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‘Buy Marine Debris’: A Digital Platform for Sustainable Marine Debris Management Involving Fishermen

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Abstract

Marine debris is a problem that requires a global solution. This is particularly important for Indonesia, the world’s second-largest producer of marine debris after China. Two-thirds of Indonesia’s territory is oceans, and fish is Indonesia’s main protein; as such, marine debris threatens the nation’s food security even as it damages coral, disrupts transportation, and indirectly harms Indonesia’s tourism industry. Affected first and foremost by marine debris are fishermen and other people who live near water. Indonesia can learn much from Taiwan, which has successfully used technology to stop the illegal sale of the subsidized oil of fishing boats in the middle of the ocean, thereby enabling it to save money.

This work proposes a digital platform to connect communities that live near water, including fishermen, with stakeholders including government offices, social institutions, environmental organizations, and waste processing companies to reduce waste at sea. Such a concept can also help empower its community participants, who are generally in a more precarious economic situation. In this concept, fishermen and other community members collect waste in the waters around their homes, sort it, and then use a digital application to call for collection. Stakeholders check the community communities' reports, then ask waste pickers or collectors to fetch the waste, which stakeholders exchange for health care, food vouchers, schoolbooks, or money.

Keywords: digital platform, marine debris, waste, stakeholder

1 Introduction

Marine debris remains rampant, and Indonesia—the world's second-largest producer of such debris—is still fighting to mitigate its impact (Jambeck et al., 2015). Almost 80% of marine debris comes from land (Wang et al., 2016).

Indonesia consists of 17,508 islands, with a combined total coastline of more than 81,290 km. The archipelago covers a total area of approximately 7.8 km^2; of this, almost two-thirds is water. These five km^2 of oceanic territory consists of 0.3 km^2 of territorial sea, 2.9 km^2 of archipelagic sea, and 2.7 km^2 of exclusive economic zone (Agoes, 2006, p. 99).

Given the country's archipelagic nature, it is not surprising that fish is an important component of Indonesians' diet. In 2019, a survey by the Indonesian Ministry of Marine Affairs and Fisheries[1] found that Indonesians consumed an average of 55.95 kilograms of fish per capita per annum (Nuraini, 2020). However, another study has found anthropogenic waste in 28% of individual fish and 55% of all fish species in Indonesia. Some micro marine debris was found in fish that were sold in markets for human consumption (Rochman et al., 2015).

Marine debris' effects are far-reaching. Debris such as ghost nets destroys coral, either by causing tissue damage or crushing coral; some genera are more susceptible (Perinchery, 2021). Marine debris can become stuck to ship propellers, thereby reducing their ability to generate thrust. Consequently, debris causes maritime safety problems and disrupts transportation. Maritime debris also causes significant environmental harm, which can in turn result in damage to the Indonesian tourism industry.

Taiwan, on the other hand, has succeeded in stopping the illegal sale of fish in the middle of the ocean by using digital technology, thus ensuring domestic fish needs are met and saving money. Lin et al. (2018) proposed installing voyage data recorder (VDR) devices visual monitoring systems that use global positioning system (GPS) data to record ships' locations on fishing boats that received subsidized oil from the Taiwanese government, thereby ensuring that boats routes and time at sea could be monitored. Data were then stored and processed at the Department of Systems and Naval Mechatronic Engineering, National Cheng Kung University. Fishermen were thus no longer able to sell oil at sea, as their activities were tracked by a land-based monitoring system.

1 Kementerian Kelautan dan Perikanan (KKP)

Indonesia could learn from these experiences. The country annually produces 65.8 million tons of waste, of which 15% is plastic (Purwanto, 2021). An estimated 24% of Indonesia's untreated waste is produced in major cities located near the water, such as Jakarta, Surabaya, Medan, Semarang, Makassar, and Balikpapan (Ratnawati et al., 2020, p. 10), and thus an estimated 1.3 million tons of waste enters the sea every year (World Bank Group, 2018). If this debris is caught before reaching the sea, the amount of marine debris will not increase.

Many communities live near rivers or coasts, and thus are directly affected by waste. Often, Indonesians rely on fishing for their livelihoods. Although numbers have dwindled in recent years (Kementerian Kelautan Dan Perikanan [KKP], 2019, p.19), in 2019, 1.8 million Indonesians were fishermen (KKP, 2020). However, many are struggling economically. According to Indonesia's central statistics agency, 25.14 million Indonesians lived below the poverty line set at IDR 425,250 (about USD 30) per capita per month (Bagindo et al., 2020). Of these poor families, 49.41% depended on fishing or farming.

Often, fishermen are unable to compete with larger vessels, as they still rely on traditional methods for fishing, aquaculture, processing, and trade (Taher, 2020). Even if they are willing to modernize, interest rates are prohibitively high. Work conditions exacerbate this situation. In a study conducted by Musawa et al. (2007), respondents indicated that they would spend eight hours at sea in favorable conditions; in difficult conditions, they could not sail, and thus not earn an income. An alternative solution is therefore necessary, one that can help fishermen when they cannot work, but their lives must continue.

This article argues that the above-discussed problems of waste management and welfare could be addressed simultaneously. Ships, including fishing vessels that function as means of transportation and tools for catching fish, can be used for waste management and collection (Sugianto & Chen, 2020). Similarly, fishing gear such as nets be they installed on the side or in the front of the ship—and puller tools can be used to collect marine debris (Sugianto & Chen, 2019).

Involving fishing vessels in waste work has three objectives: first, to stop trash from flowing to the sea and remove existing waste from the sea; second, to help fishermen and water communities earn additional income; and third, to connect water communities, such as fishermen, with stakeholders including government offices, social institutions, environmental organizations, and waste processing companies in an effort to reduce maritime debris.

2 Current Digital Waste Platforms

Three digital platforms for marine waste management are currently being developed in Indonesia or elsewhere.

Octopus (Indonesia) app

This platform was launched in March 2020 in Makassar, Indonesia, to help waste pickers look for trash. Using this application, individuals with household waste can contact a waste picker, who will come and collect the trash. Payment is made using points, which can be exchanged for cash or vouchers (Asikin, 2021). However, this platform does not deal with maritime waste or trash that could potentially flow into the sea. Likewise, it prioritizes densely populated urban locations and thus has a limited effect on fishermen and their communities.

Clean Swell app

This application aims to collect data (i.e., location, type, and weight) on maritime waste (Ocean Conservancy, n.d.), thereby providing researchers and policymakers with information that can be used to formulate solutions. This application does not, however, focus on short-term cleaning activities, nor does it directly involve fishermen.

Marine Debris Tracker app

As with the *Clean Swell* app, the *Marine Debris Tracker* app aims to collect GPS data on maritime debris. This application was developed by researchers at the University of Georgia and can be accessed by researchers and residents interested in tracing debris (UGA News Service, 2014).

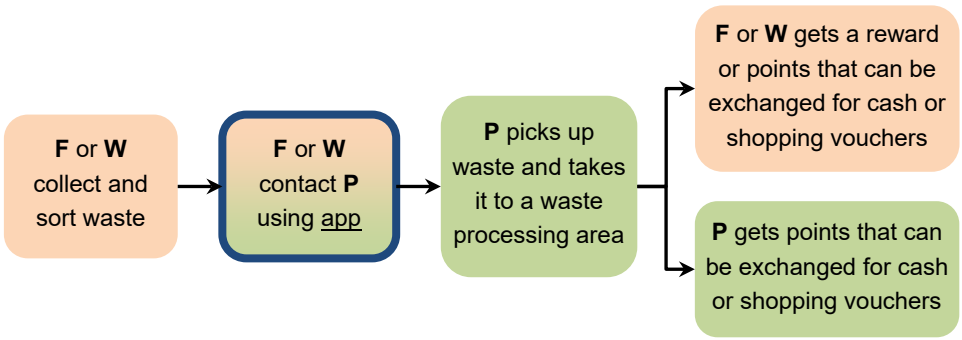
3 *Buy Marine Debris*: A Digital Platform

This article proposes a digital platform, accessible either through an application or a website. Four groups will be involved in this digital platform: first, communities living near water, including fishermen and non-fishermen; second, stakeholders, including government offices, social institutions, environmental organizations, and waste processing companies; third, waste pickers or collectors tasked with taking garbage from communities to stakeholders; and fourth, the researchers and developers of this digital platform.

A simple overview of this digital platform's operations is provided in Figure 1. First, community members collect maritime waste. Fishermen can collect waste at sea, while other residents can collect waste from the waters around their homes. They then sort the waste and report its location, type, and estimated amount to stakeholders using the digital platform. Photographs are appended to their report.

Once a report is submitted, it is read by stakeholders, who then ask waste pickers or collectors to collect and weigh the waste. Stakeholders may buy garbage directly or exchange it for points or other rewards (including free health checks, basic food vouchers, and schoolbooks). As the process continues, the researchers can modify the application to meet their needs.

Figure 1. Process involved in the *Buy Marine Debris* app



Note. F = Fishermen, W = Communities who live near water, P = Waste picker.

Actor Network Theory Perspective

Actor network theory (ANT) can be used to explain the relationship between technology as an artifact (design, procedure, mechanization, work process) with the practice of its use (norms, rules, habits, life goals). More specifically, it can help us understand how the ideas, values, or norms of human society are embedded in a technology (Callon, 1986). This theory holds that all things can be seen as interrelationships between actors, both human and non-human (i.e., computers and other technological artifacts).

In the proposed digital platform, the actors are:

Human:

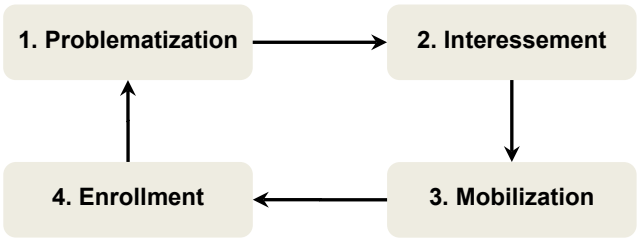
1. Initiator: Researcher
2. Application user: fishermen and local communities
3. Application user: waste pickers or collectors
4. Supervisor: government offices
5. Supervisor: social institutions and environmental organizations
6. Supervisor: waste processing companies

Non-human:

1. *Buy Marine Debris* application
2. Website
3. Marine debris or waste
4. Ships used to collect marine debris

According to Callon (1986), ANT describes not only the way knowledge is translated into culture, but also the technology and artifacts involved. As shown in Figure 2, ANT involves four stages: problematization, interessement, enrollment, and mobilization.

Figure 2. Four stages of ANT



Note. Created by the author. Adapted from Callon (1986).

Within the context of the *Buy Marine Debris* digital platform, these stages may be described as follows:

1. Problematization

During the problematization stage, the researchers (functioning as initiators) are the main actors. They define the roles of other actors, in accordance with their interests. In the case of the *Buy Marine Debris* digital platform, the initiators have defined other actors' roles as follows: the role of fishermen is to look for waste at sea; the role of local communities is to collect waste from nearby waters; the role of waste pickers is to collect garbage from the previous actors; the role of waste management companies is to buy and processes waste; and the role the government is to provide support or subsidies and makes regulations to support waste management activities.

2. Interessment

The initiators convince other actors that prescribed roles are actually in line with their own interests. In the case of the *Buy Marine Debris* digital platform, fishermen get additional income, waste pickers get ready access to garbage, and waste management companies get raw materials at low prices. With fewer people becoming ill because of water pollution, meanwhile, the government can reduce expenditures in the health sector. Further benefits include a cleaner marine environment and healthier marine animals.

3. Enrollment

In this stage, the initiator seeks to ensure all members feel a sense of belonging as well as a stake in the digital platform. This political process requires persuasion and strategic endeavors to maintain stability, thereby ensuring that the digital platform can be used. For example, an online discussion forum is needed so that participants can provide feedback and express other concerns.

4. Mobilization

When members feel a sense of ownership, they will believe that other actors are members of the same team and must be supported. According to Callon (1986), mobilization is the stage wherein actors become speakers representing a particular network. In the case of the *Buy Marine Debris* digital platform, mobilization will occur when fishermen, communities, waste pickers, waste management companies, and government officials are all active on the digital platform, and when communication occurs between these actors.

4 Discussion

As a digital platform, *Buy Marine Debris* may exist separately from existing applications, or it may work in conjunction with them. The researchers recommend working with *Octopus* to develop the *Buy Marine Debris* application because a computer background is necessary to create the application. It is also possible, however, to create a team specifically to develop an application.

In its usage, the *Octopus* application is like *Gojek*, a popular ride-sharing application, as both have the same target: people (Asikin, 2021; de León, 2021). Their key differences lie in the actors involved: motorcycle taxi drivers are replaced with waste pickers, motorcycle taxis are replaced with carts or modified motorcycles, and passengers are replaced with waste. The *Buy Marine Debris* platform would use a similar basic digital concept. However, its development would require consideration of two factors: the requirement to validate specific maritime waste and the focus on fishermen and communities living near water.

How would the *Buy Marine Debris* platform interact with waste tracking applications, such as the aforementioned *Clean Swell* and *Marine Debris Tracker*? Ideally, these platforms would be symbiotic. Existing platforms, which focus on tracking waste (Ocean Conservancy, n.d.; UGA News Service, 2014), could be used to find the location of specific waste and tag it for collection. Similarly, as fishermen and coastal communities locate waste, new types of waste can be identified, thereby providing the other applications with more robust and accurate data. However, to ensure that fishermen and community members enter this data, special points or rewards are needed.

Lessons from Taiwanese Fishermen

When designing and implementing the *Buy Marine Debris* platform, it would be fruitful to learn from Taiwan's experience. The Taiwanese government once made a policy of subsidizing oil for Taiwanese fishermen in order to reduce their operating costs (Shih, 2011), thereby enabling them to benefit more from their fishing activities. However, fishermen abused the policy, selling their oil to other ships at sea at prices that were slightly lower than the market price. To ensure a continued supply of fish, fishermen used money from their sales to purchase fish from Chinese fishermen, bringing it home and selling it for a tidy profit. This was detrimental to the Taiwanese government, as the money used to subsidize fishermen ultimately went to China through the sale of oil.

Lin et al. (2018) proposed a technological solution: installing VDR devices on fishing boats that received subsidized oil from the Taiwanese government, thereby ensuring that the boats' routes and time at sea could be monitored. Data were collected from ships' GPS units, and stored and processed at the Department of Systems and Naval Mechatronic Engineering, National Cheng Kung University. Fishermen were thus no longer able to sell oil at sea, as their activities were tracked by a land-based monitoring system. Implementing this system has saved the Taiwanese government a lot of money.

GPS is also useful when serious crimes and incidents occur at sea. For instance, in 2013, when a Taiwanese fishing boat was shot by the Philippine Coast Guard or Navy, citing incursions into the country's territorial waters, GPS records showed that the ship had never sailed into Filipino waters (Shih et al., 2020; Tamayo, 2013).

For the *Buy Marine Debris* digital platform, we must likewise consider the possibility that fishermen could take trash from land and claim that it was collected at sea. Scenarios such as this must be considered when preparing a digital platform. The principle is to have a simple, user-friendly application with suitable technology, one that enables the tracking of fishermen through their registered GPS or other means.

To avoid potential fraud, it is also possible to ensure that the amount paid for waste is less than the price of fish and other maritime products. For fishermen, catching fish and other seafood is their main job; waste collection should, at best, provide supplemental income.

Funding issues must also be considered because waste is a shared and multidimensional problem. Government intervention is needed, either through the direct purchasing of trash or the provision of subsidies to waste processing companies that buy from fishermen.

5 Conclusion

A digital platform can connect communities, waste pickers, and stakeholders. It is very possible to involve fishermen and their communities in efforts to clean the sea and prevent further pollution, as these people are the closest to the sea and the waters that feed it. Such a platform would also provide them with much-needed supplemental income.

This digital platform may provide a sustainable system for reducing marine debris. It could save fish (Indonesia's main source of protein), protect coral, secure shipping lanes, create a clean marine environment, and save the Indonesian tourism industry. Such success using digital platforms to deal with fish and marine issues has been exemplified by Taiwan and its successful use of VDR devices to stop the illegal sale of subsidized oil.

The *Buy Marine Debris* digital platform could be complemented by working symbiotically with existing digital platforms. However, several factors should be considered, including the possibility of fishermen taking trash from land and claiming it as maritime debris. Furthermore, if the amount paid for waste is too high, fishermen may forget that their main goal is to catch fish.

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