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METRO CEBU RIVER SCAN CHALLENGE 2024

RESEARCH REPORT AND INNOVATIVE SOLUTION PROPOSAL



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PART A. RESEARCH REPORT

I. INTRODUCTION

The Butuanon River, which lies between the islands of Cebu and Lapu-Lapu, is a 23-kilometer tributary of the Mactan Channel. Its catchment area is 62.5 square kilometers in total. Moreover, the river runs across the two main cities of Metro Cebu, Cebu City and Mandaue City. The land use of the surrounding area of the river situated within Mandaue City is a combination of residential, commercial, and industrial structures.

One of the surrounding areas of the river is Barangay Tingub in Mandaue City. The barangay is divided into five Puroks. However, the river only traverses the western edges of Purok I and Purok II. According to a 2020 census, the population of the barangay reaches 6082 (PhilAtlas, 2020). With thousands of residents living in the area, the river became a primary livelihood source and a big part of their daily lives.

The river was once used for purposes such as bathing and fishing. However, in 1992, the Department of Environment and Natural Resources (DENR) declared the river biologically dead. The deterioration of the river over time has now caused it to be one of the most polluted rivers in the province of Cebu. This sparked the creation of the Butuanon River Watershed Management Board (BRWMB) in 1996. (Sunstar, 2016). With the surrounding areas going through urbanization, the degradation of the waterway has worsened over time. (Cebu Daily News, 2018).

1.1. Statement of the Problem

Brgy. Tingub resides beside the Butuanon River, which has been declared biologically dead. With waste and garbage from residents and establishments polluting the river, the community continues to face several different issues daily. One of the main effects of pollution in the river is the stench emanating from it, which affects the living conditions of the people. Thus, the study aims to identify the causes of pollution in the river and subsequently propose a solution that can improve these living conditions and prevent further river pollution.



Figure 1.1 Current Condition of the Riverside of Brgy. Tingub

1.2. Objectives

The polluted Butuanon River has been detrimental to the environment in Brgy. Tingub. Moreover, it has been negatively affecting the lives of the residents who live near the river. Thus, the main objective of the study is to determine and investigate the main issue experienced by the residents of Purok I, Brgy. Tingub, who resides near the Butuanon River. Specifically, the study aims to achieve the following:

- i. Identify the problems of living near a biologically dead river and their corresponding severity.
- ii. Determine the effects of the identified issues on the community.
- iii. Determine the causes of the identified problems.
- iv. Formulate recommendations and possible solutions according to the main issues of the area that would benefit the community.

1.3. Significance of the Study

With information gathered from the community meetings and site observations, the research study will be able to give information on the current status of the community and the river itself. Identifying the causes of community issues will help provide policies and provisions that can enhance the way of living amongst them. The study will also raise awareness of the

causes of pollution and the issues the different community members face. The various health risks assessed through the study will allow safe provision and mitigation of contaminant exposure. The study will allow for the formulation of a solution that will tackle the main community issues at hand and further mitigate pollution in the river.

1.4. Research Question

The study aims to answer the main research question and the following sub-questions below to accomplish the objectives mentioned earlier:

1. What are the main issues faced by the community living near the site due to the pollution in the river?
 - 1.1. What caused these problems to arise and what are their effects on the community?
 - 1.2. How did these problems further damage the river?
 - 1.3. What solution can be proposed to address the effect of the problem on the residents and alleviate the pollution in the river?

II. METHODOLOGY

This chapter explains the various methodologies for gathering and analyzing data relevant to the research study. This includes the research design, respondents, environment, procedure, and instruments.

2.1. Research Design

The study employs a descriptive and phenomenological approach to qualitative research that centers on the community members to identify the problems in the area and propose a solution to address the chosen community problem.

2.2. Research Respondents

There were 37 respondents interviewed in the study, all of whom are residents of Purok I, Brgy. Tingub, Mandaue City. It was ensured that the chosen respondents had at least five years of

residency in the area to provide a more extensive and substantial comment on their living experience beside the Butuanon River. All of the respondents were around the ages of 16 and above. They were an amalgamation of both sexes, with the majority having a poor socio-economic background. Most residents there are informal settlers, with houses usually made of light materials.

2.3. Research Environment

The study was conducted in Purok I, Brgy. Tingub, Mandaue City, near the Butuanon River. A narrow road beside the Tingub National High School allows you to enter the village beside the Butuanon River. The residential area is not easily accessible due to the narrowness of the roads. The vast amount of garbage accumulated within the river caused the river to omit a foul odor. The area has no available shade and is polluted. The houses are clustered together in a small space.

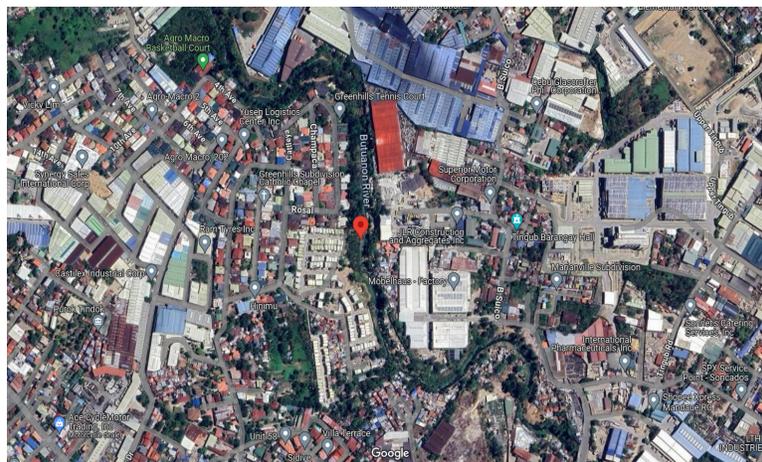


Figure 2.1. Satellite Image of the Butuanon River in Purok I, Brgy. Tingub, Mandaue City

2.4. Research Procedure

Qualitative observations and the documentation of notable features were taken during the community walk with the community members on April 15, 2024. This measure was done to develop an understanding of the physical, social, and economic facets of Brgy. Tingub.

The first round of interviews was conducted on the 15th of April 2024, involving four participants, all of whom are residents of Brgy. Tingub living in proximity to the Butuanon River.

This measure was done to gain informative insights into their lives throughout their residency near the river and to identify recurring and prominent problems that need to be addressed.

A second round of interviews was arranged for April 17, 2024, after a mutual agreement was reached between the Dutch-Filipino research team and the community members. The subsequent set of interviews was a collaborative effort between the two teams assigned in Brgy. Tingub, involving 37 residents. This was done because of the proximity between the areas of the two groups. Subsequently, it allowed results and resources to be maximized. The interviews allowed further understanding of the problems and how they affect their lives. Written documentation of the interviews as well as audio recordings were utilized for the research.

In line with the empirical findings and the data gathered from the interviews, the researchers used reliable existing documents and other similar sources of data to have a more comprehensive understanding of the problems identified in Brgy. Tingub.

III. RESULTS AND DISCUSSION

3.1 Findings from the Interviews

On April 17, 2024, a community meeting was conducted with community members of different ages. The participants were subdivided into five groups and tasked to write the most critical issues of the community on meta cards. There were varying results based on the cards. The most common answers are the following: Flooding, Safety concerns, Foul Odor, and the dirtiness of the river.

The residents explained that flooding occurs only during heavy precipitation in the mountainous regions upstream of the tributary. They pointed out that too much runoff from elevated catchment areas discharging to the river is the main culprit during flooding. They added that flooding does not necessarily happen during regular rainfalls near their vicinity.

There are also safety concerns addressed by most of the interviewees, most of which are regarding the bridges made of tied-up bamboo sticks with no proper stepping and railings to hold on. The problem has been addressed to the government, but a call to action still has yet to be implemented. There have also been some minor injuries that the locals have experienced, but none that are life-threatening. The pollution of the river has caused a decrease in water quality and increased health risks among the community members. Polio is a disease previously

contracted by residents and has thus prompted barangay captains to offer vaccinations against the disease. (Palubsanon & Malinao, 2020).

The pollution of the river has been the main driver of inconvenience to the residents, particularly the foul odor it produces. The acrid smell is powerful when the flow of the river is nearly stagnant, with barely any movement. They argued that the cause of the stench is the wastewater that the JLR Construction and Aggregates Company discharges into the river. The wastewater may contain the byproducts of their industrial processing, and it may contain harmful chemicals damaging to the river and the residents. This presumption is substantiated by the observations of the residents of their wastewater being murky white that is occasionally bubbly. Harmful chemicals and biological contaminants will cause suspended particles to make the water appear murky. (Eldorado Springs, 2022).

3.2 Water Quality Tests

Table 1. Water Quality Index

Parameters	1	2		3		4
Date	April 17, 2024	April 17, 2024	April 15, 2024	April 17, 2024	April 15, 2024	April 17, 2024
Nitrates (No2) [mg/L]	0.25	0.25	0.25	0.2	0.25	0.5
Nitrates (NO3) [mg/L]	18	18	25	18	18	25
GH (General Hardness) [°dH]	>21	>14	>21	>21	>21	>21
KH (carbonate Hardness) [°dH]	>20	15	>20	>20	>20	15
pH	8.2	9	>9	8	8	8

Chlorine (Cl ₂) [mg/L]	0	0.8	0.8	0	0	0
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Based on the water quality tests conducted, the river tested high on Nitrate (NO₃). In excess amounts, nitrate can cause a decrease in water quality and increase safety issues. In high concentrations, nitrate becomes harmful to warm-blooded animals and causes low oxygen levels. (United States Environmental Protection Agency, 2012). Primary sources of nitrate include human and animal feces; these can stem from livestock and septic tanks. (National Library of Medicine, 1995). High pH values presented by the river would also indicate that the water is polluted and not safe for human contact. (Fondriest Environmental, 2013)

3.3 River Observations

There were clear signs of improper garbage disposal in the river. It was evident that the residents themselves were one of the main contributors to the pollution of the river. Their reason is that the implemented garbage disposal system set by the local government barely reaches their location because of the long, narrow pathway in and out of their area to the street. Proper disposal of their garbage out into the street to be collected by garbage trucks is physically demanding to them. This causes their undisposed trash to accumulate in their vicinity and eventually make their way to the river, thus affecting the water quality. The safety issues brought by the aforementioned high levels of nitrate and the vast amount of garbage make it necessary to address the problems brought about by the pollution promptly. Providing the community with a proper system to dispose of their garbage is essential in solving the pollution within their section of the river.

IV. CONCLUSION AND RECOMMENDATIONS

In conclusion, the main issue faced by the community of Purok I, situated near the Butuanon River, is the pollution of the river, particularly the section of the river that traverses their area. The dirtiness of the river releases a powerful acrid odor that all the residents smell, especially when the flow of the river is nearly stagnant. This odor pollution lingers all the time and disrupts their day-to-day lives. The contaminated water of the river also contains harmful

toxins that may be a health hazard to the community. In addition, the residents face safety risks due to the lack of safe and appropriate bridges to travel across the river in some sections where there are deep waters. Thus, the residents made use of bamboo bridges with no proper stepping and railings to hold on.

This pollution problem is primarily caused by the improper garbage disposal of the residents in the community. The residents do not abide by the implemented daily garbage collection of the local government. It was determined that it was physically demanding for the residents to carry their trash and place it on the streets to be collected because the only way in and out of the area was via a long, steep, narrow pathway. Thus, their undisposed garbage accumulates in the area and eventually makes its way to the river. Moreover, a secondary cause of this pollution is the JLR Construction and Aggregates Company, which directly discharges its wastewater into the river. All these activities significantly contribute to the degradation of the river by contaminating its waters, making the river unsuitable to support local flora and fauna.

Hence, to solve the primary cause of pollution in the river, a viable and effective garbage disposal system needs to be implemented in the community. One solution is to transport the garbage of the residents over the narrow roads leading to Tingub National High School via a cable transport system. It will span from the entrance of the community, specifically in a vacant lot, to the entrance of the narrow road near Tingub National High School. The length of the cable transport system would be approximately 200 meters. The garbage collected and transported via the cable transport system would be disposed of properly via the implemented garbage disposal system of Brgy. Tingub. This automated garbage collection in the community would significantly reduce the physical strain of carrying their garbage. If this were strictly imposed daily, their garbage would no longer reach the river, and the apparent solid waste contaminating the river would diminish.

It is recommended that the cable transport system be designed to carry the maximum possible loading capacity fully and more conservatively than the minimum design. This requirement is to ensure the structural integrity of the cable transport system in case of unforeseen circumstances and to ensure the safety of the residents near the structure. There are other problems in the river affecting the community that future researchers could tackle. These include but are not limited to the following: flooding, safety risks, health risks, etc.

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PART B. PRACTICAL SOLUTION

I. DESIGN OF THE SOLUTION

In response to the chosen problem of inadequate waste management, added to the limitation posed by having only one narrow, steep path for garbage collection in Brgy. Tingub, the team proposes a cable transportation system called “The Cable Can.” The system has three posts/stations. The first station, the central station, is located in an open area near the riverbank of Purok I. Garbage is loaded onto the cable car at this station. The second station is located on top of the hill. And lastly, the third station is located near Tingub National High School, where the garbage will be unloaded from the cable car.

The whole system is powered manually with the use of a crank. It consists of two box-like containers suspended from cables parallel to each other. The weights of the two containers work together to act as a pulley system to lift or drag down each other. The trash-filled container in the main station is first pulled uphill with the use of the crank. As it reaches the top of the hill, the trash-filled container will act as a counterweight as it moves down, pulling the empty container back to the main station where the cycle continues.

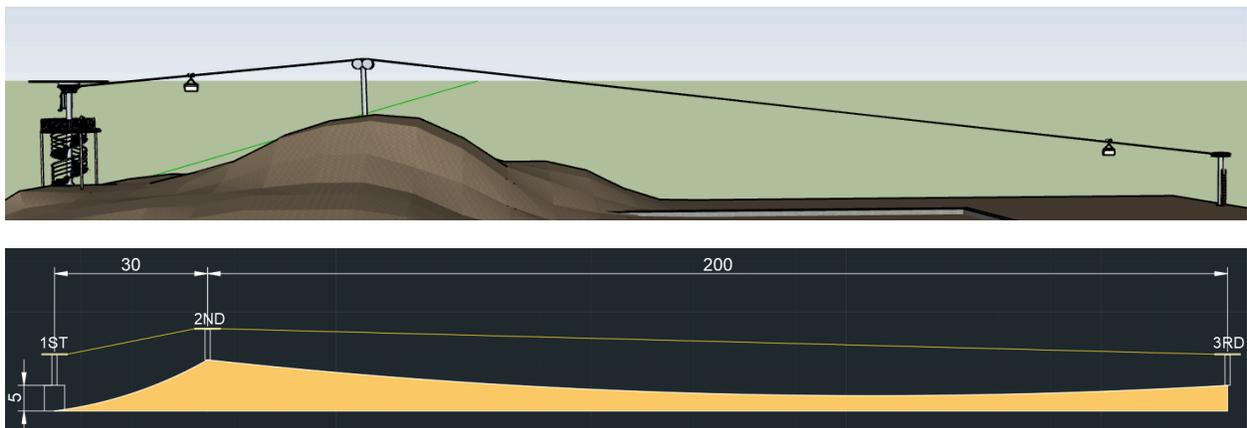


Fig. 1.1 *Elevation View*

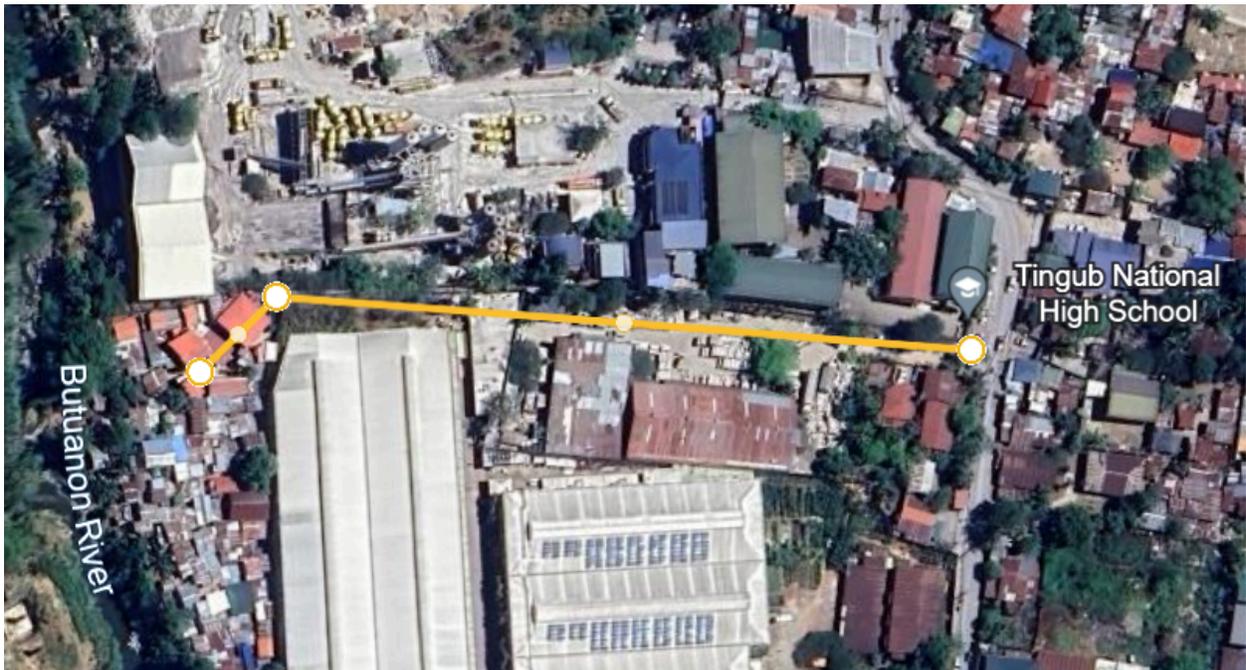
Table 1. Description of Components

Description of Components	
Item	Description
Cart	It holds a maximum capacity of 200 kg. Made of steel plates bolted and welded together. It is essentially a metal bucket that is connected to the cable via a suspension mechanism. The bucket is free to rotate around its long axis and is locked in place by a latch. When the bucket is loaded, the latch is locked in place and is released upon reaching the unloading area.
Main Station	It is about 5m high. The station is mainly supported by a concrete-filled steel post that goes up to the roof of the structure. It has a spiral staircase that goes up to a circular platform where the trash is loaded onto the cart. It is also where the manual driver or power unit of the system is housed.
Middle Post	It is about 3m high. Made of a hollow steel post filled with concrete. It is a T-shaped post with rollers on each side of its upper portion to ease the movement of the cable.
End Station	It is about 3m high, made of a hollow steel post filled with concrete. This is the endpoint of the system, and it redirects the empty cart back to the main station by way of a circular guide rail located on top of the station. A ladder is installed on its side to allow people access to unlatch the locking mechanism of the cart and allow the bucket to tip over and pour its contents.
Power Unit	The movement of the system is powered by hand through the use of a crank that is connected to a set of pulleys and gears, which converts linear motion into circular motion of the cable. At downhill points, the system is powered by the weight of the trash-filled cart.



Fig. 1.2 *Design Perspective*

II. LOCATION ANALYSIS



The proposed solution is to be implemented at the edge of the residential area in Purok I and over the narrow roads leading to Tingub National High School. The first station of the proposed cable transportation system is located at the red dot as seen in the image above and will then go to the top of the hilly area, where the second station is located. Then it will go downhill

over the narrow path towards the main road near Tingub National High School. This will negate the accessibility problem caused by the narrow roads and make it possible for the garbage collectors to get the trash of the community at a more convenient location.

III. SOCIAL COST-BENEFIT ANALYSIS WITH EXPLANATION

Table 2. Rough Estimate of the Cost of Proposed Solution

Cost of the Materials				
Item	Specifics	Quantity/ Unit	Unit Price	Subtotal
Steel Wire/Cable	1 reel (75m)	7	₱9,432.64	₱56,595.84
Metal Sheets/ Mild Steel Plate	8mm, Size: 4 ft x 8 ft	2 sheets	₱8,736.00	₱17,472.00
Metal Bars/ Deformed Bars	Grade 33, 12mm	2 pieces	₱319.68	₱639.36
Metal Pipes/ GI Pipe	3", Sch40, Seamless, 6 meters in length	6 pieces	₱7,352.82	₱44,116.92
Rollers	Bearing Pulley	6 pieces	₱2,243.64	₱13,461.84
Stairs	½" GI Pipe, Sch40, Seamless, 6 meters in length	10 pieces	₱946.27	₱9,462.70
	3mm Mild Steel Plate, Size: 4 ft x 8 ft	1 sheet	₱3,204.00	₱3,204.00
Catwalk	½" GI Pipe, Sch40, Seamless, 6 meters in length	10 pieces	₱946.27	₱9,462.70
	3mm Mild Steel Plate, Size: 4 ft x 8 ft	4 sheets	₱3,204.00	₱12,816.00
Grand Total				₱167,231.36

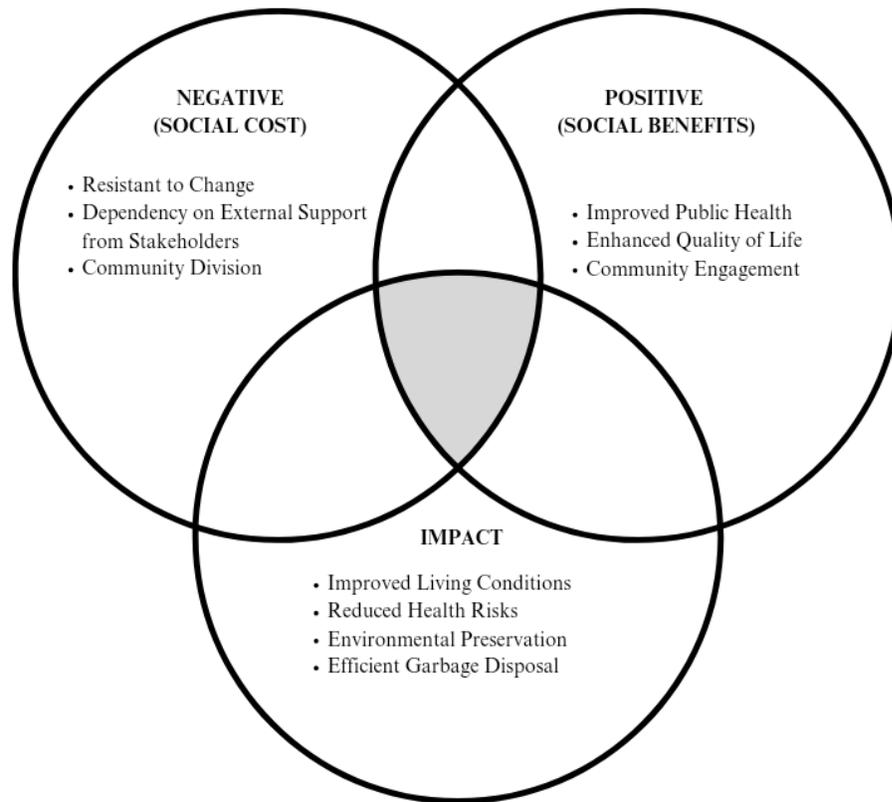


Figure 3.1. *Social Cost-Benefit Analysis*

The cable transport garbage disposal system would improve the living conditions of the community as it provides a convenient and efficient way to dispose of their garbage. Such a system can also help prevent further contamination of the river as it would reduce the amount of waste entering it. In short, efficient waste management provides significant improvements to social and health benefits for communities.

Firstly, it ensures the proper disposal of garbage, minimizing waste-associated health risks and leading to healthier populations. Secondly, it enhances the overall quality of life by maintaining cleaner living environments, improving air and water quality, and creating safer public spaces. Lastly, waste management initiatives promote community engagement through education, awareness campaigns, and participatory programs, fostering a sense of ownership and responsibility among residents. These initiatives not only improve the physical environment but also strengthen social cohesion and resilience within communities.

As such a project will improve community engagement as the system would require maintenance such as; cooperation and involvement of the community. A study conducted by Attree (2010) found that ‘engaged’ individuals experienced positive benefits in terms of physical and emotional health and well-being. The removal of such pollutants from the river would greatly improve the quality of life of the residents as the removal of pollutants can take away the foul odor that comes from the river. The absence of such odor can improve the overall ambiance and quality of life for its residents.

Researching the capability of materials for a cable transport garbage disposal system would involve assessing factors such as durability, load-bearing capacity, resistance to corrosion, and environmental impact. Common materials used for such systems include steel cables, high-strength alloys, and corrosion-resistant coatings. Additionally, the cost of materials varies depending on factors such as quantity, quality, and sourcing. Steel cables, for example, may vary in cost depending on their diameter, strength, and coating. Conducting a detailed cost analysis would involve comparing prices from suppliers, considering transportation costs, and factoring in any additional expenses such as installation and maintenance.

In conclusion, while cable transport garbage disposal systems offer significant benefits such as improved living conditions, reduced health risks, and enhanced community engagement, they also come with social costs. These include resistance to change, dependency on external support, and community division. Addressing these challenges is crucial to maximizing the positive impacts of waste management initiatives and fostering sustainable development within communities.

Garbage and waste collection will no longer be an issue due to the proposed system. This would lead to a decrease in the waste of the residents, subsequently reducing the waste that ends up in the river. However, it is important to note that the proposed project will not be an instant solution to the problem as a study by Muego (2006) suggests that the contributory factors of why initiatives fail in rehabilitating the Butuanon River are caused by fragmented and uncoordinated initiatives, as well as the lukewarm attitude and token gesture from the local government.

IV. PLANNING

The Local Government Unit (LGU) is an indispensable part of the planning process for the execution of the solutions. Several contractors that have the expertise to manage and successfully construct this cable transportation system effectively would significantly impact and formulate an accurate timetable and metrics in the performance of this initiative. Moreover, the planning for the proposed solution should also involve a proper survey of the area. This is to ensure there will not be any safety risks to the actual solution, take into consideration the development of the community, and address the problems of the community and concerns. Once the proposed solution is adopted by the LGU, the implementation process of the solution can start. The LGU should also coordinate and hold meetings with, most importantly, the residents, and other stakeholders such as the NGOs, the Cebu City LGU, and the University of San Carlos to enhance and realize the feasibility of this project.

V. STAKEHOLDERS INVOLVED

Residents

As the ones primarily affected by the problems posed by the river, the residents of the community would be the most essential stakeholders for this project.

Land Owners

Land ownership of the area beside the river is disputed between some of the residents and the government. However, regardless of whether it is publicly or privately owned, the landowners would also be affected by the problems caused by the river, mainly due to pollution.

Nearby Establishments

Residents near the river are not the only ones affected by pollution; nearby establishments are also affected. They also smell the acrid, foul odor that the river emits. Although they experience its effects less than the residents, neglecting this problem would only exacerbate and widen the scope of this issue in the future.

LGUs

Being the primary entity responsible for local governance, the LGU has the most influence on the creation and execution of municipal regulations for the protection of public

health and the state of the rivers in the city. The area of Brgy. Tingub is politically and geographically within Mandaue City; thus, only the LGUs will be included.

NGOs

Environmental non-governmental organizations have significant influence since they are responsible for funding, volunteerism, and specialized knowledge to support local law enforcement related to the well-being and environmental preservation of the public. These organizations are actively involved in various environmental initiatives and would likely welcome support or involvement from concerned individuals. The power and resources they have would be necessary for the success of this collaborative effort and project.

University of San Carlos

The University of San Carlos has been conducting initiatives to help the environment and society. USC has shown dedication to making the River Scan challenge successful and thus would be an essential stakeholder in resolving the Butuanon River situation. The successful implementation and application of these technical papers, reports, plans, and projects would reflect and serve as a basis for the integrity, efficacy, and competence of this drive conducted by the school.

Mass Media

In this digital age, it is crucial to utilize the media to spread awareness. Letting people know about the issues and problems in their surroundings would cultivate and inspire them to take action. The dissemination of political information and the facilitation of public discussions on topics such as the environmental conservation of the Butuanon River could significantly be influenced by the mass media; thus, the public and mass media have an impactful role as stakeholders.

Cebuanos

It is a shared cause and responsibility to protect and take good care of the environment. The problems currently experienced in Brgy. Tingub is a result of excessive pollution not only in their section of the river but also in the entire river, which affects all the areas it traverses. Needless to say, it is the right of every Cebuano to have access to healthy and humane natural resources. As stakeholders, Cebuanos are responsible for shaping the future of Metro Cebu through the decisions, initiatives, and actions towards the environment.

VI. OPERATION AND MAINTENANCE

Residents would handle the operation of the cable transportation system as they would use it regularly. Due to its automated features, the procedures to transport waste to the main road are straightforward and manageable. However, it is required that the barangay officials implementing the solution would teach the residents about the mechanisms, instructions, and proper usage guidelines of the system. On the other hand, simple maintenance activities such as inspections for wear and tear, cleaning, and lubrications would be handled by trained barangay personnel. Likewise, safety, electrical, and structural inspections and restoration of damages would be handled by professionals to ensure compliance with the building codes and the full functionality of the system.

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