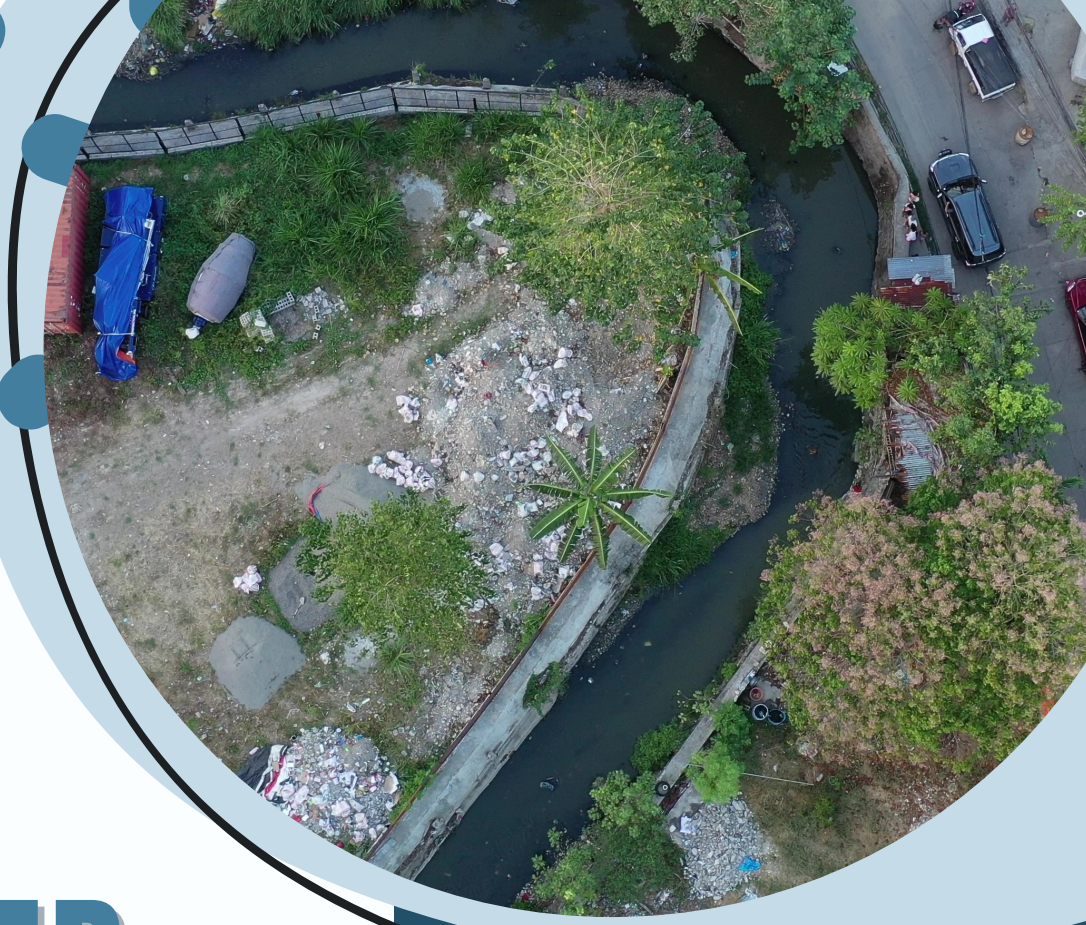

PROPOSED SOLUTION

FOR MIDSTREAM MAHIGA RIVER

(PANAGDAIT, MANDAUE CITY)

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ORGANIZED BY

UNIVERSITY of SAN CARLOS · ROTTERDAM UNIVERSITY · Hanze University of Applied Sciences Groningen · CEBU LEADS FOUNDATION, INC.

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PART A: RESEARCH PAPER

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I. INTRODUCTION

In our ecosystem, a river is its integral part that provides us with fresh water and food (Ali & Gupta, 2021). However, it faces many pressing environmental issues, which are river wastes and loss of marine life. The increasing amount of waste that is disposed of into these bodies of water- intentionally or unintentionally- is resulting in a concerning effect that damages both the river ecosystems and the communities that depend on them (Dey et al., 2021). The problem is particularly apparent in developing countries, where the implementation of waste management infrastructure is often lenient (Kumar et al., 2021). In particular, the rivers in the Philippines are highly polluted where an estimate of 73% of its water bodies are unfit for water-related activities (NEDA, 2019). This problem is due to the unregulated disposal of untreated sewage and lenient implementation of environmental laws (Garcia, 2020).

Mahiga River, situated in Mandaue City, starts in the Banilad mountains down to Subangdako as its midstream and downstream at Mabolo Reclamation Area. The river is facing a significant challenge in managing wastes. The river, in particular, was once a vital source of livelihood for local communities but is now heavily polluted due to untreated sewage and improper waste disposal. The water quality in Mahiga River is only suitable for irrigation, livestock watering, and industrial water supply (DENR, 2019). Due to this, it has caused health and environmental impacts such as water-borne diseases and depreciation of marine biodiversity (Caballes, 2020) and in 2018, the river was considered biologically dead. In response, the local government unit has performed many programs and initiatives to resolve this issue including installation of waste traps and clean-up drives (Garcia, 2021).

The accumulation of river waste not only pollutes the water but it also affects the marine life around the river, as well as the residents relying on it for their livelihoods. With this, it is of utmost importance to address the river waste problem by executing proper resolutions to the problem and protect our rivers' health and the people's wellbeing. In this regard, the case of the Mahiga River in Mandaue City stresses the pressing need for waste management policies that could help restore the river's health and biodiversity. By encouraging the local government unit and the residents to come together, these resolutions can effectively reduce the volume of waste that ends up in our rivers, protecting them and the communities that heavily rely on them.

PROBLEM STATEMENT

The Mahiga River is a small river that runs through Cebu City and Mandaue City. It originates from two sources and intersects with a larger river, flowing into the Mactan Chanel. Despite the efforts made to clean up the river, the problem of illegal settlements and improper waste management remains unsolved.

OBJECTIVES

In the present, the Mahiga River still faces two major issues, and these are the worsening level of water pollution due to waste disposal in the river and flooding that occurs when it rains too hard or too long. The goal of this project is to restore the river with an innovation that can aid in eliminating the wastes present in the river and maintaining its cleanliness. Specifically, this project aims to achieve these objectives by:

- Interpreting the information gathered from the fieldwork activities and interviews from the residents
- Designing the machine that will help in eliminating non-biodegradable or inorganic wastes
- Redirecting human wastes from households to a centralized location that would be eventually used as biomass fuels to power the designed machine
- Identifying the cost of the project and the stakeholders involved

RESEARCH QUESTION

To accomplish the objectives of the project and help resolve the problem, the following questions should be addressed:

1. What is the current state of the Mahiga River?
2. What is a potential and innovative solution to address the waste problem in the Mahiga River?
3. What are the challenges in implementing this potential solution?
4. How can these difficulties be addressed?

II. PLAN OF ACTION

Project Planning and Preparation (April 17 - 18)

- Identify project objectives and goals
- Formulate project plan and timeline
- Assign roles and responsibilities to team members
- Conduct an ocular inspection of project site
- Attend the ClimateScan River Scan Challenge Opening Ceremony

Research and Development (April 19 - 23)

- Conduct group fieldwork at identified stations for Mahiga and Butuanon River
- Attend River Scan Lectures I and II
- Collect and analyze data on the pollution levels and plastic waste in the river
- Research existing solutions and their limitations
- Brainstorm and develop ideas for the river skimmer solution

Prototype research (April 24 - 25)

- Finalize the design and specifications of the river skimmer
- Gathering info about developing a prototype using available materials and resources
- Research effectiveness of the prototype based on references

Refinement and Improvement (April 26 -27)

- Analyze the results of the prototype testing
- Identify areas for improvement and refinement
- Research a revised version of the river skimmer
- Conduct independent group work and polishing of formulated outputs

Presentation and Evaluation (April 27 - 28)

- Prepare a final pitch and presentation of the river skimmer solution
- Attend the Gallery Presentation of Outputs and Presentation of Pitches
- Participate in the Plenary Session for Final Evaluation of Pitches and Outputs
- Receive feedback from judges and evaluate the success of the project

Deadlines:

- April 18: Project plan and timeline
- April 23: Data collection and analysis
- April 25: Prototype research
- April 27: Final pitch and presentation preparation
- April 28: Gallery presentation and plenary session participation

III. METHODOLOGY

In this chapter, the solutions to the problem experienced by the nearby residents, and the river are discussed. Specifically, the problem is determined through the use of the qualitative and quantitative data gathered from the fieldworks and interviews with the residents.The qualitative data is based on the identification of the problems experienced by the residents of the Mahiga Midstream, and the quantitative data gathered based on the analysis of the water samples provides a view of the current state of the Mahiga River. Following this, the methodology of a proposed solution is discussed in this chapter. The group formulated the solution to directly solve the problems of improper river waste management. Various factors are also taken into consideration when proposing the solution such as financial budget, residents' participation and operational constraints.

INTERVIEW OF THE LOCAL RESIDENTS

In terms of the perspectives of the local residents, a consent form was given to ensure that their information (name, age, sources of income, etc.) and responses were to be used for the research report and video documentation. The local residents were asked questions from the questionnaire which were translated into Cebuano for better understanding, and then their responses were transcribed in order for their expectations and perceptions of the river to be recorded. It is noted that all the selected residents were given consent forms, for ethical information gathering to take place. The following questions were asked to the local residents:

1. What are your good or fond memories about the river?
2. How do you use the water from the river, before and now?
3. What changes have you observed about the water quality (smell, color, irritation to skin) over there?
4. What problems, issues, or concerns do you have about the river?
5. What programs or projects from the government have you seen or observed or known so far?
6. Do you see the need of having clean water from the river? If yes, what solutions would you want to suggest for the river to be clean and be useful to you?

In addition to these, more questions have been asked throughout the informal interviews between the fieldworkers and the residents situated at the midstream of Mahiga River regarding topics such as schedule of garbage collection in the barangay and the residents' waste management practices.

DETERMINATION OF MAXIMUM FLOOD HEIGHT

To determine the maximum flood height of the river, a measuring rod was used. The height of the rip rap was measured relative to the maximum flood height of the river. The height of the river during normal and heavy rainfall was also measured and the flood height during normal and heavy rainfall was also measured.

DETERMINATION OF THE RIVER WIDTH

The width of the river was measured using a measuring tool with three widths measured for the inner width and outer width. Three measurements were done since there are three different widths at different points of the river. The measurements were then used to calculate for the average width of the river.

DETERMINATION OF THE RIVER WIDTH

The fieldworkers gathered information regarding the urban water quality of the Mahiga Midstream 2, located at Panagdait through collecting water samples in the Midstream. After the fieldwork the samples were brought to the University for testing. The fieldworkers used test strips to determine the Nitrate, Phosphate, Alkalinity, pH, chlorine & free chlorine, total hardness and transparency of the water. The water sample in a small container was shaken, and after the test trips were submerged. After submerging, the test strips were immediately removed from the container, the fieldworkers then waited for 40 seconds for the test strips to dry. Afterwards, the fieldworkers took note of the results based on the graphics found in the container.

RIVERINE PLASTIC WASTE POLLUTION METHOD AND RANDOMIZED OSPAR FLOATING PLASTIC WASTE

One of the methods conducted by the fieldworkers was the riverine plastic waste pollution method wherein a rectangle quadrant is used for measurements in terms of the amount and types of wastes in the riverbank. On the other hand, the Randomized OSPAR Floating Plastic Waste was used to identify the amount and types of wastes in the middle of the river. These methods are used to identify the category of Mahiga Midstream in terms of it being almost clean to extremely polluted.

DETERMINATION OF THE RIVER STREAM VELOCITY

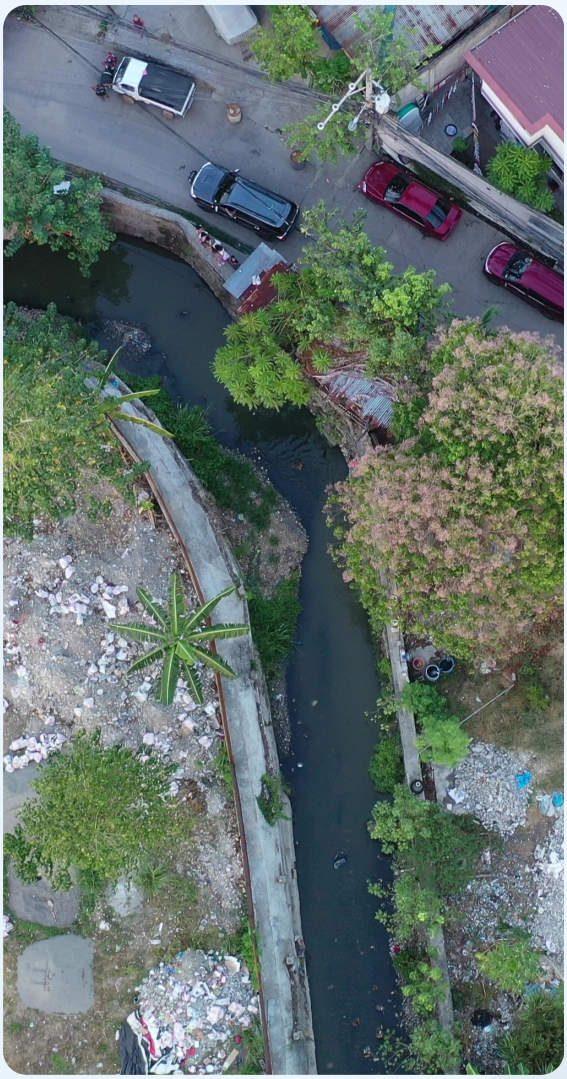
The river stream velocity was measured using the float method. This method measures the time (in seconds) it takes for a floating object to travel a known distance (between 50 and 100 feet) downstream. By dividing the distance and time, an estimate of the velocity of the water can be determined.

IV. RESULTS

This chapter will discuss the results of the quantitative and qualitative data collected and its interpretation. Further, the quantitative data discusses the results specifically related to the urban water quality of the river, category of Mahiga Midstream and the severity of flood. On the other hand, the qualitative data regarding the residents' perceptions and experiences supplements information for the quantitative data.

QUALITATIVE DATA

- ### INTERVIEWS



In the past, the Mahiga River was used as a source of water for the local residents where specifically, they use the river as a source of water for their everyday activities such as bathing and cleaning. The river before was even abundant with marine life, many fishes thrived in the river. However, populations have increased in recent years as well as the urban developments near the area which altogether led to multiple problems that contributed to the current situation of the Mahiga River. Based on the interview conducted with the residents situated near the midstream of the river, what used to be a river that served as their source for their daily needs is now lost, due to the contaminants present in the water. Another problem tackled was about the accumulation of wastes in the river, due to the improper disposal of garbage from the residents since there is a lack of designated areas for trash collection in the area and strict monitoring. This problem has eventually led to the usual flooding in the area and overtime has worsened since the river was deepened before as a solution to the flooding in the area. Deepening the river can potentially slow the speed of the river's flow since there is more time for the water to build and accumulate especially if heavy rain occurs. The height of the flood can reach up to the waist of the residents. One project the government implemented was building a rip rap which was used to prevent erosion to reduce the risk of flooding, and protect the households nearby, serving as a barrier between the land and the river. However, the construction of the rip rap was halted since it was deemed ineffective in fighting against the flood in the area. Clean-up drives were also conducted in the river once or twice every 10 years depending on the mayor of the city.

QUANTITATIVE DATA

• DETERMINATION OF THE MAXIMUM FLOOD HEIGHT

In mitigating the impacts of flood on the community and households, understanding the maximum flood height data should be collected to aid stakeholders in making informed decisions and strategies to combat . Shown below are the maximum flood height of the river relative to the height of the rip rap.

Height of the riprap	59 inches
Height during normal rain	21 inches
Height during heavy rain	51 inches
Flood height during normal rain	80 inches
Flood height during heavy rain	110 inches

TABLE 1: MAXIMUM FLOOD HEIGHTS

From the data above, it can be observed that the height of the river goes above the height of the rip rap indicating that the rip rap is ineffective in preventing flood from the area. If flood frequently occurs in the river, it would cause damage to nearby infrastructures and even loss of life. The floodwaters can also carry pollutants and debris which would worsen the impact of the flood.

• DETERMINATION OF THE URBAN WATER QUALITY OF THE RIVER

Tools were given to the fieldworks to determine the water quality of the river and were used to determine the results of strips. The parameters of the urban water quality are shown:

Sample	Nitrate/ Nitrite (ppm)	pH	Alkalinity (ppm)	Total Hardness (ppm)	Total Chlorine (ppm)	Free Chlorine (ppm)	Phosphate (ppm)
1	0	8.4	250	425	0	0	40
2	0	8.4	250	425	0	0	40

TABLE 2 PARAMETERS OF THE URBAN WATER QUALITY

Based on the data, the river has a nitrate level of zero indicating that no nitrates were found in the river. Since it has a nitrate level of zero, it could indicate that the source of the pollution in the river is not related to nitrates. However, it is also possible that the testing method used may not be sensitive enough to detect very low levels of nitrates. A pH level of 8.4 suggests that the river is slightly alkaline due to the presence of minerals and the presence of waste in the area contributing to the rise in the pH level of the Mahiga River. An alkalinity of 250 ppm and a phosphate level of 40 ppm is an indication that the river is receiving alkaline substances from wastes and other pollution sources. It also suggests that there is a problem with the water quality of the river as a high level of phosphate lead to excessive growth of algae leading to lower oxygen levels harming aquatic life. A total hardness of 425 ppm indicates that indeed the river is being impacted by pollution sources and that it could lead to problems for aquatic life. Since the total chlorine of the river and free chlorine is 0, this means that the water quality of the river has not been treated with chlorine but some sources also indicate that a chlorine level of 0 suggests that the water is not being adequately treated.

- # RIVERINE PLASTIC WASTE POLLUTION METHOD AND RANDOMIZED OSPAR FLOATING PLASTIC WASTE

A. RIVERINE PLASTIC WASTE MEASUREMENT FLOATING

Plastic pieces > 50 cm (hard and soft)	4
Plastic bags (shopping bags)	55
Small plastic bags (freezerbags, sandwich bags)	40
Candy/ sweet packets and lolly sticks	21
Food containers incl. fast food containers and plastic cutlery & trays	14
Large drink bottles (0,75 / 1 / 1,5 ltr)	1
Small drink bottles 0,5 ltr or smaller	10
Drink bottle wrapping	7
6-pack rings	2
Caps/lids (incl bottle caps)	2
Balloons, including plastic valves, ribbons, strings etc.	4
Clothing	3
Paper Bags	10
Cardboard	12
Drink cartons e.g. tetrapak	1
Paper drinking cups	1
Newspapers & magazines	1
Face mask	3
Condoms, sanitary towels, tampons etc	1
TOTAL	192

TABLE 3.1 DATA COLLECTED FROM THE RIVERINE PLASTIC WASTE MEASUREMENT FLOATING

B. RIVERINE PLASTIC WASTE MEASUREMENT FLOATING

Plastic pieces > 50 cm (hard and soft)	1
Industrial packaging, plastic sheeting	2
Plastic bags (shopping bags)	8
Small plastic bags (freezerbags, sandwich bags)	21
Candy/ sweet packets and lolly sticks	37
Food containers incl. fast food containers and plastic cutlery & trays	37
Small drink bottles 0,5 ltr or smaller	1
Drink bottle wrapping	4
Drink cups or part therof (plastic or styrofoam)	2
Drinking straws	3
Caps/lids (incl bottle caps)	4
Cosmetics (bottles & containers e.g. sun lotion, shampoo, shower geld, deodorant)	12
Cigarette lighters, pens, combs/ hair brushes, toys & party poppers	6
Cigarette butts	3
Oil containers & drums and Jerrycans (square plastic container with handle)	1
Balloons, including plastic valves, ribbons, strings etc.	9
Clothing	5
Cardboard	1
Drink cartons e.g. tetrapak	3
Cigarette packets	3
Wooden beams, planks, crates, cork etc. Please specify:	1
Spray cans (paint, deodorant etc)	1
Drink cans	2
Other metal pieces	3
Face mask	3
Cotton bud sticksCotton bud sticks	3
TOTAL	176

TABLE 3.2 DATA COLLECTED FROM THE RIVERINE PLASTIC WASTE MEASUREMENT FLOATING

The data from the table above show that there are more trash found floating in the river than the river bank. BIg and small plastic bags are the majority of the trash found floating in the river, while in the river bank most of the trash are candy packs and lolly sticks, and food containers. There are 156 plastic trashes that are floating in the river which amount to 80% of the trash in the river. There are 142 plastic trashes that are floating in the river which amount to 81% of the trashes in the river. Most of the trashes found in the Mahiga River midstream are plastics.

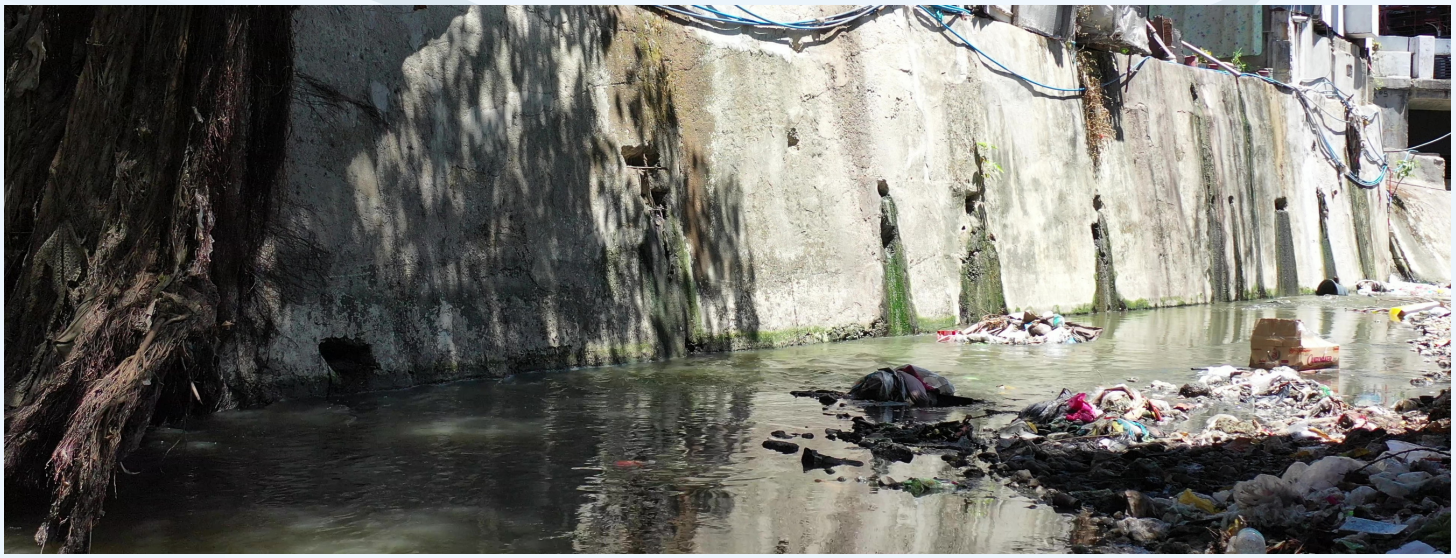
- # RIVER STREAM VELOCITY

Trial	Length	Average Width	Depth #1	Depth #2	Depth #3	Average Depth	Area	Time for Orange to Travel	Average Time	Stream Velocity
1	32.81	8.70	1.21	1.61	0.82	1.21	10.56	12.88	13.90	4090.60
2	32.81	8.70	1.21	1.61	0.82	1.21	10.56	15	13.90	4090.60
3	32.81	8.70	1.21	1.61	0.82	1.21	10.56	13.81	13.90	4090.60

TABLE 4: RIVER STREAM VELOCITY

Based on all of the three trials, it can be observed that the length of the river is 32.81 feet and the average width of the river is 8.70 feet while the average depth of the river is 1.21 feet and the area of the river is 10.56 sq m and the volume of water flowing in the stream is 4090.60 cfs (cubic feet per second) at a specific point in the river. It is noted that the stream velocity varies throughout the river and at different points.

V. CONCLUSION & RECOMMENDATIONS



The Mahiga River in Mandaue City is indeed facing a challenge in terms of waste management, which has led to heavy pollution from untreated sewages and improper waste disposal. As a result, it has caused detrimental impacts to the environment which takes the form of frequent flooding and loss of biodiversity in its waters. This has been difficult for the locals residing there as well since their day to day activities and livelihoods are disrupted.

Based on the quantitative data provided, the maximum flood heights during normal and heavy rain were 80 and 110 inches, respectively. On the other hand, the height of the riprap during normal rain was 21 inches and 51 inches during heavy rain. The data suggests that during heavy rain, the water level goes beyond the height of the riprap which could result in erosion and damage to the riverbank. In terms of urban water quality, the samples tested showed that there was no presence of nitrate/ nitrate and total chlorine. However, the alkalinity and total hardness were high, which means a problem may be present with water treatment and distribution. Regarding the stream velocity, the average velocity was calculated to be 4090.60 cm/s, an average width of 8.7m and an average depth of 1.21m. These data may have been utilized for the calculation of water volume and discharge however such data was not necessary for the solution. Despite this, the aforementioned values can be utilized for further study, as this could help gauge the amount of water flowing through the river at a point in time and understand the potential impacts of any changes in the river. In addition, a more specific aspect for the proposed solution may be added in future studies if such a parameter was acquired such that different flow rates and turbulence levels can be simulated, allowing the skimmer's effectiveness to be evaluated under a range of conditions.

Based on the qualitative data gathered, Mahiga River used to be an important source of water for the local residents however, due to urban development and population increase, the river has suffered from the key problems in the area which have been determined from the interviews; specifically, these problems are the contaminated water, waste accumulation in rivers and flooding. These data have been useful in providing the group supplemental information for the quantitative data but a downside from these interviews was the lack of reliability and consistency of answers for all of the information that the residents have provided. In addition, due to time constraints, there was only a limited sample size in terms of the amount of interviewees that the data was gathered.

Because this is a pressing issue caused by various sources, an immediate plan of action must be implemented while the possibility to restore the river exists, by implementing either short-term or long-term solutions. Although solutions such as river deepening and riprap construction have been initiated, they have yet to reach completion or assist communities long-term. Thus, the Kleen Floating Cell (KFC) is presented which could serve both as a short and long term solution. The KFC, when used for operation, could be used for immediate removal of debris and pollutants from the surface of the water that would prevent them from sinking to the bottom of the river, making them harder to remove. When used and maintained properly, the KFC could then help maintain the river's cleanliness and restore the river overtime. Given that the solution is yet to be implemented, its efficiency wouldn't be determined right away. Thus, further studies could be conducted in the future that would test the effectiveness of utilizing the Kleen Floating Cell in maintaining the river's cleanliness in terms of speed, accuracy, and efficiency.

PROJECT KFC
KLEEN FLOATING CELL

PART B: PRACTICAL SOLUTION

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I. DESIGN OF THE SOLUTION

The Mahiga Midstream experiences a variety of problems as said by the local residents when interviewed by the fieldworkers. These problems include improper waste disposal, and management, floods, and contamination of river water which have disrupted the livelihood of the nearby residents. It is known that the residents in the Mahiga Midstream do not have an adequate system of human waste disposal, wherein there is a lack of a stable proper sewage system. The human waste that is disposed in the river can have an effect on how sanitary the river is which has contributed to the Mahiga Midstream being considered as an ecological dead zone.

One of the clearer problems mentioned by the local residents is how the wastes within the river have affected both the well-being of the river and the residents. With this, the solution to the issues present in the river are discussed.

KFC (KLEEN FLOATING CELL)

The Mahiga Midstream experiences a variety of problems as said by the local residents when interviewed by the fieldworkers. These problems include improper waste disposal, and management, floods, and contamination of river water which have disrupted the livelihood of the nearby residents. It is known that the residents in the Mahiga Midstream do not have an adequate system of human waste disposal, wherein there is a lack of a stable proper sewage system. The human waste that is disposed in the river can have an effect on how sanitary the river is which has contributed to the Mahiga Midstream being considered as an ecological dead zone. One of the clearer problems mentioned by the local residents is how the wastes within the river have affected both the well-being of the river and the residents. With this, the solution to the issues present in the river are discussed.

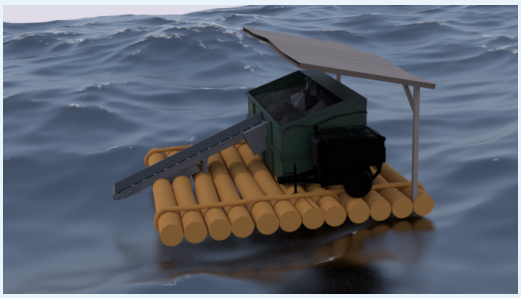

Figure 2.1. Model of the Kleen Floating Cell

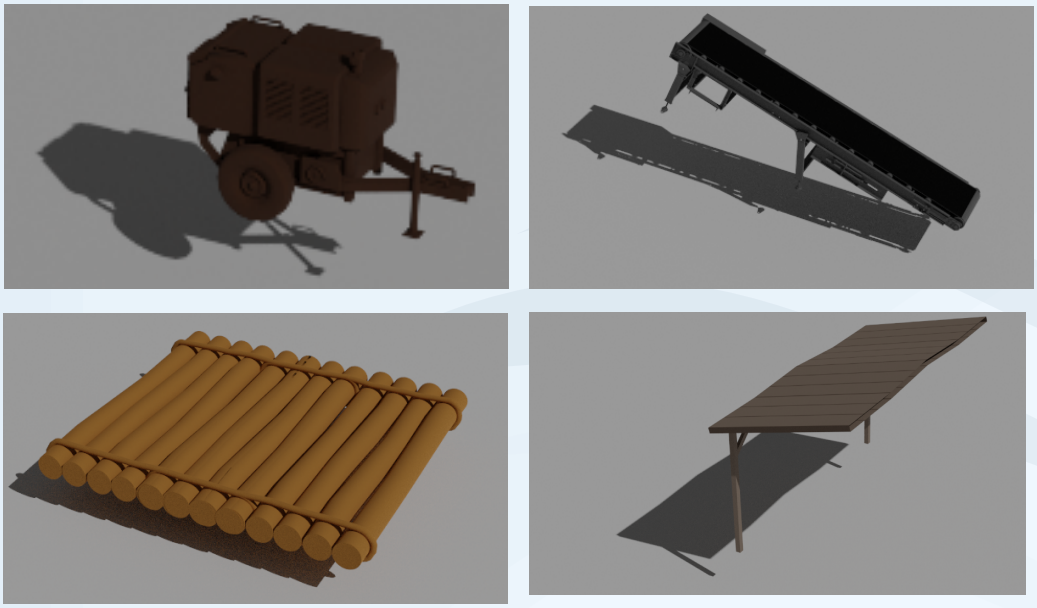

Figure 2.2. Components of the Kleen Floating Cell

II. LOCATION ANALYSIS

Mahiga River is located in Mandaue City, specifically in the central region of the Philippines. The river originates in the Banilad Mountains and flows down to Subangdaku as its midstream and downstream at Mabolo Reclamation Area before emptying into the Mactan Channel. The river crosses through densely populated areas, one of which are the barangays of Kasambagan and Banilad.

Kasambagan has a population of approximately 10,000 people while Banilad has around 50,000, according to the Philippine Statistics Authority. These communities in the past have relied on the river for their livelihoods and recreation. However, it faces a significant challenge in managing wastes which resulted in heavy water pollution in the river.

The 2- km midstream of Mahiga river comprises the barangays of Kasambagan and Banilad in Mandaue and Cebu City. For maintaining its cleanliness, the settling chamber should be placed at close proximity to the residential areas at the midstream section as it will be collecting wastes from various forms of outages to power the KFC. The KFC can be placed at different locations on the Mahiga river due to its versatility and smaller size. Another factor which dictates where the KFC should be located is the different widths the Mahiga River has this can have an effect on the exact location the KFC is, but it is more optimal if possible for the KFC to be situated on the middle of the river to increase its efficiency in gathering waste.

Figure 2.3 Ideal Location of KFC in the river

III. SOCIAL COST-BENEFIT ANALYSIS

The product is highly effective in removing plastic waste from rivers, compared to other solutions such as the bio fence. It can significantly improve the water quality, reduce flooding risks, and improve the social welfare of communities living along the rivers.

AQUAFENCE VS THE KFC

An aquafence is a temporary flood protection system designed to provide a solution for protecting homes and infrastructures from flood damage (Aquafence, n.d.). It is made of interlocking panels that can be quickly assembled to form a continuous barrier along the body of water. The panels used are made of durable materials such as aluminum or plastic. While an aquafence mitigates flood damage, there are still disadvantages to consider. First, an aquafence needs to be custom-designed to fit a location which can be a barrier to some communities (Flood Protection Association, n.d.). Second, the durability of the panels may not be long-lasting as it may degrade over time especially if they are exposed to harsh weather conditions (Flood Protection Association, n..d).

Comparing the aquafence to the KFC, the KFC has greater efficiency, it is more efficient than an eco fence as it can capture a larger volume of waste in a shorter amount of time, reducing the amount of pollution in the river more quickly. It has higher ROI (return of investment), since our solution can collect a larger volume of waste, it can potentially generate a higher return on investment than an eco fence. The KFC is also versatile, it can be adapted to different river conditions and can be deployed in various locations, providing a more versatile solution than an eco fence. Further, our solution utilizes a new and innovative approach to address the problem of river pollution, making it more appealing to investors who are looking for cutting-edge solutions as the device is powered by using the human waste of the resident into a biomass fuel. With increasing public awareness and concern about environmental issues, there is a growing demand for innovative solutions to address pollution problems. Therefore, our solution may be more appealing to investors who want to invest in a product with a high potential for market demand.

Thus, the KFC is a highly efficient and effective solution in removing plastic waste from rivers as it is cost-effective compared to other solutions in the market and more sustainable and eco-friendly, as it uses renewable energy sources.

COST OF THE PROJECT

The cost of the project includes the construction materials to build the device. It can be observed below that one KFC costs about P20,100.00. Since the human waste of the residents needs to be redirected to a settling chamber

Part/Material	Quantity	Estimated Cost (PHP)
Plastic drums (200-liter)	2	1,200.00
Steel mesh (1 meter x 2 meter)	2	1,000.00
Wooden planks (2 meters long)	2	500.00
Steel pipe (3 inches diameter)	4m	1,500.00
PVC pipes (3 inches diameter)	15m	2,250.00
Bearings	4	800.00
Stainless bolts and nuts	N/A	500.00
Electric Motor	1	5,000.00
Gear box	1	3,500.00
Chain and Sprockets	N/A	500
Electrical Components (Wiring, switches, etc.)	N/A	1,000
Welding and Fabrication	N/A	5,000
BioGas Storage	N/A	5,000
Canopy	3m	250
TOTAL COST	**28,250.00 PHP**	

PRODUCTION TEAM FOR KFC CONSTRUCTION

Staff Position	Responsibilites	Estimated Monthly Salary (PHP)
Project Manager	Overall project management, coordination, and administration	50,000 - 80,000
Mechanical Engineer	Design and construction of the river skimmer prototype	25,000 - 45,000
Electrician	Electrical wiring and installation of the prototype	15,000 - 25,000
Fabricator	Assembly and fabrication of the prototype components	15,000 - 25,000
Quality Control Inspector	Inspection and testing of the prototype	15,000 - 25,000
Field Technician	Field testing and maintenance of the prototype	10,000 - 15,000

FUNDING OF THE PROJECT

The primary areas impacted by this environmental issue are Cebu City and Mandaue City, and to address this, both local government units (LGUs) must collaborate and reach a mutual agreement to finance the project. Additionally, private entities and businesses in the vicinity can also be enlisted as partners in this endeavor, as their involvement can significantly aid the affected areas.

IV. PLANNING

PROCESS OF IMPLEMENTATION

The main stakeholders involved in the implementation of the KFC project are the LGUs of both Mandaue and Cebu City, and DENR- EMB 7. Also other stakeholders that can be involved are those that are directly linked to the river, like the nearby barangays in the Mahiga Midstream Brgy.Kasambagan and Brgy. Subangdaku.Nearby businesses or establishments that contribute to the wastes in the river are secondary stakeholders in the project. Other organizations like the CUSW can be possible stakeholders since the KFC project is inline with their future initiatives regarding river rehabilitation. Government departments like DPWH can also be a stakeholder in the KFC project because it can be seen as a good complimentary innovation to their constructed Infrastructure that addresses flooding in Cebu Rivers.

STAKEHOLDERS INVOLVED

The main stakeholders involved in the implementation of the KFC project are the LGUs of both Mandaue and Cebu City, and DENR- EMB 7. Also other stakeholders that can be involved are those that are directly linked to the river, like the nearby barangays in the Mahiga Midstream Brgy.Kasambagan and Brgy. Subangdaku.Nearby businesses or establishments that contribute to the wastes in the river are secondary stakeholders in the project. Other organizations like the CUSW can be possible stakeholders since the KFC project is inline with their future initiatives regarding river rehabilitation. Government departments like DPWH can also be a stakeholder in the KFC project because it can be seen as a good complimentary innovation to their constructed Infrastructure that addresses flooding in Cebu Rivers.

CONSTRUCTION OF THE KFC

1. Prepare the materials and tools needed for construction.
2. Cut the plastic drums in half lengthwise to create two semi-circular shapes.
3. Attach the two semi-circular drum halves together using bolts and nuts to create a circular drum.
4. Cut a circular piece of steel mesh to fit the top of the drum and attach it using bolts and nuts.
5. Cut two wooden planks to the same length as the drum diameter and attach them vertically to the drum to create a support structure.
6. Weld the steel pipe into a rectangular frame with two parallel sides and two perpendicular sides.
7. Attach the rectangular frame to the support structure using bolts and nuts.
8. Cut the PVC pipes to the desired length and attach them to the steel pipe frame at equal intervals using bolts and nuts.
9. Attach the bearings to the bottom of the steel pipe frame using bolts and nuts.
10. Attach the electric motor to the top of the support structure using bolts and nuts.
11. Attach the gearbox to the electric motor and connect it to the chain and sprockets.
12. Connect the chain and sprockets to the bearings on the steel pipe frame.
13. Wire the electrical components (switches, wiring, etc.) to the electric motor and gearbox.
14. Test the river skimmer to ensure that it is working properly and make any necessary adjustments.
15. Please note that some of the steps may require specialized tools and expertise, such as welding and electrical work. It's important to consult with experts and experienced professionals before attempting to build a river skimmer prototype.

OPERATION AND MAINTENANCE

The Kleen Floating Cell is designed to detect and collect trash from the river. The device is responsible for sucking in the trash using a suction mechanism and compressing it into small cubes. To ensure the proper functioning of the device, it is necessary to conduct regular operation and maintenance activities. Residents in the area will receive proper training conducted by the LGU regarding the cleaning and maintenance of the device. They will be taught how to empty and clean the device every 3-4 hours to prevent clogging and maintain the efficiency of the suction mechanism. Aside from the regular cleaning, weekly inspections of the gasifier, air dryer and heating unit in the biogas storage are to be done as well. These machines should be checked for any leaks or other issues to keep track of its functionality. If any problems are identified, immediate action should be taken to fix or replace the faulty component of the device to avoid any disruption in the device’s operation.

IV. CONCLUSION & RECOMMENDATIONS

The Mahiga River has major problems concerning waste pollution in its waters which resulted in the contamination of the rivers and loss of biodiversity. The systematic solution, specifically starting from the clean-up drive to the operation of the Kleen Floating Cell, aims to resolve the waste problem in the area. The design and construction of the KFC has a total cost of 28,000 Php, without accounting for the budget of the technical team assigned in the construction of the device since their salary is subject to various factors, depending on the employed individual's skills and experience.

Investing in the device is a worthwhile investment for many reasons. Firstly, the product's key strengths such as its efficiency and cost-effectiveness make it a highly attractive solution for removing plastic wastes from rivers. Compared to other solutions, KFC offers a more sustainable and eco-friendly option as it makes use of renewable energy sources. As plastic pollution in rivers continues to be a pressing global issue, the product has a significant potential for market demand. In addition, investing in the device can lead to a positive environmental impact, improved social welfare and potential financial returns as it provides a unique and innovative solution to address a critical global problem. With a strong focus on sustainability and environmental impact, the product can resonate with consumers and attract positive publicity. Additionally, by building a prototype the investors can witness the product's effectiveness and gain confidence in its potential.

As mentioned, the KFC offers many potential benefits, however, there are still areas for improvement. One mentioned downside is the need for regular maintenance to ensure the device operates properly. The device needs to be maintained every 3 to 4 hours. Further, it is recommended to conduct further research on the effectiveness of the device in removing plastic waste from the water and ensuring the device does not disrupt the natural flow of the river. Thus, the Kleen Floating Cell (KFC) is a powerful device that removes the plastic waste and is cost effective compared to other solutions in the market. The designed device is also sustainable and eco-friendly, the fuel used in the device is a biomass fuel from the human waste of the residents.

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