The Causes and Solutions of Marine Littering and Water Area Destruction

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Abstract: With the development of modern society, most land space has been developed and occupied for industrial development, human habitation, or other purposes. Streams, lakes and oceans seem to be the only solutions for sewage discharge. However, such a short-sighted solution will mediate devastating and detrimental impacts on the ecosystem: the flora and fauna, and ultimately human beings. In this work, researchers have hypothesized that the issue of marine littering and deteriorating water conditions is the result of negligence and underestimation of the citizens living in nearby areas. This research's hypothesis was confirmed via online surveys and face-to-face interviews with dustmen working beside local parks and streams. Littering is a widespread and conventional problem due to the citizens not attaching their importance to it. Based on the above survey results, researchers have proposed two potential solutions including effective lectures on reducing marine debris and protecting nature in our community and planning to build a semi-autonomous vessel that is applied to collecting surface wastes, which is a long-term effective and cost-efficient solution that propagated and generalized. Overall, this research's study does not only include an insight into the problem by analysis but also attempts to solve the problem through our innovative mindsets.

1. Introduction

The research would like to discuss the core problem of water area destruction and ecosystem damages through the causes of such problems and people's impressions and opinions towards them.

Marine littering is a tragedy that has appeared and aggravated over the past few decades along with the rapid industrialization and technological advancement. Oceans comprise 70% of the total surface area on Earth, so the exploitation of inland resources and occupation of terrestrial spaces coerced manufacturers to discharge their industrial refuse into the ocean. The negativities and drawbacks include: 1. Harm to biota 2. Social economic effects 3. Human health risks. All of the mentioned damages will contribute to devastating global environmental issues or the outbreak of severe diseases in the upcoming future if they are not being effectively controlled or managed. Therefore, seeking valid solutions for these problems is urgent and inevitable, as it'll not only absolve millions of lives, but also rescue the human civilization from teetering and toppling.

Noticing the looming crisis, governments and non-profit organizations have attempted to tackle the problem through education. For instance, the Chinese environmental protection agency has provided lectures and speeches involving water area protection for public middle school and high school students, while TV commercials are also launched to propagandize the importance of maintaining water conditions. However, the existing solutions towards the problem can be overly dependent on the citizens' responsiveness, while more direct and immediate actions arerarely taken. Our team would recommend expeditions of squads to observe and analyze the problem more

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specifically. Moreover, the currently utilizing ships that collect surface wastes are usually large in size and cumbersome, which results in the fact that they'll not be released without a significant accumulation of wastes. Our team will aim to design more efficient and mobile technology that enables waste collection to be a regular basis.

As citizens and parts of the community ourselves, researchers do understand the difficulties that triggers littering and effluent discharging. Yet their experiences and interactions with nearby water areas strengthened our determination to tackle the problem and enabled us to investigate and examine the problem in more elaborated and resultful manner. A long-term effective solution will be figured out and popularized.

According to our literature comprehensions and prior investigations, the research propose the hypothesis: The tragedy of water area destruction is a result of negligence and underestimation of citizens and faculties, which can be solved via providing lectures, online propagandas and progressive technology.

2. Literature Review

2.1 Points Supporting Our Team's Hypothesis

2.1.1 Low Education Levels Lead to Low Awareness of Water Protection

Although urbanization has promoted education in many countries and regions, people in many areas still don't possess the opportunity of acquiring high-level education, which is the reason for their unawareness of social problems. For example, a high proportion of youngsters in Europe have attended high school or college, on the contrary, teenagers in Africa may not have obtained the chance of doing so (Max Roser and Esteban Ortiz-Ospia 2013). Hence, as grown-ups, citizens in Africa are not being informed of the importance and cruciality of the marine ecosystems, and therefore have no means to protect them. Moreover, education on environmental projection also determines the well-being of the environment locally. Education through various forms especially for the youth plays a significant role in the conservation of a decent environment (Jerry R. Schubel 2008).

The ocean does not seem to be crucial in people's daily life Since humans are terrestrial biotas, and more and more people have started to live in the city, the opportunity of people to main water bodies like the ocean are limited (Hannah Ritchie 2018). With the limited interaction, it is difficult to realize the severeness of litter in the ocean. Due to the lack of awareness of the public to the actual environment of the ocean, the number of people and resources devoted to the area of ocean cleaning is minor in comparison to the expenditure on land sanitation. According to the SDG14 (Sustainable Development Goals-life below water) promoted by the United Nation, the estimated expenditure annually required to reach the goal is 175 billion USD, but currently, the world is only spending 52 billion USD a year (Despina F. Johansen 2019).

2.1.2 The Absence of Little Government Regulation.

The litter in the ocean, mainly plastic products, introduces severe damage not only to the marine environment but also to humans through microplastic form as the degraded small pieces would be eaten by fishes or other marine animals then later been consumed by humans as food (Matthew Cole 2011). Nowadays, the annual production of plastics has reached 300 million tonnes, and among the 300 million 79% of the plastics products are accumulated in natural environments. Rivers account for the massive litter in the ocean, nearly 8 million tons of plastic waste are carried into the oceans. (Claudia Giacovelli 2018). If the government had regulated the emission of plastics through rivers or introduced sturdy policies, then the situation would sure be mitigated. However, seldom regulations from the government are established and effective mainly due to the lack of awareness of the problem of ocean pollution (Shauna Pettipas).

2.2 Points Against Our Team's Hypothesis

2.2.1 The Rapid Speed of Population Growth Causes the Shortage of Land

The intensive growth of population from 1 billion to 7.7 billion (Max Roser 2019) in the past 200 years served as the token of the modern era, accompanied by the growth of population is the increasing production of goods. However, the ever-rising production of plastic and other material were not grown with an effective waste management system. A person would produce 4.9 pounds of various garbage per day which is equal to 1788.5 pounds of garbage a year (Andrew Krosofsky 2021). To offset the extra 1788.5 pounds of waste every new individual is producing, the conservative way of landfill or burning could not satisfy, so pouring the waste into the ocean is a relatively cheap and efficient way to process the litter. Moreover, the reduced land to factories or living space for people limited the space for landfills, therefore more litter was dumped into the ocean.

2.2.2 The Current of Water Acts as Obstacles in Collecting Litter on Water Surface.

As the litters on the surface of the water are somewhat light, the current of the ocean flowing 5-50cm per second that seems to be minor in human perspective would push those litters to a far distance (Arnold L. Gordon 2021). The dispersive and constantly moving litter in the wide and enormous ocean caused the execution of ocean cleaning to be extremely difficult and costly. On the other hand, the current also can gather up litter and form a “garbage patch”. The grand patch with great mass could be tracked easily since its size of it makes it conspicuous, but the patches are in the middle of oceans so operating a large cleaning project is impossible.

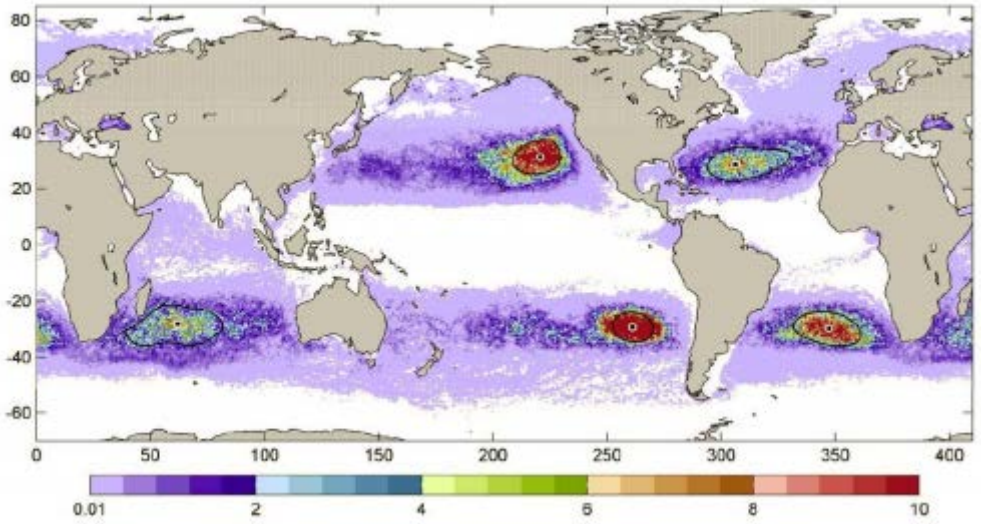

Fig.1 : Convergent Zones for Surface Tracers (Dohan and Maximenko, 2010).

(the distribution of major garbage patch in the ocean)

3. Research Methods

3.1 Literature Research

Our team has been searching and observing essays and documentaries involving marine littering and water area destruction all over the world. From these essays and documents, we are able to derive and analyze the facts and opinions regarding the cause of marine littering. From the 46 documents our team has read, 38 of them contain information and reason supporting our hypothesis that people's negligence and underestimation is the main cause of marine littering, which allow our team to examine and interpret our hypothesis in a more specified manner and ultimately maintain the hypothesis.

3.2 Questionaries

Our team released questionaries electronically through the app Wenjuanxin. The goal is to evaluate and understand the public view on marine litters, garbage recycling and their opinion towards marine robots. There were multiple alterations of the questionaries before the release in order to best convey our intention and to express our question as simple and as concise as possible. We end up with 969 valid responses. The main age group are around 31-60 which participate actively among the labor force and having the most up to date mindset, but none of any age groups exceed 25%. Moreover, there is an even distribution between the two sexes and most of the participant live in areas with main water body which is crucial to our topic of marine litters. Therefore, the team conclude that the data acquire from the questionaries are reasonable and could be further assessed.

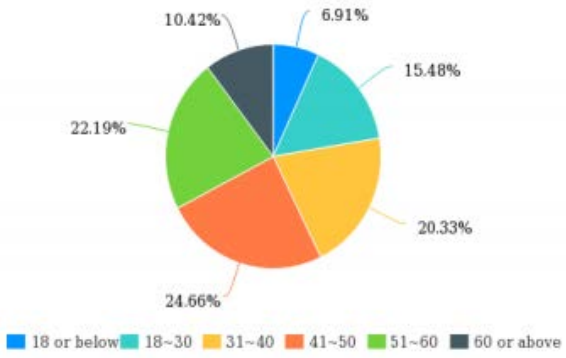

Fig.2 : the Distribution of Age Group of Questionaries Fillers

3.3 Face-to-Face Interviews

In order to obtain more precise and accurate insights from experts, our team has interviewed 2 groups of workers related to water area protection, with the former group being dustman working at the Shenzhen Bay Park and the latter being investigators in Shenzhen Water Affairs Bureau. For the first group, our team has designed questions like ‘What is your opinion about the cause of marine littering?' and ‘How often are actions taken to remove wastes in the lake?' in order to gain more accurate data and more credible understandings towards the problem. As for the latter group, our team focused on investigating the government's protectionisms of the local water areas and the experts' opinions towards the potential of technological advancements to alleviate the problem. However, being restricted by time and sample size, our results may be biased or inaccurate.

4. Research Findings & Analysis

From December 28th to January 8th, in about two weeks, our research group posted a national wide survey based on the topic of “surface littering”, and has collected over a thousand fully-filled surveys. After eliminating unsound answers, which is identified as surveys filled in less than 30 seconds, 969 valid sets of data were obtained. The participant includes 416 male (42.93%) and 553 female (57.07%), and the geographical distribution of the population taking the questionnaire, represented by the map (Figure 2), is mainly in Guangdong (57.07%), Shaanxi (6.09%), Sichuan (5.68%), Zhejiang (4.13%), Beijing (3.61%), and from abroad (3.10%).

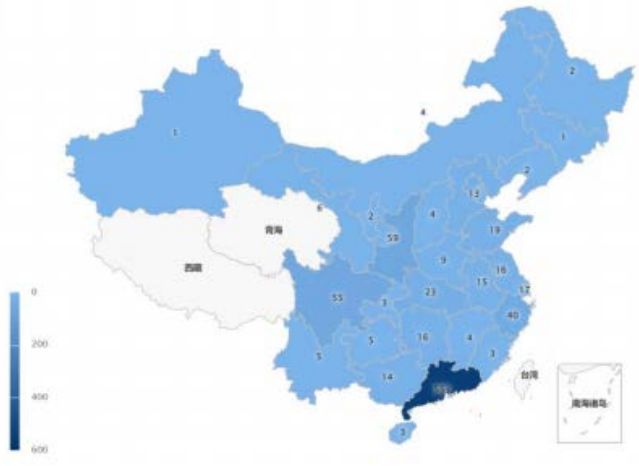

Fig.3 : Geographical Distribution of Questionnaire Fillers

According to our survey results, we find that there is a common undervaluation and lack of acknowledgment of the effect of surface water pollution on the environment and society.

4.1 Participant's Understanding of Water Bodies Protection and Sanitations

4.1.1 The Lack of Awareness and Recognition for Nearby Water Environment

3. Is there any natural water bodies in the city you live in? [单选题]

选项	小计	比例
Yes	860	88.75%
No	47	4.85%
Not sure	62	6.4%

Fig.4 : Chart Concerning Whether Participant Lives Near Any Natural Water Bodies

Based on the results from Figure 3, which illustrates the comparison between percentage of choice in each option in question 3, it is clear that most participants (88.75%) recognize natural water bodies around the city they live in, and the answer “No” only appears in 4.85% of the answers. Hence, it could be concluded from this information that the majority of people are living in a city that consists of one or more natural water ecosystems, and would inevitably experience impact from the ecosystem either through primary or secondary effect.

4.1.2 Participant's Cognition of Water Pollution

选项 Options	小计 Subtotal	比例 Percentage
严重 Severe	63	6.5%
中等 Moderate	347	35.81%
轻微 Slight	496	51.19%
无 None	63	6.5%

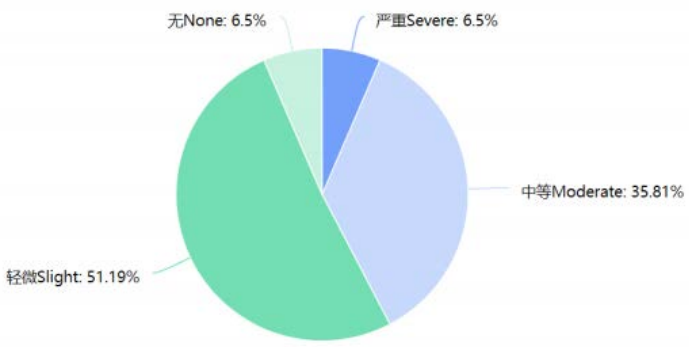

Fig.5 : Chart and Graph of Participants' Recognition of the Severity of Water Pollution

As shown in figure 4, which portrays the proportion of choice regarding the severity of water pollution, the results in the question “how do you think the water bodies are polluted by litter and waste” suggest that most people underrate the effect of water pollution. While 51.19% of surveys deeming that there is only slight pollution, only 63 out of 969 surveys answered “severe” Such results deviate from the data of the document we researched. According to Alistair Mcllogorm, “The cost of marine litter damage to the global marine economy: Insights from the Asia-Pacific into prevention and the cost of inaction”, Marine Pollution Bulletin volume 174, treating marine and water litter caused great economic loss, progressing from 18.3 billion USD in 2015 to 21.3 billion USD in 2020. Thus, the results of the survey contradict our research, which indicates that general crowds are negligent about the severeness of water pollution, which in fact requires significant economic losses to mitigate the effect of water pollutants.

4.1.3 Difference in the Participator's Attention for Environmental Protection in Land and Water

X\Y	了解 Yes	不了解 No	小计
Yes有参与	165(26.61%)	455(73.39%)	620
No没参与	36(10.32%)	313(89.68%)	349

Fig.6 : Cross-Analysis of X (Do You Usually Participate in Garbage Sorting) and y

(Do you understand how the water surface litters are been processed)

Figure 5 illustrates the cross-analysis of questions 6 and 8 and addresses the participants' perception of environmental protection in both land and water environment. From these results, the preponderance (63.98%) participates in recycling and garbage sorting daily. In this population, however, over 73% do not cognize how surface water waste is being collected. Similarly, in the population of participants who do not participate in garbage sorting (36%), about 89.68% of them do not perceive the method in dealing with water pollution. As in total, 79.25% of all participators of the survey lack understanding of how water waste is being cleared even though most of them are aware of the importance of garbage sorting.

According to Hannah Ritchie and Max Roser, “Urbanization”, Our World in Data 2018, people living in urban areas tend to interact less with natural water bodies. Such reduction in interaction is the main cause for people's undervaluation of the significance in sustaining water ecological environments, which might as well contribute to the result of the survey, where only 20.74% of participators comprehend the methods in handling water pollution.

Based on the surveys collected, it could be concluded that there is a lack in the awareness of protection for water environment.

4.2 Potential Problems and Solution for Water Pollution

4.2.1 Issues That Participants Consider

4.2.1.1 Hazards of Water Surface Pollution

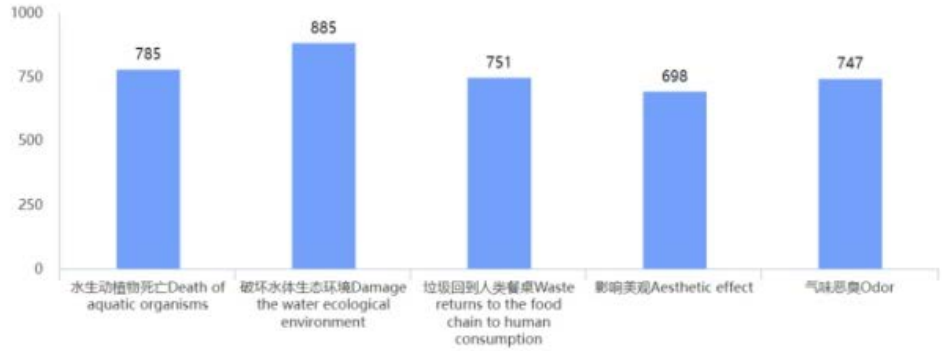

Fig.7 Graph Regarding the Concerned Hazards Caused by Water Surface Garbage

In terms of the multiple-choice question “What do you think the hazards are if the surface garbage is not treated”, our research group collected 3866 choices from 969 responses. According to the results, over 90 percent (91.33%) of participators select “Damage the water ecological environment” as one of their answers, it is also notable that 81% of the questionnaire fillers are also concerned about the well-being of aquatic organisms. On the contrary, participators are less mindful of the subjective effect of pollution, including aesthetic influences and odor. It could be interpreted that as education becomes more accessible, more people are concerning environmental issues. However, the lack of interaction between people and natural water bodies still results in water surface sanitations to be blind to the crowd, as only 20.74% of participants in our survey are familiar with it, which brings about the population's unawareness of water pollution.

4.2.1.2 The Hardship of Collecting Water Surface Litters

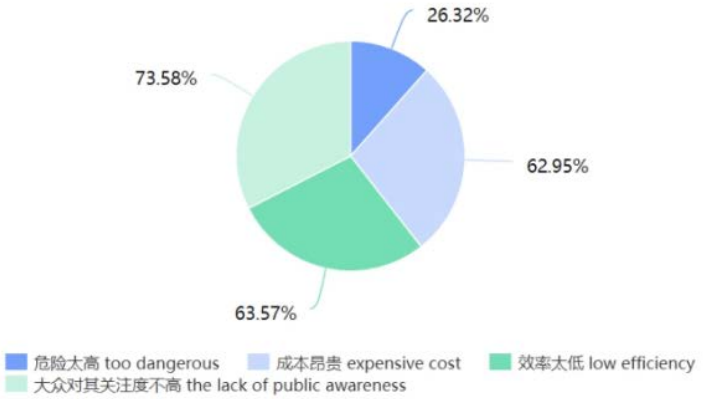

Fig.8 Graph of the Difficulties Faced by Typical Surface Waste Collection

According to Figure 7, a pie chart representing the proportion of various difficulties of water surface sanitations, the majority of the population (73.58%) deems that “the lack of public awareness” is the main hardship for surface litter collection. This reflects our hypothesis that eradicating negligence to water body protection is vital and inevitable for reducing surface wastes. Furthermore, low efficiency (63.57%) and the cost (62.95%), both external and private, are also noticeable hindrances in promoting sustainable water environment, which could be resolved via our research group's development of a semi-autonomous surface vessel.

4.2.2 Potential Solutions

4.2.2.1 Overall Evaluation over the Need of Waste Clearing Vessels

In evoking awareness and attention, a semiautonomous surface clearing vessel would poetically be an innovative desideratum in altering the devastating crisis of water body pollution. To examine the crowd attitude to such object, our investigation group added an evaluation question based on the topic: To what extend do you think waste collecting robots would help in controlling the litters.

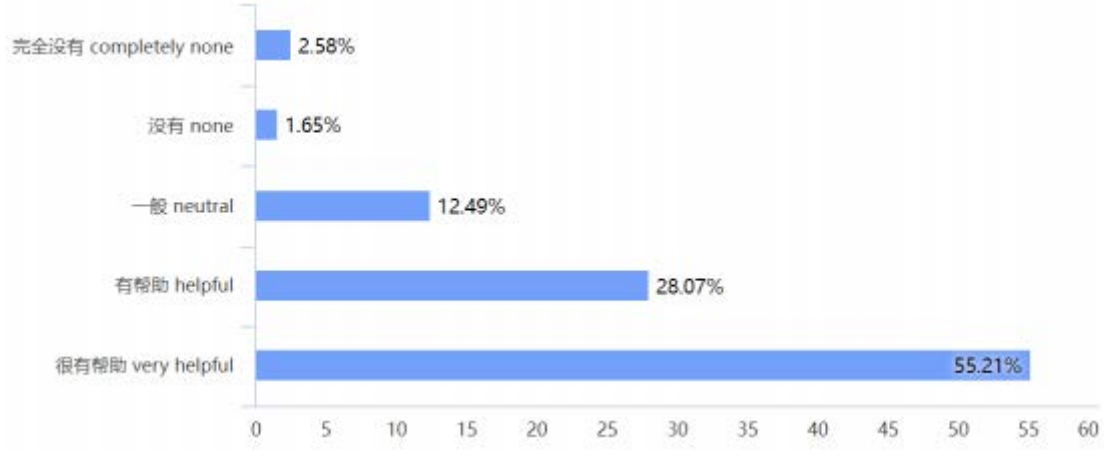

Fig.9 : Result of Participant's Rating on the Need for a Waste Clearing Vessel

As represented by the bar diagram regarding the results of participant's evaluation on a surface litter collecting vessel (Fig 8), the options are ranking into five levels. Since the average rank of the necessity of the semi-autonomous vessel locates around 4.32, which is near the option “helpful”, it can be learned that the crowds are approbative and would ratify such innovation. Noticeably, around 55.21% of the participators deem a surface waste clearing vessel would be “accommodating.” Thus, the results support our research group's further investigation and development of the vessel.

4.2.2.2 Considerable Elements in the Vessel

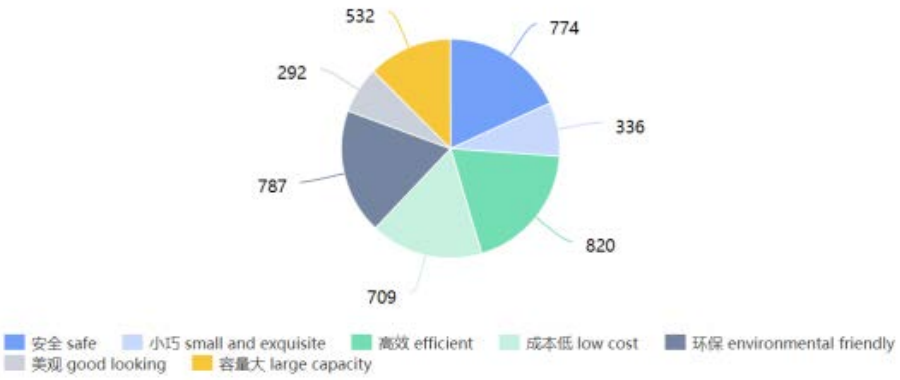

Fig.10 Characteristics That the Vessel Should Posses

Based on the population's requirement on the vessel's design and characteristics, we concluded four prerequisite terms to be set in our vessel. This is represented in Figure 9 by the pie chart that highlights the voted proportion concerning the traits of the vessel. Based on these votes, environmentally friendly (787), efficient (820), low cost (709), and safety (774) stands out and are taken in as primitive considerations for our group's surface vessel.

5. Conclusion & Discussion

5.1 Conclusion

To sum up, the formation of severe water pollution has a crucial reason for lacking the knowledge and understanding of the adverse impacts such pollution can cause and deficient public awareness towards water waste collection. Therefore, more interaction and understanding towards the cruciality

of the problem results in less water area destruction in the region. Possible solutions include popularizing the importance of marine ecosystems and the fearful negativities of marine littering through lectures, online tweets, posters, Etc. It is also noticeable from the online surveys that more than 50% of people consider a surface clearing vessel ‘very helpful.' Hence, designing a cost-efficient and safe vessel has a great potential of alleviating the severe problem to a large extent.

5.2 Flaws and Imperfections

5.2.1 Sample Size

Limited by time and other objective factors, this research has only carried out face-to-face interviews with two groups of less than ten people and received effective online surveys, which may result in deviation and bias.

5.2.2 Sample Boundedness

In this research's interviews and surveys, researchers have only made connections with students, standard laborers, and experts. While companies and factories also comprise a large proportion of the waste discharged into the water areas, the research has not managed to investigate their opinions and understandings towards the problem.

5.2.3 Ways to Improve

For the investigations taking place in the future, increasingly variegated forms of interviewing should be involved, including experts and people with occupations of different kinds, various levels of education, or multiple places of living, so that the results can be more realistic and integrated. In the future, researchers can proceed in the mental state and reasons behind people contributing in marine pollution, and derive the cause of the rapid expansion of such problems. Hopefully, the problem can be solved fundamentally.

5.2.4 Outlook and Expectations

In the future, researchers can proceed in the mental state and reasons behind people contributing to marine pollution and derive the cause of the rapid expansion of such problems. Hopefully, the problem can be solved fundamentally.

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