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METRO CEBU RIVER SCAN CHALLENGE 2025

## RESEARCH REPORT AND INNOVATIVE SOLUTION PROPOSAL



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## PART A. RESEARCH REPORT

### CHAPTER I INTRODUCTION

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#### 1.1 Background of the Study

Water pollution has increasingly become a critical issue in the Philippines, with nearly half of its rivers affected. The Butuanon river, which cuts across Cebu City and Mandaue City, exemplifies this growing environmental concern. In 1992, the Butuanon River was officially declared biologically dead by the Department of Environment and Natural Resources (DENR). Once a vital resource for residents engaging in fishing and bathing, the river has deteriorated to a biologically dead state due to persistent pollution and mismanagement.

The Butuanon River traverses Barangay Tingub, making the barangay one of the critical areas directly affected by the river's environmental state. Historically, the river served the community by providing water for daily household activities and agricultural needs. Today, Barangay Tingub faces serious challenges related to flooding, foul odors, and health risks, all linked to the Butuanon River's degradation.

The degradation of the Butuanon River is not merely an environmental issue but a public health and socio-economic concern. Polluted rivers pose risks of waterborne diseases, loss of biodiversity, and the collapse of livelihoods dependent on clean water resources. The issues arising from the degradation of the Butuanon River reflect the failure in environmental governance, public awareness, and corporate accountability.

Previous studies, such as the Senate's 2023 findings, have emphasized the widespread problem of river pollution in the Philippines. Despite the vast data collection on river pollution, there is limited localized research focusing on the root problem of the Butuanon River's degradation. Most studies do not delve deeply into identifying specific lapses in government action or analyzing the role of community and corporate behavior in worsening the pollution. Existing interventions often fail to address the socio-political dynamics that hinder effective implementation.

Given the continuing deterioration of the Butuanon River nearly three decades after the establishment of its management board, it is crucial to investigate the specific factors causing this failure. This study aims to fill the research gap by identifying governance lapses, evaluating community and corporate practices, and proposing practical, evidence-based policy

interventions. The researchers believe that understanding and solving this local issue can serve as a stepping stone towards improvements in our water resource management.

## **1.2 Statement of the Problem**

According to a Senate report, 43% or 180 out of 421 rivers in the Philippines are polluted due to untreated domestic sewage and industrial and agricultural waste (Senate of the Philippines, 2023). The same report reveals that 30 water agencies lack proper coordination with regards to regulation, management, and policy-making with regards to water resources. These data reveal a glaring truth on how pollution has to do with improper and inefficient government actions.

The Butuanon River, a river that runs through both Cebu City and Mandaue City has been utilized by residents particularly for bathing and fishing but was declared by the Department of Environment and Natural Resources (DENR) as biologically dead due to being polluted. A portion of the river, particularly, the portion in Purok 1, Barangay Tingub, Mandaue City has become so polluted that the water now possesses health hazards due to contamination because of improper garbage disposal and treatment of water waste particularly by the residents and a construction company nearby.

Although a water management board, known as the Butuanon River Watershed Management Board was created in 1996, still, the river's deteriorated to its current state. A question arises whether there are lapses in government action given that for 29 years already, the Butuanon river remains unsafe for people.

Certainly not an isolated case, the lack of coordination between the citizens, businesses, and the government can be present in those areas where rivers are also polluted or becoming polluted. The problem is a complex one, requiring both community involvement, government action, and a more sustainable approach on social corporate responsibility.

## **1.3 Objectives of the Study**

The general objective of this study is to determine the factors that affect the water quality in Butuanon River. Specifically this study aims to:

1. Identify the lapses in government action; and
2. Formulate a policy intervention to address pollution in the Butuanon river and the surrounding communities.

## **CHAPTER II METHODOLOGY**

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This chapter discusses the methodology in data gathering and analysis applicable to the research study. It provides a detailed explanation of how the research was conducted, the participants involved, the environment, methods of data collection and analysis, the research procedure, and ethical considerations. The purpose of this chapter is to ensure transparency and replicability, offering insight into the steps followed to achieve the research objectives.

### **2.1 Research Design**

This study employed a descriptive research design, which aims to systematically describe the perceptions, experiences, and awareness of residents living within three meters of the river in Brgy. Tingub. This research design allows for the collection of detailed information that can be used to identify patterns, assess risks, and support the formulation of potential intervention strategies.

### **2.2 Respondents**

The student researchers conducted a survey of 8 residents of Brgy. Tingub who live within three meters of the river. The objective of the survey was to gather data on the community's awareness, experiences, and perceptions regarding the effects of river proximity on their health, safety, and livelihood. To efficiently obtain relevant data, the researchers employed a combination of convenience and purposive sampling methods, selecting participants based on their proximity to the river and their availability. Only residents who had been living in the area for more than five years were included in the interviews to ensure the reliability and depth of the data collected.

### **2.3 Research Environment**

The study was conducted in Barangay Tingub, a community located in a low-lying area traversed by a local river. Several households are situated within close proximity—less than three meters—from the riverbanks. The area is known to be prone to flooding, especially during the rainy season, which raises concerns related to environmental hazards, property damage, and public health. This makes Brgy. Tingub is a relevant and critical setting for the research.

### **2.4 Data Collection Method**

Data were collected using a face-to-face interview using a guide questionnaire as the main instrument. The interviews were conducted in a comfortable setting within the respondents' houses. Each session lasted about 20 to 30 minutes. The researcher asked the questions, while a recorder documented the responses. Prior to the interview, respondents were informed of their

rights, ensuring confidentiality and voluntary participation. All collected data were treated with strict confidentiality and used solely for academic purposes.

## **2.5 Procedure**

First, permission was obtained from the barangay officials to conduct the research. After that, the researcher created the questionnaires to be asked to the selected respondents on the day of the fieldwork. Then, the researcher selects respondents that are qualified to be interviewed. The interview is then conducted by the interviewer, while the recorder is responsible for handling the data. Responses were automatically recorded and stored in a secure google form.

## **2.6 Instruments Used**

The primary research instrument used in this study was a semi-structured interview guide. This approach enabled the researchers to ask a consistent set of key questions while also allowing for follow-up questions based on the respondents' answers. This flexibility helped capture both quantitative data and in-depth qualitative insights relevant to the study.

The interview guide was designed to gather information on the respondents' demographic background, their experiences related to living near the river, their perceptions of health, safety, and livelihood risks, as well as their practices regarding garbage disposal. The combination of close-ended and open-ended questions ensured that the data collected was both systematic and comprehensive, while also allowing participants to share personal experiences and elaborate on issues they deemed important.

The interview questions were provided to the researchers as a standardized set, ensuring consistency across all interviews and alignment with the overall research objectives.

## **2.7 Ethical Considerations**

The researchers ensured that all ethical standards were observed during the conduct of the study. Prior to data collection, respondents were informed about the purpose of the research, the voluntary nature of their participation, and their right to refuse or withdraw at any time. Informed consent was obtained from all participants before proceeding with the interviews.

While some respondents chose to remain anonymous, others were comfortable sharing their names or preferred aliases, which were recorded with their permission. The confidentiality of all collected data was maintained, and any identifying information was used only with the explicit consent of the individuals involved.

Additionally, the research activity was coordinated with and approved by the Barangay Tingub officials to ensure transparency and adherence to local protocols.

Aside from the water filter system that the group proposes to the factories in Mandaue City. An ordinance has been drafted by the researcher that shall be endorsed to the Local Government Unit. The Policy/Ordinance shall be entitled, “An ordinance Providing for a Water Management Program for Factories in the City of Mandaue, Providing Fees and Imposing Penalties for Non-Compliance Thereof”. The said ordinance is as follows:

**AN ORDINANCE PROVIDING FOR A WATER MANAGEMENT PROGRAM FOR  
FACTORIES IN THE CITY OF MANDAUE, PROVIDING FEES AND IMPOSING  
PENALTIES FOR NON-COMPLIANCE THEREOF**

**WHEREAS**, Article I, Section 15 of the 1987 Philippine Constitution provides that the "State shall protect and promote the right to health of the people and instill health consciousness among them";

**WHEREAS**, Section 16 of Republic Act 7160, known as the Local Government Code of 1991, provides that local government units shall ensure and promote health and safety of the people;

**WHEREAS**, the Republic Act No. 9275, known as the "Philippine Clean Water Act of 2004" mandates the local government units to prepare and create a program on water management, thus to share the responsibility in the managing and improving the of water quality within their respective jurisdiction;

**WHEREAS**, there is an urgent need to enact legislation to ensure proper wastewater treatment that will protect and promote the interest and welfare of the city and its constituents, in accordance with the provisions of the Local Government Code of 1991.

**NOW THEREFORE, BE IT RESOLVED, AS IT IS HEREBY RESOLVED BY THE SANGGUNIANG PANLUNGSOD OF MANDAUE CITY, BY VIRTUE OF THE POWER VESTED IN IT BY LAW IN SESSION ASSEMBLED THAT:**

**SECTION 1. *Title*** - This Ordinance shall be known as "WATER MANAGEMENT PROGRAM ORDINANCE FOR FACTORIES" IN THE CITY OF MANDAUE.

**SECTION 2. *Declaration of Policy*** - It is the policy of the City Government of Mandaue to adopt measures protecting the health of the people and its residents, and the environment by controlling and managing the storage, collection, treatment, and disposal of water from factories.

**SECTION 3. *Definition of Terms*** - As used in this Ordinance, the following terms are defined as follows:

**3.1. CCENRO** - refers to the Cebu City Environment and Natural Resources Office.

**3.2. Disposal Fee** - refers to the fee paid by the desludging/hauling service provider to the Cebu City Government for the acceptance and treatment of wastewater, septage or sludge, and disposal of treated wastewater and biosolids at the Septage Treatment Facility managed by the Cebu City Government.

**3.3. DENR.** - refers to the Department of Environment and Natural Resources.

**3.4. DOH** - refers to the Department of Health.

**3.5. Effluent** - refers to the discharge from known sources which is passed into a body of water or land, or wastewater flowing out of a manufacturing and/or industrial plant including domestic, commercial, and recreational facilities.

**3.6. EMB** - refers to the Environment Management Bureau.

**3.7. Environmental Sanitation Clearance (ESC)** - refers to the clearance issued by Secretary of the Department of Health or his duly authorized representative, allowing the collection, handling, transport, treatment, and disposal of domestic sludge or septage.

**3.8 Excrete** - human waste composed of urine and feces.

**3.9. Groundwater** - refers to the sub-surface water that exists beneath a water table in solid and rocks or in geological formations.

**SECTION 4. *Coverage and Application*** - This ordinance shall cover the entire territorial jurisdiction of the City of Mandaue. It shall apply to all industrial factories and establishments, whether public or private, operating within the City.

**SECTION 5. *Right of Inspection*** - The City Government of Mandaue, through the CCENRO and other concerned offices, shall have the right to enter premises during reasonable hours to inspect wastewater treatment facilities, monitor discharges, and verify compliance with this Ordinance. Inspections will be conducted monthly and refusal to allow inspection shall be deemed a violation.

**SECTION 6. *Sanitary Facility in Every Factory*** - All factories shall be required to install, operate, and maintain adequate sanitary and wastewater facilities to ensure that wastewater is properly collected, treated, and disposed of in accordance with applicable environmental standards.

**SECTION 7. *Pre-Treatment*** - Factories must pre-treat their wastewater to remove harmful pollutants before discharge to public sewers, drainage systems, or receiving bodies of water. The standards for pre-treatment shall be based on existing DENR and EMB guidelines.

**SECTION 8. *Water Filter System*** - Factories must install water filtration systems appropriate for the nature and volume of their wastewater output to reduce pollutants and harmful substances. Factories shall regularly maintain and upgrade these systems to meet evolving environmental standards.

**SECTION 9. *Disposal of Water***- For the purpose of water disposal, factories shall implement the following:

- a) Untreated water or used wastes must not be discharged onto the surface of the ground, into any street or road, and most especially stream water, or any body of water.
- b) Sewage or other putrescible, impure or offensive wastes and water must not be discharged to an abandoned water supply well, spring, cisterns or into a natural or artificial well. The local health unit may require percolation tests and other water testing that may be deemed necessary to determine the acceptability of the site.

**SECTION 10. *Improper Water Disposal Fee*** - Any factory found improperly discharging wastewater shall be subject to an Improper Water Disposal Fee amounting to ₱100,000.00 per violation, in addition to any other applicable fines and sanctions under national laws and regulations.

**SECTION 11. *Administration of Funds*** - All fees collected under this Ordinance shall be deposited in a special account of the City Government of Mandaue and shall be used exclusively for environmental programs, including the maintenance and improvement of wastewater treatment facilities and enforcement activities.

**SECTION 12. *Role of the Barangay*** - Barangay officials hereby are mandated to assist in monitoring and reporting any violations of this Ordinance within their respective jurisdictions. They may recommend actions and assist in preliminary inspections in coordination with CCENRO.

**SECTION 13. *Prohibited Acts***- The following acts shall be deemed prohibited under this policy:

- a) The discharge of untreated wastewater into public or private drainage systems and natural water bodies such as rivers.
- b) Tampering with or disabling the installed wastewater treatment or filtration systems within the factory.

- c) Refusal to allow inspection or monitoring by authorized personnel.
- d) Operation of factory activities without appropriate wastewater management systems and filter systems.

**SECTION 14. *Penalties***- Aside and in addition to the Improper Water Disposal Fee under Section 10, the following penalties shall be applied:

- a) First Offense: Fine of ₱100,000.00 and issuance of a Notice of Violation.
- b) Second Offense: Fine of ₱130,000.00 and suspension of the business permit until compliance is achieved.
- c) Third Offense: Fine of ₱150,000.00, revocation of the business permit, and possible closure of the establishment.

Let it be known that in each day of continuing violation shall be deemed a separate offense.

**SECTION 15. *Separability Clause*** - If any provision of this Ordinance is declared invalid or unconstitutional, the remaining provisions shall remain in full force and effect.

**SECTION 16. *Effectivity*** - This Ordinance shall take effect fifteen (15) days after its publication in a newspaper of general circulation within the City of Mandaue.

### **CHAPTER III**

#### **RESULTS AND DISCUSSION**

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In Mandaue City, particularly, Purok 1, Barangay Tingub, a barangay situated near the Butuanon river opens the reality to a pollution problem that not only concerns the community but also and most especially the government authorities. Residents of the purok are subjected to foul odor caused by the garbage that traverses the river, especially if the water becomes stagnant. This illustrates how pollution in the area does not only affect the water but possibly the health of the residents who smell the odor from the river and from the contamination of the water.

There is a lack of coordination between agencies and the community. The situation of the residents in Purok 1, Barangay Tingub reveals this reality. Residents state that it is physically demanding for the residents to carry their trash and place it to the collection area given that the only way in and out of the area is going through a long, narrow, and steep pathway. A private construction company near the area discharges wastewater directly into the river contributing to more harmful toxins and making the river more hazardous.

### **CHAPTER IV**

#### **CONCLUSION AND RECOMMENDATIONS**

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This study highlights the ongoing environmental degradation of the Butuanon River, particularly in Purok 1, Barangay Tingub, Mandaue City, where pollution has reached critical levels. Findings reveal significant lapses in government enforcement, poor waste disposal practices among residents, and the unregulated discharge of industrial wastewater by nearby construction firms. A Butuanon River Watershed Management Board was established in 1996, yet no action has been taken, and government agencies are poorly coordinated, allowing the biological death of the river to happen. Residents living beside the river face health and environmental peril, making the need for action that would unify all actors and be enforceable essential.

The research also indicated that solutions to the pollution problem must be two-pronged, first, through enforceable policy implementation that holds the industries accountable, and second, through implementable, community-oriented, solutions. The suggested ordinance provides a policy umbrella that would require industrial compliance with wastewater treatment standards, and the “Bin Aid” presents a scalable, low-cost, implementable solution that gives local communities control over river waste.

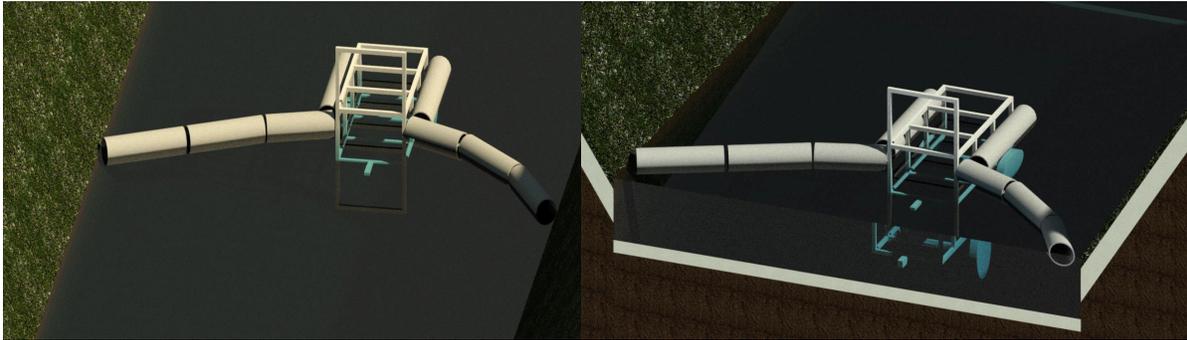
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## PART B. PRACTICAL SOLUTION

### I. DESIGN OF THE SOLUTION



*Figures 2 and 3: Rendered model of the Bin Aid*

In response to the continuing pollution of the Butuanon River and the need for an efficient and inexpensive remedy, the team proposes a floating river trash trap system called "Bin Aid." The solution will target the accumulation of solid waste in the river, in particular the impact of human activity such as industrial discharge and disposal practices, which is most significant in areas such as Purok 1, Barangay Tingub, Mandaue City.

The Bin Aid system is a portable, cage-like framework, utilizing a rectangular aluminum frame (120 cm × 60 cm × 75 cm), covered in layers of mesh that can perform two functions. The mesh and its layered function will aim to capture floating trash as its first purpose, but also provide a basic filtration design to retain larger solid particles or contaminants by opening sizes of mesh ( $\frac{1}{4}$  inch, 2 inch, and 3 inch). The mesh will allow for various types of debris to be trapped in the system.

The unit is equipped with a set of side-handles to manually lift the unit and rear-wheels for transport. A hook system is placed in the front, enabling the bin to be pulled by a motorcycle to the designated disposal area of the barangay so the bin does not have to be carried beyond long distances. The mobility of the Bin Aid system responds to the difficulty of movement applicable to the terrain and restricted access in parts of Barangay Tingub.

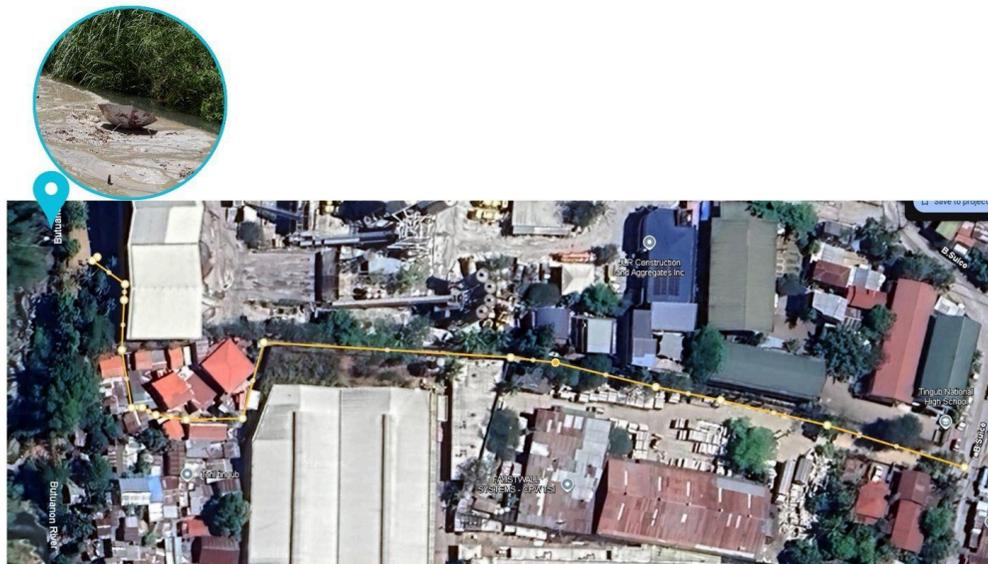
The Bin Aid is equipped with HDPE float pipes on both sides to enable it to float and stable on the river. The Bin Aid system is also fitted with plastic mesh fencing to assist in directing the trash towards the body of the Bin Aid system using the natural flow of the river. It

is secured in place using nylon rope and U-bolts and easily emptied of collected swage using the sliding door design.

The model can be easily constructed, low-cost, user-friendly and most importantly, is designed to address and remediate existing pollution in the river and provide an additional response to land-based solutions to waste, suggesting a practical response to the progressive health of the Butuanon River.

## II. LOCATION ANALYSIS

An estimated location of the proposed solution to pollution will be along a section of the Butuanon River, specifically Purok 1, Barangay Tingub, Mandaue City, near the discharges from the construction and aggregate factory. The position of the Bin Aid was determined based on an earlier pollution site; in areas where there are concrete wash down sites and other industrial discharges. So, it is intended to find a location to place the project that not only allows for filtering practice on site of the factory but also acts like a litter catcher that can collect floating litter prior to it continuing downstream. This is one way to mitigate both onsite and future river pollution.



*Figure 2. Proposed Implementation Site Map*

### III. SOCIAL COST-BENEFIT ANALYSIS WITH EXPLANATION

Below is a rough estimate detailing the required materials, quantity, and cost per material to build the Bin Aid.

*Table 1. Rough Estimate of the Cost of Proposed Solution*

<b>Cost of the Materials</b>				
<b>Item</b>	<b>Specifics</b>	<b>Quantity/ Unit</b>	<b>Unit Price</b>	<b>Subtotal</b>
aluminum tubing	12 meters long 1.5-inch thick Size: 2x2 inch	12 meters	₱824.00 (per 6m)	₱1648.00
1/4 inch opening aluminum mesh	5 square meter	5 sheets	₱687.00	₱3435.00
3 inch opening aluminum mesh	2 square meter	1 sheet	₱605.00	₱605.00
2 inch opening aluminum mesh	2 square meter	1 sheet	₱315.00	₱315.00
Mesh Fastener		98 pieces	₱117.00 (100 pcs)	₱117.00
Hex Bolts	M6 x 20mm Stainless Steel	18 pieces	₱10.00	₱180.00
U-channel rails	1/4x2x2 inch	2 pieces	₱740.00	₱1480.00
Latch	Stainless steel latch	1 piece	₱63.00	₱63.00
Handles	Stainless steel handle	5 pieces	₱80.00	₱400.00
HDPE Float Pipes	Bestank CF-12 30cm dia. (spherical)	4 pieces	₱700.00	₱2800.00
Plastic Mesh Fencing	4 meter wide 1 meter deep	4 meters	₱70.00	₱280.00
Recycled Rebar or Flat Steel Bars	1 meter	4 pieces	₱175.00 (6m)	₱175.00
U-bolts	1/4x1/2 with nut and washer	8 pieces	₱44.00	₱352.00
Nylon Rope	6mm	10 meters	₱7.80	₱78.00
			<b>TOTAL</b>	<b>₱11,928.00</b>

The Bin Aid is a litter catcher that promotes the cleanup of the Butuanon River in Barangay Tingub, Mandaue City, Philippines. The Bin Aid was designed to be placed along the river in areas where a large volume of litter is flowing, particularly in areas near factory runoff and stormwater drains. The Bin Aid consists of a rigid aluminum frame and mesh netting used to capture floating litter and plastic. The Bin Aid is buoyed by floats and has fencing along both sides to funnel litter into the Bin Aid. The Bin Aid has wheels and a tow hitch, allowing it to be towed with a motorcycle, which allows for easy mobility after it has collected litter.

When the Bin Aid is properly set up, it will be anchored to the river using ropes. It has plastic mesh netting as fencing on either side, which is used to capture litter. As litter accumulates downstream, the litter trapped in the Bin Aid will increase. When the Bin Aid is full of litter, it will be opened by sliding the door open. The Bin Aid can be lifted using the side handles for moving, or position and pulling with the wheels. As a rule of thumb, the teamwork of cleanup crews should empty debris every 3 to 5 days in anticipation of large predicted rainfalls, due to the more significant trash buildup in the water.

#### **IV. PLANNING**

The Bin Aid project's success involves proper planning and the full cooperation and collaboration with the stakeholders of Barangay Tingub and Mandaue City . Since Bin Aid is designed to collect litter and assist in filtering polluted water in the river, it needs to be placed in areas with high waste flow—probably around factories, or any areas where trash accumulates.

First, the site needs to be confirmed. A quick visual inspection of the river should verify the best place for the Bin Aid to be installed safely. It is a fundamental step to ensure that the current is not too strong and that the Bin Aid can be secured properly. Bin Aid is much simpler and inexpensive than large and costly machines, therefore large contractors are not required. The units shall be constructed and installed with assistance by local welders or barangay workers or volunteers. This will help the community feel ownership and bring accountability to taking care of the river.

The LGU can provide support by assisting in the setup and commitment to regular pick-up and proper disposal of waste collected from Bin Aid. They can also engage by promoting the Bin Aid project to residents and potentially asking residents to assist with monitoring and light cleaning. It is also suggested to implement collaborations with institutions

such as the University of San Carlos and local environmental groups for experts. These groups and institutions can assist in providing expert advice, monitoring the water quality, and provide capacity to support the education of the community and proper usage of Bin Aid.

Once the Bin Aid is installed, the barangay and community can monitor the Bin Aid every week to gauge the amount of waste collected. Monitoring the waste collected will provide valuable information to assess whether the Bin Aid project is successful and thus, potentially warrant the use of an additional Bin Aid unit in other areas of the river.

## **V. STAKEHOLDERS INVOLVED**

### **LGUs, or local government units**

#### *Mandaue City Government*

The city government is responsible for implementing local environmental protection laws, monitoring compliance, managing environmental programs, and collecting funds for their implementation. They are instrumental in the general implementation of environmental standards.

#### *Barangay Tingub Officials*

The barangay authorities are the primary link between the local community and the city government. They assist in monitoring violations and reporting problems and serve as a linkage to the community to ensure that initiatives at the community level are in line with environmental objectives and regulations.

### **National Government Organizations**

#### *Department of Environment and Natural Resources (DENR)*

The DENR plays a vital role in regulation in terms of technical standards and ensures that local activities conform to federal environmental law, as well as giving any advice on the best environmental management practices for the sustainability of natural resources.

#### *Environmental Management Bureau (EMB)*

The EMB monitors industrial discharges and inspections to ensure compliance with effluent regulations. They play a key role in ensuring industry compliance with wastewater and other environmental directives.

### *Department of Health (DOH)*

The DOH is mandated for environmental sanitation measures to meet public health requirements, especially for wastewater disposal. They give environmental sanitation.

## **The Private Sector**

### *Industrial Factories of Mandaue City*

Filtration installations and maintenance are made mandatory for factories and industrial establishments for safe wastewater disposal; hence, public health and environment will not get affected by their operations, which are the main contributions in reducing pollution.

### *Construction Firms Close to the Butuanon River*

To construct buildings close to the Butuanon River, companies have to obey strict environmental laws regarding illegal discharges. Everything the construction companies do greatly affects the river's quality, and if they are not careful with their environmental rules, they will ruin the natural aspect of the river.

### *Landowners Near the Butuanon River*

Landowners along the Butuanon River are essential to the success of environmental projects because they must cooperate with them to grant site access, attach an asset for infrastructure, and adhere to land use regulations that impact certain communities and also have an impact on the river's health.

## **Community**

### *Barangay Tingub (Purok 1) residents*

Residents are directly affected by the condition of the river, thus they are active in waste disposal and reporting violations. They also promote local environmental quality monitoring and sustainable practices.

### *Environmental Advocates and Local NGOs*

NGOs and advocacy groups promote community involvement in environmental monitoring, thereby enhancing public awareness and increasing environmental education. Their determination has increased public and stakeholder involvement and accountability.

## **Educational and Research Establishments**

### *Colleges and Student Research Teams*

The research and academic institutions provide necessary data and scientific research for improving evidence-based policymaking. In addition, they monitor environmental law implementation to ensure the effective running of programs and to recommend enhancements.

## **VI. OPERATION AND MAINTENANCE**

The Bin Aid is a litter catcher and a water filtration that promotes the cleanup of the Butuanon River in Barangay Tingub, Mandaue City, Philippines. The Bin Aid was designed to be placed along the river in areas where a large volume of litter is flowing, particularly in areas near factory runoff and stormwater drains. The Bin Aid consists of a rigid aluminum frame and mesh netting used to capture floating litter and plastic. The Bin Aid is buoyed by floats and has fencing along both sides to funnel litter into the Bin Aid. In addition to that, the Bin Aid has wheels and a hook system, similar to a tow hitch, allowing it to be towed with a motorcycle, which allows for easy mobility after it has collected litter.

When the Bin Aid is properly set up, it will be anchored to the river using ropes. It has plastic mesh netting as fencing on either side, which is used to capture litter. As litter accumulates downstream, the litter trapped in the Bin Aid will increase. When the Bin Aid reaches its capacity limit, it will be opened by sliding the door open. The Bin Aid can be lifted using the side handles for moving, or position and pulling with the wheels. As a rule of thumb, the teamwork of cleanup crews should empty debris every 3 to 5 days in anticipation of large predicted rainfalls, due to the more significant trash buildup in the water.

It is essential to consider maintenance of the Bin Aid. However, it is as easy as having a designated person checking the mesh for excessive litter or noting any displacement of the parts or likely failure of broken parts each day. Maintenance takes very little time out of the day. It may require retightening of its bolts and rivets, cleaning of the mesh, and collecting litter on a weekly basis. On a monthly basis, regularly check for rust of the wheels and sliding door, and check the ropes for signs of wear that would require replacement, if damaged. On a three-month basis, the whole unit should be pulled from the river and thoroughly cleaned, and each frame washed, with careful checks for rust and broken or damaged parts.

Always place safety first. Anyone who is cleaning, examining, or fixing any element of the Bin Aid at any other point in time must wear gloves and boots, and masks if necessary. It is important to use tools safely and properly.

With that being said, the Bin Aid's success still highly depends on the community and its stakeholders. Neighbors living next to the Bin Aid can help check and clean it. A small group from the barangay can help orchestrate and track cleaning and repairs.

Provided there is care moving forward, the Bin Aid can promote the cleanliness and conservation of the Butuanon River and other rivers in Metro Cebu. A simple tool like the Bin Aid - facilitated through collective action and shared responsibility - provides care and aid, and creates action.

## VII. REFERENCES

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