Received April 2022; | Revised May 2022; | Accepted May 2022
DOI: 10.52631/jemds.v2i2.115

RESEARCH ARTICLE

Flood Control Measures in One Municipality in Camarines Sur, Philippines: Bases for Community-Based Flood Control Interventions

Romeo B. Sotto, Jr.*

[1]Camarines Sur Polytechnic Colleges
Nabua, Camarines Sur, Philippines

Correspondence
*Corresponding Author.
Email: rsotto@cspc.edu.ph

Abstract

Hydrometeorological hazards like flooding are inevitable; these affect agriculture and impact the economy for a prolonged duration. This research study was conducted to determine and assess the flood control measures in the municipality of Nabua in the Province of Camarines Sur, Philippines as bases for developing community-based flood control interventions. Using the descriptive evaluative survey method with a validated questionnaire as the primary data gathering instrument, gathered data were computed, tabulated, analyzed, and interpreted. It has shown that the degree of implementation of the flood control measures is high for structural and non-structural flood management. The null hypothesis is rejected. The difference between the responses of the respondents was significant. The extent of the effect of the factors directly influences the implementation of the flood control measures. It can be concluded that the Municipality of Nabua controls flooding primarily through its flood control infrastructures that are strategically situated in the municipality, human resources, and collaboration and linkages. Moreover, the responses of the respondents are significantly different. Improvement and upgrading of its physical facilities and equipment to acquire real-time information; intensifying its campaign and information drive to build a more vital link between the municipality and its constituents, and information dissemination using social media and communications technology can increase awareness, mitigation, control, and response to flooding are thereby recommended. The community-based interventions on flood control can serve as a guide and an eye-opener for the local government unit of Nabua to promulgate and enact municipal ordinances about flood control.

KEYWORDS:
Flood Control Measures, Municipality of Nabua, Flood Control Interventions, Community-based

1 | INTRODUCTION

The Philippines, being one of the countries found in the Pacific Ring of Fire, frequently experiences various hydro-meteorological disasters like typhoons, earthquakes, volcanic eruptions, flooding, El Niño, and La Niña from all over the different parts of the country. Of these hydro-meteorological disasters, flooding is the major disaster that devastates property

and human lives, causes displacement of farms, affects plant growth and survival, and ultimately impacts socio-economic welfare. According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), flooding is characterized as an "abnormal progressive rise in the water level of a stream that may result in the overflowing by the water of the normal confines of the stream with the subsequent inundation of areas which are not normally submerged" (2006). The municipality of Nabua remains predominantly agriculturally related in terms of industrial activities. This is manifested by its: (1) proximity to both Balatan Port and Pantao Port, (2) Inherent vast agricultural lands, (3) An urban growth center, and (4) suitable agro-industrial site. During heavy rains, subsequent flooding usually occurs in significant parts of the municipality, affecting agriculture and impacting the economy for a prolonged period of flooding. Numerous research was conducted and studied by various authors concerning flooding and along with its many sub-issues like risks, hazards, mitigation, reduction, among others - Merz, Hall, Disse, and Schumann (2010) have studied the interaction of danger and vulnerability that results on flood risks; Kellens, Terpstra, De Maeyer (2013) concluded that flood hazards are the most common and destructive of all natural disasters; Morrison, Westbrook, Noble (2017) stated that environmental management literature suggests that resilience is key to managing complex systems and reducing vulnerability resulting from uncertainty and unexpected change; de Bruijin (2010) indicates that resilience strategies for flood risk management focus on minimizing flood impacts and enhancing recovery; Bradford, O'Sullivan, van der Craats, Krywkow, Rotko, Aaltonen, Bonaiuto, De Dominicis, Waylen, and Schelfaut (2012) have posited that the public perception of flood risk and flood risk information is often overlooked when developing flood risk management plans; and, Tripathi (2018) stated that the project for Community-based Approaches developed self-help capabilities in flood-prone communities. Locally, very little research focused on the flood in the municipality of Nabua - Abinal (2003) stipulated that the occurrence of floods cannot be avoided in the Rinconada area, and Balang et al. (2016) have conducted a study assessing the Barit River as a possible solution to resolve flood in the Rinconada. Despite this much research on the flood, there was no research on flooding in the municipality of Nabua concerning all the sectors at the community level and proposing an intervention plan for community-based flood control interventions.

The Municipality of Nabua has systematically evaluated the municipality's Strengths, Weaknesses, Opportunities, and Challenges across hazards through the Municipal Disaster Risk Reduction Management Office (MDRRMO). Flooding is the first hazard evaluated, and the municipality has come up with the institutionalizing of the Republic Act 9003 (R.A 9003), also known as the Ecological Solid Waste Management Act of 2000, which provides an Ecological Solid Waste Management Program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited and providing penalties.

As per the record of the Nabua-MDRRMO, the historical timeline of the disastrous typhoon which affected Nabua shows that flooding is the main problem of the municipality, involving the various sectors of the community, namely – the agricultural sector, transport sector, market/vendor sector, religious sector, academic sector, barangay sector, local folk sector, senior citizen sector, and youth sector. These sectors are affected by floods for two to three days on average. Last December 2018, the Municipality of Nabua experienced severe flooding that partially submerged the marketplace, the Población area, and some of the rice fields of Nabua. The flooding was caused by tropical depression Usman, leading to three days of impassable roads. The height of the flood was measured as approximately six feet in the Población area and knee-deep to other surrounding barangays in the Población.

Most of the barangays in the municipality are low-lying barangays that annually experience flooding with an approximate average height of 2 feet during heavy rains and typhoons, making it difficult for Nabuaeños to travel from house to the Población, thus affecting the daily routines of going to the market, selling, and buying goods and even going to work. This study aims to help solve flooding in Nabua through environmental education to raise awareness of students and local folks, suggest measures to mitigate flooding, promote sustainable environmental practices in schools, homes, and offices, and empower the community folks through activities that will reduce flooding. With this, the need for enhanced community-based flood control interventions to control, if not eradicate, the occurrence of floods in the Municipality of Nabua is imperative. The researcher felt the need to appraise existing measures/interventions to help the local government unit of Nabua come up with more effective and efficient flood control interventions.This research study aims to assess the flood control measures in the municipality of Nabua as bases for developing community-based flood control interventions. Specifically, the research aims to: Determine the respondents' assessment of the flood control measures the respondents would be obtained.

2 | METHODOLOGY

2.1 | Research Setting

The Municipality of Nabua traces the historical origin of its name way back during the Spanish Colonization. In 1571, an Augustinian Friar named Fray Alonzo Gimenez reached one of the rancherias called Lupa, under Datu Panga from Borneo. The good friar found persons inside the said rancheria cutting coconuts. He was offered to partake in the inside shoot of coconut, which the native's called "BOA." Immediately, the good friar tagged the place as "NABUA," pronounced with his Spanish Accent. From that time onwards, this place becomes popularly known as NABUA.

The municipality of Nabua is geographically located between 123 degrees and 124 degrees longitude and 13- and 14-degrees latitude. It is bounded on the north by the Municipalities of Baao and Bula, on the south by the Municipality of Baao, on the east by the Iriga City, and on the west by the Municipality of Balatan. The municipality is an established growth center in the Southeast part of Camarines Sur province or the mid-section of the Bicol River Basin Area. Along the Legazpi-Iriga-Naga-Daet growth corridor, the municipality is located about 53.0 km from Legazpi City and 2.0 km from Iriga City, a minor urban center.

The topography of the Municipality of Nabua is one (1) in-land mass containing a total area of 8 854.4193 hectares. This whole land area is distributed among the forty-two (42) barangays of the municipality, nine (9) of which are considered urban barangays, and thirty-three (33) are deemed rural barangays. San Antonio Poblacion has the most significant land area of 2.176 hectares among the urban barangays. In the rural barangays, Duran has the largest land area in the entire municipality of 428.1501 hectares, while San Roque Madawon has the smallest size of 76.3228 hectares.

Several rivers and creeks can be found in the municipality. On the northeast is the Waras River extending to the Iriga-Nabua. In contrast, the Barit River extends the Nabua-Baao boundary going south until it passes the west side of the población encircling it east up to the Nabua-Iriga boundary. The Bicol River crosses the central part of Nabua extending from Nabua-Bula boundary to Nabua-Bato boundary. Based on Figure 1 - the topographic map of the municipality of Nabua, most of the barangays are low-lying, ranging from 4.012510 (blue) – to 36.949805 (pale yellow), signifying that during typhoons, monsoon rains, and locally heavy rains, these areas can be quickly submerged in floodwaters.

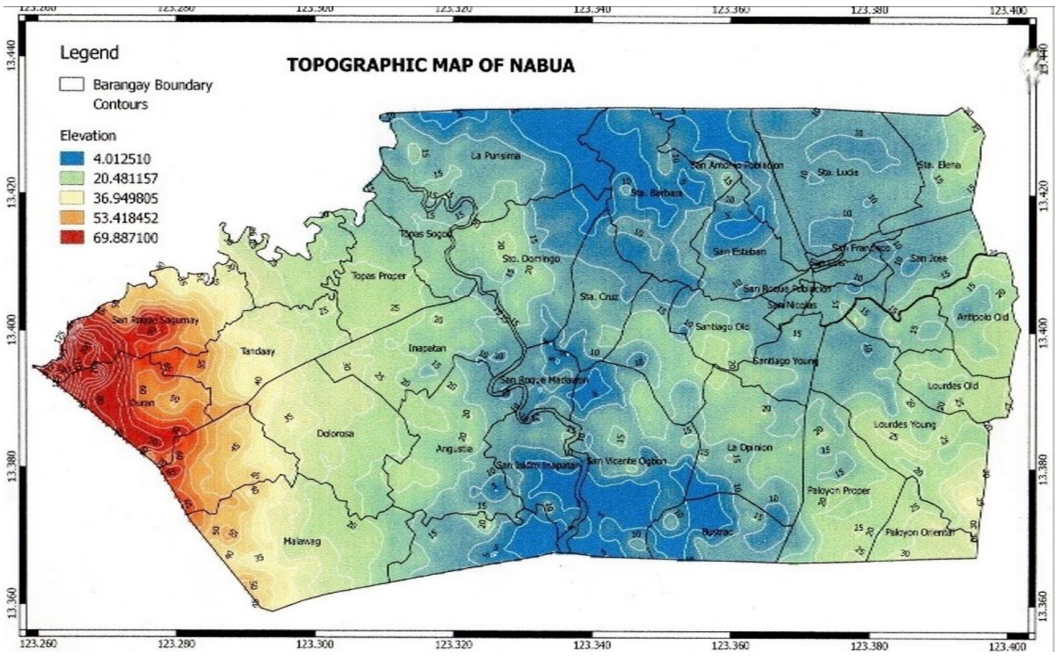

FIGURE 1 Topographic Map of Municipality of Nabua, Camarines Sur

2.2 | Research Tools

The primary tool used in this study is the questionnaire purposely designed by the researcher to answer the salient questions of the survey. It consisted of two parts: Part I was the extent of implementation of flood reduction management measures along with structural and non-structural management measures of the municipality of Nabua, and Part II was the extent of the factors that affect the implementation of the existing flood reduction management measures. The questionnaire underwent several revisions in its development, validation, dry run, and approval. Experts in the field were consulted on the questionnaire's consistency, clarity, content, and language. The questionnaire was also translated into Filipino and English.

2.3 | Procedure

A formal request to undertake the study was sought from the Municipal mayor's office through a letter sent to the Municipal Disaster Risk Reduction Management Office (MDRRMO) to allow the researcher to distribute questionnaires to the concerned respondents of the study. The researcher personally distributed and retrieved the questionnaires to the concerned respondents of the survey through the concerned offices of the respondents. After the retrieval, the gathered data was tabulated, organized, analyzed, and interpreted descriptively.

2.4 | Data Analysis

The researcher treated the data gathered statistically with frequency count, percentage, weighted mean, Likert's scale, and Kruskal-Wallis H-Test. The results were computed, tabulated, analyzed, and interpreted. For the quantitative approach, the study used descriptive statistics such as weighted mean, frequency counts, percentage, and rank to analyze the data that were acquired from the respondents. Frequency count, which refers to tallying and classifying responses, describes respondents' total number. The percentage, which refers to the fraction of a hundred, and derived by dividing one quantity by another with the latter rebased to a hundred, was also used. It helped make comparisons and differences of a benchmark or initial value relevant to the study. The mean score, calculated by getting the sum of the variables divided by the total number of observations and the cumulated mean, was estimated to describe and interpret each indicator. It assessed the extent of implementation of the community-based flood management interventions. Kruskal-Wallis H-Test was employed to determine the significant difference between the respondents' responses per barangay. The data was supported using MS Excel in further analyzing the results.

3 | RESULTS AND DISCUSSIONS

Data gathered was statistically analyzed, interpreted, and discussed. The discussion was based on the evaluations that answer the problems which are investigated in this research – mainly, the assessment of the respondents on the degree of implementation of flood reduction management measures and the factors that affect the performance of the flood reduction management measures as implemented by the municipality of Nabua. The gathered information was presented in a tabular organization to ensure a vivid presentation.

3.1 | Implementation of Flood Control Measures

Several flood control measures were determined and assessed by the different sectors: the agricultural industry, Academic sector, Transport sector, Market/Vendor sector, religious sector, Youth sector, Senior Citizen sector, Barangay sector, and Local Folk sector. The following data shows the assessment of the various sectors as to the degree/extent of implementation of the flood control measures as to (a) structural and (b) non-structural flood control measures in the municipality.

3.2 | Structural Flood Control Measures

Flood control measures about the structures or infrastructures' property counteract the flood event to protect people and reduce the hazard or influence the course or probability of occurrence of the flood event. Natural Water Retention Measures - involves implementing measures to restore or mimic the natural functions of rivers, floodplains, and the wider catchment, to store water in the landscape and slow the rate at which water runs off the landscape into rivers, streams, and other bodies of water as a

water catchment. Infrastructure - These are flood control practices that include construction, reconstruction, and rehabilitation of watercourses and water protection facilities that help lessen flood occurrence. Table 1 shows the summary of the respondents' assessment as to the degree of implementation of the municipality of Nabua of the structural control measures.

TABLE 1 Structural Flood Control Measures

Indicators	AWM	Interpretation	Rank
Structural Flood Control Measures			
Natural Water Retention	3.7	HI	2
Infrastructure	3.8	HI	1
Overall Average Weighted Mean	3.75	HI	

Infrastructural measures ranked first among the two subcategories under the structural flood management measures with an average weighted mean of 3.8, interpreted as high implementation. In contrast, natural water retention measures ranked second with an average weighted mean of 3.7, interpreted as High Implementation. The overall average weighted mean for the Structural Flood Management Measures is 3.75, interpreted as High Implementation. The Municipality of Nabua's degree of implementation of the structural flood management measures is high, implying that the municipality is trying its best to reduce flooding through the construction of many infrastructures that control flooding in the area and least for the natural water retention measures. It is concluded that the municipality's pursuit of reducing floods is focused primarily on building flood protection infrastructures rather than the restoration and rehabilitation of natural water retention facilities.

Abinal (2003) studied that the flooding in the Rinconada area can be minimized through the proper construction of the flood reduction infrastructures, especially along its rivers. The more improved the physical facilities and the equipment, the greater the chance of flooding occurring in the municipality. With the municipality's investment to upgrade to a state-of-the-art facility, the city of Nabua can control flooding.

3.3 | Non-Structural Flood Control Measures

Non-structural flood control measures refer to flood management measures that do not include structural or infrastructures that directly influence flooding. This category pertains to the human actions and behavior that reduce flooding. Physical Facilities / Equipment - this pertains to the available material resources that can be utilized in flood control in the occurrence of a flood; Pieces of training and Seminars – these are essential in providing information and technical knowledge to a group of individuals or community; Human Resources - in the implementation of the flood control measures, it would not be possible without the personnel that would be implementing it, and; Linkages and Collaboration - to sustain feasible measures, the municipality ventures to collaborate with different organizations towards the attainment of a flood-free municipality.

Table 2 shows the summary of the assessment of the respondents as to the degree of implementation of the municipality of Nabua of the non-structural flood control measures.

TABLE 2 Non-Structural Flood Control Measures

Indicators	AWM	Interpretation	Rank
Non-Structural Flood Control Measures			
Physical Facilities/Equipment	3.8	HI	3
Training and Seminars	3.6	HI	4
Human Resources	3.9	HI	1.5
Linkages and Collaboration	3.9	HI	1.5
Overall Average Weighted Mean	3.8	HI	

Based on Table 2 , among the different subcategories of the non-structural flood management measures, Human Resources and Linkages and Collaboration have both ranked first with an average weighted mean of 3.9, interpreted as High Implementation, followed by the Physical Facilities and Equipment with an average weighted mean of 3.8 interpreted as High Implementation. Lastly, Training and Seminars have an average weighted mean of 3.6, interpreted as High Implementation. With the different responses of the respondents, the overall average weighted mean for the non-structural flood control measures is 3.8, interpreted as High Implementation. The municipality of Nabua's degree of implementation regarding non-structural flood management measures is high, implying that the city has empowered its human resources and linkages and collaboration gearing towards one goal of reducing floods. Furthermore, the municipality should also improve its physical facilities and equipment and provide proper training and seminars for all its sectors. As studied by Balang et al. (2016), flooding can be reduced through collaboration and cooperation of the NGOs and GOs towards this concern.

4 | SIGNIFICANT DIFFERENCE IN THE ASSESSMENT OF THE DIFFERENT FLOOD CONTROL MEASURES

The study used the Kruskal-Wallis H-test to compare three or more independent groups. This is a non-parametric test that does not require normal distribution. This is an F-test (ANOVA) alternative in a parametric test. Table 3 shows the summary of the Kruskal-Wallis H-Test for the different subcategories under structural flood management.

TABLE 3 Kruskal-Wallis H-Test: Structural Flood Control Measures

STRUCTURAL FLOOD CONTROL MEASURES	NO. OF OBSERVATION	TABULAR VALUE (TV)	DECISION RULE	COMPUTED VALUE (CV)	DECISION
Natural Water Retention	45	$X^2_{0.05} = 15.507$	If CV<TV, accept H_o; If CV>TV,reject H_o	19.14	Reject H_o
Infrastructure	63			30.74	Reject H_o
AVERAGE COMPUTED VALUE				24.94	Rejected H_o

Since the computed H-value of 19.14 and 30.74 for Natural Water Retention and Infrastructure, respectively, is greater than the X^2 tabular value of 15.507 at a 0.05 level of significance with 8 degrees of freedom, the null hypothesis is rejected. This means a significant difference in assessing the different sectors and structural flood management measures. It can be concluded that the other sectors do not equally perceive the degree of implementation along with the structural flood management.

Table 4 summarizes the Kruskal-Wallis H-test for the different subcategories under the non-structural flood management.

Since the computed value of 50.27, 25.09, 18.74, and 34.64 for Physical Facilities and Equipment, Training and Seminars, Human Resource and Collaboration and Linkages, respectively, is greater than the X^2 tabular value of 15.507 at a 0.05 level of significance with 8 degrees of freedom, the null hypothesis is rejected. This means a significant difference in the assessment of the different sectors of flood management along with non-structural flood management measures. It is concluded that the other sectors do not equally perceive the degree of implementation and non-structural flood management.

As stated by A. Morrison, C.J. Westbrook, B.F. Noble (2017), the environmental management literature suggests that resilience is key to managing complex systems and reducing vulnerability resulting from uncertainty and unexpected change. Yet, flood risk management (FRM) has mainly emerged from a culture of resistance. This paper takes the pulse of the current state of FRM research, with a focus on how the scholarly community has approached governance for flood resilience. It is also concluded that the different sectors are not equally wise on the degree of implementation of the other structural and non-structural flood control measures implemented by the municipality of Nabua. Furthermore, the difference in the respondents' perception denotes that the different sectors keep an eye on every action of the local government.

TABLE 4 Kruskal-Wallis H-Test: Non-Structural Flood Control Measures

NON-STRUCTURAL FLOOD CONTROL MEASURES	NO. OF OBSERVATION	TABULAR VALUE (TV)	DECISION RULE	COMPUTED VALUE (CV)	DECISION
Physical Facilities and Equipment	99	$X^2_{0.05} = 15.507$	If CV<TV, accept Ho;	50.27	Reject H_o.
Training and Seminars	45			25.09	Reject H_o.
Human Resource	27			18.74	Reject H_o.
Collaboration and Linkages	54		If CV>TV, reject Ho	34.64	Reject H_o.
AVERAGE COMPUTED VALUE				32.185	Reject H_o

5 | EXTENT OF EFFECTS OF THE FACTORS

Different identified factors affecting the implementation of Flood Control Measures of the Municipality of Nabua were appraised as to the extent of the effect on the performance of the municipality by the different sectors, namely – Academic sector, Agricultural sector, Barangay sector, Local Folk sector, Market/Vendor sector, religious sector, Senior Citizen sector, Transport sector, and Youth sector. The following data show the assessment of the various sectors as to the extent of the effect of the flood control (a) structural and (b) non-structural in the municipality.

5.1 | Structural Flood Control Measures

Flood control measures refer to the structures or infrastructures that counteract the flood event to protect people and property from reducing the hazard or influencing the course or probability of flooding. These include the Natural water retention measures and the Infrastructural measures.

Table 5 summarizes the extent of the effect of the factors affecting the implementation of the flood management measures in the municipality of Nabua. The size of the impact of the factors affecting the performance of the city of Nabua is relatively large, as shown by the average weighted mean, both the natural water retention and infrastructure, which is 3.7, interpreted as a High Extent. Findings imply that the factors affecting these two subcategories under the structural flood management of Nabua are high. It can be inferred that the elements under these two categories may directly influence the degree of implementation; the more extensive the factors are, the higher the degree of performance.

It is concluded that the factors can significantly influence the control of floods once the municipality of Nabua has improved its characteristics. With greater heights, the city can be flood-controlling. Its topography is a catch basin of floodwater in the Rinconada area; this leaves no choice for the town but to control flooding in its coverage. According to the article on Urban flood disaster management and the publication on Flood Disaster Mitigation and Management: A Synthesis and Key Lessons, flooding has significantly impacted the communities in both urban and rural communities; rural and urban planning is of significant difference. Thus, the government must thoroughly plan flood control and mitigation with the different local government units.

TABLE 5 Summary of the Extent of Effect of the Factors- Structural Flood Control Measures

Indicators	AWM	Interpretation	Rank
Structural Flood Control Measures			
Natural Water Retention	3.7	HE	1.5
Infrastructure	3.7	HE	1.5
Overall Average Weighted Mean	3.7	HE	

TABLE 6 Summary of the Extent of Effect of the Factors-Non-Structural Flood Control Measures

Indicators	AWM	Interpretation	Rank
Non-Structural Flood Control Measures			
Physical Facilities/Equipment	3.6	HE	3.5
Training and Seminars	3.6	HE	3.5
Human Resources	3.9	HE	1
Linkages and Collaboration	3.8	HE	2
Overall Average Weighted Mean	3.7	HE	

Based on Table 6 , the factors affecting the implementation of the Municipality of Nabua along the non-structural flood management are high, as shown by the average weighted means of the different subcategories, which are 3.9 for the human resources, 3.8 for the linkages and collaboration, and 3.6 for both physical facilities/equipment and training and seminars. The extent of the effect on these different subcategories directly influences the degree of implementation. It can be concluded that the Municipality of Nabua has felt the impact on its Human resources extensively but least extensively on the physical facilities/equipment and the conduct of training and seminar. It can be inferred that the municipality pivots towards hiring knowledgeable personnel and staff, but less on physical facilities, acquiring equipment, and conducting training and seminars. According to Dawson et al., the stakeholders must plan the flood practices to develop a more feasible and sustainable plan for mitigating floods. With this, the municipality of Nabua must continue to improve its relations and communications with its sectors for the city to have one move for flood control.

6 | COMMUNITY-BASED FLOOD CONTROL INTERVENTION (FLOOD MANAGEMENT MEASURES: A PRACTICAL GUIDE FOR FLOOD CONTROL)

The output of this study is the development of a community-based program on flood control depicted on a brochure-type display. The guide has been developed to provide simple, straightforward information on flood reduction management measures for the various sectors of the municipality of Nabua. The focus has been put together in collation of the different flood reduction measures utilized by the other countries and urban-rural communities in the Philippines, which eventually can be adopted by the municipality of Nabua to reduce the occurrence of floods in the city. The community-based program on flood control brochure or guidebook showcases various interventions that can help gear the municipality towards its aim of reducing floods.

Using the Handbook. Flood Control Measures (FCM) implementation can vary in complexity, cost, and benefits. This guide offers advice on the range of FCM measures available and critical information on the different sectors they can choose as to which FCM they can be of help. Data is also provided on the potential sources of government collaboration to help support the work. The following legends were utilized for the organization.

ABOUT. This section provides a brief background and information about the presented intervention or measure. This section also explains the rationale of the intervention and its classification as to structural or non-structural flood reduction measures.

IMPACT. This section provides the possible effect of the intervention on the different sectors. Furthermore, this section gives an overview of the possible outcomes once the intervention is appropriately implemented and sustained.

SUSTAINABILITY. This section provides information regarding the sustainability and the maintenance efforts (if the intervention needs high effort maintenance or low effort maintenance) and the maintenance cost (ranging from high-cost care or low-cost maintenance). This section provides an idea of which intervention is suitable for a specific community.

COLLABORATION. This section provides insight into possible linkage or partnership with government agencies in the locality. This section also offers networks for possible connections.

The guide also has some addendum like the Municipal Ordinances, Background of Flood Reduction Management, and the Prayer for the Deliverance of Calamities (Oratio Imperata) – since Nabuaeños are known to be pilgrims of the Holy Cross and are devotees to Our Lady of Katipanan and Agustia.

Photos are also included in the guide to provide concrete examples of the actions being pointed out in the intervention presented. Those photos with credits appearing in the direction were taken from the official Facebook account of the MDRRMO-Nabua (@MDRRMO Nabua) and the rest of the pictures were personally taken by the researcher during the conduct of the study.

7 | CONCLUSIONS

The municipality of Nabua has a high implementation of both the Structural and Non-Structural Flood Control Measures. Construction of flood-reducing infrastructures like dams, dikes, water reservoirs, pumping stations, human resource development, collaboration, and linkages are the primary flood control measures in the Municipality of Nabua. The responses of the respondents varied significantly, indicating varying perceptions and assessments. The extent of the effect of the different factors is excellent for both structural and non-structural flood control measures.

8 | RECOMMENDATIONS

In support of the Sustainable Development Goal (SDG) 13, the study focuses on mitigating and combatting climate change and its impacts. This study aims to capacitate communities locally through community-based intervention in flood control. In this relation, the municipality of Nabua should focus on the construction of infrastructures that control flooding and concentrate on the restoration and renaturation of natural waterways. Furthermore, it is recommended that the Municipality of Nabua improve and upgrade its physical facilities and equipment to acquire real-time information about the flood forecasting and alert systems. Moreover, the Municipality of Nabua should give symposiums and training to the different sectors to build a more vital link to other community stakeholders. Proper information dissemination and 'text blasting' can augment the variation of the perceptions of the different sectors about flood control, preparedness, mitigation, and control. Furthermore, a centralized data system and a data server should be utilized. Improvement of the floodplains or low-lying areas to become flood resilient, further construction of flood reducing infrastructures, upgrading to state-of-the-art facilities and equipment, and conducting monthly, quarterly or annual training and seminars must be given per sector to increase the degree of implementation.

References

Abinal, Y. V. . (2003). Status of Flood Control Program in Rinconada: An Assessment, unpublished Master's Thesis, Master of Arts in Engineering Technology,. *Camarines Sur Polytechnic Colleges (CSPC)*.

Balang, C.J., Briones, J., Ireno, P.J., Malate, N., and Menorca, E. (2016). *Assessment of Waterways along Barit River to its outfall, unpublished undergraduate thesis, Bachelor of Science in Civil Engineering*, *Camarines Sur Polytechnic Colleges (CSPC)*.

Bradford, R., O'Sullivan, J. J., Van der Craats, I., Krywkow, J., Rotko, P., Aaltonen, J., … Schelfaut, K. (2012). Risk perception–issues for flood management in Europe. *Natural hazards and earth system sciences*, *12*(7), 2299–2309.

Carey, T.G., Naval, V.C., and Prieto, N.G., . (2016). Practical Research II for Senior High School. *Quezon City: Lorimar Publishing Inc.*.

Dawson, R. J., Ball, T., Werritty, J., Werritty, A., Hall, J. W., & Roche, N. (2011, May). Assessing the effectiveness of non-structural flood management measures in the Thames Estuary under conditions of socio-economic and environmental change. *Global Environmental Change*, *21*(2), 628–646. Retrieved 2022-06-23, from `https://linkinghub.elsevier.com/retrieve/pii/S0959378011000148` doi: 10.1016/j.gloenvcha.2011.01.013

De Bruijn, K. (2004). Resilience indicators for flood risk management systems of lowland rivers. *International Journal of River Basin Management*, *2*(3), 199–210.

ESCAP, U. (2019). The disaster riskscape across Asia-Pacific: pathways for resilience, inclusion and empowerment.

Fiscal, R.R. . (2010). Research Methods in Education: Integrating Diversity with Quantitative and Qualitative Approaches. *Society Publishing. 2010 Winston Park Drive, 2nd floor, Oakville Canada*.

Kellens, W., Terpstra, T., & De Maeyer, P. (2013, January). Perception and Communication of Flood Risks: A Systematic Review of Empirical Research: **Perception and Communication of Flood Risks**. *Risk Analysis*, *33*(1), 24–49. Retrieved 2022-06-23, from https://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2012.01844.x doi: 10.1111/j.1539-6924.2012.01844.x

Merz, B., Hall, J., Disse, M., & Schumann, A. (2010). Fluvial flood risk management in a changing world. *Natural Hazards and Earth System Sciences*, *10*(3), 509–527.

Morrison, A., Westbrook, C., & Noble, B. (2018, September). A review of the flood risk management governance and resilience literature: Flood risk management governance and resilience literature. *Journal of Flood Risk Management*, *11*(3), 291–304. Retrieved 2022-06-23, from https://onlinelibrary.wiley.com/doi/10.1111/jfr3.12315 doi: 10.1111/jfr3.12315

Municipal Disaster Risk Reduction Management Council (MDRRMC) of the Municipality of Nabua . (2019). Profile of Nabua.

Tripathi, R. . (2018). WMO Secretariat, Community-based Approaches to Flood Management in Thailand and Lao People's Democratic Republic. , *67*(1).

How to cite this article: R. J. B. Sotto, (2022), Flood Control Measures in One Municipality in Camarines Sur, Philippines: Bases for Community-Based Flood Control Interventions, *Journal of Education, Management and Development Studies*, *Vol. 2 No. 2*