroks with high population densities but low income such as Polo, San Antonio, and Tuburan. On the other hand, there were no reports of waterborne diseases in the other study areas (San Pedro, Galas, and Olingan). Typhoid fever and skin diseases were the most common waterborne disease affecting children and middle-aged household members. Diarrhea ranked second, while worm or helminthes infection ranked as only three instances of it were recorded across the study areas. Those of productive age were mostly afflicted with different diseases. There were 19 incidents reported among residents aged 26–45, the age group that is most prone to waterborne diseases across the three study areas. On the other hand, those in the 16–25 age group are the second most prone to the diseases after flooding.

San Antonio posted the most number of waterborne diseases and the most number of household members with the varying diseases as reported by the respondents. Thus, the impact of flooding and typhoon on the health of households is highest in San Antonio.

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[2] Based on field notes by purok and by barangay submitted by enumerators

[3] In a February 2008 medical health study, eight types of parasites were actually detected in 205 participants from Katipunan Municipality (Argente and Estacion 2014).

Table 18. Gender-differentiated damages and loss of income from other sources

Damages/ Losses	Dapitan City		Dipolog City		Katipunan		Whole Sample
	Polo	San Pedro	Galas	Oli-ngan	San Antonio	Tubu-ran	
Wife's income loss from other sources due to work stoppage							
Observations	27	15	12	22	55	25	156
Mean	0	0	0	0	116.18 (429.14)	16 (57.23)	43.53 (259.98)
Damages to wife-owned appliances							
Observations	0	0	0	0	2	0	2
Mean	0	0	0	0	2,055 (2750.65)	0	2,055 (2,750.65)
Damages to wife-owned livestock							
Observations	0	0	0	0	2	0	2
Mean	0	0	0	0	680 (452.55)	0	680 (452.55)
Husband's income loss from other sources due to work stoppage							
Observations	27	15	12	22	55	25	156
Mean	25.19 (69.69)	13.33 (51.64)	123.33 (308.64)	62.27 (175.01)	167.27 (852.68)	1,638.8 (7,167.51)	345.51 (2,923.12)
Damages to husband-owned appliances							
Observations	0	0	0	0	1	0	1
Mean	0	0	0	0	4,000	0	4,000
Damages to husband-owned livestock							
Observations	0	0	0	0	3	0	3
Mean	0	0	0	0	533.33 (408.57)	0	533.33 (408.57)

Note: Standard deviations in parentheses

Table 19. Incidence of waterborne diseases by age bracket and barangay

Barangay/	Incidence by Age Bracket					Total
Waterborne Disease	0–6	7–18	16–25	26–45	46–65	
Polo						
Diarrhea	2	1		2		5
San Antonio						
Typhoid fever	1	3	3	2	2	11
Diarrhea	5	3	3	8	3	22
Dengue	0	1	1	0	1	3
Worm/Helminths infection	0	0	1	1	1	3
Skin Diseases	1	2	1	2	1	7
Tuburan						
Typhoid fever	3	3	1	3	1	11
Diarrhea	2	0	2	1	1	6
Total	**14**	**13**	**12**	**19**	**10**	**68**

4.6.5 Health expenditures

In Polo, five household members were inflicted with diarrhea, and this cost their families an average of PHP 1,250 in expenses (Table 20). There were those who stayed at home or consulted a rural health worker in a health center. In terms of time devoted for care, both the husband and wife allocated equal time and spent almost two days caring for the sick family member.

San Antonio alone had four cases of typhoid fever (Table 21). Respondents spent an average of PHP 152.50 on health center, a healer, or home care. The wife and other members of the family spent more than a day taking care of the afflicted household member while the father usually spent less than a day. Diarrhea affected eight household members and greater amounts of money (PHP 207.50) and time were spent on them compared to those afflicted with typhoid fever. This time, it was the husband and wife who devoted much time to care for the sick family member. Rare cases of dengue, worm/helminthes infection and skin disease also affected three residents in San Antonio.

Much less was spent by household members in Tuburan in treating household members with typhoid fever and diarrhea (Table 22). Household members merely relied on healers while others stayed at home. The wife and husband spent almost a day caring for the sick member of their family. In Barangay Tuburan, afflicted members were brought to the health center where an average of PHP 25 was spent on treatment. Both the husband and wife shared the responsibility of caring for the afflicted household member.

Table 20. Mean expenditure on waterborne diseases and intra-household decisions on caring for sick members in Barangay Polo, Dapitan City

Barangay Polo	Expenditure (PHP)	Hours Spent Caring for Sick Members		
Waterborne Disease	**Mean**	**Husband**	**Wife**	**Other Relatives**
Diarrhea (n = 5)	1,250.00	42.00	42.00	0

Table 21. Mean expenditure on waterborne diseases and intra-household decisions on caring for sick members in Barangay San Antonio, Katipunan

Barangay San Antonio	Expenditure (PHP)	Hours Spent Caring for Sick Members		
		Husband	Wife	Other Relatives
Waterborne Disease	Mean	Mean	Mean	Mean
Typhoid (n = 4)	152.50 (66.02)	15.00 (30.00)	75.00 (77.38)	42.00 (84.00)
Diarrhea (n = 8)	207.50 (2367.26)	57.75 (60.77)	66.25 (50.17)	6.00 (16.97)
Dengue (n = 1)	6,000.00	0.00	48.00	0.00
Worms/Helminths (n = 1)	350.00	0.00	0.00	120.00
Skin disease (n = 2)	2,550.00 (3,464.82)	362.00 (506.29)	2.00 (2.83)	0.00

Note: Standard deviations in parentheses

Table 22. Mean expenditure on waterborne diseases and intra-household decisions on caring for sick members in Barangay Tuburan, Katipunan

Barangay Tuburan	Expenditure (PHP)	Hours Spent Caring for Sick Members		
		Husband	Wife	Other Relatives
Waterborne Disease	Mean	Mean	Mean	Mean
Typhoid (n = 4)	47.25 (40.04)	10.50 (21.00)	25.50 (23.17)	2.50 (5.00)
Diarrhea (n = 2)	25.00 (35.36)	1.00 (1.41)	1.00 (1.14)	6.00 (5.66)

Note: Standard deviations in parentheses

Table 23 consolidates all the aforementioned data and shows that diarrhea is the most common waterborne disease across study areas. Household members spent an average of PHP 6,000 on diarrhea treatment. Treating skin diseases of household members after flooding or typhoon is also costly, amounting to an average of PHP 2,550. Among the members of the household, the wife spent the most time caring for the sick household member.

Table 23. Mean expenditure on waterborne diseases and intra-household decisions on caring for sick members, whole sample

Whole Sample Waterborne Disease	Expenditure (PHP)	Hours Spent Caring for Sick Members		
		Husband	Wife	Other Relatives
Typhoid (n = 8)	99.88 (75.63)	12.75 (24.09)	50.25 (59.13)	22.25 (59.00)
Diarrhea (n = 12)	1,550.83 (2,063.96)	45.67 (53.12)	51.33 (47.33)	5.00 (13.84)
Dengue (n = 1)	6,000.00	0.00	48.00	0.00
Worms/Helminths (n = 1)	350.00	0.00	0.00	120.00
Skin Diseases (n = 2)	2,550.00 (3,464.82)	362.00 (506.29)	2.00 (2.83)	0.00

Note: Standard deviations in parentheses

4.6.6 Gender-differentiated impacts on leisure time

The impact of extreme weather events on the amount of leisure time and time spent on unpaid household work of male decision makers is significant, particularly when compared to the time they spend on these activities on normal days. As may be seen in Table 24, male decision makers participate in cleaning the house and surroundings, washing clothes, cooking, fetching water, caring for the children, and attending to personal hygiene. After extreme weather events, there is a decrease in the number of hours for feeding pets or other house animals, watching television, or listening to the radio and sleeping.

Table 1. Impact on leisure time in a day of male decision maker

Activities	Male Decision Maker (Hours) (n = 300)		
	Normal Days	After Extreme Weather Event	
	Mean	Mean	t-value
Cleaning the house	0.38 (0.39)	1.05 (1.02)	12.88*
Cleaning the House's surroundings	0.44 (0.51)	1.32 (1.81)	8.71*
Washing clothes	0.69 (0.90)	0.94 (1.29)	4.80*
Cooking	0.43 (0.45)	0.53 (0.56)	5.67*
Fetching water	0.12 (0.18)	0.18 (0.28)	4.77*
Taking care of the children	1.11 (1.27)	1.41 (2.1)	3.62*
Feeding pets/house animals	0.12 (0.40)	0.12 (0.4)	0.60
Watching TV/Listening to the radio	1.28 (1.24)	1.14 (1.29)	–2.89*
Personal hygiene	0.26 (0.13)	0.29 (0.18)	3.86*
Sleeping	7.37 (1.36)	5.62 (2.20)	–14.98*

Note: Figures with asterisk (*) are significant at degrees of freedom = 298, critical value = 1.96, level of significance = 0.05

Table 25 reflects a similar pattern among female decision makers. That is, the time spent on everyday household activities becomes even greater for both men and women decision makers after hazardous events. To the disadvantage of women, however, the increase in the number of hours they spend on household chores like washing clothes is greater than their male counterparts. On average, time spent on this activity increases by an hour. On the other hand, time devoted to cleaning the house increased by about two hours on average after an extreme weather event, and the time spent on cooking and caring for children increase also. This is time that could have been spent earning for the family, usually by offering laundry services to the neighbors. Apart from nipa thatch making, this is a common source of income for women in the area. The income women get from these activities decreases as the frequency of hazards increases.

Given the increased frequency of hazards, a day would not be enough to do house chores. In fact, the sacks of laundry seen while interviews were being conducted served as evidence that more time in the next days would have to be allotted to doing household chores.

Table 25. Impact on leisure time in a day of female decision maker

Activities	Female Decision Maker (Hours) (n = 300)		
	Normal Days	After Extreme Weather Event	
	Mean	Mean	t-value
Cleaning the house	0.81 (0.59)	1.45 (1.09)	12.71*
Cleaning the house's surroundings	0.77 (0.6)	1.60 (1.45)	12.03*
Washing clothes	2.07 (1.10)	2.62 (1.42)	9.35*
Cooking	0.62 (0.42)	0.73 (0.53)	5.24*
Fetching water	0.94 (0.13)	0.17 (0.66)	2.13*
Taking care of the children	2.32 (2.63)	2.66 (3.23)	3.16*
Feeding pets/house animals	0.07 (0.30)	0.07 (0.24)	–0.29
Watching TV/Listening to the radio	1.43 (1.45)	1.24 (1.43)	–3.95*
Personal hygiene	0.36 (0.20)	0.39 (0.28)	2.73*
Sleeping	7.81 (1.35)	6.08 (2.26)	–15.36*

Note: Figures with asterisk (*) are significant at degrees of freedom = 298, critical value = 1.96, level of significance = 0.05

4.7 Household Adaptation Choices

4.7.1 Frequency of male and female decision makers who respond to coastal hazards by barangay

Table 26 compares the distribution of male and female decision makers from the same households in terms of how they respond or adapt to flooding and typhoon. Men in Polo, San Pedro, Galas, San Antonio, and Tuburan respond more proactively than women, while the distribution of men and women when it comes to making reactive responses was more equal.

Table 26. Comparative distribution of male and female decision makers who respond to flooding/typhoon by barangay

Study Site	Proactive		Reactive	
	Men	Women	Men	Women
Polo (n = 53)	21	19	39	39
San Pedro (n = 32)	1	0	2	2
Galas (n = 49)	22	19	32	32
Olingan (n = 42)	18	19	26	27
San Antonio (n = 79)	54	39	72	72
Tuburan (n = 45)	26	23	30	29

Table 27 shows the number of male and female decision makers who respond to storm surge. Women in Polo and Olingan responded more than the men do, while men in Galas and San Antonio were more active in responding to storm surge than their female counterparts.

Coastal erosion was a concern to which six women in Polo responded; in contrast, it was the men in San Antonio and Tuburan who reported responding to the same concern (Table 28). However, when asked on the specific costs regarding their adaptation responses, they reported needing no amount of money in order to carry them out.

The six women from Polo and one male decision maker in San Antonio also reported responding to saltwater intrusion (Table 29), but as is the case in their response to coastal erosion, they did not assign any amount to the simple actions they made.

Table 27. Comparative distribution of male and female decision makers who respond to storm surge by barangay

Study Site	Men	Women
Polo (n = 53)	4	6
San Pedro (n = 32)	0	0
Galas (n = 49)	2	1
Olingan (n = 42)	2	3
San Antonio (n = 79)	7	6
Tuburan (n = 45)	0	0

Table 28. Comparative distribution of male and female decision makers who respond to coastal erosion by barangay

Study Area	Men	Women
Polo (n = 53)	0	6
San Pedro (n = 32)	0	0
Galas (n = 49)	0	0
Olingan (n = 42)	0	0
San Antonio (n = 79)	2	1
Tuburan (n = 45)	1	0

Table 29. Comparative distribution of male and female decision makers who respond to saltwater intrusion by barangay

Study Area	Men	Women
Polo (n = 53)	0	6
San Pedro (n = 32)	0	0
Galas (n = 49)	0	0
Olingan (n = 42)	0	0
San Antonio (n = 79)	1	0
Tuburan (n = 45)	0	0

4.8 Proactive Household Coping Mechanisms and Adaptation Responses to Flooding and Typhoon

4.8.1 Defensive adaptation responses to flooding and typhoon of female respondents

From the perspective of female decision makers in Polo, Galas, Olingan, San Antonio, and Tuburan, both husband and wife equally decided to undertake improvements to make their house more resilient (Table 30). While households in Polo, Galas, and Tuburan took only an average of an hour to undertake house improvements in response to typhoon and flooding, Olingan and San Antonio households required three hours. San Pedro households, on the other hand, did not practice any of these defensive adaptation responses.

Female decision makers responded that making improvements to the house after being stricken by typhoon and flooding is predominantly a wife's decision, if not hers entirely. Other adaptations include preparing food and flashlights, digging canals, and reinforcing ponds, fish cage or animal pens. Reinforcing ponds or fish cages or animal pens is the most expensive defensive adaptation activity across study areas with expenses amounting to PHP 1,000, and deciding on it is predominantly done by the husband.

4.8.2 Defensive adaptation responses to flooding and typhoon of male respondents

Table 31 shows that majority of the male decision makers tally with the responses of female decision makers on decision making between husband and wife on defensive adaptations to undertake. However, there are specific activities that were left for males to decide on like in the case of Polo, where male decision makers believed that the decision to improve their houses was more of their decision than one shared with their wives. Likewise, male decision makers also believed that reinforcing ponds, fish cages, or animal pens during the recent typhoon and flooding was largely their decision, which ties in with what came out in the survey of female decision makers.

4.8.3 Accommodating adaptation responses to flooding and typhoon of female respondents

Accommodating adaptation responses such as moving fishing equipment, livestock, and appliances to safer places and harvesting crops early remained mostly a shared decision between husband and wife for households in Galas, Olingan, San Antonio and Tuburan (Table 32). There were, however, activities like moving fishing or farming equipment to a safe place, which were pursued solely by female decision makers in Polo. In Olingan, the same activity was a decision that rests more on the husband. Survey results also showed that there were female decision makers who solely decided on moving livestock to prepare for flooding and typhoons. In San Antonio, the decision to harvest crops early was made solely by the husband in one case and solely by the wife in another, implying that the call is made by the one who owns the land. The most expensive accommodation activity involved moving fishing or farming equipment which amounted to PHP 3,000 in Olingan and PHP 5,000 in San Antonio.

Table 30. Defensive adaptation responses to flooding/typhoon of female respondents

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who Decided to Pursue the Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Undertook Improvements to make house more resilient to flooding and typhoon	3	1.17	0.00			3		
Barangay Galas								
Undertook improvements to make house more resilient to flooding and typhoon	1	1.00	0.00			1		
Others (prepared food & flashlights)	1	1.00	0.00			1		
Barangay Olingan								
Undertook improvements to make house more resilient to flooding and typhoon	1	3.00	0.00			1		
Others (prepared food & flashlights)	1	0.50	100.00			1		
Barangay San Antonio				1	2	3	4	5
Undertook improvements to make house more resilient to flooding and typhoon	4	2.75	108.33	1			1	2
Dug canals	2	2.00	0.00			2		
Others ("copra dryer")	1	4.00	300.00			1		
Barangay Tuburan								
Undertook improvements to make house more resilient to flooding and typhoon	3	1.00	0.00	1		2		
Dug canals	3	1.67	75.00	1		2		
Reinforced ponds/fish cages/animal pens	1	2.00	1,000.00		1			
Others (prepared food & flashlights)	1	0.33	250.00					1

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 31. Defensive adaptation responses to flooding/typhoon of male respondents

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who Decided to Pursue the Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Undertook improvements to make house more resilient to flooding and typhoon	7	0.93	0.0	4		2		1
Barangay Galas								
Undertook improvements to make house more resilient to flooding and typhoon	1	1.00	0.0			1		
Others (Prepared food)	1	0.50	100.0			1		
Barangay Olingan				1	2	3	4	5
Undertook improvements to make house more resilient to flooding and typhoon	2	2.00	0.0			2		
Others (Tied parts of house)	1	1.00	280.0	1				
Barangay San Antonio								
Undertook improvements to make house more resilient to flooding and typhoon	5	50.70	3,802.5	3		2		
Dug canals	1	1.00	0.0	1				
Barangay Tuburan								
Undertook improvements to make house more resilient to flooding and typhoon	4	1.50	80.0	2		2		
Dug canals	3	1.67	75.0	1		2		
Reinforced ponds/fish cages/ animal pens	1	2.00	1,000.0		1			

Table 32. Accommodating adaptations (female respondents)

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who Decided to Pursue the Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Moved fishing or farming equipment to safe place	1	0.50	0.00					1
Moved livestock/animals to a safer place	3	0.83	0.00			2		1
Others (Settled household facilities, prepared foods, clothes, and lighting equipment)	12	0.85	30.50	1		10		1
Barangay Galas								
Moved household appliance to a safer place	6	0.54	0.00	1		5		
Moved livestock/animals to a safer place	5	0.57	0.00			4		1
Others (Settled household facilities, prepared foods, clothes, and lighting equipment)	13	0.62	146.25			10		3
Barangay Olingan								
Moved fishing or farming equipment to safe place	1	1.00	3,000.00		1			
Moved household appliance to a safer place	7	0.30	0.00	1		5		1
Moved livestock/animals to a safer place	8	1.04				7		1
Others (Settled household facilities, Prepared/bought food, clothes, lighting equipment, and fetched water)	9	11.61	92.50			8		1
Barangay San Antonio								
Harvested crops or fish early	2	3.00	113.00	1				1
Applied flood-resilient farming methods	0							
Moved fishing or farming equipment to safe place	6	1.42	5,000.00	1	1	3		1
Moved household appliance to a safer place	9	1.67	0.00	1	1	4		3
Moved livestock/animals to a safer place	9	1.00	0.00	2		5		2
Others (Pack up things)	1	2.00				1		
Barangay Tuburan								
Moved household appliance to a safer place	5	0.20	0.00	1		1		3
Moved livestock/animals to a safer place	15	0.97	0.00	1		12		2
Others (Packed up things & gathered firewood)	2	1.00	0.00					2

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

4.8.4 Accommodating adaptation responses to flooding and typhoon of male respondents

Although the husband and wife were said to again share decision making on accommodating adaptations, male decision makers reported that there were households where husbands dominate the decision making process. Table 33 shows that most households across study sites shared decision making equally between the husband and wife when it comes to preparing packed food, clothing, and lighting materials.

4.9 Reactive Adaptations

4.9.1 Defensive adaptation responses to flooding and typhoon of female respondents

Survey responses of female decision makers (Table 34) show most households spent more during or immediately after the latest flooding or typhoon than during preparations. Five respondents from San Antonio also spent more time (25.9 hours) reinforcing their houses after the typhoon that before it. However, household have fewer activities in the aftermath of flooding and typhoon than during preparations. Contrary to deciding on house improvements as part of preparing for extreme weather events in Polo, making improvements to the house in the aftermath was now the sole decision of the husband. The decision to reinforce animal pens was also solely decided on by husbands in Tuburan.

4.9.2 Defensive adaptation responses to flooding and typhoon of male respondents

Table 35 summarizes the survey responses of male decision makers when it comes to undertaking defensive adaptations. Female decision makers equally shared decision making with their male counterparts most of the time but also reported making sole decisions to pursue independent reactive adaptations in rare instances.

4.9.3 Accommodating adaptation responses to flooding and typhoon of female respondents

The number of households who conducted accommodating adaptation responses as reactive household coping mechanisms increased when respondents were asked about their adaptation activities during or after the latest flooding or typhoon. Table 36 indicates the frequency of households who reported that they had conducted accommodating responses as reactive adaptations. All of the households cleaned their houses and surroundings, with those in Polo, Galas, Olingan, and Tuburan devoting almost two hours. San Antonio households spent more time on cleaning their homes and surroundings (3.45 hours) after the latest flooding or typhoon. The decision to pursue this adaptation strategy was shared by the husband and wife in Polo, Galas, Olingan, San Antonio, and Tuburan. One female decision maker in San Antonio, however, revealed that her husband had made the decision to borrow PHP 1,000 from a non-formal lender.

Table 33. Accommodating adaptations (male respondents)

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who Decided to Pursue The Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Moved fishing or farming equipment to safe place	1	0.50	0.00					1
Moved household appliance to a safer place	2	0.17	0.00	1				
Moved livestock/animals to a safer place	7	0.59	0.00	4		2		1
Others (settled household facilities, prepared foods, clothes, and lighting equipment)	12	0.85	29.55	1		10		1
Barangay San Pedro								
Moved household appliance to a safer place	1	2.00	12,000.00			1		
Barangay Galas								
Moved fishing or farming equipment to safe place	2	0.75	0.00	2				
Moved household appliance to a safer place	6	0.49	0.00			5		1
Moved livestock/animals to a safer place	9	0.51	0.00	6		3		
Others (settled household facilities, prepared foods, clothes, and lighting equipment)	11	0.66	161.67	1		10		
Barangay Olingan								
Moved fishing or farming equipment to safe place	4	0.75	0.00	4				
Moved household appliance to a safer place	6	0.30	0.00	1		5		
Moved livestock/animals to a safer place	10	0.44		5		4		1
Others (settled household facilities, Prepared/bought food, clothes, lighting equipment, and fetched water)	7	0.45	87.33			7		
Barangay San Antonio								
Harvested crops or fish early	1	168.00	2,000.00	1				
Moved fishing or farming equipment to safe place	30	1.13		24		6		
Moved household appliance to a safer place	8	1.00	0.00	3		4		1
Moved livestock/animals to a safer place	22	1.29	0.00	17		4		
Others	0							
Barangay Tuburan								
Applied flood-resilient farming methods	1	1.00	0.00			1		

Table 33 continued

Activities	Yes	Hours it took to undertake activity	Material Expenses	Who decided to pursue the adaptation strategy*				
Barangay Tuburan				**1**	**2**	**3**	**4**	**5**
Moved fishing or farming equipment to safe place	6	0.72	3,000.00	4	1			1
Moved household appliance to a safer place	3	0.28	0.00	1		1		1
Moved livestock/animals to a safer place	18	1.11	0.00	7		9		2
others (packed up things)	1	1.00	0.00					1

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 34. Defensive adaptation responses to flooding and typhoon of female respondents

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who Decided to Pursue the Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Undertook improvements to make house more resilient to flooding and typhoon	1	2.00	100	1				
Barangay Galas								
Undertook improvements to make house more resilient to flooding and typhoon	1	1.00	0			1		
Barangay Olingan								
Others (Repaired walls)	1	1.00	100			1		
Barangay San Antonio								
Undertook improvements to make house more resilient to flooding and typhoon	5	25.90	1,532	2		2		1
Dug canals	1	2.00	0	1				
Barangay Tuburan				1	2	3	4	5
Undertook improvements to make house more resilient to flooding and typhoon	3	1.00	0	1		2		
Dug canals	3	1.67	75	1		2		
Reinforced ponds/fish cages/animal pens	1	2.00	1,000		1			
Others (food, flashlight)	1	0.33	250					1

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 35. Defensive adaptation responses to flooding and typhoon of male respondents

Activities	Yes	Hours it took to undertake activity	Material Expenses (PHP)	Who Decided to Pursue the Adaptation Strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Undertook improvements to make house more resilient to flooding and typhoon	12	9.50	156.88	8	1	2		1
Barangay San Pedro								
Barangay Galas								
Undertook improvements to make house more resilient to flooding and typhoon	2	1.75	150.00	1		1		
Barangay Olingan								
Dug canals	1	1.00	0.00	1				
Others	1	1.00	100.00			3		
Barangay San Antonio								
Undertook improvements to make house more resilient to flooding and typhoon	5	6.40	650.00	3		2		
Dug canals	1	3.00	0.00				1	
Reinforced ponds/fish cages/ animal pens	1	2.00	0.00			1		
Others ("30m rope")	1	0.50	750.00	1				
Barangay Tuburan								
Undertook improvements to make house more resilient to flooding and typhoon	2	3.00	2,570.00	2				
Dug canals	2	1.50	225.00	1		1		
Reinforced ponds/fish cages/animal pens	2	0.54	2,000.00	1		1		
Others	0							

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 36. Accommodating adaptation responses to flooding and typhoon of female respondents

Activities	Yes	Hours it Took to Undertake Activity	Material Expenses (PHP)	Who decided to pursue the adaptation strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Cleaned the house and surroundings	39	1.69		1		36		2
Barangay San Pedro								
Cleaned the house and surroundings	2	1.50		2				
Barangay Galas								
Cleaned the house and surroundings	32	1.52	0.00			32		
Replaced livestock	3	0.83				2		1
Barangay Olingan								
Cleaned the house and surroundings	26	1.57	0.00	1	1	22		2
Replaced livestock	1	1.50	0.00			1		
Barangay San Antonio				1	2	3	4	5
Replanted farm	2	1.50	0.00					2
Cleaned the house and surroundings	70	3.45	18.25	1		54	2	13
Replaced livestock	3	1.33	0.00	1		2		
Joined savings-credit group/cooperative	1	1.00	1,000.00		1			
Others (Replanted ornamental plants)	1	2.00	0.00					1
Tuburan								
Cleaned the house and surroundings	27	1.72	70.00	1		21		5
Replaced livestock	1	1.00	0.00			1		

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

4.9.4 Accommodating adaptation responses to flooding and typhoon of male respondents

Table 37 shows a longer list of accommodating adaptations for male responses, such as making repairs in the house. More husbands also reported replacing their livestock after a typhoon or flooding. Repair costs amounted to an average of PHP 250 in Galas, whereas the cost was at PHP 475 in Olingan. Decisions to pursue accommodating adaptations were also shared by the husband and wife, although some male respondents reported that they had arrived at a decision on their own. In San Antonio, more husbands also solely decided to spend an average of PHP 600 to replace their livestock.

4.9.5 Choice of adaptation by main household decision maker and WEI

Table 38 shows that based on male and female decision makers in Polo, Galas, Olingan, San Antonio, and Tuburan, husbands solely decide on the household's adaptation responses before, during, or after the latest typhoon and flooding, as indicated by a mean value of one. On the other hand, a WEI value of 3 for Polo, Galas, Olingan, San Antonio, and Tuburan indicates that joint decisions were made within the households regarding adaptation responses to employ before, during, or after the latest typhoon and flooding.

4.9.6 Adaptation participation rate within each age and gender cohort by barangay

Table 39 shows the adaptation participation rates for each age and gender cohort by barangay before, during, and after typhoon and flooding, storm surge, and coastal erosion. Results showed that those aged 25–65 posted the highest participation rates for Polo, San Pedro, and Tuburan.

4.9.7 Demographic adaptation within the households

Table 40 shows adaptation participation rates for each age and gender cohort within households before, during, and after typhoon and flooding, storm surge, and coastal erosion. The 25–65 age group had the highest adaptation participation rate within households, which tallies with the adaptation participation rates for each age and gender cohort by barangay.

In one of the interviews, the elderly male household head reported deciding for the 11 members in his household living in a small makeshift shack beside a swampy area of nipa along a creek in Barangay San Antonio's Purok 7. The extended family comprises married daughters, grandchildren, and a distant relative with mental disability who gathers palwa, a coconut stem, every day.

Table 37. Accommodating adaptation responses to flooding and typhoon of male respondents

Activities	Yes	Hours it took to undertake activity	Material Expenses	Who decided to pursue the adaptation strategy*				
Barangay Polo				**1**	**2**	**3**	**4**	**5**
Replanted farm	1	1.00	0.00					1
Cleaned the house and surroundings	38	1.43	0.00	1		36		1
Barangay San Pedro								
Replanted farm	2	1.50	0.00	2				
Barangay Galas								
Cleaned the house and surroundings	32	1.37	0.00			32		
Replaced livestock	3	0.92	0.00	2		1		
Others (repaired damages to house)	1	1.50	250.00	1				
Barangay Olingan								
Cleaned the house and surroundings	26	1.58	0.00	3	1	19		3
Replaced livestock	1	1.00	0.00			1		
Others (repaired damages to house)	4	2.50	475.00	2		1		1
Barangay San Antonio								
Cleaned the house and surroundings	70	3.32	58.75	8		52	1	9
Replaced livestock	7	4.71	660.00	6				1
Others (moved fishing equipment)	1	2.00	0.00	1				
Tuburan								
Replanted farm	1	2.00	0.00					1
Cleaned the house and surroundings	28	1.72	70.00	4	22			2
Replaced livestock	1	2.00	0.00			1		
Others (repaired damages to house)	2	2.00	650.00	2				

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 38. Adaptation choices of main household decision makers and women empowerment by barangay

Hazard	Male Decision Maker*	Female Decision Maker*	WEI (Male's Perspective)	WEI (Female's Perspective)
Barangay Polo (n = 53)	Mean			
Typhoon/Flooding	1	1	3	3
Storm surge	0	1	3	3
Barangay San Pedro (n = 32)				
Typhoon/Flooding	0	0	2	1
Barangay Galas (n = 49)				
Typhoon/Flooding	1	1	3	3
Storm surge	0	0	–	–
Barangay Olingan (n = 42)				
Typhoon/Flooding	1	1	3	3
Storm surge	0	0	3	3
Barangay San Antonio (n = 79)	Mean			
Typhoon/Flooding	1	1	3	3
Storm surge	0	0	3	3
Coastal erosion	0	0	–	–
Saltwater intrusion	0	0	–	–
Barangay Tuburan (n = 45)				
Typhoon/Flooding	1	1	3	3
Coastal erosion	0	0	–	–

Note: *Decision maker: 1 = husband only, 2 = husband dominates, 3 = husband and wife equally, 4 = wife dominates, and 5 = wife only

Table 39. Adaptation participation rate by age and gender cohort by barangay

Gender & Age Group	Polo (n = 53)		San Pedro (n = 32)	Galas (n = 49)		Olingan (n = 42)		San Antonio (n = 79)				Tuburan (n = 45)			Whole Sample (N = 300)			
	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Saltwater Intrusion	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Saltwater Intrusion
Male																		
7–18 years old																		
Obs	19	19	19	25	25	21	21	35	35	35	35	21	21	21	140	140	140	140
Mean	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
SD	0	0	0	0	0	11	0	0	0	0	0	0	0	0	4	0	0	0
19–24 years old																		
Obs	14	14	6	9	9	7	7	24	24	24	24	11	11	11	71	71	71	71
Mean	29	0	0	0	0	14	0	15	0	0	0	27	0	0	16	0	0	0
SD	43	0	0	0	0	38	0	35	0	0	0	47	0	0	36	0	0	0
25–65 years old																		
Obs	45	45	30	47	47	38	38	73	73	73	73	41	41	41	274	274	274	274
Mean	72	12	3	72	4	63	8	83	8	4	1	65	0	1	65	6	1	0
SD	45	32	18	41	20	47	27	33	28	20	12	46	0	8	45	24	11	6
> 65 years old																		
Obs	4	4	3	4	4	4	4	8	8	8	8	2	2	2	25	25	25	25
Mean	25	25	33	100	0	75	0	50	13	0	0	50	0	0	56	8	0	0
SD	50	50	58	0	0	50	0	53	35	0	0	71	0	0	51	28	0	0
Female																		
7–18 years old																		
Obs	23	23	14	21	21	18	18	38	38	38	38	26	26	26	140	140	140	140
Mean	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
SD	21	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
19–24 years old																		
Obs	5	5	5	9	9	7	7	20	20	20	20	8	8	8	54	54	54	54
Mean	40	0	0	22	0	43	0	15	0	0	0	38	0	0	24	0	0	0
SD	55	0	0	44	0	53	0	37	0	0	0	52	0	0	43	0	0	0
25–65 years old																		
Obs	48	48	30	42	42	36	36	70	70	70	70	41	41	41	267	267	267	267
Mean	72	13	3	81	5	72	8	82	7	4	0	67	0	2	67	6	1	0
SD	45	33	18	37	22	45	28	32	25	18	0	46	0	16	45	23	11	0
> 65 years old																		
Obs	3	3	2	4	4	5	5	7	7	7	7	4	4	4	25	25	25	25
Mean	3	3	50	50	0	40	0	71	14	0	14	50	0	0	52	8	0	4
SD	58	58	71	58	0	55	0	49	38	0	38	58	0	0	51	28	0	20

Table 40. Demographic distribution of adaptation within the households

Gender & Age Group	Polo (n = 53)		San Pedro (n = 32)	Galas (n = 49)		Olingan (n = 42)		San Antonio (n = 79)				Tuburan (n = 45)			Whole Sample (N = 300)			
	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Storm Surge	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Saltwater Intrusion	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Typhoon/ Flooding	Storm Surge	Coastal Erosion	Saltwater Intrusion
Male																		
7–18 years old																		
Mean	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SD	0	0	0	5	0	5	0	0	0	0	0	0	0	0	2	0	0	0
19–24 years old																		
Mean	2	0	0	0	0	1	0	1	0	0	0	2	0	0	1	0	0	0
SD	6	0	0	0	0	4	0	35	0	0	0	8	0	0	5	0	0	0
25–65 years old																		
Mean	14	4	1	17	1	14	2	17	1	1	1	14	0	0	14	2	0	0
SD	14	11	4	13	7	14	9	11	5	5	6	13	0	3	13	7	3	3
> 65 years old																		
Mean																		
SD																		
Female																		
7–18 years old																		
Mean	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SD	5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
19–24 years old																		
Mean	15	0	0	0	0	15	0	16	0	0	0	14	0	0	1	0	0	0
SD	14	0	0	5	0	14	0	10	0	0	0	13	0	0	5	0	0	0
25–65 years old																		
Mean	15	4	1	17	1	15	2	16	1	1	0	14	0	0	14	2	0	0
SD	14	11	4	13	7	14	9	10	5	5	0	13	0	3	13	7	3	0
> 65 years old																		
Mean	1	1	1	1	0	1	0	2	0	0	1	1	0	0	1	0	0	0
SD	7	7	18	5	0	6	0	8	2	0	6	4	0	0	6	3	0	3

5.0 CONCLUSIONS AND POLICY IMPLICATIONS

The study first involved the conduct of FGDs with association representatives in each identified hazard-prone coastal barangay. The participants identified hazards that usually occur alongside typhoons. Male participants described the intensity of hazards based on the damage that such hazards brought to the community, while female participants remembered how it damaged their homes.

As part of the study, a household survey was also conducted. Results provided details on how hazards affected decision making within the household, household members, their assets, and income.

Men in most areas played the most important role in making choices related to adaptations, especially where hazards are more intense and frequent like in San Antonio. Diverse sources of income were also more available to men than to women in the study areas, but it was also men who incurred more damages to their livestock and higher income loss.

Although female decision makers add to the income of the household, a large slice of their contribution is from the cash grant they receive from the government as 4Ps beneficiaries. Taking care of the sick household member was shown to be more of the wife's responsibility. In addition, it is important for women to lead or participate in groups organized by the LGU to promote measures to prevent hazards to human health and avoid exposure of inhabitants to contaminated water.

Women in the barangay show greater participation in adaptation activities within the household and even in the community. These should be recognized through plans and programs of the BDRRM that will be initiated by the women themselves and could pave the way for women empowerment.

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