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Climate Change Vulnerability and Adaptive Capacity of the Guagua Community in Pampanga

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Abstract - The study specifically endeavored to identify the pattern of climate variability that affected the study site and assess its social and economic impacts, determine the adaptation strategies employed by the municipal local government unit (LGU) and its constituents, improve their awareness on the climate change phenomenon and on the urgency to take action and plan accordingly, and, propose measures to enhance the adaptive capacity of the affected sectors and stakeholders. Necessary data were collected through community consultations, key informant interviews and focus group discussion. Continuous rain is the most harmful or destructive climate change related event in Guagua as its adverse impact on all identified most vulnerable groups or sectors (agriculture, fishery, business, students, transport service, households and LGU) is considerably large. Agriculture, on the other hand, is most vulnerable sector followed by the group

of students, LGU, HH, transport service and fishery sector. The municipal LGU is implementing innovative adaptation strategies at the local level, such as the establishment, effective recording, and appropriate use of the rain gauge information to reduce adverse impacts of typhoons/heavy rains. Human resource capacity is very important for promoting effective adaptation. The enhancement of adaptive capacity is a necessary condition for reducing vulnerability.

Keywords - Climate change, vulnerability, adaptive capacity, Pampanga

INTRODUCTION

Guagua is beset with seasonal flooding discharge. This problem is largely due to the relatively low elevation of the municipality and an offshoot of the effect of lahar flow which made Pampanga's major water channels heavily silted. A high tide of above 1 meter triggers flooding in the study site.

During the height of the wet seasons, rainwater from the more elevated portions of the town drains towards the low lying regions, by way of the secondary waterways and interior tributaries. Based on the Guagua flood hazard map (2002), about half of the municipality is affected by flooding.

In the Philippines, local government units (LGUs) are in the forefront of disaster management including responding to the impacts of climate change. However, many LGUs are not aware of the climate change phenomenon. They, therefore, do not have the capacity to assist the affected communities in preparing climate change adaptation measures. It is this light that this vulnerability assessment had been conducted.

OBJECTIVES OF THE STUDY

This study specifically aimed to:

- identify the pattern of climate variability that affected the study site and assess its social and economic impacts;
- determine the adaptation strategies to the observed climate change related events employed by the municipal LGU and its constituents;
- improve awareness by municipal LGU officials and community residents on the climate change phenomenon and on the urgency to take action and plan accordingly; and,
- propose measures to enhance the adaptive capacity of the affected sectors and stakeholders.

FRAMEWORK

Vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change. Vulnerability is a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards. Under this framework, a highly vulnerable system would be a system that is very sensitive to modest changes in climate, where the sensitivity includes the potential for substantial harmful effects, and for which the ability to adapt is severely constrained. Resilience is the flip side of vulnerability-a resilient system or population is not sensitive to climate variability and change and has the capacity to adapt.

METHODOLOGY

The study gathered data on climate variability and extremes observed in the last decades in the municipality as well as their social, economic and ecological impacts. They were collected through

community consultations, key informant interviews (KIIs) and focus group discussion (FGD) with residents and LGU officials of Guagua. Village Bancal was chosen as the particular study area in the town of Guagua, Pampanga.

Specifically, the data needed by the study included historical events of climate variability and extremes as well as their impacts, socio-economic groups affected by the identified climate change related events, adaptation strategies of the affected socio-economic groups, government programs related to environmental protection/ conservation or climate change and amount of rainfall in the locality. The necessary data were analyzed using descriptive method of analysis.

For ease of recall and discussion on climate change related events experienced in the municipality, village leaders and residents who are mostly elder farmers and fishermen of Bancal were asked to focus on weather-related phenomena and/or events that took place by decades (1960-70, 1970-80, 1980-90, 1990-2000 and 2000-2008).

The participants in the FGD were asked to determine the magnitude of the impact of their identified climate variability and extremes on groups or sectors in the study area by using different sizes (small, medium and large) of a paper cut into a circle shape with the large-sized circle having the largest negative impact and the small circle having the least negative impact.

RESULTS AND DISCUSSION

Extreme Climatic Events Recalled by Community Residents

For the 1960-1970 period, Typhoon Gading was clearly remembered due to the massive destruction it brought to the town in 1966 (Table 1). It brought very strong wind which caused the falling or destruction of houses.

In 1972, the residents experienced continuous intense rain for 90 days which was referred to as the "Great Flood of Luzon." The roads were flooded to a level of human height which was the first time to be experienced in the municipality. There was no reported specific typhoon during that heavy flooding. That was much destructive compared to the usual nine (9)-day rain (referred to as siyam-siyam in the local dialect) which caused an ordinary flooding.

The flood in 1985, according to the FGD respondents, was caused both by a typhoon and the release of water from Angat Dam. The situation was aggravated by high tide during that time. From 1991, the monitoring of typhoons is regularly done by the LGU as to disaster situation, amount of rainfall, road closure, infrastructures damage, class suspension, flood level per village, evacuation of residents, disease outbreak and damage to crops or agriculture.

A severe drought was experienced in 1995 when an El Nino hit the municipality. According to the LGU officials, this was the time when the Small Water Impounding Project (SWIP) concept started and many SWIPs were installed on the farms. However, SWIPs were not quite successful in Guagua due to the porosity of its soil that is not suitable for impounding water.

Table 1. Major climate events identified by the participants in the FGD

Year	**Climate Variability and Extremes**
1966	Typhoon Gading
1972	"Great Flood of Luzon" (90 days continuous intense rain)
1985	Flood caused by typhoon, release of water from Angat Dam and high tide.
1995	El Nino
1997	Severe flood up to the 1st floor of Municipal Hall Building caused by a typhoon.
2002	For July alone, six typhoons (Florita, Gloria, Hambalos, Inday, Juan and Kaka) brought the most intense rainfall and flood.
2004	Typhoon Marce
2006	Typhoon Glenda
2008	Typhoon Julian

Before the 80's, less typhoons are heard. After the 80's, however, there is always a typhoon almost every week during the wet season and the alphabets are not enough for the names of typhoons. The FGD participants estimated that prior to 1986, an average of 15 typhoons per year visited their community. After 1986, however, not less than

24 typhoons are being experienced by the people in the study area. In 1997, the municipality had a severe flood due to typhoon which reached up to the first (1st) floor of the municipal hall which was then elevated by 1.10 meters from the road.

For the month of July alone in 2002, there were already six (6) typhoons (Florita, Gloria, Hambalos, Inday, Juan and Kaka) which brought the worst or most intense rainfall and flood that reached the ground floor of the Guagua Municipal Building by 11 inches deep. The building's ground floor is elevated by 1.10 meter from the road. Typhoon Marce, on the other hand, caused severe flooding in August 26-27, 2004 in the town. The strongest typhoon that hit Guagua on July 24-26, 2006 was Glenda. Typhoon Julian was so far the most destructive in 2008. It caused flooding in the Central Business District to as high as 1.50 feet which affected 8,313 people from 1,600 families in seven (7) villages, including Bancal.

Indications of Climate Change in the Study Area

Based on the results of the FGD, KIIs and Municipal Disaster Coordinating Council (MDCC) reports, the climatic events related to climate change that have been observed in the study community in the last three decades were typhoon, delay on the onset of rainy season, drought and continuous or prolonged rain.

It has been observed in the study area that the rice planting schedule starts in May or early June of each year. August is the wettest month. Hottest months during summer are March and April. Due to the frequent occurrence of drought (El Nino phenomenon) and delay on the onset of rainy season than what has been traditionally usually observed in the locality, rice plantings are now being done at relatively late schedules. Farmers, therefore, prepare their land to plant rice only when they are convinced that the rainy season has already started due to lack of irrigation water. The wet season now starts in the month of July. It used to start in June.

It is interesting to note that before, according to farmers, wind has been the only major threat to rice production. The situation, however, has been now aggravated by the combination of wind and rain that seriously threatens the standing rice crop of the farmers in the area.

Typhoons are characterized now as having strong wind and heavy rain which were not experienced by the old farmers in their younger years. According to them, there was a time before that rain continued to pour for nine (9) days (which they coined as siyam-siyam). Despite the continuity of rainfall for 9 days, the water was just enough for plants, especially for rice and vegetables. Moreover, it has been observed also that hale storms have become more frequent in the municipality.

Most elders agreed that typhoons before were only observed during the months of July and August. This weather pattern has, however, changed as there are typhoons that now come in any month. The change in the weather pattern has also affected the livelihood of the locality's fishermen. They used to have ample time for fishing from February to May and the Southwest Monsoon (Habagat) used to bring in fishes along the bay. The fishermen from Guagua, however, could no longer enjoy the luxury of time for fishing as rain now falls year round in the area. Moreover, fishes are now out of sight along the bay. This is due to the heavy siltation of the Guagua River brought about the eruption of Mt. Pinatubo in 1991.

Rice cropping intensity in the municipality has been lessened from three (3) to two (2) due to unstable weather patterns and low level of water table which serves as the main source of irrigation among rice and vegetable farmers in the study area. The first (1st) cropping is usually being done from May to June while the second (2nd) cropping of rice is from July to October. On the other hand, the third (3rd) cropping cycle is from November to February. The last cropping cycle has been sacrificed by the farmers due to their lack of efficient irrigation system.

Effects of Observed Climate Change and Extreme Events in the Study Area

Continuous or Prolonged Rain. Continuous or prolonged rain results to flooding of low lying areas of the municipality, including its Poblacion area. Flooding makes the roads impassable, thus, affecting transportation. Fishermen make the most out of the situation to earn additional income by using their boats as alternative means of transportation. During rainy season, few fishers are able to go fishing for their livelihood. The business sector is also affected by flooding brought about by continuous rain.

The Guagua-LGU conducts 24-hour monitoring of rainfall during the wet season, from the middle of May to end of October every year, through the rain gauge that is installed at the rooftop of the municipal building. From the five (5)-year rainfall data, they have identified a weather pattern which they used in developing a local forecasting system for the municipality. If rainfall reach 80 to 100 millimeter per second, then they send flood warning signal that within six (6) hours the Poblacion area will be surely flooded with one (1) foot to two (2) feet of water. The municipal building is no exemption to the flooding. It has been observed that this occurs more often now than before.

Typhoons. Typhoons mostly affect farmers, fishermen, students, business and transport service in the study area,. Farmers agreed that typhoon reduced their crop yield. According to a study of the Southeast Asian Regional Center for graduate Study and Research in Agriculture (2007), a rice farm in Nueva Ecija, for instance, can suffer from calamities estimated at 10% due to typhoons, 30% to 80% due to floods, 15% due to drought, and 10% due to pest and diseases. If all these calamities happen in one cropping season, the loss for rice may be equal to 50% of expected yield. If climate change will continue, rice production will decrease by 50-70% in 2020 according to the Asian Development Bank (ADB).

Fishermen also suffered from small quantity or no fish catch at all for they are unable (and risky) to go fishing when there is a typhoon. Farm to market roads (FMRs) are also damaged due to scouring and erosion brought by strong current, rushing flood and overflowing of river tributaries. The surrounding areas of the said FMRs are mostly freshwater fishponds and rice fields.

Strong typhoons usually lead to suspension of classes in the Poblacion area due to flooded school grounds and roadways which make going to and from schools difficult for students. Prolonged flooding brought by typhoon also poses a threat on the health of the children as they can catch diseases brought about by floods. The people in the low lying residential area are suffering from odorous trapped flood water that can trigger health problems, like dengue and malaria.

A continuous flooding would take its toll to the Guagua's business sector, like the 26-day flood that took place from July 12, 2006 to August 8, 2006 and the flooding that had been stagnant for two months (August

to September) in 2007. The municipal authorities had estimated the losses incurred by the Guagua's business sector (encompassing all sub-sectors: i.e., retail, service, transport, utilities, manufacturing, etc.) due to flooding to be an average P210,000 per day. A loss in the business sector also results in a reduction of municipal tax revenues. The reduced collection of tax and other municipal fees in Guagua amounts to P20,000 per day. The losses in business activities and municipal internal revenue collection are due to business dislocation in the CBD, comprising the villages of Plaza Burgos, Sto. Nino, Sto Cristo and Bancal.

During flooding brought by typhoon, major thoroughfares in going to and from the CBD are only accessible to heavy vehicles. Thus, the cost of transportation fare increased to more than 50%. Typhoons, on the other hand, have positive effect on fishermen as they can use their boats (bancas) as a form of transportation within the CBD during flooding. Light vehicles, such as jeepneys and tricycles, could no longer pass on the roads that are heavily flooded due to typhoon. Fishermen see this situation as an opportunity for them to earn additional income for their family by using their boats as a means of transportation as substitute to jeepneys and tricycles. An average P300 per day income is generated by a fisherman from the use of his paddled boat as a transport service for passenger commuters.

Delay on the Onset of Rainy Season. Agriculture is adversely affected by the delay on the onset of rainy season. Farmers, therefore, are the only identified group who are unfavorably affected by delayed rainy season. Rice and vegetable farmers, in particular, plant their crops at lower intensity due to delayed wet season. Cropping intensity for rice farming has now been reduced from three (3) to two (2) in a year.

The reduction in the cropping intensity is mainly due to the difficulty of hitting the water table as a source of irrigation water. It has been observed that the water table level is getting deeper or increasingly depleted. Before, farmers were able to hit a good level of water table with only 2 pieces of galvanized iron pipes of four (4) inches in diameter and 20 feet long. They now use seven (7) to eight (8) pipes of the same diameter and length for the installation of their farm irrigation pumps.

Drought. In agriculture, additional cost in irrigation is incurred as insufficiency of irrigation water is experienced when there is drought. Water is essential for all plant growth, but the quantity of water needed to produce rice is greater than that required for any other major crop (Bhuiyan, 1992). Revelle (1963) noted that 4,000 tons of water were used to grow one (1) ton of rice, whereas wheat used only 1,000 tons. Although rice will grow as an upland crop, yields are almost always considerably less than when it is grown under appropriate flooded conditions.

More fuel and oil are, therefore, consumed by pumps in irrigating the rice farms when there is a significant lack of rainfall. Drought results in a decline in yield for farmers who do not have pump irrigation system or do not have enough financial capital to buy fuel and oil and could not avail of loan (either from formal or informal sources) for farm irrigation.

For the fishing industry, the fishermen experience smaller catch due to the shrinking bodies of water in the locality. The sea coast, Pampanga Bay and Guagua River are getting shallower since the Mt. Pinatubo eruption due to lahar siltation. Water depth in the Pampanga Bay has been reduced from 40 feet to 4 feet. With shallow water, the fish habitat gets warm, especially when there is drought. This situation drives away fish to the sea or deeper water that is much farther from the shore. Therefore, fishermen incur higher cost in fishing, particularly on fuel consumption and maintenance/depreciation of their boats. An estimated additional P200 for the extra fuel consumption alone is incurred by a fisherman every time he goes out for fishing.

Fishponds need to be regularly or continuously supplied with water when there is a drought. Additional costs (in terms of fuel, labor and equipment depreciation), therefore, are incurred for inland fisheries.

Drought is believed to be a major contributor to the reduction in the number of fish species. According to the local fishermen, drought breaks the seasonal reproduction cycle of fish because of high temperature. Fishermen have observed that only two (2) resistant fish species survive this situation.

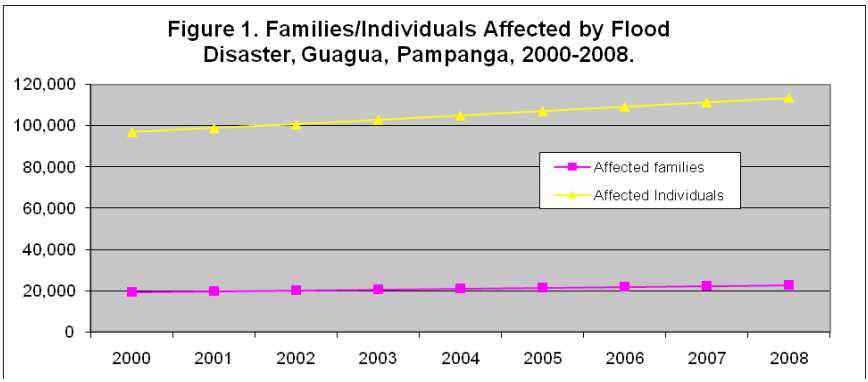
Due to lower vegetable yield during drought period, prices of vegetables are higher because of their lower supply in the market.

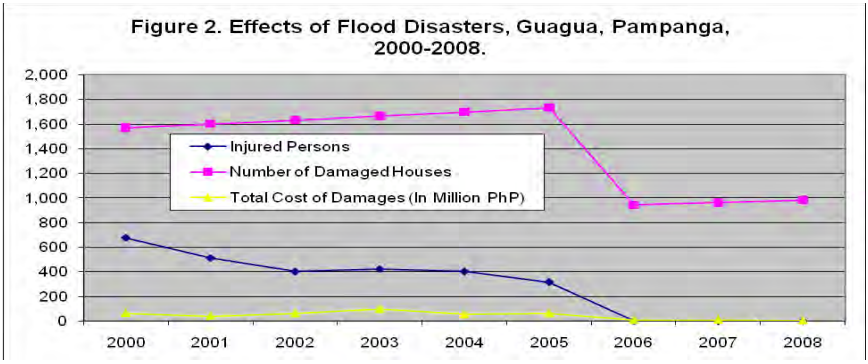
Higher power cost is also incurred in the conduct of business activities due to hotter temperature.

According to the respondent-participants in the FGD, those involved in providing transport service generate lower earnings due to lesser driving hours when there is drought. Driving and commuting during hot days are very inconvenient for drivers and passengers. Thus, fewer drivers and passengers are going out during drought period.

Many people are requesting for financial assistance from their LGU for the purchase of diesel oil for their pumps and artesian wells when there is a drought. Bigger power cost is also incurred by the LGU due to warmer temperatures. Hot days would make the air conditioning units to work harder and consume more electric power.

Extent of Damages. The floods in 2008 affected 113,485 persons from 22,697 families. Individuals affected by floods had been increasing since 2000 (Figure 1). It is, however, interesting to note that no casualty, injured and missing person had been reported for the period 2006 to 2008. Furthermore, there were generally declining trends in the number of damage houses, costs of damages to properties and agriculture as well as in income losses during the 2000-2008 period (Figure 2).





Cases of various water borne diseases numbering to 60 individuals which resulted to four (4) deaths in a two-year (2004 – 2005) period caused by stagnant flooding were reported by the Municipal Health Office (MHO). Treatment was done and prescribed medication was provided.

Based on the August 9-10, 2007 MDCC reports, two (2) old residential houses were swept away by strong current and five (5) residential houses were in the direct target of the overflowing of the Sapang Maragul River. A total of 14,202 families and 72,059 individuals from 24 villages were affected by flooding of 1.6ft to 4.7ft level caused by Typhoons Chedeng and Dodong. Power failure in the Poblacion area was experienced due to a busted transformer line. Typhoon Milenyo, on the other hand, brought strong winds in the 1st week of August 2006 which caused power interruption that lasted for almost three (3) days due to uprooted electric posts and trees.

Income loss of the business sector (especially those located within the Poblacion area) due to floods caused by the Typhoons Frank, Igme and Julian was estimated at P3.69 million in 2008. A satellite market was temporarily established at San Antonio Intersection for almost two (2) weeks (August 9-21, 2007) to cater to the needs of the constituents due to difficulty in transportation caused by high flood at the market area. A flooding that usually lasts for three (3) months in the municipality's Poblacion area is estimated to affect a volume of business worth P90 million. The average economic losses due to flooding is computed at P230,000 per day from interrupted business activities and lost municipal government business taxes (Table 2). Due to the mitigation

measures being adapted and implemented by the LGU of Guagua, the usual three (3)-month flooding period has been shortened to only three (3) weeks. A flood that would last for three (3) weeks (21 days) would cost the LGU and its business sector a projected loss of P4.83 million while the losses from a 3-month period is estimated at P20.70 million. Therefore, the economic losses was cut by P15.87 million or a reduction of 76.67%.

Table 2. Projected economic losses (in Philipine Pesos) due to flooding.

Average annual revenue from business taxes	7,000,000.00
Average worth of business activities per year	350,000,000.00
Average worth of business activities per day	1,000,000.00
Projected Daily Economic Losses Per Sector	
Municipal government (business taxes)	20,000.00
Business sector (retail, service, transport, manufacturing, etc.)	210,000.00
Average economic losses per day	230,000,00
Reduction in Economic Losses due to LGU Mitigation Measures	
Total economic losses from a three (3)-month (90 days) flooding	20,700,000.00
Total economic losses from a three (3)-week (21 days) flooding	4,830,000.00
Reduction in Peso values	15,870,000.00
Reduction in percent	76.67%

Source: MDCC, Guagua, Pampanga.

Typhoon Onyok wrought the biggest havoc on properties valued at P66.09 million in 2003. Damaged properties were mostly broken concrete fence, collapsed walling, ruined first floor, collapsed roofing and appliances that got wet. The breaches of Sapang Maragul at San

Juan Nepomuceno, Betis on August 9, 2007 affected 21 families. Their houses were either totally swept or partially damaged by strong current. The total damage was estimated at P1.175 million. For 2008, no damaged property was reported.

As per the report of the Municipal Agricultural Office (MAO), rice seedlings worth P60,000 were damaged in 2008. The destruction of farmers' crops (valued at P3.90 million) was significantly worse in 2007. On the other hand, the damage on agriculture was estimated at P665,512.00 in August 2006. Typhoons Henry and Milenyo destroyed newly planted rice and seedlings of 168 affected farmers from nine (9) villages. On the other hand, 14 villages comprising of 539 farmers were affected by floods due to Typhoons Chedeng and Dodong in August 2007. The cost of damage by the said two (2) typhoons to 563 hectares of planted rice amounted to P3.9 million. Sampaguita and ilang-ilang bushes in the Pangulo area were damaged due to a flash flood. For the period 2000-2008, total cost of damages to agriculture was estimated at P168.81 million.

Farm to market roads (FMRs) in various areas particularly along river channels suffered scouring and erosion due to strong current, rushing flood and overflowing of river tributaries. The reported damages due to Typhoons Chedeng, Dodong and Egay to 13 FMRs were estimated at P2.25 million in August 2007.

Roads at San Juan Nepomuceno were cleared of sand and other debris using a truck loader from the Provincial Engineering Office (PEO). More than 6,000 pieces of sacks and 10 truckloads of filling materials were delivered to affected areas for sandbagging operations to repair and rehabilitate bridges, drainage canals, dikes and pathways for the period August 10-18, 2007 alone.

Figure 3 shows the magnitude of damages on agriculture, fishponds, business, residential and built-up areas caused by floods in 2006. As per the MDCC reports, the following were the damages on infrastructure during the last week of July 2006:

Series of cracks appeared along the western portion of the Megadike;

Clogged floodwater shed at Sapang Uyong section;

Breaches along Sapang Silab at Village San Jose, swelling and over-tapping of San Juan Bautista RCDG (reinforced concrete deck girder)

Bridges and all interior tributaries of Guagua;

Over-tapping of San Isidro and Box Type Culvert at the back of St. James Parish;

Breach in the Dalan Bapor area, thus, spreading the flooding within that area and hindered the flow out of Guagua river; and,

Clogged river channels

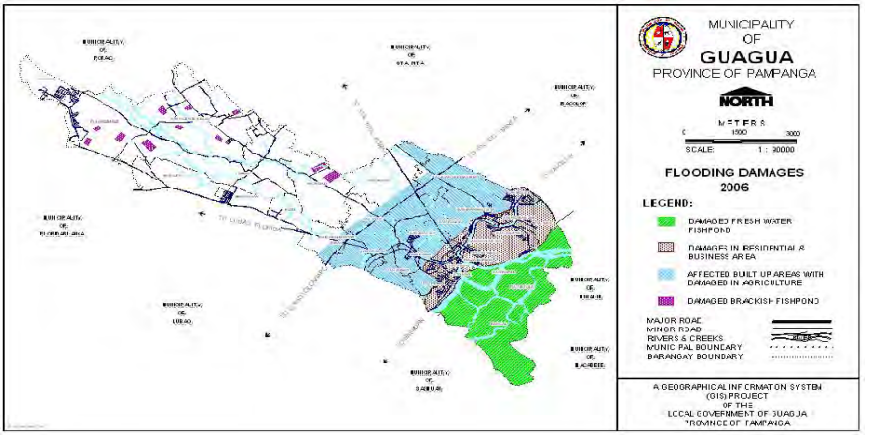


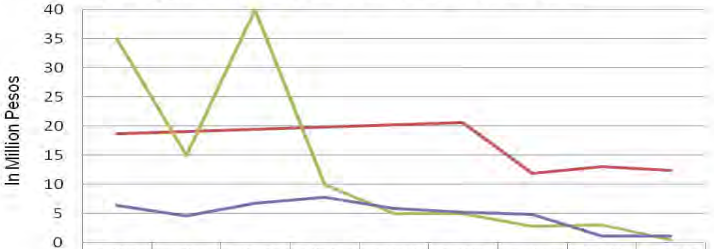
Figure 3. Magnitude of damages caused by floods in Guagua, Pampanga, 2006.

Nine (9) families were affected by the breaches of Sapang Maragul River at San Juan Nepomuceno, Betis last August 9, 2007. Their houses were either totally swept or partially damaged by strong current brought by the breach of Sapang Maragul River. A temporary evacuation center was established at San Roque Cockpit Arena from August 10, 2007 to August 19, 2007 which served six (6) families composed of 19 individuals from Village San Roque. A total of 3,000 packs of relief goods were distributed to flood-affected 31 villages.

Figure 4 shows the trend in estimated damages and municipal LGU expenditures related to typhoons/floods. An increasing number of houses were either partially or completely damaged by typhoons from 2000 to 2005. Thus, the cost of damaged houses rose from P18.65 million to P20.58 million due to typhoons observed during the said period. A reduction of 45.50% in the cost of destroyed houses was

observed in 2006 (only P11.91 million) due to the decline in the number of damaged houses from 1,732 in 2005 to 944 in 2006. From then on, their number rose by an average of only about 2% per year until 2008. The cost of damaged housed was estimated at P13.08 million and P12.35 million in 2007 and 2008, respectively.

Figure 4. Estimated damages and municipal LGU expenditures related to typhoons, Guagua, Pampanga, 2000-2008.



	2000	2001	2002	2003	2004	2005	2006	2007	2008
Houses	18.65	19.02	19.40	19.79	20.18	20.58	11.91	13.08	12.35
Infrastructures	35.00	15.00	40.00	10.00	5.00	5.00	2.75	3.00	0.50
LGU Expenditures	6.33	4.61	6.69	7.83	5.87	5.21	4.79	1.13	1.10

Infrastructure damages (mostly on roads and bridges) were exceptionally high at P35 million and P40 million in 2000 and 2002 due to the extraordinary floods from intense rainfalls which brought 8,940 mm and 7,993 mm, respectively, in the month of July alone of the said years. From 2002, damage to infrastructures has consistently decline to only P2.75 million in 2006. It slightly increased to P3 million in 2007. Infrastructure damage was at its lowest level (only P0.50 million) in 2008.

The LGU utilizes its Calamity Fund and 20% of its Development Fund for the purchase of basic commodities to be given as relief goods, medicines, other medical supplies and equipment as well as construction, repair and rehabilitation of infrastructures, such as roads, dikes, bridges and irrigation/drainage canals which reached to P7.83 million in 2003 from P4.61 million in 2001. After 2003, the municipal LGU expenditures related to typhoons/floods dropped to only P1.10 million in 2008.

General Attitude about Climate Change. The different vulnerable sectors perceive these climatic events as real and they recognize the need

to take positive actions to mitigate their negative impacts. They believe that their adaptive capacity can be improved. The LGUs in the village, municipality and province, in particular, are very much concerned with the lack of resources (funds, information and manpower) for preparedness to climate change. Despite the insufficiency of resources, however, the LGU of Guagua has devised innovative steps (such as establishment of rain gauge, systematic record-keeping of climate-related information, promoting of early warning system, transferring market location during flooding) which are quite useful and effective.

People in the study area agree that climate change is already taking place with the frequent occurrences of droughts (El Nino), floods (La Nina), strong typhoons, intense rainfall during summer, sudden rain in the midst of a hot daytime, raining in one place while it is too hot in a nearby vicinity, and extreme temperatures during dry and wet seasons.

Adaptation Measures/Response Actions

A. Agriculture

Delayed Onset of the Rainy Season and Drought

Planting of early maturing varieties, especially for rice.

Development of viable alternative sources of irrigation water.

Continuous Rain

Opening up and development of upland areas for rice production.

Conversion of frequently flooded rice farms into freshwater fishponds.

Drought

Installation of small farm reservoirs (SFRs) or small water impounding projects (SWIPs) in appropriate/suitable areas where the soil is not porous.

Typhoon

Proper timing of planting and harvesting schedules. Full knowledge or awareness of weather forecasts and patterns is essential for this to be accurately realized.

Construction of secondary dike by the people of Betis and Poblacion which was their initiative. They solicited voluntary contribution from students, residents and banks which led to the formation of Lahar Control Measure Fund which reached to more than P3 million. They

used the fund in constructing the secondary dike which served as their secondary protection, in case the primary dike collapse. The primary dike then was not yet megadike but an earthed dike. When the secondary dike has been established, people have initiated the conduct and implementation of adaptation strategies, such as: construction of new houses on elevated level; use of boats (bancas) as temporary place to stay when their houses are flooded; and, placing the machines for furniture making and kiln drying on the elevated part of the house or shop and selling the saw dust as a source of additional income. Thus, the upper portion of the house serves as a storage area.

B. Fishery

Typhoon and Continuous Rain

Before June or July, fishpond operators harvest the fish before the start of excessive rainfall to avoid the escape of their fish if the typhoon would lead to the destruction of their ponds.

Development and creation of alternative livelihood projects or opportunities by the LGU for its fishermen-constituents.

C. Business

Typhoon and Continuous Rain

The municipal LGU has been conducting 24-hour monitoring from middle of May to end of October over five (5) years which enabled them to chart a pattern in their local flooding forecasting. Monitoring of rainfall amount that will cause flooding. An 80 to 100 mm per second of rainfall will result to a 1 to 2 ft flooding infront of the municipal building within a 6-hour period. When this amount of rainfall is collected by the rain gauge installed on top of municipal building, the LGU disseminates an announcement of flooding in the Central Business District of the town. The businessmen and residents then transfer their vehicles to higher grounds.

Relocation of retail outlets is advised. The public market gets easily flooded due to its low elevation. A satellite market is established while the public market is submerged with flood water.

The type of soil (swampy) in Guagua, especially in its CBD, is not suitable for high rise building. Under a municipal legislation, one should show through a boring test that his soil type is suitable for the

building structure he or she wants to construct. A 500 psi requirement for a three (3)-storey building or higher is needed for the application of a Mayor's building permit.

A long-term solution of the LGU is road improvement. The municipal LGU has been gradually elevating its road network around its Poblacion area. However, the old businessmen negatively look at this solution because it would be very costly for them to rebuild/ renovate their buildings.

Another long-term solution is to radiate/commence the westward development of the town proper, especially its CBD, where the place is located on high elevation which does not easily get flooded. Schools, gasoline stations, biggest supermarket and hospital are now located in that place with the new breed of liberal businessmen leading the way.

Sufficiency/Efficiency of Adaptation Measures

According to the FGD participants, the fishery sector has the most sufficient/efficient adaptation measures because fishermen have lower investment in fishing. As compared to farming, fishing is less input/capital intensive. Fishermen can temporarily stop and leave the sea during unfavorable weather and do some other productive employment, such as working in construction projects and providing transport service with the use of their paddled boats during flooding and hence earn in the process. Fishermen are more flexible (versatile) and can explore other opportunities when the weather condition and situation are not favorable for fishing. They are quite innovative, in terms of their ability to shift in their sources of livelihood during times of calamities, like flood. They are less-climate dependent, they can do fishing as long as there is water. Water is not easily affected by drought. Fish catch only declines when the water level is low and the weather is too hot.

Agriculture is more vulnerable compared to fishery sector. The basic component of agriculture is land which is immovable and subject to many factors. Land could not be transferred to make it adaptable to climate change related events. With higher investment in agriculture, farmers are focused in farming. They cannot easily leave their lands as grasses will readily grow on the soil and land preparation will be more difficult. Agriculture is more climate dependent and is sensitive to sunlight.

The municipal LGU adaptation measures to climate change related events are not yet fully implemented due to lack of resources. Another constraint or limitation is the brewing misunderstanding between the Provincial and Municipal Chief Executives (Governor and Mayor). This makes the available resources which can possibly be tapped for the conduct or implementation of climate change adaptation strategies in the municipality not accessible to LGU chief executives.

Factors that Facilitated or Constrained Adaptation or Response Action

Based on the experience of the LGU of Guagua, the factors that affect or influence adaptation or response actions are effective organizational structure, sound data gathering and storage system, proper planning and management, effective monitoring and evaluation, effective information dissemination, cooperative and well-informed constituents/residents, receptive and dynamic leadership, competent manpower/human resources and unity among the LGU officials.

Conflict among Pampanga LGU officials (such as those of between the municipal and the provincial executives as well as between the provincial board and the governor) significantly slow down or limit the funding and implementation of relevant climate change adaptation and disaster response measures.

CONCLUSIONS

It can be concluded from the results of the FGD that the negative impact of typhoon is substantially huge on agriculture, business, students, service/utility (transport, power, water, communication/ telephone lines) and LGU. Business activities greatly suffer because the commercial establishments close their shops and completely stop their operations. On the other hand, fishermen endure a moderately negative impact of typhoon on their main livelihood.

The impact of drought on agriculture, fishery, transport service and students is moderately negative while its unfavorable impact on the town's business sector has been deemed small.

Agriculture suffers the most when the onset of the rainy season is significantly late. The most adversely affected and vulnerable is the

farmer who is very climate (season) dependent. Therefore, climate change is threatening crop productivity and food security. Delayed rainy season, however, has a little harsh impact on business activities, students, transport service and LGU.

Continuous rain (that is associated with too much water) is the most harmful or destructive climate change related event in Guagua, Pampanga as its adverse impact on all identified most vulnerable groups or sectors (agriculture, fishery, business, students, transport service and LGU) is considerably large. Agriculture, on the other hand, is most vulnerable sector followed by the group of students, LGU, transport service and fishery sector.

The provincial government always coordinates with LGU chief executives but nothing happens due to their political conflict with the governor despite his willingness and ability to support climate change mitigation measures. Thus, the adaptive capacity is affected by the system of governance. It is dependent on governance (that is, harmony between the Governor and Provincial Board Members as well as between Governor and Mayors). Even if there are funds, if there is no support from the provincial and municipal legislative bodies, nothing will happen and their adaptive capacity will not be enhanced. Such as the case of Pampanga where there are available sufficient resources (especially funds that were generated from the provincial quarrying activities) but the present Provincial and Municipal Boards do not support the plans, projects and programs of the governor.

However, the LGU of Guagua is implementing innovative adaptation strategies at the local level, such as the establishment, effective recording, and appropriate use of the rain gauge information to reduce adverse impacts of typhoons/heavy rains. Human resource capacity is, therefore, very important for promoting effective adaptation (such as the presence of very good Municipal Administrator and Municipal Planning and Development Officer). The enhancement of adaptive capacity is a necessary condition for reducing vulnerability, particularly for the most vulnerable community and socioeconomic groups.

The generally declining trend in the costs of damages on infrastructures and houses as well as in the expenditures of the municipal government related to typhoons or floods despite their

observed increasing frequency and intensity indicates the increasing improvement and effectiveness of adaptation strategies being implemented by the LGU of Guagua. Thus, losses are being minimized in the process. This implies the vital role of the municipal LGU, in terms of early warning system, that reduces risks to the different sectors.

RECOMMENDATIONS

1. More Focused Formulation of Mitigation and Adaptation Plan - The LGUs should spearhead the formulation of mitigation and adaptation measures that would address vulnerabilities of sectors and areas where climate change will have the greatest impact. Focus should be on disaster-prone settlements, high-risk population centers, and food production areas. Inasmuch as residents have individual adaptive capacity, targeting of assistance should be properly done.

2. Continuous Strengthening of Institutional and Individual Capacity - Capacity, both institutional and individual, at the provincial, municipal and village (grassroot) levels continues to be quite limited and will need sustained strengthening. There is a need for more intensive information dissemination to LGUs in the province, towns and villages for them to be able to clearly distinguish events that are climate change related, lahar-related or Pinatubo-related. Extension services in agricultural capacity strengthening (such as in water capture and storage techniques) should be extended to small-scale farmers and fishermen. Introduction of climate change in educational curricula at schools and encouragement of the celebration of important environmental occasions (e.g. tree festivals) are also deemed necessary.

3. Strong Linkaging or Partnership with R&D Institutions and Stakeholders - In support of mitigation strategies, climate-friendly technologies have to be shared with local communities and sectors to establish low-carbon infrastructure for transportation, energy, agriculture, industry, and settlements. On the adaptation side, agricultural and fishery technologies along the lines of developing drought- and flood-resistant crop seed varieties and climate change resistant fish species, for instance, would have to be introduced. The LGU should lead in forging memorandum of agreements, provincial/ municipal cooperation and action towards this direction and to facilitate

transfer of technology, such as with research and development (R&D) institutions like the Philippine Rice Research Institute (PhilRice) and Bureau of Fisheries and Aquatic Resources (BFAR).

4. Massive Promotion of Efficient and Effective Mitigation and Adaptation Measures - The use of effective information, education and communication (IEC) materials should be strengthened in the promotional campaign for climate change mitigation and adaptation. To encourage local households, the LGU should widely promote and even subsidize the implementation of certain efficient and effective farm level mitigation and adaptation measures. Among these are the use of appropriate crop varieties with high water use efficiency, proper planting schedule, planting of early maturing varieties as well as judicious soil and water management.

5. Other mitigation and adaptation strategies that the LGU could develop and/or promote include the following:

Producing organic fertilizers and encouraging their wider application; Greater use of effective water-conserving agricultural land management practices; Establishment of drought monitoring and early warning systems for disaster preparedness similar to floods; New affordable water harvesting/spreading techniques; Rehabilitation of available irrigation facilities and establishment of new ones; Improvement of access to groundwater supplies for humans, animals and crops; Conduct of extension programs that target environmental conservation; Introduction of a revolving micro-credit fund to support small fishpond- and farm-level implementation of proven mitigation and adaptation measures; Support for civil society organizations working for environmental protection; Establishing environment conservation societies in vulnerable areas; and, Legislation of local ordinances that would promote the return or back to basics, for instance, the use of bayong and paper bags in shopping and buying groceries.

6. Enhancement of the Planning and Implementation of Climate Change Adaptation and Mitigation Strategies - Integrating climate change mitigation and adaptation in development strategies and policies strengthens these strategies and increases their efficiency. LGUs should ensure political and financial support for the implementation of adaptation strategies. Political will and commitment is indispensable.

The bottom up approach of planning and implementing adaptation and mitigation strategies should be employed. Community-based measures by stakeholders' involvement in adaptation planning, and improving the capacity of vulnerable sectors should also be developed.

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