RESEARCH ARTICLE OPEN ACCESS

INTEGRATED ACTION PLAN: MITIGATING FLOOD RISKS AND PREVENTING DENGUE OUTBREAK AFTER HEAVY RAINFALL IN THE MUNICIPALITY OF GLORIA, ORIENTAL MINDORO

Leslie A Arriola, RN, LPT
Co – Author : Reyan Derrick C Marquez, LLB, MPM
Batangas State University – The National Engineering University
23-53448@g.batstate-u.edu.ph

ABSTRACT

This summary presents the highlights of the Integrated Action Plan addressing two interrelated hazards affecting the Municipality of Gloria, Oriental Mindoro: flooding due to heavy rainfall and subsequent dengue outbreaks. The municipality's geographic location and climate conditions make it highly vulnerable to these hazards. Flood events create stagnant water, providing breeding grounds for mosquitoes, particularly the Aedes aegypti, the primary dengue vector.

The study combined quantitative data from local government units and health offices with qualitative inputs from community surveys. Results show a strong link between flooding and increased dengue cases. Key issues identified include poor drainage infrastructure, limited public health awareness, and inadequate emergency response mechanisms.

The three-year action plan (2025–2027) focuses on infrastructure improvement, vector control, early warning systems, community education, and inter-agency coordination. Monitoring and evaluation mechanisms are integrated to track progress. This initiative aims to strengthen Gloria's disaster resilience and public health systems against climate-related and health hazards.

Keywords: Dengue, Flood, Heavy Rainfall, Gloria, Oriental Mindoro, climate change, Disaster Risk Reduction, MDRRMO

1. INTRODUCTION

The Philippines, located along the Pacific Typhoon Belt, faces severe climatic hazards including typhoons and heavy rainfall. Gloria, Oriental Mindoro, with its geographic location and riverine systems, experiences frequent flooding exacerbated by extreme weather events. Flooding triggers conditions favorable for dengue outbreaks by increasing stagnant water, the primary breeding ground for Aedes mosquitoes. Historical data shows recurring floods and rising dengue cases, with the most alarming surge occurring in 2024.

The Integrated Action Plan aims to address these linked hazards through a multi-sectoral and risk-informed approach. It consolidates infrastructure interventions, health surveillance, community education, and early warning systems to minimize health and economic impacts.

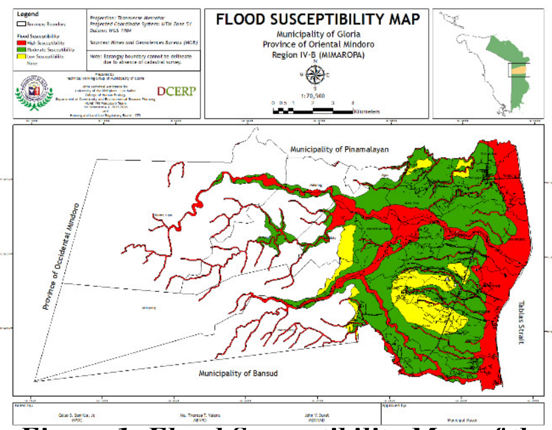

Figure 1. Flood Susceptibility Map of the Municipality of Gloria

1.1 Background

Gloria is divided into 27 barangays, with over 9,644 hectares vulnerable to varying levels of flooding:

Flood Category	Total Affected Area (Hectares)
Low Flooding	1,047.35
Moderate Flooding	5,205.62
High Flooding	3,391.43

Barangays such as Agos, Agsalin, Balete, Banus, Bulaklakan, and Malamig fall under high-risk zones.

Dengue Outbreak Trends

Dengue cases in Gloria and the entire Oriental Mindoro province have risen sharply in recent years.

Dengue Cases and Fatalities (2020–2024)

Year	Or. Min Morbidity	Or. Min Mortality	Gloria Morbidity	Gloria Mortality
2020	1,094	3	104	0
2021	419	4	15	0
2022	1,495	4	83	2
2023	1,527	12	43	1
2024	5,587	22	171	0

Flooding and dengue outbreaks exhibit clear seasonal patterns, often peaking during the rainy season (June to December).

2. SCOPE AND LIMITATION

This plan covers all 27 barangays of Gloria but prioritizes high-risk areas identified by municipal risk assessments. The plan operates within the framework of Disaster Risk Reduction and Management (DRRM) and Public Health Disease Prevention, tackling both infrastructure needs and health interventions.
Limitations include funding availability, technical capacity, data gaps, and varying levels of community participation. Institutional coordination and climate variability also present challenges to full implementation.

3. METHODOLOGIES OF THE PLAN

The plan was developed through:

a. **Quantitative data collection:** Historical dengue cases, flood-affected areas, and health surveillance data.
b. **Qualitative assessments:** Key informant interviews and community surveys.
c. **Risk mapping:** Flood susceptibility mapping using Geographic Information System (GIS).
d. **Literature review:** Local, national, and global reports on flood-dengue linkages.
e. **Stakeholder consultations:** Barangay officials, Municipal Engineering Office, MDRRMO, and MHO.
f. **Scenario building:** Multi-hazard scenario analysis for Gloria following intense rainfall.

4. ASSUMPTIONS OF THE PLAN

- Flooding leads to water stagnation, increasing Aedes mosquito breeding.
- Community cooperation will be sustained during implementation.
- Funding will be allocated on time by the LGU and national agencies.
- Technical support from DOH, DPWH, and NGOs will continue.
- Climate conditions during the project timeline will align with historical trends.

These assumptions form the basis for the designed intervention.

5. SITUATIONAL ANALYSIS

Global Context

Worldwide, flooding and vector-borne diseases like dengue are recognized by organizations like WHO and IPCC as interconnected hazards. Urbanization, poor drainage, and climate change intensify both risks. The WHO's Global Vector Control Response 2017–2030 calls for integrated strategies combining environmental management and disease prevention.

Local Context

Dengue Cases (2020–2024)

Year	Oriental Mindoro Cases	Gloria Cases
2020	1,094	104
2021	419	15
2022	1,495	83
2023	1,527	43
2024	5,587	171

This sharp rise, especially in 2024, underscores the urgent need for an integrated response.

5.1 RESULTS FROM SURVEY

5.1.1 Demographic Profile

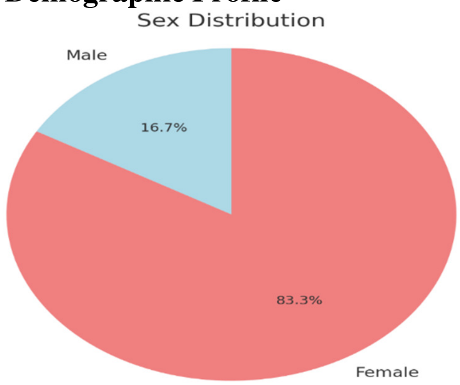

Figure 2. Age of the Respondents

The data revealed that the majority of individuals fall within the 31 to 40 years old age group, comprising 40% of the total population. This showed that the workforce or surveyed group was predominantly in their early to mid-career stage. The second most represented group was the 41 to 50 years old category, accounting for 26.67%, indicating a significant number of experienced individuals. Meanwhile, the 21 to 30 years old and 51 to 60 years old age groups each make up 10% of the total, showing lower representation among both younger and older demographics. Additionally, 13.33% of individuals belong to the 61 to 70 years old category, signifying a continued presence of senior individuals. The distribution highlighted a concentration of middle-aged individuals, with relatively fewer younger participants, which may had implications for workforce planning, generational diversity, or succession strategies.

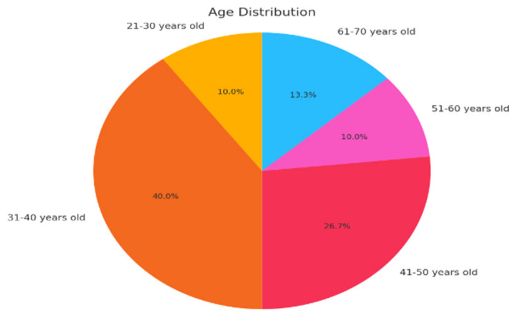

Figure 3. Gender of the Respondents

The data on gender distribution indicated that the majority of individuals in the group were female, comprising 83.33% of the total population. In contrast, males make up only 16.67%, highlighting a significant gender imbalance. This showed that the population surveyed in the community, was predominantly female. Such a distribution could have implications for gender diversity, representation, and inclusivity. The large gap between male and female participation may also reflect industry trends, organizational demographics, or societal factors influencing gender representation.

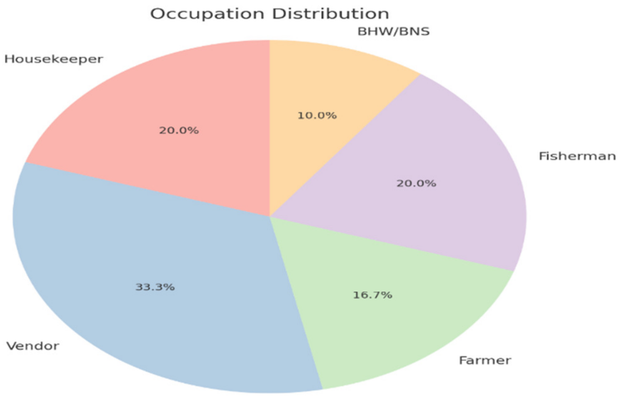

Figure 4. Occupation of the Respondents

The data presented the occupational distribution of a group of 30 individuals. Among these, vendors constitute the largest group, comprising 33.33% (10 individuals), followed by housekeepers and fishermen, each representing 20% (6 individuals). Farmers account for 16.67% (5 individuals), while BHWs/BNSs make up the smallest proportion at 10% (3 individuals). Vendors, who make up the largest group, were often found in public markets, streets, or community spaces, making them easier to approach for surveys or interviews. Similarly, housekeepers were typically available in households, where they can be easily reached. Fishermen, might had been accessible due to their regular return to shore, allowing for interactions during non-working hours.

On the other hand, farmers and BHWs/BNSs may had been more challenging to reach. Farmers often work in fields located in rural or remote areas, limiting their availability during the day.

5.1.2 Survey Results

TABLE 3
Preparedness and Early Warning Systems

Statements	Frequency	N	Weighted Mean	Interpretation
1. The community has a reliable early warning system for heavy rainfall and flooding.	115	30	3.83	Neither agree nor Disagree
2. The drainage systems in the area are well-maintained and effective in preventing water stagnation.	103	30	3.43	Neither agree nor Disagree
3. Evacuation plans for flood-prone areas are clearly communicated to residents.	124	30	4	Agree
4. Public awareness campaigns about flood preparedness are conducted regularly.	114	30	3.8	Neither agree nor Disagree
5. Residents know how to respond to early flood warnings.	117	30	3.9	Neither agree nor Disagree
6. Emergency response teams are well-trained and equipped to handle flood-related incidents.	101	30	3.36	Neither agree nor Disagree
7. The local government conducts regular risk assessments for heavy rainfall and flooding.	93	30	3.1	Neither agree nor Disagree

Legend: 5 - Strongly Agree; 4 – Agree; 3 – Neither agree nor Disagree, 2 – Disagree; 1 – Strongly Disagree

The survey results provided valuable insights into the community's flood preparedness, highlighting both strengths and areas for improvement. Overall, the weighted mean scores range from 3.1 to 4, indicating that most respondents fall between "Neither agree nor disagree" and "Agree" on the Likert scale.

TABLE 4
Flood Management and Response

Statements	Frequency	N	Weighted Mean	Interpretation
1. There are sufficient flood control infrastructures (e.g., barriers, drainage systems) in place.	101	30	3.37	Neither agree nor Disagree
2. The community has a clear and effective flood evacuation plan.	118	30	3.93	Neither agree nor Disagree
3. Flood-prone areas are regularly monitored and mapped by local authorities.	102	30	3.4	Neither agree nor Disagree
4. Disaster relief efforts (e.g., food, shelter, medical aid) are adequate and timely.	81	30	2.7	Disagree
5. Authorities effectively coordinate with emergency responders during flood events.	92	30	3	Neither agree nor Disagree
6. Safe drinking water is provided to affected communities after floods.	103	30	3.43	Neither agree nor Disagree
7. Post-flood clean-up efforts are carried out effectively to remove stagnant water.	100	30	3.33	Neither agree nor Disagree

Legend: 5 - Strongly Agree; 4 – Agree; 3 – Neither agree nor Disagree, 2 – Disagree; 1 – Strongly Disagree

The survey results highlight key areas of flood management and post-disaster response in the community, revealing both strengths and significant areas for improvement. The weighted mean scores range from 2.7 to 3.93, with most responses falling under "Neither agree nor disagree," suggesting a general uncertainty or lack of confidence in existing flood preparedness and response measures.

TABLE 5
Dengue Prevention and Control Measures

Statements	Frequency	N	Weighted Mean	Interpretation
1. Mosquito breeding sites are regularly identified and eliminated by authorities.	100	30	3.3	Neither agree nor Disagree
2. The community actively participates in dengue prevention programs (e.g., removing standing water, using mosquito nets).	94	30	3.13	Neither agree nor Disagree
3. Fogging and larvicide treatments are conducted effectively in high-risk areas.	95	30	3.16	Neither agree nor Disagree
4. Local health agencies provide sufficient information on dengue prevention and symptoms.	117	30	3.9	Neither agree nor Disagree
5. Waste management systems are effective in reducing potential mosquito breeding grounds.	112	30	3.73	Neither agree nor Disagree
6. Health facilities are well-prepared to handle an increase in dengue cases during outbreaks.	91	30	3	Neither agree nor Disagree
7. The community has access to free or affordable dengue testing and treatment.	98	30	3.27	Neither agree nor Disagree
8. Suspected dengue cases are tracked and reported in a timely manner.	106	30	3.53	Neither agree nor Disagree

Legend: 5 - Strongly Agree; 4 – Agree; 3 – Neither agree nor Disagree, 2 – Disagree; 1 – Strongly Disagree

The survey results provide insights into the community's efforts in dengue prevention, control, and response. With weighted mean scores ranging from 3.0 to 3.9, all responses fall under "Neither agree nor disagree," indicating a general uncertainty or lack of strong confidence in the effectiveness of current dengue-related measures.

TABLE 6
Coordination and Community Involvement

Statements	Frequency	N	Weighted Mean	Interpretation
1. Government agencies, health organizations, and local authorities coordinate effectively in flood and dengue response efforts.	114	30	3.8	Neither agree nor Disagree
2. Residents are encouraged to participate in flood and dengue control initiatives.	98	30	3.27	Neither agree nor Disagree
3. There are designated community volunteers trained for emergency and health response.	112	30	3.73	Neither agree nor Disagree
4. Public complaints about mosquito breeding sites and flood concerns are addressed promptly.	89	30	2.97	Disagree
5. Schools and workplaces are actively involved in dengue awareness campaigns.	107	30	3.57	Neither agree nor Disagree
6. Local businesses and industries comply with sanitation regulations to prevent mosquito breeding.)	104	30	3.47	Neither agree nor Disagree

Legend: 5 - Strongly Agree; 4 – Agree; 3 – Neither agree nor Disagree, 2 – Disagree; 1 – Strongly Disagree

The survey results reflect the community's perception of flood and dengue response coordination, public participation, and regulatory compliance. With weighted mean scores ranging from 2.97 to 3.8, most responses fall under "Neither agree nor disagree," indicating uncertainty or mixed opinions about the effectiveness of current measures.

TABLE 7
Post-Flood Recovery and Monitoring

Statements	Frequency	N	Weighted Mean	Interpretation
1. Post-flood sanitation programs effectively reduce mosquito breeding risks.	80	30	2.67	Disagree
2. Medical assistance is readily available for individuals affected by dengue after a flood.	77	30	2.57	Disagree
3. The government implements improvements based on past flood and dengue outbreak experiences.	76	30	2.53	Disagree
4. Community feedback is considered when developing future flood and dengue prevention policies.	79	30	2.63	Disagree
5. Resources (e.g., funding, manpower) are adequate for continuous flood and dengue outbreak management.)	72	30	2.4	Disagree

Legend: 5 - Strongly Agree; 4 – Agree; 3 – Neither agree nor Disagree, 2 – Disagree; 1 – Strongly Disagree

The survey results reveal significant concerns regarding the effectiveness of post-flood and dengue outbreak management in the community. With weighted mean scores ranging from 2.4 to 2.67, all responses fall under "Disagree," indicating widespread dissatisfaction with key aspects of government and community response efforts.

5.2 PESTEL ANAYSIS

5.2.1 Political

The Municipality of Gloria, nestled in the province of Oriental Mindoro, had a political landscape shaped by its rich history and a commitment to sustainable development. Established as an independent municipality on June 9, 1966, through Republic Act No. 4651, Gloria was once a barangay called Maligaya. It was named in honor of Gloria Macapagal Arroyo, the daughter of then-President Diosdado Macapagal, who would later become the 14th President of the Philippines.

5.2.2 Economic

The Municipality of Gloria, Oriental Mindoro, had experienced notable economic developments shaped by its agricultural roots, strategic initiatives, and regional challenges.
Gloria's economy was predominantly anchored in agriculture. The fertile lands of the municipality yield essential crops such as rice and corn, serving as primary sources of livelihood for many residents. Additionally, fishing plays a significant role, contributing to both local sustenance and commerce.

5.2.3 Social

The Municipality of Gloria, Oriental Mindoro had made significant strides in enhancing the social welfare of its residents through comprehensive programs in health, education, social services, and community development.

5.2.4 Technological

The Municipality of Gloria, Oriental Mindoro had been progressively integrating technological advancements to enhance governance, environmental management, and public services.
In 2022, Gloria embarked on modernizing its administrative processes by implementing a cloud-based Electronic Business One Stop Shop (eBPLS). This system streamlines business registration and licensing, promoting efficiency and transparency. To support this initiative, the local government procured Information and Communications Technology (ICT) equipment, as detailed in their procurement documents.

5.2.5 Environmental

The Municipality of Gloria had been actively engaged in environmental management and conservation efforts. However, recent events had posed significant challenges to its ecological well-being.

Gloria had demonstrated a commitment to environmental sustainability through various initiatives. Collaborations with the Department of Science and Technology led to the implementation of the Vertical Helophyte Filter System (VHFS) in 2018, an eco-friendly wastewater treatment solution aimed at improving water quality and protecting aquatic ecosystems.

On February 28, 2023, the sinking of the MT Princess Empress oil tanker resulted in a substantial oil spill in the Tablas Strait, affecting several municipalities in Oriental Mindoro, including Gloria. The tanker was transporting 900,000 liters of industrial fuel oil, leading to widespread environmental contamination.

5.2.6 Legal

The Municipality of Gloria had developed a legal framework that underpins its governance and community welfare. This framework encompasses the establishment of the municipality, the delineation of its boundaries, the structure of its local government,
and the enactment of ordinances addressing various aspects of municipal life.

5.3 SWOC Analysis

Strengths

- Active Barangay Disaster Risk Reduction and Management Committees (BDRRMCs).
- Barangay health workers engaged in public awareness campaigns.
- Functional early warning systems.

Weaknesses

- Inadequate drainage and waste management systems.
- Insufficient hospital and diagnostic facilities.
- Weak community participation in dengue prevention.

Opportunities

- Access to National DRRM Fund and health grants.
- Community willingness to engage in clean-up and vector control activities.
- Potential partnerships with NGOs and private sector.

Challenges

- Climate variability causing more frequent and intense rainfall.
- Limited municipal budget for infrastructure and health projects.
- Insufficient technical expertise on integrated disaster and health risk management.

6. ACTION PLAN

Goal 1: Mitigate Flooding through Infrastructure Development and Environmental Management

Programs and Activities:

- Design and upgrade drainage systems in 5 flood-prone barangays (e.g., Papandungin, Kawit, Balete, M. Adriatico, San Antonio).
- Conduct riverbank stabilization and reforestation.

Recognizing the insufficient capacity of existing drainage systems, this goal focuses on infrastructure upgrades. Planned projects include constructing larger culverts, improving canal linings, and implementing regular desilting programs. Barangays identified with the highest flood risks will receive priority. Environmental measures such as reforestation along riverbanks will help reduce surface runoff and soil erosion. These projects not only mitigate floods but also enhance ecological stability. The LGU will engage the Department of Environment and Natural Resources (DENR) and local communities for tree-planting activities. To ensure sustainability, the LGU will establish a maintenance task force. This team will conduct periodic inspections and community clean-up drives. Monitoring and evaluation metrics include reduced flood occurrences and improved water flow in key drainage channels.

Goal 2: Strengthen Community Awareness and Participation in Dengue Prevention

Programs and Activities:

- Conduct annual information campaigns.
- Establish barangay dengue task forces.

This component prioritizes behavioral change through education. Multi-platform information campaigns (radio, social media, barangay assemblies) will disseminate dengue prevention tips. Schools and workplaces will serve as additional channels for awareness.

To ensure lasting impact, the plan encourages the creation of Barangay Dengue Task Forces composed of local leaders, youth, and health volunteers. These groups will spearhead source reduction activities, distribute larvicides, and conduct periodic fogging.

The Municipal Health Office will provide technical support, monitoring community engagement, and assessing the reduction in mosquito breeding sites. Community satisfaction surveys will track improvements in public awareness and participation.

Goal 3: Enhance Community Readiness for Floods and Health Emergencies

Programs and Activities:

- Conduct annual disaster simulation drills.
- Establish fully functional evacuation centers.
- Strengthen dengue surveillance with rapid diagnostic test kits.

Improving disaster preparedness is central to this goal. Simulation drills will be held annually in all barangays to test evacuation protocols and emergency communication systems. Schools, health centers, and barangay halls will serve as focal points for training.

Evacuation centers will be upgraded to meet national standards, with provisions for sanitation, food storage, and medical care. Early warning systems will integrate real-time weather monitoring.

For dengue readiness, barangay health centers will receive rapid test kits and training for health workers. Early case detection will minimize hospital overcrowding during outbreaks.

Goal 4: Strengthen Emergency Response and Relief Operations

Programs and Activities:

- Establish a centralized disaster operations center.
- Deploy temporary dengue treatment units (TDTUs).

This goal focuses on enhancing coordination during crises. The Disaster Operations Center will house a 24/7 command hub with communication and data tracking systems. It will centralize decision-making during floods and health emergencies.

Temporary Dengue Treatment Units will be set up in all high-risk barangays. These TDTUs will help decongest hospitals by treating mild to moderate cases locally, equipped with beds, IV fluids, and diagnostic tools.

The MDRRMO and MHO will conduct joint emergency drills to improve response times. Partnerships with the Philippine Red Cross and NGOs will ensure adequate resource mobilization during large-scale emergencies.

Goal 5: Facilitate Rehabilitation of Flood-Affected Communities

Programs and Activities:

- Conduct psycho-social support programs.
- Provide livelihood assistance.

- Rehabilitate damaged infrastructure.

Post-disaster recovery will focus on both physical reconstruction and mental health recovery. Psychosocial First Aid (PFA) sessions will help trauma-affected individuals, especially vulnerable groups like children and the elderly. Livelihood programs will assist affected farmers and small businesses through grants and training in alternative income-generating activities. The Department of Social Welfare and Development (DSWD) will lead this component. Infrastructure rehabilitation will prioritize road repairs, bridge reconstruction, and drainage clearing. The plan includes a monitoring system to track progress and ensure timely completion of recovery projects.

Conclusion

The Integrated Action Plan for Gloria, Oriental Mindoro provides a roadmap to mitigate the compounded threats of flooding and dengue. It emphasizes multi-stakeholder collaboration, community engagement, and data-driven decision-making. When fully implemented, the plan is expected to enhance public safety, build resilience, and reduce both environmental and health risks for the people of Gloria.

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