

ENHANCING ZAMBOANGA CITY'S URBAN FLOODING RESILIENCE: A FORWARD-LOOKING EVALUATION OF FLOOD MANAGEMENT AND HAZARD MITIGATION STRATEGIES

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Abstract

Rivers are vital to sustaining human settlements, yet human interventions have disrupted natural fluvial processes, leading to ecological degradation, altered river dynamics, and heightened flood risks. Floods remain the most common and destructive natural disaster worldwide, causing severe social, economic, and environmental damage. Zamboanga City, Philippines, exemplifies these challenges, frequently experiencing floods exacerbated by inadequate management and mitigation strategies. This study evaluates the effectiveness of the city's flood management and hazard mitigation programs as a forward-looking assessment of its urban flood resilience, aligning with Sustainable Development Goals (SDG) 16.3 on Strong Institutions and SDG 17 on Partnerships for the goals. A mixed-methods approach was adopted, combining surveys of 200 residents in flood-prone barangays with qualitative data from KIIs and FGDs of 30 government officials, planners, engineers, and disaster risk reduction personnel. Findings revealed that 59.5% of respondents perceived their communities as inadequately prepared, and 57.5% expressed dissatisfaction with mitigation measures. Key challenges identified include poor infrastructure (36.5%), limited public awareness (28%), weak inter-agency coordination (21.5%), and insufficient funding (13.5%). Governance gaps were also evident, with respondents citing poor coordination (32.5%) and inadequate resources (27%) as primary issues. The study concluded that in order to address the key challenges identified policy recommendations derived should include infrastructure enhancement (adoption of state-of-the-art) and maintenance (through drainage systems improvement, river rehabilitation and dredging, and evacuation infrastructure); strengthening governance and coordination (through inter-agency collaboration, policy enforcement, and resource allocation); and community engagement and education (through public awareness campaigns, capacity building programs, and empowerment through volunteerism).

Keywords: urban flooding resilience, flood management, hazard mitigation, governance and policies, and infrastructure and engineering

1. INTRODUCTION

Rivers are the lifeline of the human race across the world. Many of the villages, towns, hamlets and cities in the world are located along the riverbanks. However, the intervention of human with the natural process of the fluvial streams has contaminated the water, damaged the ecology, altered the transit capacity, raised the suspended load, and triggered the fluvial hazards (Chaudhuri et al. 2022). For instance, due to rapid growth of population and raising demand for land, humans began to live within the valleys and flood plains of rivers. Consequently, these inhabitants are constantly threatened during high- and low-discharge intervals (Shivashankar et al. 2022)

The most prevalent fluvial risks encountered in river systems are generally classified as follows: floods, lateral erosion, strainers, and undercuts. Floods are the most common, widespread, and devastating natural disaster, causing significant social, economic, and environmental damage in both developing and wealthy countries (Singh et al. 2022; Wallwork et al. 2022).

Zamboanga City, located in the southern part of the Philippines, is highly vulnerable to natural disasters such as floods due to its location near major rivers. Over the past few decades, the

city has experienced several devastating floods that have caused significant damage to infrastructure, homes, and properties, resulting in economic losses and displacement of communities, as well as loss of life. Despite the city's vulnerability to floods, there is a lack of effective flood management and hazard mitigation strategies in place. The proposal seeks to address the challenges faced by the local government in addressing urban flooding resilience and to identify potential solutions to mitigate the impact of flooding.

Ultimately, this research proposal aims to explore forward-looking evaluation on the effectiveness of the various flood management and hazard mitigation strategies to enhance the understanding of the complex interactions among different stakeholders, policies, infrastructures, and natural processes to address urban flooding resilience in the context of Zamboanga City, Philippines. The findings will contribute to evidence-based decision-making and the development of more robust flood management and hazard mitigation strategies in the urban areas of this city grounded on **United Nation's Sustainable Development Goals (SDGs) 16.3 Strong Institutions as well as 17 Partnership for the Goals.**

Background of the Study

In an article penned by Noriega of GMA News in October 29, 2022, Zamboanga City was placed under a state of calamity, through the City Disaster Risk Reduction and Management Council as chaired by Mayor John Dalipe, due to the onslaught of severe Tropical Storm *Paeng*. In a statement, the Zamboanga City LGU said this was approved by the Sangguniang Panlungsod during a special session. *"The declaration will enable the city government and the affected barangays to utilize resources and address [the damage] caused by the tropical storm,"* the LGU said. The local government, citing the Emergency Operations Center, said one person died, while four others are still missing following a series of flash floods. More than 5,000 families were evacuated in at least 42 barangays affected by the floods and heavy rains.

Further, as stated by Alipala of Inquirer in January 11, 2023, some 2,540 persons from 13 villages in Zamboanga City were evacuated from their homes as flood waters rummaged through their communities, spawned by incessant rains brought by a low-pressure area. Rescuers from the local government, backed by those from the city police, rushed to the villages of Cabaluay, Sangali, Guisao, Sto. Niño, Putik, Tugbungan, Tetuan, Tumaga, Guiwan Porcentro, Santa Maria, Cawit, Ayala, Zone IV, and San Jose to haul them off to safety. The evacuees were sheltered in 14 evacuation sites, mostly covered courts and barangay halls.

The City Disaster Risk Reduction and Management Office warned residents living along the Tumaga river after the water at the Pasonanca intake diversion dam rose to 77.60 meters, indicating it has breached the highly critical mark as its normal level is only 74.20 meters. The Zamboanga City Electric Cooperative cut off the power supply in some 18 areas of the city that were flooded as a precaution. Mayor John Dalipe suspended work in all local government offices due to the floods and continuing heavy rains. Dalipe also suspended classes at all levels throughout the city. The city's airport was closed to commercial flights on Wednesday after its runway was flooded. Flights were diverted either to Cagayan de Oro or Davao.

Just two weeks after being displaced from their homes due to massive flooding, hundreds of families in several villages in Zamboanga City experienced floods again due to continuous heavy rains. Due to the persistent inclement weather, Mayor John Dalipe ordered the suspension of classes in all levels in public and private schools of the city. He also cut short the work in local government offices. However, offices doing essential work were directed to maintain skeleton workforce, while frontline offices were told to maintain ample workforce for possible augmentation during emergency response. Some parts of the national highway and city streets turned into virtual rivers. Hundreds of families living along riverbanks had been advised by local rescuers to seek safer grounds.

On this outset, floods are the outcome of imbalances in natural forces and processes and are inevitable in the scheme of nature which occurs with a predictable frequency year after year, causing widespread morbidity and mortality over the continent.

1.1 Objectives

General objectives

The main objective of this research is to evaluate the effectiveness of the flood management and hazard mitigation strategies as implemented by Zamboanga City's local government in urban barangays as a forward-looking appraisal on its urban flooding resilience.

Specific objectives

The specific objectives of this study are as follows:

- a. To examine the interagency collaboration among government bodies involved in flood management and hazard mitigation.
- b. To identify the importance of strengthening early warning systems to enable timely and accurate flood warnings.
- c. To propose policies to improve governance on infrastructure resilience, engage communities through awareness campaigns and workshops, and establish a robust monitoring and evaluation framework for the enhancement of urban flood resilience in Zamboanga City.

1.2 Significance of the proposal

The proposed study on urban flooding resilience to analyze the effectiveness on the flood management and hazard mitigation of the local government of Zamboanga City can make a significant contribution to epistemology and practice of profession of public administration and good local governance for several reasons, to wit:

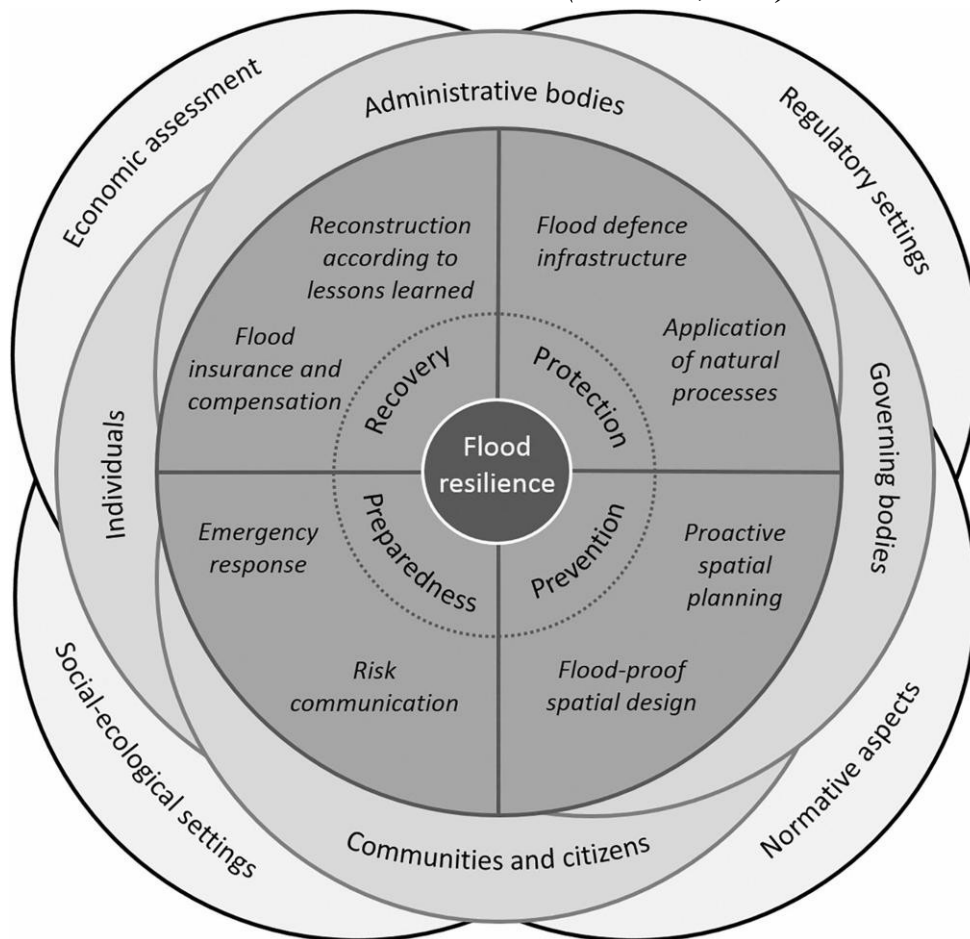
1. The study will contribute to a better understanding of the complex issues related to flood management and hazard mitigation in urban areas, particularly in cities located in low-lying areas and exposed to natural hazards.
2. The study will provide insights into the administrative challenges faced by local government in managing floods as well as mitigating hazards by enhancing interagency collaboration among government bodies.
3. The study will identify potential solutions to these challenges, such as improving governance on infrastructure resilience, enhancing community engagement, and establishing robust and monitoring and evaluation framework.
4. The findings of the study can inform policy and decision-making processes in the local government of Zamboanga City, potentially leading to more effective and sustainable urban flooding resilience strategies.

The study can serve as a model for other cities and countries facing similar challenges, providing valuable insights into the factors that contribute to successful urban flooding resilience efforts.

1.3 Review of Relevant Literature (RRL)

The Flood Resilience Rose is a practice-informed management tool that addresses, in particular, actors and institutions working in the field of river and coastal zone management. It has the overall goal to operationalize the Floods Directive and make flood risk management more resilient. It provides not only a list of measures but also helps to consider the respective context. That way, it supports practitioners in how different measures can be combined in order to reach a more holistic flood risk management strategy. Thus, the FRR helps practitioners both to arrange new flood risk management measures and to reflect on measures already taken. The different layers and levels together allow a comprehensive consideration of structure and potential of different measures. In practice, the application of the FRR may nevertheless be hampered by limitations in relation to time frames, the scope of different measures and the willingness of practitioners either to make use of the tool or to reflect on measures more generally. (Karrasch et al. 2021)

Figure 1
The Flood Resilience Rose (Karrasch, 2021)



The Flood Resilience Rose helps to increase flood resilience on three different levels of operation. Flood Resilience can be increased by operationalizing the multi-layer safety approach (level 1, dark grey) within the institutional context (level 2, grey). Both are embedded in the wider context (level 3, light grey). The multi-layer safety approach has four layers of action taking, namely protection, prevention, preparedness, and recovery. The institutional context involves collaboration of administrative bodies, governing bodies, communities and individuals. The wider context comprises regulatory settings, normative aspects, social-ecological settings and economic assessment.

On this outset, this literature review investigates the effectiveness of the Zamboanga City local government's flood management and hazard mitigation in urban barangays. By reviewing relevant literature and research conducted in Zamboanga City, this study aims to identify the factors that influence the success or failure of flood management and hazard mitigation efforts.

In a study conducted by Johnson (2020) examines urban flooding through a system thinking lens, emphasizing the interconnections of various factors influencing flood management. The author argues that a comprehensive understanding of the urban flood system is essential for effective flood management and hazard mitigation. Further, Rodriguez, M.A., et al. (2018) explore social vulnerability in flood-prone urban areas, emphasizing the need to incorporate social factors into flood management and hazard mitigation strategies. The study highlights the importance of community engagement and equitable resource allocation. Furthermore, Smith, J., et al. (2017) assesses the economic impact of flood damage and evaluates the cost-effectiveness of various flood mitigation measures. The study emphasizes the importance of economic analysis in decision-making for flood management and hazard mitigation.

Moreover, Brown R., et al. (2019) investigate the role of governance and institutions in flood risk management. The study highlights the importance of effective governance structures, stakeholder engagement, and policy coordination for successful flood management and hazard mitigation. Lastly, Chen, S. et al. (2021) examines the relationship between climate change and urban flooding, emphasizing the need for adaptive strategies in flood management and hazard mitigation. The study underscores the significance of incorporating climate change projections into planning and decision-making processes.

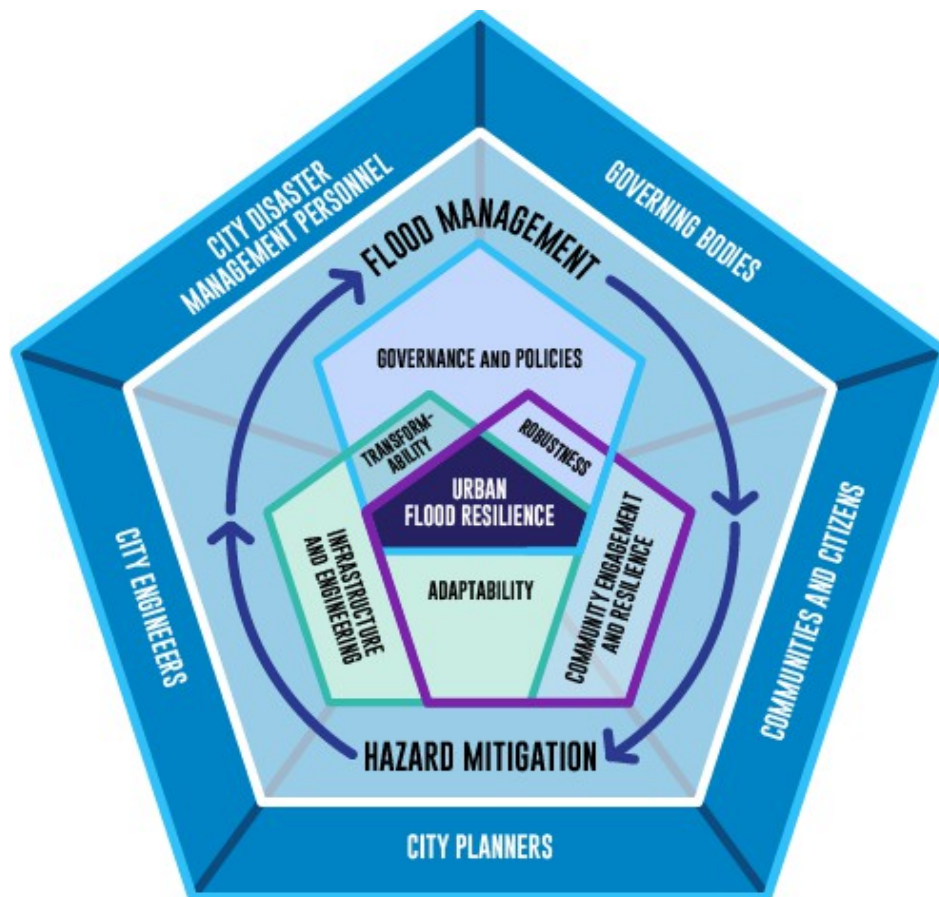
To gain insights into flood management and hazard mitigation efforts specific to Zamboanga City, Santos, A. (2017) assesses the vulnerability of urban barangays. The study examines the physical, social, and economic aspects of vulnerability and proposes targeted interventions to enhance flood resilience in the identified areas. To add up, Garcia, R., et al. (2019) evaluate the effectiveness and challenges of a community-based flood early warning system implemented in Zamboanga City. The research assesses the system's ability to provide timely and accurate information to at-risk communities and identify areas for improvement. In addition-thereto, Fernandez, L., et al. (2020) investigates the impact of urbanization on flood risk in Zamboanga City. The research explores the relationship between urban development, land use changes, and increased vulnerability to flooding. The findings inform the formulation of land use policies and urban planning strategies for flood risk reduction. As an addendum, Reyes, J., et al. (2018) evaluate the effectiveness of structural measures implemented for flood control along the urban barangays within the riverbanks in Zamboanga City. The study assesses the performance of constructed flood control structures, such as dikes and river channels, and provides recommendations for their improvement based on observed strengths and weaknesses. Lastly, Torres, E., et al. (2021) examines the role of multi-stakeholder engagement in flood management in Zamboanga City. The study analyzes the collaboration between the local

government, communities, NGOs, and other stakeholders involved in flood management and highlights the importance of participatory approaches for effective decision-making and implementation.

1.4 Conceptual Framework

Figure 2

Enhancing Zamboanga City's Urban Flood Resilience: A Forward-Looking Evaluation of Flood Management and Hazard Mitigation Strategies (Atilano-Tang and Zabala Model, 2025)



The **Conceptual Framework** of the proposed research proposal is grounded in the concept of flood resilience, which refers to the ability of communities and systems to anticipate, respond to, and recover from floods. This builds upon the theoretical foundations of systems thinking and integrates key elements relevant to flood management and hazard mitigation in Zamboanga City. The framework encompasses three primary dimensions: (1) governance and policy, (2) infrastructure and engineering, and (3) community engagement and resilience.

These dimensions reflect the multifaceted nature of flood management and hazard mitigation and provide a comprehensive lens through which to assess the effectiveness of the Zamboanga City local government's efforts. In totality, the study underscores the need for a collaborative and participatory approaches of governing bodies, communities and citizens, city planners, city engineers, and city disaster risk reduction and management personnel to consider the interrelated social, economic, and environmental factors in achieving flood resilience.

2. RESEARCH METHODOLOGY

This research employs a mixed-methods approach, combining quantitative and qualitative methods, to evaluate the effectiveness of Zamboanga City's local government efforts in flood management and hazard mitigation. The quantitative aspect involves structured questionnaires administered to approximately 500 community respondents across various *barangays*, focusing on their flood experiences, perceptions of local management strategies, and suggestions for improvement. The qualitative component includes in-depth interviews and focus group discussions with 30 selected stakeholders, including government officials responsible for policy formulation, city planners and engineers handling infrastructure solutions, and disaster risk reduction personnel engaged in community resilience activities.

Participants were selected based on their expertise and direct involvement in urban flood management. However, limitations exist, notably the potential bias introduced by self-reported data and a possibly unrepresentative sample size. The study is situated in Zamboanga City, known for its recurrent flooding due to its geographic vulnerability. The research utilizes a systems-thinking approach to identify interdependencies affecting urban flood management, aiming to generate evidence-based insights for policy enhancement.

Data collection employs structured questionnaires for quantitative insights, supplemented by semi-structured interviews, focus groups for qualitative depth, and document analysis for contextual understanding. Quantitative data analysis will utilize descriptive statistics, while qualitative data will undergo thematic analysis to identify key patterns and themes. Triangulation will validate the findings, offering a holistic evaluation of the local government's flood management effectiveness. Ethical considerations include obtaining informed consent, ensuring participant confidentiality, and maintaining anonymity throughout the research process.

3. RESULTS OF THE STUDY

The study surveyed 200 participants from Zamboanga City, with a slight female majority (54%). Generation Z (18-24 years old) formed the largest age group (39.5%), followed by Generation X (31.5%) and Millennials (19.5%). Most participants were long-term residents, with 51% living in Zamboanga for over 20 years and 34% for 11-20 years. Occupation-wise, government employees represented half of the respondents, with students closely following at 39.5%. Other groups, including private sector employees, self-employed, retirees, and unemployed, made-up smaller percentages. Geographically, respondents spanned various *barangays*, with higher representation from Baliwasan (7.0%), Tugbungan (6.5%), and Tumaga (5.5%), and the remaining areas each contributing less than 5%.

Flooding is a prevalent issue, with 93.5% of respondents personally experiencing it. Most reported minimal household damage (65%), while a significant 25.5% suffered severe impacts, such as displacement and property loss. Familiarity with local flood management strategies was moderate, with 66.5% somewhat familiar, but satisfaction was notably low, 62.5% dissatisfied or very dissatisfied.

Table 1
Flood Management Strategies in Zamboanga City, Philippines from 2018-2024

Variable	F	%
Have you personally experienced flooding in Zamboanga City?	187	93.5
Yes	13	6.5
No		
How severe were the impacts of flooding on your community?	51	25.5
Houses and crops were totally destroyed, and families were displaced.	130	65.0
There was minimal damage to households. Not affected at all.	19	9.5
How familiar are you with the flood management practices or strategies of the local government of Zamboanga City?	36	18.0
Very familiar	133	66.5
Somewhat familiar	31	15.5
Not familiar at all		
How satisfied are you with the current flood management strategies and programs of the local government of Zamboanga City?		
Very satisfied	1	0.5 %
Satisfied	74	37.0
Dissatisfied	100	50.0
Very Dissatisfied	25	12.5

Frequent flooding experiences were common, with 57.5% experiencing floods three or more times in five years. Awareness of local hazard mitigation strategies was limited; 67.5% were somewhat familiar, and 20% were not familiar at all. Consequently, 59.5% felt their communities were inadequately prepared, and 57.5% expressed dissatisfaction with hazard mitigation measures. Regarding flood resilience strategies, dissatisfaction was predominant (50.5% dissatisfied, 8% very dissatisfied).

Table 2
Hazard Mitigation Strategies in Zamboanga City, Philippines from 2018-2024

Variable	F	%
How often have you experienced flooding in your community in the past FIVE (5) years?	115	57.5
3 or more	63	31.5
1-2 times	22	11.0
None at all		
How aware are you of the hazard mitigation strategies of the local government of Zamboanga City?	25	12.5
Very familiar	135	67.5
Somewhat familiar	40	20.0
Not familiar at all		
Do you feel that your community is adequately prepared to deal with floods?	81	40.5
Yes	119	59.5
No		

How satisfied are you with the current hazard mitigation strategies and programs of the local government of Zamboanga City?		
Very satisfied	3	1.5
Satisfied		
Dissatisfied	82	41.0
Very Dissatisfied	100	50.0
	15	7.5

Major identified challenges included poor infrastructure (36.5%), limited public awareness (28%), poor inter-agency coordination (21.5%), and insufficient funding (13.5%). Respondents identified poor governance coordination (32.5%) and inadequate resources (27%) as primary governance issues, recommending infrastructure improvements (37.5%), public awareness initiatives (30.5%), and budget allocation (22.5%) as critical solutions.

Table 3

Urban Flooding Resilience (Improved Governance and Policy Framework) in Zamboanga City, Philippines from 2018-2024

Variable	F	%
How satisfied are you with the current urban flood resilience strategies and programs of the local government of Zamboanga City		
Satisfied	83	41.5
Dissatisfied	101	50.5
Very Dissatisfied	16	8.0
In your opinion, what are the most significant challenges that Zamboanga City faces regarding flood resilience?		
Poor infrastructure	73	36.5
Lack of coordination among agencies	43	21.5
Insufficient funding	27	13.5
Limited public awareness and participation	56	28.0
All of the above	1	0.5
What specific governance and policy challenges do you think the local government faces in addressing flood resilience in Zamboanga City?		
Inadequate resources	54	27.0
Limited technical expertise	48	24.0
Poor coordination among government agencies	65	32.5
Lack of political will	32	16.0
Corruption	1	0.5
In your opinion, what are the best solutions to improve the governance and policy framework and eventually reach urban flooding resilience in Zamboanga City?		
Building more flood control infrastructures	75	37.5
Improving public awareness and participation	61	30.5
Enhancing interagency coordination	14	7.0
Allocating more budget for flood resilience measures	45	22.5
All	3	1.5
Addressing Corruption	1	0.5
Zamboanga city can integrate green infrastructure as it can help reduced flood risk	1	0.5

Table 4
Urban Flooding Resilience (Enhanced Infrastructures and Engineering Solutions) in Zamboanga City, Philippines from 2018-2024

Variable	<i>F</i>	<i>%</i>
How satisfied are you with the response of the local government (infrastructure and engineering solutions) to floods in your community? Very satisfied	4	2.0
Satisfied	75	37.5
Dissatisfied	104	52.0
Very Dissatisfied	17	8.5
Do you think that the local government should do more to prevent flooding (infrastructure and engineering solutions) in your community?		
Yes	173	86.5
No	27	13.5
How satisfied are you with the response of the local government (infrastructure and engineering solutions) to floods in your community? Very satisfied		
Satisfied	2	1.0
Dissatisfied	75	37.5
Very Dissatisfied	110	55.0
	13	6.5
Do you think that the local government should do more to prevent flooding (infrastructure and engineering solutions) in your community?		
Yes	177	88.0
No	23	12.0
How satisfied are you with the current urban flood resilience strategies and programs of the local government of Zamboanga City?		
Very satisfied	3	1.5
Satisfied	84	42.0
Dissatisfied	101	50.5
Very Dissatisfied	12	6.0

Overwhelmingly, respondents believed the local government needed to enhance flood prevention infrastructure (86.5-88%) and improve community participation and resilience programs (98%). Satisfaction with community initiatives like awareness campaigns (45.5%), capacity building (39.5%), and early warning systems (45.5%) was generally low, highlighting a need for substantial improvements in these areas.

Table 5
Urban Flooding Resilience (Strengthened Community Engagement and Resilience) in Zamboanga City, Philippines from 2018-2024

Variable	F	%
How satisfied are you with the local government initiatives to strengthen community awareness campaigns on flood preparedness and response?		
Very satisfied	8	4.0
Satisfied	81	40.5
Dissatisfied	102	51.0
Very Dissatisfied	17	4.5
How satisfied are you with the capacity-building initiatives for local communities to enhance urban flooding resilience for Zamboanga City?		
Very satisfied	11	5.5
Satisfied	68	34.0
Dissatisfied	109	54.5
Very Dissatisfied	12	6.0
How satisfied are you with the establishment of community-based early warning systems of the local government of Zamboanga City?		
Very satisfied	10	5.0
Satisfied	81	40.5
Dissatisfied	95	47.5
Very Dissatisfied	14	7.0
Do you believe that the local government of Zamboanga City must increase community participation and resilience in flood management and hazard mitigation?		
Yes	196	98.0
No	4	2.0

The disaster management program in Zamboanga City emphasizes proactive preparedness, community engagement, infrastructure investment, and strategic planning to enhance flood resilience. The local government prioritizes timely communication through PAG-ASA's weather updates, disseminating critical information via social media and direct messaging to ensure community awareness and preparedness. Additionally, a robust volunteerism program equips residents to act as first responders, strengthening community resilience and social cohesion. Infrastructure projects like comprehensive drainage plans, flood control measures, and green spaces significantly mitigate flooding impacts. Collaborative efforts involving barangays, national agencies, NGOs, and academic institutions play a crucial role, with strong emphasis on training and capacity building through workshops, drills, and disaster summits. These coordinated initiatives have earned Zamboanga recognition in national disaster preparedness awards.

However, implementation faces challenges, notably inadequate evacuation facilities, budget constraints, high costs of flood mitigation infrastructure, insufficient maintenance funding, and complex administrative procedures. Efforts to address these include establishing evacuation clusters equipped with necessary resources, the creation of mega evacuation centers, and mobilizing community involvement to develop evacuation sites. Monitoring and evaluation systems assess effectiveness through comparative analyses of past flooding incidents and key performance indicators, such as infrastructure damage and response efficiency. Political and

administrative barriers—such as conflicting policies, bureaucratic delays, and differing leadership priorities propose additional hurdles.

Recommendations for improvement include relocation of families from high-risk areas, river rehabilitation, community education programs, and enhanced use of technology like real-time monitoring systems, mobile applications, and IoT sensors. Policy enforcement and urban planning integration, alongside increased community empowerment through volunteer programs, are advocated to improve flood resilience. Technology, especially social media and emergency management apps, plays a critical role in communicating risks and facilitating quick responses, significantly improving public safety and community preparedness. Continuous community involvement in planning and implementation of early warning systems and flood response mechanisms remains fundamental to achieving effective and sustained resilience.

On this outset, the study identified several key challenges affecting the city's flood management and hazard mitigation strategies through comprehensive focus group discussions, to wit: **Ineffective Drainage System** (Flooding incidents occur due to poorly maintained or inadequately designed drainage systems, causing significant water accumulation even without nearby rivers); **Swamp Overflow** (Areas adjacent to swamps face recurring flooding issues during heavy rains due to insufficient mechanisms for handling overflow); **Insufficient Dredging Measures** (Flooding severity increases as rivers become narrower and shallower, compounded by unmet dredging requests); **Ineffective Solid Waste Management** (Flooding is exacerbated by improper waste disposal practices, clogging waterways. Enhanced community education and significantly increased penalties for littering violations were recommended); **Structural Assessment and Urban Design** (Poor infrastructure design, particularly concerning drainage and road projects, contributes significantly to flooding. Participants stressed the need for improved planning, adherence to design standards, and better implementation practices, suggesting a comprehensive master plan inspired by successful systems in other urbanized cities); **Strict Implementation of Laws and Ordinances** (Weak enforcement of anti-littering ordinances and toleration of informal settlers along riverbanks impede effective flood mitigation efforts. Respondents emphasized strict law enforcement as crucial for success);

Community Education and Engagement (Successful flood management requires educating communities on responsible waste disposal practices. Community-based initiatives and empowerment programs, including active participation in volunteerism, were highlighted as effective strategies); **Environmental Factors and Reforestation** (Rapid deforestation contributes significantly to flooding by reducing natural water absorption. Participants advocated strict enforcement of reforestation laws and initiatives to combat environmental degradation); **Effective Communication and Coordination** (Communication between local government units and stakeholders is critical for timely flood response. Advanced communication systems, early warnings, community spotters, and effective evacuation protocols were identified as essential); **Inter-Agency Collaboration** (Strong collaboration among various city agencies, stakeholders, and barangay units is fundamental. The importance of clear policies, disciplined constituents, and committed leadership was underscored); **Funding and Resource Allocation** (Participants suggested proactive funding for infrastructure projects, dredging, and maintenance to ensure timely implementation of flood control measures. Local initiatives such as "Pintakasi" were mentioned as effective interim solutions); and **Adoption of Technology** (Modern technological solutions, such as the proposed state-of-the-art ZCDRRMO Building for better disaster detection and response, were strongly recommended).

4. CONCLUSION

Based on the findings, the study concludes that the persistent and critical challenges Zamboanga City faces concerns urban flooding and disaster management. With a significant majority of residents experiencing frequent floods, the adverse impact ranging from minimal household disruption to severe displacement—highlight the urgent need for comprehensive interventions. The dissatisfaction expressed by respondents regarding flood management strategies, hazard mitigation efforts, and community preparedness underscores substantial gaps in existing frameworks.

Key issues identified by the respondents include inadequate infrastructure, limited public awareness, ineffective inter-agency coordination, and insufficient funding, compounded by weak governance coordination and resource allocation challenges. To address these concerns effectively, stakeholders strongly recommend improving infrastructure, particularly drainage systems and flood control mechanisms, bolstering public education and awareness initiatives, and increasing dedicated budget allocations.

The city's proactive disaster management efforts, such as real-time information dissemination, strategic community engagement, and vigorous volunteer programs, demonstrate promising foundations for enhancing flood resilience. However, critical implementation barriers—such as inadequate evacuation facilities, budget limitations, and complex administrative processes—must be systematically addressed.

Figure 3

Scenarios for Urban Flooding Resilience in Zamboanga City, Philippines from 2026-2040

“DRIFT AND DRAIN”	COORDINATED ADAPTATION
No Change	Adaptive Change
- Flood frequency unchanged - Dissatisfaction with flood management - Informal riverside settlements expand - More volunteers but prevention lags	- Multiyear drainage + dredging program - EWS Framework standardized - Volunteer program institutionalized - Graduated penalties on anti-littering + MRF Access
“PATCH AND PRAY”	“RESILIENCE BY DESIGN”
Marginal Change	Radical Change
- Drainage rehab in hotspots - Some anti-littering “blitzes” - Uneven resilience map - O&M underfunding re-creates backlogs	- Citywide Blue-Green Infrastructure Plan - Managed retreat - ZCDRRMO 24/7 SMART Center - Pay-for-performance contracts for O&M

Four Scenarios (2026–2040)

A. No Change Scenario — “Drift and Drain”

In this scenario, Zamboanga City continues a business-as-usual trajectory where maintenance remains inconsistent, policies are more declarative than operational, and funding for flood mitigation projects remains minimal and irregular. Awareness campaigns are conducted sporadically and fail to create lasting behavioral change.

Between 2026 and 2030, flooding continues to occur at roughly the same frequency, with 57.5% of residents still experiencing three or more floods within a five-year period. Severe impacts from flooding—such as displacement and property damage—remain high at around 25–28%. Public dissatisfaction with flood management efforts persists, exceeding 60%, as inter-agency coordination and project implementation remain weak. Although emergency response mechanisms marginally improve through volunteer engagement, preventive strategies continue to lag.

By 2040, the problem worsens due to unchecked urban expansion and the proliferation of informal settlements near rivers and swamps, further increasing vulnerability. The key risks under this scenario include disaster fatigue among residents, declining public trust in government initiatives, and escalating long-term costs due to deferred infrastructure maintenance. The burden of flooding disproportionately affects low-income barangays located in high-risk zones, reinforcing existing social inequities.

B. Marginal Change Scenario — “Patch and Pray”

The marginal change scenario envisions incremental improvements that fail to bring about systemic transformation. The city undertakes selected drainage rehabilitation projects and constructs a few evacuation clusters, yet these efforts remain localized and fragmented. Awareness programs are implemented through short-term campaigns rather than institutionalized education or engagement.

Between 2026 and 2030, limited progress is made—localized flooding decreases in targeted areas such as Tumaga River, and severe impacts drop slightly to around 20–22%. Public dissatisfaction marginally improves, with about half of respondents still expressing disappointment (50–55%). Sporadic anti-littering drives are conducted but lack consistent enforcement, leading to minimal behavioral change.

By 2040, the city exhibits an uneven resilience landscape where some barangays experience significant improvement while others remain highly vulnerable. The underfunding of operations and maintenance (O&M) results in recurring infrastructure deterioration, nullifying earlier gains. Risks under this scenario include piecemeal project implementation, the absence of a holistic governance framework, and persistent inter-agency coordination gaps.

C. Adaptive Change Scenario — “Coordinated Adaptation”

Under the adaptive change scenario, Zamboanga City transitions from fragmented project-based interventions to an integrated systems approach. Governance becomes more coordinated, investments are strategically targeted, and community participation is institutionalized.

From 2026 to 2030, the city implements a multiyear drainage and dredging program supported by a dedicated operations and maintenance fund. An enhanced early warning system (EWS) is standardized across barangays, integrating sirens, SMS notifications, and social media

dissemination. Barangay “spotters” are formalized, and volunteerism is strengthened through partnerships with schools and civil society organizations, resulting in regular community drills conducted twice a year. Anti-littering laws and easement regulations are enforced consistently through a combination of graduated penalties and access to material recovery facilities.

By 2040, measurable improvements are evident—severe flooding impacts decline to 10–12%, and the frequency of households experiencing three or more floods in five years drops to around 30–35%. Public satisfaction with flood management and hazard mitigation increases significantly to 65–70%, bolstered by greater transparency and data-driven coordination among agencies. Nonetheless, this scenario faces potential risks, including leadership turnover, complacency following early successes, and challenges related to technological integration and interoperability.

D. Radical Change Scenario — “Resilience by Design”

The radical change scenario represents a transformative shift toward a fully resilient and sustainable Zamboanga City. This vision emphasizes blue-green master planning, the integration of technology, and the redesign of urban infrastructure to coexist harmoniously with the city’s natural water systems.

Between 2026 and 2030, the city executes a comprehensive Blue-Green Infrastructure Plan that includes river rehabilitation, the creation of floodable parks, bioswales, permeable streets, and sponge-city retrofits. A managed retreat program relocates families from high-risk flood corridors to safer areas, providing them with livelihood opportunities and improved transport connectivity. A state-of-the-art 24/7 Zamboanga City Disaster Risk Reduction and Management Office (ZCDRRMO) Smart Center is established, integrating Internet of Things (IoT) sensors, hydrologic modeling, and real-time incident management. Operations and maintenance are managed through pay-for-performance contracts, and participatory budgeting empowers barangays to implement micro-resilience projects.

By 2040, the city achieves a high level of resilience, with severe flooding impacts reduced to 5% and the proportion of households experiencing three or more floods in five years dropping below 15%. Public satisfaction exceeds 80%, while insurance losses and infrastructure damage are markedly lower. Co-benefits include cooler urban microclimates, improved air and water quality, and the expansion of green public spaces. However, the pathway to radical transformation carries its own risks, such as substantial upfront financial investments, political resistance to relocation initiatives, and temporary disruptions during major construction and retrofitting phases.

5. POLICY RECOMMENDATIONS

Based on comprehensive research involving demographic insights, community experiences, and identified flood management challenges in Zamboanga City, the following policy programs and portfolios by scenarios are put forth:

No Change Scenario – “Drift and Drain”

In the *No Change* scenario, Zamboanga City’s policy and program portfolio remains fragmented and largely reactive. Flood management efforts continue to rely on ad-hoc maintenance activities and post-disaster cleanup operations rather than proactive risk reduction. Information, Education, and Communication (IEC) campaigns are sporadic, with scattered postings and limited follow-through. Annual flood missions are conducted primarily as short-term relief efforts instead of being part of a sustained disaster preparedness strategy.

Governance structures remain weak and uncoordinated, resulting in the absence of clear performance indicators or accountability mechanisms. This reactive approach perpetuates inefficiency and dependency on emergency response rather than long-term resilience building.

Marginal Change Scenario – “Patch and Pray”

Under the *Marginal Change* scenario, Zamboanga City begins to take small, incremental steps toward flood mitigation but still lacks a comprehensive framework. Policy interventions focus on selected hotspots, with limited drainage rehabilitation projects and the construction of one or two mega evacuation centers. Occasional dredging operations are carried out but without a consistent maintenance schedule. Soft measures such as quarterly IEC campaigns, volunteer mobilization drives, and limited barangay-level drills are implemented but fail to achieve citywide coverage or institutional sustainability.

On the governance side, disaster management task forces are formed and hold meetings, yet outcomes are confined to meeting minutes and reports rather than measurable joint Key Performance Indicators (KPIs). The city experiences minor improvements in localized flood management, but the absence of systemic coordination and integrated monitoring mechanisms hinders meaningful progress.

Adaptive Change Scenario – “Coordinated Adaptation”

The *Adaptive Change* scenario represents a shift from fragmented efforts to a coordinated and system-oriented approach to flood governance. The infrastructure portfolio under this scenario includes multiyear drainage and dredging programs supported by operations and maintenance (O&M) contracts to ensure sustainability. Additional projects focus on riverbank stabilization and the installation of swamp overflow gates to prevent recurrent inundation. On the community front, Zamboanga institutionalizes volunteer corps drawn from youth groups, government employees, and students, establishing a formal barangay spotter network for early warning and response. Regular disaster preparedness drills are conducted twice a year across high-risk areas.

Governance systems become data-driven, with an inter-agency performance dashboard tracking progress, resilience budget tagging ensuring resource transparency, and ordinance enforcement applied through graduated penalties to encourage compliance. Technological advancement plays a key role in this scenario through a standardized Early Warning System (EWS) that integrates multiple communication channels—SMS alerts, sirens, Facebook posts, and radio announcements—while pilot Internet of Things (IoT) sensors are deployed in critical flood-prone chokepoints for real-time monitoring.

Radical Change Scenario – “Resilience by Design”

In the *Radical Change* scenario, Zamboanga City undergoes a transformative shift toward an ecologically balanced, technology-enabled, and socially inclusive flood resilience framework. Urban planning is guided by a *Blue-Green Infrastructure* strategy that incorporates floodable parks, linear river parks, bioswales, permeable pavements, and urban reforestation to enhance natural water absorption and reduce surface runoff. Stormwater capture systems are integrated into city design to manage rainfall more efficiently. On the social front, a managed retreat program relocates residents from the most flood-prone easements to newly developed social housing areas equipped with livelihood corridors and access to basic services. A grievance redress mechanism ensures that relocation processes remain transparent and humane.

Technological innovation and data-driven governance anchor this scenario through the establishment of a *Zamboanga City Disaster Risk Reduction and Management Office (ZCDRRMO) Smart Center*, which employs citywide sensor networks, hydrologic modeling,

and a centralized incident command system. Open-data platforms promote accountability and citizen engagement. Financial mechanisms become more diversified and sustainable through blended financing that combines national grants, public-private partnerships (PPPs), climate budget tagging, and the issuance of resilience bonds. Participatory budgeting processes empower communities to co-design local projects that strengthen resilience. Finally, law enforcement becomes more rigorous and performance-based, focusing on strict easement recovery, comprehensive solid waste management with expanded Material Recovery Facility (MRF) coverage, and contractor accountability tied to measurable outcomes.

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