THE FUTURE OF FISH CATCH IN NORTHERN PHILIPPINES

Nestor Respondo Jr., May-Ann Asuncion, Rainel Yap,
& Jennifer C. Bangi, MARS
Bachelor of Secondary Education major in Mathematics

*Presented during the **2017 National Conference on Mathematical Modeling** organized by the Mathematical Modeling Organization of the Philippines held at the Cagayan State University – Carig Campus on February 3-5, 2017.*

ABSTRACT

Fishing is a vital industry in the Philippines especially in Aparri, Cagayan. It contributes to income, employment, foreign exchange earnings, and nutrition. This study aimed to predict the future of fish catch of Aparri for the year 2016-2030 using two variables which are the temperature and the fish catch of Aparri from 2003-2015 . This descriptive research utilized ARIMA Model and Curve Fitting to predict the future fish catch. ARIMA Model was used to predict the value of fish catch as temperature is held constant. The result showed that with the average temperature of 27.3932°C in every year, the fish catch value of Aparri will increase and by 2030 the value of fish catch is expected to reach 500,000 kg. The curved fitting design was used to get the value of fish catch for the year 2016-2030. The result showed that if the value of fish catch will increase, it is expected to reach more than 2,000,000 kg in the year 2030 and if the value of fish catch will decrease, it is expected only to reach less than 1,000,000 kg in the year 2030.

Keywords: *Fish Catch, Arima Model, Curve Fitting*

INTRODUCTION

Climate change is the most widespread anthropogenic threat that ocean ecosystems face (Halpern, 2008). Globally, oceans are warming, becoming more acidic (IPCC, 2007) and have altered nutrient conditions (Behrenfeld, 2006). These environmental changes will directly affect the physiology of ocean organisms (Portner & Farrell, 2008) and hence their population dynamics (Harley, 2006). Changes in biomass of a species alter ecological interactions and have indirect effects throughout entire marine food webs (Scheffer, 2005). Climate change will thus affect all ocean organisms, change the composition of marine communities, and alter ecosystem function.

Some 540 million people depend on fisheries and aquaculture as a source of protein and income. For 400 million people, fish provides half or more of their animal protein and dietary minerals. Therefore, more must be done to understand and prepare for the impacts that climate change will have on world fisheries and aquatic ecosystems. Coastal ecosystem are some of the most biologically productive in the world, occupying eight percent of the earth's surface, but accounting for 26 percent of all biological productivity (United Nations Environment Program, 2002).

The Philippines consists of 7,100 islands and islets with a coastline of about 18,000 kilometers. Its territorial waters cover about 2.2 million square kilometers, twelve percent of which is coastal while eighty-eight percent is oceanic, including the Exclusive Economic Zone (EEZ). The Philippine coastal ecosystem is comprised of biologically productive habitats such as mangroves, sea grasses and coral reefs that support the country's marine fisheries. The country is also endowed with 569,600 hectares of freshwater ecosystem that includes lakes, major rivers, reservoirs, swamplands and fishponds. The diverse aquatic resources favor the development of the various interrelated but distinct components of the coastal zone (Philippine Fisheries Sector Program, 1993).

Cagayan's coastline is one of the longest coastline in the country having almost 73% of Cagayan Valley Region's coasts. This is aside from the large rivers and their tributaries, lakes, creeks and streams which are also rich fishing and aquaculture grounds. Untapped coastal fishing grounds stretch from the towns of Sta. Praxedes in the west to Sta. Ana on the east, on its northern coast facing the Babuyan Channel (China Sea); and from Sta. Ana down to Peñablanca on its eastern coast facing the Philippine Sea (Pacific Ocean) (Carodan & Tubangui, 2016).

The municipality of Aparri in the province of Cagayan, which is seated at the mouth of the longest river in the Philippines, is having fishing as a main source of living. It is an important fishing center, and is especially noted for its large fish sauce, or bagoong sauce industry. This study then is intended to predict the future of fish catch in the municipality in the years 2016-2030, with the previous data on temperature and fish catch as references.

Research Objective

This study aimed to predict the future of fish catch of Aparri for the year 2016-2031 using two variables which are the temperature and the fish catch of Aparri from 2003-2015.

METHODS

This study used descriptive research design. It describes the temperature and fish catch for a period of 13 years. Furthermore, the fish catch for another 15 years was also described. Moreover, data mining was used in this study. Data on fish catch was requested from BFAR and data on temperature of Aparri was requested from PAGASA.

For the data analysis, mean was used to describe the rate of fish catch and the temperature of Aparri for the year 2003 – 2015. ARIMA Model and Curve Fitting were used to predict the future of fish catch for another fifteen years (2016 – 2030).

RESULTS

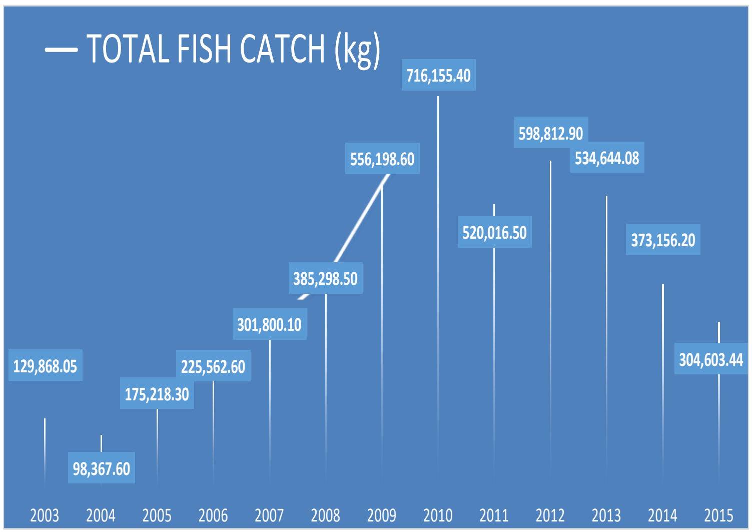
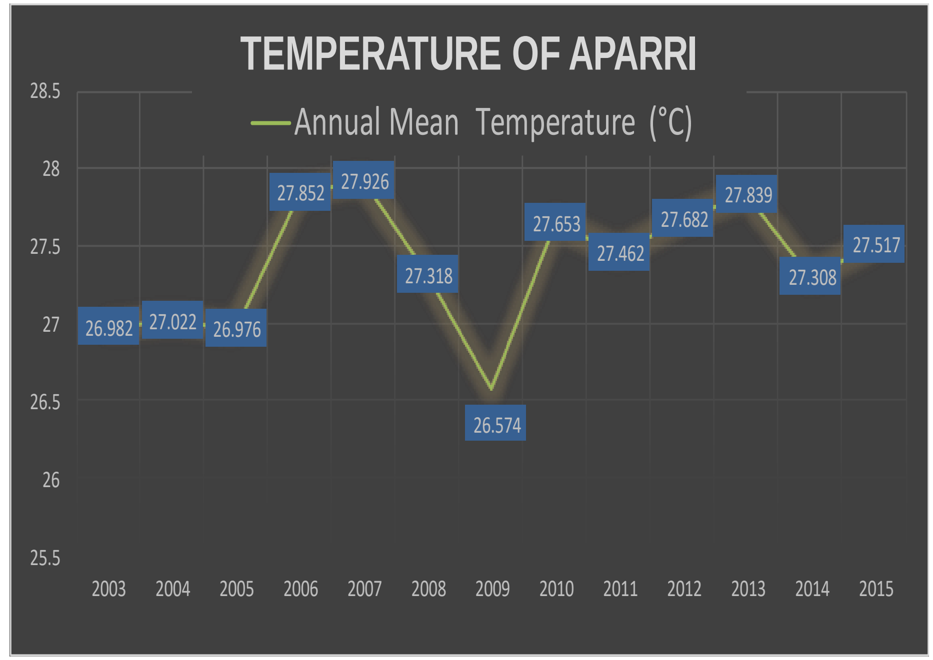


Figure 1
Total Fish Catch (kg) for the year 2003 – 2015

The graph shows the total fish catch (kg) of Aparri each year for the year 2003 – 2015. It shows a fluctuating data stating that year 2010 has the highest fish catch that reaches 715,155.40 kg while the year 2004 has the lowest catch yielding only to 98, 367. 60 kg based on the data gathered from the Bureau of Fisheries and Aquatic Resources (2016). From 2004 – 2010 the value of fish catch is continuously increasing while from 2012 – 2015 it is slowly decreasing. It can further be seen that the increase of fish catch from 2008 – 2010 has a steeper slope than the other years in the data. In like manner, the decrease of fish catch from 2013 – 2015 is also steep.

Figure 2 shows the temperature of Aparri from 2003-2015. It shows that the lowest temperature is recorded in 2009 (26.574 ℃) with the highest



temperature on 2007 (27. 926 ℃). The graph also shows the average temperature of each year which is at 27℃ aaccording to Philippine Atmospheric Geophysical and Astronomical Services Administration (2016).

Table 1: Forecast on Fish Catch with Temperature held Constant

TEMPERATURE: 27.3932 ℃	
2016	318180.8689 kg
2017	331758.3029 kg
2018	345335.7368 kg
2019	358913.1707 kg
2020	372490.6046 kg
2021	386068.0386 kg
2022	399645.4725 kg
2023	413222.9064 kg
2024	426800.3403 kg
2025	440377.7743 kg
2026	453955.2082 kg
2027	467532.6421 kg
2028	481110.0760 kg
2029	494687.5100 kg
2030	508264.9439 kg
2031	521842.3778 kg

The table shows the summary of the forecast value of fish catch from 2016-2030 with constant temperature of 27.3932 ℃ using the ARIMA Model.

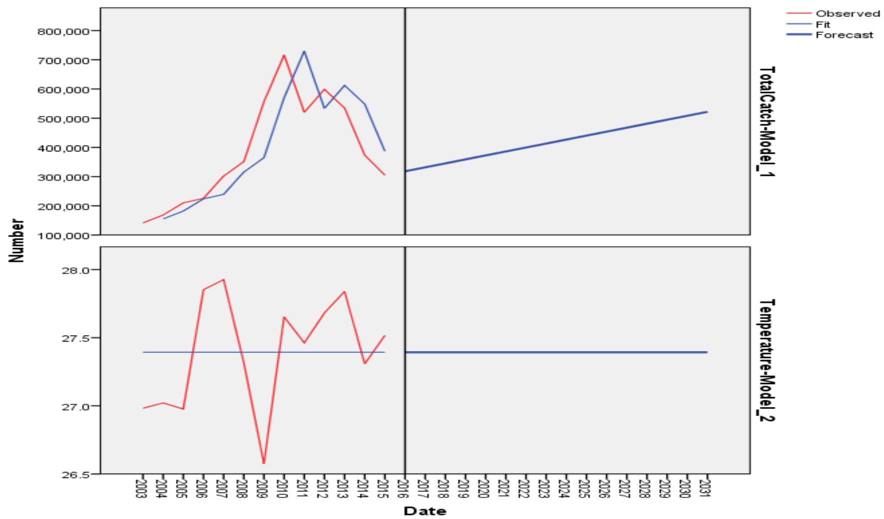


Figure 3

ARIMA Model of the expected value of the fish catch for the year 2016-2030

The figure shows the expected total fish catch for the year 2016 – 2030. Using the ARIMA model it shows a constant temperature of 27.3932 ℃. This shows that at this constant temperature an increase of fish catch up to 500, 000 kg is expected until 2030.

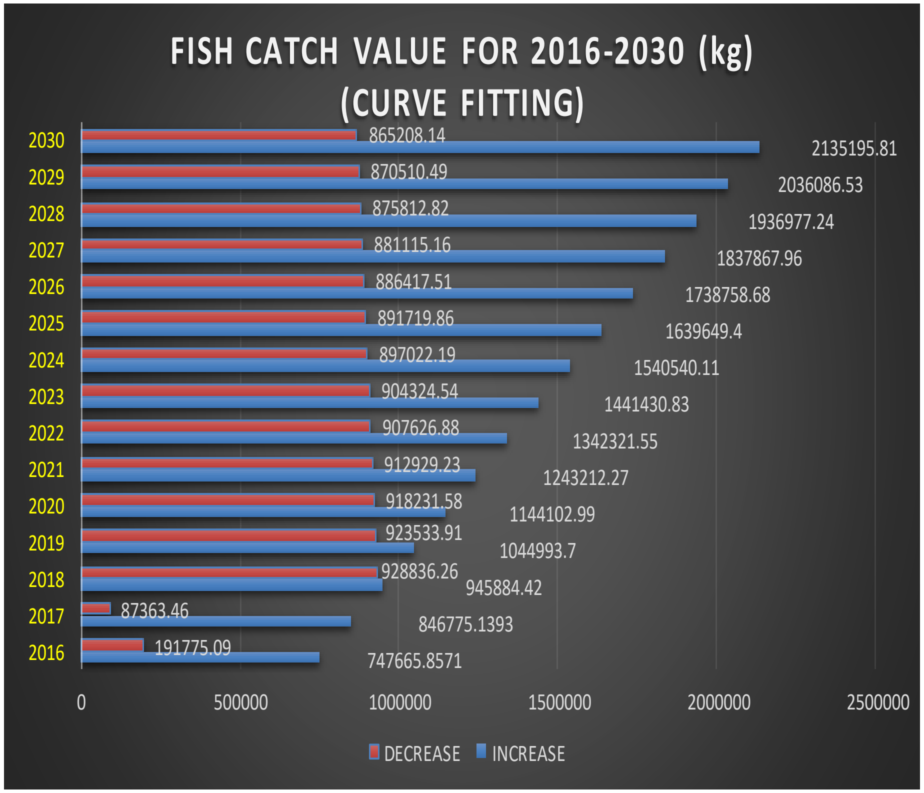


Figure 4

Expected Fish Catch for the year 2016-2030 using Curve Fitting

The graph shows the probable value of fish catch for the year 2016-2030 using curve fitting. The data gathered from the fish catch from 2003-2015 is used in identifying the possible value for the actual increase or decrease of fish catch from 2016-2030. It is then shown, that upon reaching year 2030 a probable increase of fish catch of up to 2,000,000 kg or a decrease of up to 1,000,000 kg is to be expected.

DISCUSSION

Fish catch is an important variable for the fishers in the municipality of Aparri. For the years 2003-2015, the amount of fish catch is not constant. Variables like rainfall, temperature and humidity could affect the fish production (Daw-as, Paca, and Navarra, 2010). But temperature, as one variable that is being considered in this research, doesn't have any significant effect in the fish catch of Aparri. It is similar to the findings of Zarrein (2010) who studied about the effect of temperature and rainfall on fish and shrimp catch in Pakistan, and found out that there was no significant correlation between catch of various fish and shrimp species and temperature or rainfall. Using ARIMA model, this study predicted that the amount of fish catch will be increasing yearly from 2016-2030 if temperature is held constant at 27.3932 ˚Cheung, Watson and Pauly (2013), in their study about the global fisheries catch, found out that marine fisheries catch is significantly related to the temperature change in the ocean. This implies that, even if atmospheric temperature is high but not the ocean temperature, fish catch will not be affected.

There are important weather variables though that were not included in this study which could have affected the fish catch, like humidity, rainfall, and peoples' styles in fishing. This implies that atmospheric temperature alone cannot affect the fish catch of Aparri. Contrary to the study conducted by Daw-As, Paca, and Navarra (2010) who found that temperature has an effect on the total quantity of fishery production. They said further that, as the temperature increases the total quantity of fishery production also increases. This only means that temperature has an effect on the overall production of marine resources but it has no significant effect on fish catch in this study.

The Curve Fitting design used in this study predicted an increase and decrease in the value of fish catch for the year 2016 – 2030. For the increasing and decreasing data, 2008 – 2010 & 2013 – 2015 was used respectively since this shows the gradual increase and decrease of value for the past three consecutive years for 2003 - 2015. A possible decrease of fish catch can happen as low as 1,000,000 kg in 2030, nevertheless, a much higher probability shows an increasing catch of fish which is expected to be as high as 2,000,000 kg until year 2030. The projected global fish supply in 2030 is 186,842,000 kg (World Bank, 2013). This implies that around 1.07% of the global fish supply will be caught by the fishers of Aparri, Cagayan.

CONCLUSION

Temperature does not affect the fish catch in the municipality of Aparri. But using the curve fitting, fish catch will decrease minimally when the temperature will be decreasing, and fish catch will have a dramatic increase when the temperature will increase. While some fish species could not with stand a high temperature, the fish species considered in this study can tolerate a high temperature, thus could thrive and reproduce despite the high temperature.

RECOMMENDATIONS AND IMPLICATIONS FOR FURTHER RESEARCH

Further research will be conducted to include variables as fish production, climate determinants like humidity and rainfall, fish effort, and water temperature.

An investigation on the fish species caught during warm temperatures and species caught during cold temperatures to validate the unchanged fish catch despite change in temperatures.

A qualitative study describing the time of fishing and manner of fishing to find out the reason for increase in fish catch despite high temperature is also recommended.

REFERENCES

Alexander, T. J., Vonlanthen, P., Periat, G., Degiorgi, F., Raymond, J. C., & Seehausen, O. (2015). Estimating whole-lake fish catch per unit effort.*Fisheries Research*, *172*, 287-302.

Bacheler, N. M., Bartolino, V., & Reichert, M. J. (2013). Influence of soak time and fish accumulation on catches of reef fishes in a multispecies trap survey. *Fishery Bulletin*, *111*(3), 218-232.

Barange, M., Allen, I., Allison, E., Badjeck, M. C., Blanchard, J., Drakeford, B., & Jennings, S. (2011). Predicting the impacts and socio-economic consequences of climate change on global marine ecosystems and fisheries.*World Fisheries: A Social-Ecological Analysis*, 29-59.

Barnett, L. A., Baskett, M. L., & Botsford, L. W. (2014). Quantifying the potential for marine reserves or harvest reductions to buffer temporal mismatches caused by climate change. *Canadian Journal of Fisheries and Aquatic Sciences*, *72*(3), 376-389.

Beckensteiner, J., Kaplan, D. M., Potts, W. M., Santos, C. V., & O'Farrell, M. R. (2016). Data-Limited Population-Status Evaluation of Two Coastal Fishes in Southern Angola Using Recreational Catch Length-Frequency Data.*PloS one*, *11*(2), e0147834.

Booth, D. J., Poulos, D. E., Poole, J., & Feary, D. A. (2014). Growth and temperature relationships for juvenile fish species in seagrass beds: implications of climate change. *Journal of fish biology*, *84*(1), 231-236.

Brown, C. J., Fulton, E. A., Hobday, A. J., Matear, R. J., Possingham, H. P., Bulman, C.,& Griffiths, S. P. (2010). Effects of climate-driven primary production change on marine food webs: implications for fisheries and conservation. *Global Change Biology*, *16*(4), 1194-1212.

Cohen, P. J., & Alexander, T. J. (2013). Catch rates, composition and fish size from reefs managed with periodically-harvested closures. *PLoS One*,*8*(9), e73383.

Daw-as, A. C., Paca, E. D., & Navarro, G. M. (2010, October). The impact of climate change on the Philippine fisheries: a moving direction towards full access to open market agenda?. In*11th National Convention on Statistics, Manila, Philippines*.

Fauconnet, L., Trenkel, V. M., Morandeau, G., Caill-Milly, N., & Rochet, M. J. (2015). Characterizing catches taken by different gears as a step towards evaluating fishing pressure on fish communities. *Fisheries Research*, *164*, 238-248.

Faunce, C. H., Cahalan, J., Bonney, J., & Swanson, R. (2015). Can observer sampling validate industry catch reports from trawl fisheries?. *Fisheries Research*, *172*, 34-43

Fernandes, J. A., Cheung, W. W., Jennings, S., Butenschön, M., Mora, L., Frölicher, T. L., ... & Grant, A. (2013). Modelling the effects of climate change on the distribution and production of marine fishes: accounting for trophic interactions in a dynamic bioclimate envelope model. *Global change biology*,*19*(8), 2596-2607.

Fyke, J. G., & Weaver, A. J. (2006). The effect of potential future climate change on the marine methane hydrate stability zone. *Journal of Climate*,*19*(22), 5903-5917.

Griffin, M. T., Arrigo, J., & Montz, B. (2011, December). Assessing Future Water Resources: The Influence of Climate Change, Population Growth and Land Use Change in the Lower Cape Fear Basin, North Carolina. In *AGU Fall Meeting Abstracts* (Vol. 1, p. 1345).

Hare, S. R., Harley, S. J., & Hampton, W. J. (2015). Verifying FAD-association in purse seine catches on the basis of catch sampling. *Fisheries Research*, *172*, 361-372.

Hehre, E. J., & Meeuwig, J. J. (2016). A global analysis of the relationship between farmed seaweed production and herbivorous fish catch. *PloS one*,*11*(2), e0148250.

Hiddink, J. G., & Coleby, C. (2012). What is the effect of climate change on marine fish biodiversity in an area of low connectivity, the Baltic Sea?. *Global Ecology and Biogeography*, *21*(6), 637-646

Hu, X. G., Jin, Y., Wang, X. R., Mao, J. F., & Li, Y. (2015). Predicting impacts of future climate change on the distribution of the widespread conifer Platycladus orientalis. *PloS one*, *10*(7), e0132326.

Jose, A. M., & Cruz, N. A. (1999). Climate change impacts and responses in the Philippines: water resources. *Climate research*, *12*(2-3), 77-84.

Lefort, S., Aumont, O., Bopp, L., Arsouze, T., Gehlen, M., & Maury, O. (2015). Spatial and body-size dependent response of marine pelagic communities to projected global climate change. *Global change biology*,*21*(1), 154-164.

Mayer, P., Estruch, V., Blasco, J., & Jover, M. (2008). Predicting the growth of gilthead sea bream (Sparus aurata L.) farmed in marine cages under real production conditions using temperature-and time-dependent models.*Aquaculture Research*, *39*(10), 1046-1052.

Moraga, A. D., Wilson, A. D., & Coo`ke, S. J. (2015). Does lure colour influence catch per unit effort, fish capture size and hooking injury in angled largemouth bass?. *Fisheries Research*, *172*, 1-6.

Mulazzani, L., Manrique, R., Trevisan, G., Piccinetti, C., & Malorgio, G. (2014). The relationship among catch, fishing effort, and measures of fish stock abundance: implications in the Adriatic Sea. *Canadian Journal of Fisheries and Aquatic Sciences*, *72*(3), 410-421.

Raby, G. D., Packer, J. R., Danylchuk, A. J., & Cooke, S. J. (2014). The understudied and underappreciated role of predation in the mortality of fish released from fishing gears. *Fish and Fisheries*, *15*(3), 489-505.

Riordan, E. C. (2013). Modeling the Uncertain Future of a Threatened Habitat: Climate Change and Urban Growth in California Sage Scrub.

Robertson, G., Candy, S. G., & Hall, S. (2013). New branch line weighting regimes to reduce the risk of seabird mortality in pelagic longline fisheries without affecting fish catch. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *23*(6), 885-900.

Romeo, T., Perzia, P., Esposito, V., Malara, D., Battaglia, P., Consoli, P., ... & Andaloro, F. (2011). Relationship between swordfish swimming behaviour and sea surface temperature in the central Mediterranean Sea during the reproductive period. *Marine Biology Research*, *7*(2), 186-194.

Rountrey, A. N., Coulson, P. G., Meeuwig, J. J., & Meekan, M. (2014). Water temperature and fish growth: otoliths predict growth patterns of a marine fish in a changing climate. *Global change biology*, *20*(8), 2450-2458

Shelton, C. (2014). Climate change adaptation in fisheries and aquaculture– compilation of initial examples. Retrieved February 2016 from https://goo.gl/8PfR52

Švagždys, A. (2009). The long-Term variaTion of ruff catches in the curonian lagoon. *Acta Zoologica Lituanica*, *19*(3), 197-204.

Winder, M., Berger, S. A., Lewandowska, A., Aberle, N., Lengfellner, K., Sommer, U., & Diehl, S. (2012). Spring phenological responses of marine and freshwater plankton to changing temperature and light conditions. *Marine Biology*, *159*(11), 2491-2501.

ONE FOR ALL, ALL FOR ONE: THE ROLE OF DAMAYAN AND BAYANIHAN IN BUILDING A DISASTER RESILIENT COMMUNITY

Honey Lei N. Bagalayos, Nenita Claire T. Barizo, Clarichell C. Berja,
Pia Marie G. Bucayu, Amancio A. Donato
& Darin Jan Tindowen, MA
Bachelor of Arts in Psychology

*Presented during the **2017 International Research Conference on Sustainable Development** organized by AZAARSU and Clarivate Analytics held in Azerbaijan on November 24-26, 2017.*

ABSTRACT

Natural disasters are predominant in the Philippines especially typhoons and floods where poorer communities are affected. This study looked into the factors which promote disaster resilience among the people living in flood prone poor communities since there are only few local studies about factors which promotes disaster resilience among the Filipinos. This study highlighted how damayan (culture of compassion) and bayanihan (cooperation) are used as resources by community members in coping with the effects of typhoons and its accompanying floods through the specific activities done by the participants. Using purposive sampling employing site selection and networking selection, 10 residents from each of the three flood-prone barangays were selected as participants of the study. Interview and in depth conversations had served as the main instruments used by the researchers to gather the needed data. The result of the study showed the significance of damayan and bayanihan in disaster resiliency of the participants.

Keywords: *Damayan, Bayanihan, Disaster Resilient Community, Floods, Typhoons*

INTRODUCTION

The Philippines is a natural hazard prone country, experiencing several types of natural disaster each year because of its location and landscape. Of these, the most predominant are typhoons and floods. An annual average of 30 typhoons occur in the north-western Pacific Ocean, of which 20 occur in Philippines alone causing immense damage to life and property according to Asian Disaster Preparedness Center. In November 2013, the archipelago was hit by typhoon Haiyan (Yolanda), dubbed as the strongest typhoon to ever make a landfall. The typhoon killed over 7,000 (as of the tally by the Philippine National Disaster Risk Reduction and Management Council) and displaced over 1 million households. In recent years, the Philippines was also hit by typhoon Ketsana (Ondoy) that