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Article

Formulate an incentive model to involve communities' industries in coastal waste management, Makassar, Indonesia

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Abstract: This paper proposes an incentive model to involve communities and industries in effectively managing coastal waste in Makassar, Indonesia. The model seeks to incentivize stakeholders to invest in waste management solutions and enable public stakeholders to monitor and evaluate the progress of waste management activities. The model actively encourages participation from all stakeholders and builds upon existing efforts to promote environmental accountability. The proposed model includes several key components. It focused on public and private partnerships that should be fostered to coordinate stakeholder approaches and provide capital investment. It also focused on a financial reward scheme that should be adopted to incentivize businesses and individuals that invest in waste management initiatives. Performance bonus awards and tax incentives are proposed as possible incentive schemes. Lastly, a regulatory framework should be developed to ensure environmental standards are met and regulated. The framework should include regular reporting and auditing requirements and the implementation of penalties for those who fail to comply. The proposed incentive model seeks to engage stakeholders in effectively managing coastal waste in Makassar, Indonesia, through public and private incentive schemes.

Keywords: industries; management; coastal; waste; stakeholders; environmental

1. Introduction

Makassar is the largest city in eastern Indonesia and is well known for its unique and often challenging waste management conditions. Businesses and the community need to think about ways to manage waste management effectively (Baharuddin and Nasution, 2017). The challenges facing Makassar's waste management system are numerous. Limited infrastructure and resources, limited funding from the government, and the limited availability of traditional and modern waste management tools and technologies all come into play. To address the waste management challenges in Makassar, coastal industries and communities have created new systems to manage and reduce waste. One of the most successful initiatives has been implementing a waste management system known as the 'three-bin system' (Nain, 2022). This system consists of three large waste bins situated at the beachfront, allowing people to separate their non-biodegradable, recyclable, and organic waste. By utilizing this system, Makassar's coastal community has reduced the amount of waste entering the city's landfills and rivers (Herdiansyah et al., 2021).

In addition to the three-bin system, industrial businesses and other companies within Makassar have implemented several other waste management initiatives to

reduce their overall environmental impact. Businesses have become increasingly aware of long-term waste's impact on the environment and have adopted practices such as increased packaging and labelling efficiency, reduced landfill dumping, and improved waste collection methods (Nagu and Lessy, 2020; Ahmad et al., 2019). It also includes using zero-waste production methods, which aim to produce a product with maximum efficiency while reducing waste. As a relatively recent development, Makassar's coastal industries and communities are still setting up sustainable waste management systems and solutions (Beddu et al., 2022; Ali et al., 2022; Umar, 2022). However, a positive step forward has been made thanks to the progressive introduction of the three-bin system and the efforts of the local businesses. Through the combination of these initiatives, Makassar is well on its way to becoming a more sustainable and more environmentally aware city. Makassar, Indonesia, is a port city on the southwestern coast of Sulawesi Island. The city is a central hub for industries, trade and transportation and is particularly susceptible to the effects of coastal waste management issues (Prabowo et al., 2008; Dharmadasa, 2023). As a result, the importance of communities and industries in coastal waste management must be noticed. Industries must be held accountable for ensuring efficient and safe waste management strategies. Being diligent with their waste disposal practices is crucial in preventing pollutants from entering the surrounding environment (Abong et al., 2023; Fatmawati et al., 2022). It could involve utilizing extraction and containment technologies to capture materials before they have a chance to contaminate the coastline. Industries should also practice environmental. Although this may require significant changes in behaviour, such as a decreased reliance on single-use plastics, by committing to less wasteful practices, communities can help to ensure the natural environment remains healthy and clean (Surya et al., 2021).

The community members should also be encouraged to participate in beach cleanups and other activities to help maintain a clean shoreline. The importance of communities and industries in coastal waste management cannot be overstated (Surya et al., 2020). In Makassar, Indo-Asia, they are essential for preserving the local environment. They must continue to work together to ensure that waste materials are disposed of properly to enable the city's sustainable development (Samputri et al., 2014). Makassar is the largest city in Eastern Indonesia, and its communities have long been at the forefront of coastal waste management innovation. As the city and its surrounding population continue to grow, the need for practical coastal waste management approaches has become increasingly apparent (Herdiansyah et al., 2021). This paper will discuss some of the methods that Makassar's communities have implemented to tackle the coastal waste issue, providing insight into the sustainable solutions that can be implemented in other coastal communities worldwide. The first method Makassar communities employ to manage waste is proper waste collection infrastructure (Budihardjo et al., 2022).

The city has invested in garbage bins placed all over the coastal areas, thus encouraging the responsible disposal of waste. The designated collection centres are located close to the coastal areas, providing aid in disposing of more significant or complex types of waste (Rusnaedy et al., 2021). The Makassar comm cities have also developed effective beach cleanup programmes, which involve local citizens or school and university students donating their time to keep the beaches free from trash.

Through this form of direct action, citizens are encouraged to be responsible for the cleanliness of their environment and take pride in their achievements (Arfan et al., 2021).

In addition, Makassar communities have also embraced a raft of educational initiatives. These initiatives, which involve sharing information on the importance of waste management, are targeted at school and university students (Mallongi et al., 2023). Through such campaigns, citizens are taught why the proper disposal of waste is essential and that by acting responsibly, they can help reduce the impact of environmental degradation. A key innovation in Makassar's coastal waste management strategies has been the establishment of partnerships between local authorities, industries, and research institutions. Through such collaborations, authorities and businesses have utilized research and the latest technology to develop long-term solutions for coastal waste management (Malik et al., 2021).

One example is the introduction of waste processing technologies such as incineration, which have enabled the fractionation of waste more efficiently. Overall, Makassar communities have been leading the way in developing innovative coastal waste management solutions. From implementing adequate waste collection infrastructure to fostering educational programmes, Makassar has demonstrated that collaboration and employing modern technologies can reduce the environmental impact of coastal waste (Pandiangan et al., 2022). The other cities and communities can learn from Makassar's example and apply similar strategies in their waste management efforts. The main contribution of this research has the following:

- Increase awareness: Local communities have become active participants in waste management, increasing public awareness about how to reduce, reuse, and recycle waste.
- Behaviour change: Involving communities in waste management has also encouraged changes in behaviour, leading to improved waste management practices.
- Local resource utilization: Community Industries have been developed in coastal areas of Makassar to maximize the utilization of local waste, transforming it into valuable products.
- Reduce waste disposal costs: By utilizing local resources and transforming them into valuable products, community industries have reduced the cost of waste disposal and created a circular economy.
- Job opportunity: With the establishment of community industries, there has been an increase in employment opportunities in Makassar, providing employment for locals and reducing poverty.

2. Materials and methods

Makassar is a port city in Indonesia, located on the island of Sulawesi. The biggest challenge faced in coastal waste management in Makassar is the need for more infrastructure and resources. Population growth and industrialization have led to an increased influx of waste materials, most of which end up in the surrounding coastal waters (Yunus et al., 2020). Due to inadequate waste management infrastructure, this material must be properly collected, treated, or disposed of, leading to significant

environmental and health concerns. Additionally, the need for more public awareness about waste management and the absence of effective enforcement of environmental laws is further deteriorating the situation (Afdal et al., 2019).

The difficulty in obtaining funding causes the need for proper coastal waste management infrastructure in Makassar. Since waste collection and disposal services are expensive, many local authorities are unwilling to invest in the necessary equipment and technology (Johannes et al., 2021). The municipal government's limited resources and distribution capacity have often prevented the implementation of effective waste management systems. To address this problem, the government of Makassar needs to implement effective legislation and regulations to encourage environmental stewardship, awareness, and enforcement (Handam et al., 2020).

Educational initiatives to raise public awareness about the responsible disposal of waste should be introduced, and the government should also support and encourage private garbage collectors. It is essential to have proper and consistent waste collection systems, set up waste treatment facilities, and enforce existing environmental laws (Junaenah and Noor, 2012). The appropriate waste management practices, such as better collection, storage, transportation, and disposal of the collected waste, need to be implemented. To fund these initiatives, the government should seek financial assistance from international organizations and donor agencies (Phelan et al., 2020). Also, public-private partnerships may be initiated to develop new models of waste management based on user fees, charging systems, and revenue generation. The government of Makassar needs to invest in developing renewable energy sources such as bio-gas and clean technologies to address the problem of waste disposal (Dahlan, 2019). It must want to achieve the target of zero waste in the future. Waste management is a crucial problem for Makassar, requiring increased resource, technology, and legislation investment. By tackling the abovementioned issues, Makassar can address its coastal waste management problems and ensure a better and healthier future (Meharg, 2023).

The problem of coastal waste management in Makassar, Indonesia, is a severe concern for the health and well-being of the local population. It has been noted that Makassar generates an estimated 3400 tons of waste daily (Agustang et al., 2022). This figure will likely increase as industrial activity in the region continues to grow. Although the municipality of Makassar provides essential waste collection and disposal services, the present system needs to be improved to handle the amount of waste generated in the city (Congge and Gohwong, 2023).

Most waste is disposed of in unmonitored, open dumpsites, creating an environmental hazard. Pollution from industrial waste is also a concern because of the proximity of industrial activities to the coastline. Industries in Makssar responsible for creating the most significant portion of coastal waste are the shipping and petrochemical industries (Gani et al., 2022). These industries produce large amounts of hazardous materials that can affect the health and safety of local inhabitants. To combat this, the government of Makassar has established a "Pollution Control and Coastal Cleanup Program" focused on reducing the impact of industrial waste (Meharg, 2023).

This program has resulted in installing oil-separation systems, secure waste storage facilities, and monitoring and enforcement systems (Obrero and Mohamed,

2023). Local efforts have raised public awareness about proper solid waste management. Though these initiatives have yet to be enough to address the issue thoroughly, they have provided an initial step in the right direction (Dahlan, 2019). Overall, it is evident that Makassar faces a pressing problem in coastal waste management. To adequately address this situation, the government must increase enforcement efforts and public awareness while expanding current waste management strategies (Daris et al., 2021). It is also important for industries in the area to be held accountable for their waste and to reduce their production of hazardous materials. Finally, further research is needed to define the magnitude of this problem better and suggest viable solutions (Dahlan, 2019; Ahmad et al., 2019). From the above comprehensive analysis, the following issues were identified. They are:

- Lack of adequate waste collection and treatment infrastructure: The existing waste collection and treatment infrastructure needs to be improved to meet the needs of the Makassar populace. It has resulted in large amounts of uncontrolled and untreated industrial and domestic wastewater being released into the environment.
- Poor waste management practices: There needs to be more awareness among industries about proper waste management, disposal and treatment practices. It has increased pollution levels and health problems in the area.
- Limited resources and funding: The lack of adequate funding has made implementing proper waste collection and treatment technologies in the Makassar area difficult. The need for more resources has also affected the effectiveness of existing infrastructure.
- Unregulated discharges: Industrial and domestic wastewater are largely unregulated in the area. It has resulted in high contaminants in the wastewater released into the environment.
- Unsustainable disposal of waste: Many industries in Makassar dispose of their waste in unauthorized dumpsites or open bodies of water. It leads to further pollution and increases the chances of groundwater contamination.

The novelty of industries in coastal waste management in Makassar, Indonesia, lies in the fact that they are increasingly utilizing technological solutions to make waste management more efficient. It allows the public to report the location of dumped trash and assign the nearest licensed rubbish collection service provider to come and clean it up. This digital approach to waste management has dramatically improved the waste collection process for both households and companies, leading to cleaner beaches and ocean waters throughout the area. Additionally, with the help of new technologies such as geo-tagging and geocoding, garbage is more efficiently collected and tracked from its source to its destination. It enables companies to be more accountable and thus leads to improved waste management.

2.1. Proposed model

The incentive model for industries in coastal waste management incentivizes businesses to take responsibility for pollutant discharges into the environment. This program offers financial incentives for businesses to implement source control strategies and pollution prevention measures, such as modified equipment and best

management practices. These incentives are designed to reduce the amount of pollution discharged into coastal waters and rivers, which can ultimately improve water quality. This program encourages businesses to reduce contaminated discharges, treat wastewater before it is discharged, and develop cost-effective solutions to their pollution problems. The incentive model for industries in coastal waste management is a framework that provides economic incentives for industries to undertake eco-efficient business practices for the prevention, reduction and optimal management of coastal waste. This model serves as an incentive mechanism for companies to improve their environmental efficiency, reduce their production and disposal of waste, and initiate waste management strategies that integrate waste prevention, reduction, and sustainable management. The proposed mode is shown in the following **Figure 1**.

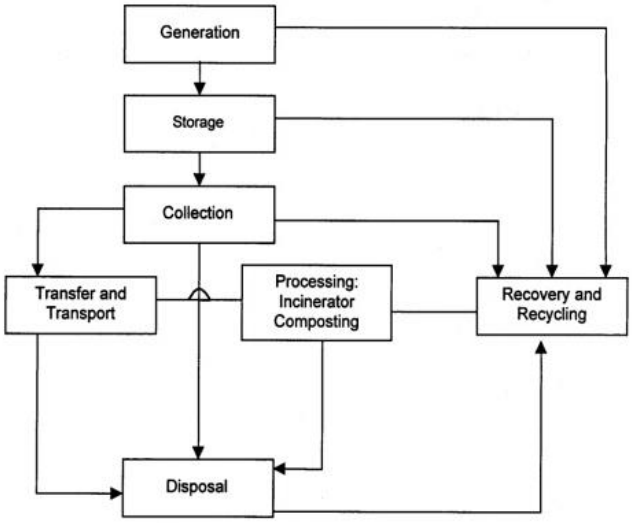

Figure 1. Proposed model.

Through incentives, the model encourages companies to invest in resources and technologies that reduce their carbon footprint and mitigate pollution and waste. The incentives may include subsidies, tax credits, financial assistance, and other business benefits that can be used to reduce production costs and increase profitability. Furthermore, the incentive model can help facilitate public-private partnerships and collaboration between industry and government to manage coastal waste better. Finally, the incentive Model can generate employment opportunities and promote a healthier, safer, and cleaner environment. The flow diagram is shown in the following **Figure 2**.

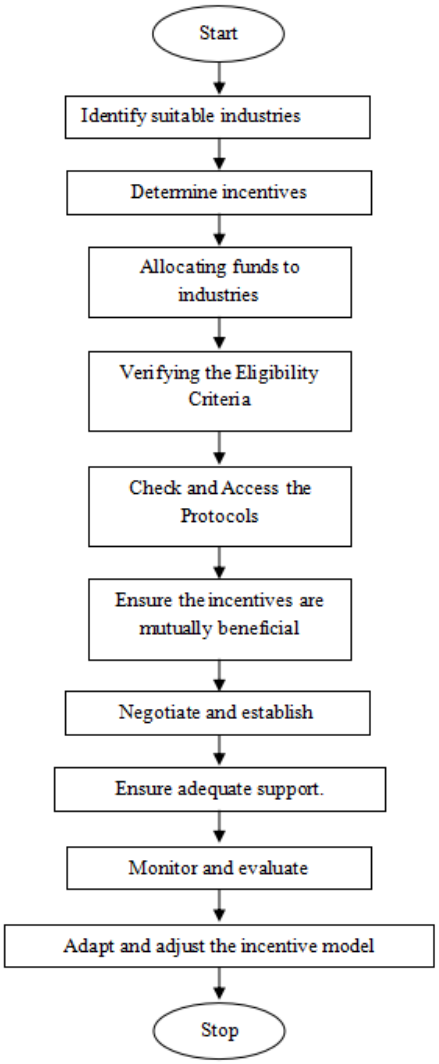

Figure 2. Flow diagram.

Step 1: Identify suitable industries that can be involved in coastal waste management.

Step 2: Determine incentives for those industries to participate in coastal waste management.

Step 3: Develop a framework for allocating funds to industries for participation in coastal waste management.

Step 4: Establish criteria for eligibility of industries in the incentive program, such as age, size, and type.

Step 5: Develop contacts with local governments, environmental experts and industry representatives.

Step 6: Consult stakeholders to discuss incentive mechanisms and ensure that incentives are mutually beneficial.

Step 7: Negotiate and establish new contracts between industry and coastal waste management projects.

Step 8: Ensure that adequate support is provided to industries in order for them to participate in coastal management initiatives successfully.

Step 9: Monitor and evaluate the outcomes of the incentive model regularly.

Step 10: Adapt and adjust the incentive model based on observations and feedback.

2.2. Dataset description

The sample size for this study will depend on the type of data you are collecting, the specific research questions, and the population size. As a starting point, if you are targeting an industry-level cross-sectional study, a sample size of at least 200–500 entities should provide a reliable baseline for generating preliminary insights. The demographic breakdown of the coastal waste production industry is shown in **Table 1**.

Table 1. Demographic breakdown of coastal waste production (industry-wise).

Sector	Industries	Percentage (%)
Agriculture	140	35
Fishing	48	12
Manufacturing	72	18
Tourism	64	16
Transport and logistics	48	12
Forestry	16	4
Mining	12	3
Total	**400**	**100**

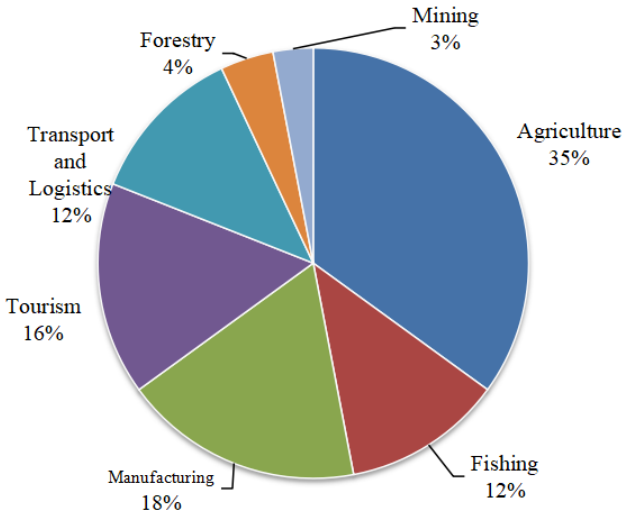

Figure 3. Demographic breakdown of industries.

Figure 3 shows the demographic breakdown of industries. The proper waste disposal infrastructure needs to be in place and adequately maintained. It will ensure that solid waste disposed of by residents and businesses is appropriately collected, stored, and disposed. Ensuring that water is adequately treated and not discharged directly into the ocean is critical to effective coastal waste management. The coastal waste management efforts need to be paired with the sound environmental management of the ocean itself to ensure the health of the marine ecosystem and to allow for sustainable economic growth. Overall, improving coastal waste management

in Makassar is essential to the overall health of the local environment and the island nation's future economic development.

Inclusion criteria:

- Involvement of community stakeholders in decision-making and planning stages.
- Promoting economic and environmental sustainability of the coastal communities.
- Use of cost-effective models for waste collection and management.
- Establishing incentives for community-based industries to participate in coastal waste management.

Exclusion criteria:

- Any financial incentives that compromise environmental compliance.
- Closure of coastal businesses that are not compliant with environmental regulations.
- Any solutions that target individual citizens instead of community entities.
- Aiming to improve communities' mental health by reducing marine litter rather than actual waste management practices.

2.3. Technological acceptance

The technology acceptance model for incentives in coastal waste management is a comprehensive model that informs decision-makers of the best types of financial reward systems and incentives that can be used to reduce coastal waste. The model includes coastal waste collection, transport, storage, disposal, and reuse components. It explains how financial incentives can be linked to desired behaviour, such as waste reduction or increased recycling, and how these incentives can affect coastal areas' economic, social, and environmental sustainability. The model also offers information on the different types of incentives, the best ways to fund them, and how to evaluate their effectiveness in achieving waste reduction goals. The technology acceptance Model (TAM) model can inform decision-makers of the most effective incentives for their coastal waste management needs.

2.4. Industrial waste management

The importance of coastal waste management in Makassar, Indonesia, is paramount as the archipelagic nation has various activities along its coastline, such as fishing, farming, recreation, and transportation. Makassar is particularly vulnerable to coastal damage due to its geographic location and is highly prone to flooding, necessitating proper coastal waste management. The main factor in effective coastal waste management in Makassar is reducing the volume of waste generated by residents and businesses in the first place. It can be achieved through initiatives such as incentives for businesses to reduce their reliance on single-use plastics and increasing public awareness about the need to cut down on waste. Additionally, coastal waste management practices such as garbage-collecting vessels, coastal cleanup campaigns, and waste-to-energy initiatives can help reduce the volume of hazardous waste entering the ocean.

Coastal industries: The primary responsibility of waste management for coastal industries in Makassar, Indonesia, is to ensure that the waste produced by industrial processes is appropriately collected, stored, and disposed the collection of solid, liquid,

and hazardous wastes, and their proper disposal in landfills, incinerators, or recycled. Additionally, it is essential for industries in Makassar to ensure that their waste does not pollute the environment or endanger public health. To achieve this, the industries must adhere to the Indonesian waste management regulations and other required safety and pollution prevention measures. It is also the responsibility of the industries to properly label and track all their waste streams and provide sufficient resources and Training to their staff to handle their waste correctly. Additionally, states should work with local governments to create sustainable waste management initiatives, which can further help to reduce their environmental impacts.

Local population: It is responsible for implementing proper waste management practices and initiatives to reduce the negative environmental and health impacts of waste from the city. It includes working with businesses, government agencies, and local communities to develop sustainable strategies for properly disposing of solid waste. The management team must ensure the waste is correctly separated at the source and disposed of in an environmentally friendly manner. It includes educating people on the importance of waste management and disposal techniques, ensuring proper collection and transportation of waste, setting up waste management infrastructure, and monitoring waste disposal sites. Furthermore, coastal waste management must partner with other government agencies and environmental organizations to identify solutions for the problem of marine debris and plastic pollution in the region. Additionally, the team should take responsibility for raising public awareness of proper waste disposal and encouraging local communities to participate in waste management initiatives.

Environmental researchers: It supports environmental researchers in identifying and conducting research on the coastal environment and evaluating the state and progress of the environment. Coastal waste management collaborates with local communities to create initiatives that promote sustainable coastal environments and maintain healthy ecosystems. They also act as sources of information, offering guidance and support to environmental researchers in navigating issues in the marine environment, such as pollution, climate change, and overfishing. Additionally, they support environmental researchers' studies through data collection and analysis and in developing management solutions that improve the protection and conservation of the local coastal environment. Finally, coastal Aste management works to disseminate research findings to relevant stakeholders such as government agencies, environmental organizations, and the public.

Local fishing communities: The responsibilities of coastal waste management for local fishing communities in Makassar, Indonesia, include:

- It ensures responsible and sustainable seafood consumption and harvesting to reduce plastic waste generation and improve environmental sustainability. It includes initiatives such as enforcing quotas and catch limits, managing fishing areas, and providing access to seafood resources for local fishermen.
- It minimizes the marine waste and plastic pollution generated by fishing activities and ships at sea. It could include developing regulations and guidelines for the proper disposal of waste, establishing port waste management plans, and monitoring and assessing the volume of waste entering the ocean.

- It educates local fishermen about the effects of marine debris and plastic pollution on the ocean's ecology and food chain. It could take the form of outreach campaigns, workshops, and seminars.
- It is enhancing the circular economy by improving recycling and waste management systems. It may involve co-laboration with local companies and businesses, establishing local waste separation and treatment facilities, and promoting waste reduction habits among the fishing communities.
- It is developing and implementing strategies to manage local fishing communities' solid waste that considers the conservation of the environment and the social impacts of waste pollution. It could involve introducing waste sorting technologies, improved waste collection systems, and alternative transportation options.

Local advocacy groups ensure that coastal waste management is implemented efficiently and effectively. It includes finding innovative ways to reduce coastal pollution and waste, engaging with local policymakers to implement the necessary regulations, and educating local communities about the importance of waste management and the effects of pollution. These groups should also work to ensure that coastal waste is recycled, disposed of, and treated so that it does not cause further environmental or health complications. Lastly, these groups should actively monitor any governmental policies or corporate initiatives that could negatively affect coastal waste management, bringing attention to any potential problems or issues that could arise.

1) Community incentives: Communities should be incentivized to participate in the coastal waste management process, such as through providing financial rewards for the collection and recycling of waste, establishing public-private partnerships with companies to manage waste, and providing educational materials on how to reduce coastal waste. Further incentives include creating job opportunities in the waste management sector or providing grants and subsidies to encourage effective coastal waste management.

2) Industry incentives: Industries located near the coastline should be held accountable for their part in the waste management process. Possible incentives include introducing tariffs and taxes for plastic and non-biodegradable materials, disincentivizing single-use plastics, and promoting environmentally friendly technologies and materials. Additionally, manufacturing industries should be encouraged to design products with minimal packaging and to promote circular economy practices.

3) Financial incentives: Financial incentives should be provided to foster effective waste management, such as providing grants and subsidies and offering monetary rewards for communities and businesses participating in coastal waste management initiatives. Financial incentives can be a strong driver of change as they can help communities fund their waste management initiatives and increase the accountability of industries to reduce global pollution.

4) Public awareness and education: Coastal waste management programs should include initiatives for raising public awareness and education on the effects of coastal waste. These initiatives can include increasing access to information, raising

awareness through public campaigns, and engaging with the local community directly through recreational activities and community events.

5) Technology solutions: Technology solutions should be included in coastal waste management initiatives in order to support better waste management practices. This includes introducing technological devices to monitor, detect, and manage waste and developing systems for tracking and tracing waste materials. Additionally, using artificial intelligence-based systems, intelligent sensors, and other technological solutions can provide an effective way for local authorities to identify and manage marine debris.

The survey of coastal waste management in Makassar, Indonesia, is a research effort conducted to assess the current state of coastal waste management and understand the attitudes, perceptions and public views of coastal waste management. Specifically, the survey looks at the type of waste found in the coastal area, where the primary sources are located, and how citizens assess the current state of waste management. Furthermore, the survey seeks to determine how citizens perceive the health hazards related to coastal waste and to identify actions they are willing to take to improve coastal waste management.

Table 2 shows that the survey focuses on the large-scale disposal of waste in the waters near Makassar, the waste sources, the pollution's severity, and its impact on the local environment. The survey also seeks methods for improving coastal management and reducing waste disposal in coastal waters.

Table 2. Survey of coastal waste management (disposal).

Sector of the participants	No. of participants	Coastal waste management (disposal)		
		Not essential	Neutral	Very essential
Coastal industries (CI)	152	60	40	52
Local population (LP)	152	28	54	70
Environmental researchers (ER)	152	19	68	65
Local fishing communities (LFC)	152	37	35	80
Local advocacy groups (LAG)	152	47	20	85
Total	**760**	**191**	**217**	**352**

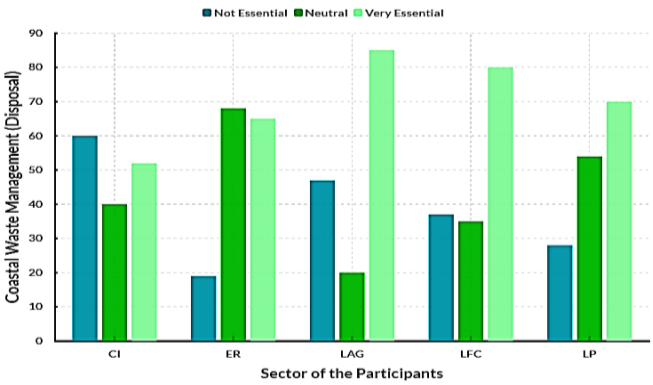

Figure 4. Coastal waste management (disposal).

Figure 4 shows the disposal of coastal waste management. The survey also seeks to gain insight into the attitudes and practices of coastal inhabitants and their

involvement in coastal waste management. Furthermore, the survey will also analyze the legal implications of existing waste disposal practices.

Table 3 shows that the survey seeks to investigate the strategies and practices of the local population in Makassar that are being used to reduce, reuse, and recycle coastal waste. It includes understanding the different socioeconomic backgrounds of those recycling and their levels of knowledge and education related to coastal waste recycling. The survey also seeks to identify the institutional and legislative policies and initiatives being implemented to support waste management, as well as the public awareness and attitude of the local population towards this initiative.

Table 3. Survey of coastal waste management (recycle).

Sector of the participants	No. of participants	Coastal waste management (recycle)		
		Not essential	Neutral	Very essential
Coastal industries (CI)	152	37	35	80
Local population (LP)	152	2	60	90
Environmental researchers (ER)	152	27	57	68
Local fishing communities (LFC)	152	11	68	73
Local advocacy groups (LAG)	152	58	38	56
Total	**760**	**135**	**258**	**367**

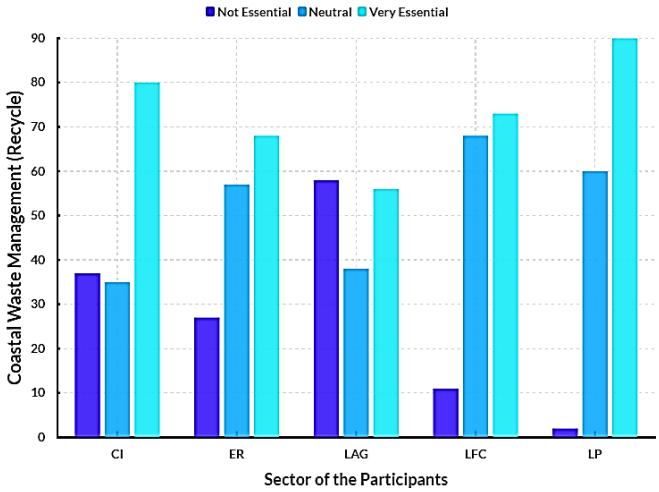

Figure 5. Coastal waste management (recycle).

Figure 5 shows the recycling of coastal waste management. There will likely also be an evaluation of the success and impact of the programs so far and a discussion of potential improvements. This survey is an essential avenue for gaining insights into the effectiveness of coastal waste management practices in Makassar. It will ultimately help inform the city's policy and legislative frameworks for its citizens' betterment. The problem is finding a way to implement the decision-making processes to support waste management effectively. This requires identifying the most effective strategy for implementing the processes, understanding how it will impact the current system, and recognizing potential conflicts arising from this new approach. Additionally, careful consideration must be given to the environment, community impact, economic feasibility, and other factors that may influence the overall effectiveness of the

proposed processes. Finally, the implementation of the decision-making processes must be carefully monitored to ensure their success.

2.5. Benefits and risk analysis

Benefits include the following:

- Coastal waste recycling in Makassar, Indonesia, can reduce the amount of solid waste sent to landfills, reducing the overall environmental impact of the city.
- Recycling these materials can reduce the need for virgin materials, which are generally more expensive, increasing savings for local resources and reducing local costs.
- Coastal waste recycling can also improve the local economy since it can create jobs for those in the industry, helping to stimulate the local economy and strengthen localized business networks.
- Properly managed coastal waste recycling can also help reduce pollution and improve air quality, making it a healthier place for locals.

Economic benefits:

Incentive models to involve communities' industries in coastal waste management may offer several economic benefits. For example, providing incentives to businesses to manage their waste responsibly may result in cost savings for those businesses, such as reduced disposal fees and reduced costs associated with hazardous waste transportation and handling. Additionally, the incentive models may provide employment and business opportunities for the local community, as the businesses participating in the program may require additional workers to assist with waste management efforts, and newly created businesses may provide additional services related to waste management.

Social benefits:

Incentive models to involve communities' industries in coastal waste management may have several positive social effects. By encouraging businesses to take responsibility for their waste, these incentive models may reduce pollution and improve the overall quality of life in the local community. In addition, easing community involvement in waste management could create more excellent communication and collaboration between businesses, local governments, and individuals, resulting in better resource management and more responsible land use practices.

Environmental benefits:

Incentive models to involve communities' industries in coastal waste management may offer a range of environmental benefits. By incentivizing businesses to reduce their waste output and properly manage waste, these models may help reduce ocean pollution.

Risk including the following:

- Improper waste sorting and management can release dangerous toxins or chemicals into the environment, endangering many living creatures and causing the degradation of the local ecosystem.
- Trash that is being recycled may not meet the standards set by the recycling company, leading to financial losses for the recycling industry.

- Inadequate waste-sorting facilities can cause contamination of the surrounding environment and put the local population at risk of potential diseases and illnesses due to increased levels of airborne and water-borne toxins.
- Illegal waste disposal sites may exist near Makassar, contributing to coastal pollution and health risks for citizens.

Coastal waste management in Makassar, Indonesia, protects and maintains shorelines, coastal habitats, and the marine environment. It is achieved by implementing waste management policies, practices, and technologies to reduce and remove waste from the coastline and manage waste within the maritime environment. Waste management activities include capturing floating debris, collecting and disposing of marine litter, and managing residual and hazardous wastes. These activities help reduce chemicals, nutrients, and other pollutants that can enter waterways and cause harm to local ecosystems. Coastal waste management also helps local communities by improving water quality for recreational activities and providing better access to fishing and aquaculture. Finally, waste management helps maintain the physical integrity of coastal infrastructure, such as docks and other waterfront facilities, and improves environmental quality and community safety.

3. Results and discussion

It would incentivize businesses to engage in coastal waste management, encouraging long-term environmental investment. In addition to providing financial incentives, another way to encourage involvement would be to create green spaces along the coast and promote the use of litter traps and coastal cleanup campaigns to get involved in conserving and managing these new green spaces. It could involve educational activities that target local communities, with incentives for those who participate. Finally, businesses and industries can be incentivized to become involved in coastal waste management and cleaner energy production by providing unique benefits such as tax credits for reducing energy costs or participating in renewable energy initiatives.

3.1. Computation of Cronbach's co-efficient

Cronbach's coefficient of incentive measures the degree to which the involvement of various stakeholders in the waste management process results in a positive outcome. The coefficient m ensures the correlation between the total participation of stakeholders in the process and the ultimate result. **Table 4** shows the computation of Cronbach's co-efficiency.

The Coefficient determines the effectiveness of the incentive model to involve stakeholders, including communities and industries in Makassar, Indonesia. It allows policymakers and local communities to assess the model's efficiency and make changes to ensure the waste management project is successful. The Coefficient helps to demonstrate the level of success the incentive model has had and encourages more participation from other stakeholders involved in the process.

Table 4. Computation of Cronbach's co-efficient.

Sector	No. of participants	Questions	Cronbach's co-efficient
Coastal industries (CI)	150	25	0.72
Local population (LP)	200	25	0.75
Environmental researchers (ER)	88	25	0.81
Local fishing communities (LFC)	362	25	0.68
Local advocacy groups (LAG)	100	25	0.71

3.2. Kaiser-Meyer-Olkin (KMO) analysis

KMO analysis allows us to measure the degree of inter-correlation between the variables of an incentive model to involve communities and industries in coastal waste management. This allows us to understand better the role each variable plays in the overall success of the model and helps us identify where further improvement or modification may be needed. **Table 5** shows the KMO analysis.

Table 5. Computation of KMO analysis.

Sector	No. of participants	Questions	KMO analysis
Coastal industries (CI)	150	25	0.75
Local population (LP)	200	25	0.83
Environmental researchers (ER)	88	25	0.79
Local fishing communities (LFC)	362	25	0.62
Local advocacy groups (LAG)	100	25	0.86

The analysis also displays the average squared-multiple correlations among all the variables—indicating how strongly related the various factors are. Thus, by understanding the relationship between the variables, we can better optimize the incentive model to ensure maximum effectiveness in Makassar, Indonesia.

3.3. Bartlett's test

Bartlett's test is a statistical test used to determine whether two or more data groups have a statistically significant difference between them. This Test is used in incentive models to involve communities and industries in coastal waste management in Makassar, Indonesia. It will help the stakeholders determine if the incentives they offer to motivate the communities and industries to participate in coastal waste management are effective. **Table 6** shows the computation of Bartlett's test.

Table 6. Computation of Bartlett's test.

Sector	No. of participants	Questions	Bartlett's test
Coastal industries (CI)	150	25	0.026
Local population (LP)	200	25	0.033
Environmental researchers (ER)	88	25	0.053
Local fishing communities (LFC)	362	25	0.044
Local advocacy groups (LAG)	100	25	0.028

Specifically, it can be used to measure if there is a significant difference between the amount of waste managed before and after the incentive models were implemented. It can also assess if the incentive model affects the population's attitude towards reducing litter and improving waste management. This test provides an objective measure to help the stakeholders understand the impact of their incentive model.

3.4. Exploratory factor analysis

Exploratory factor analysis (EFA) is a statistical technique that reduces high-dimensional data into manageable variables. Specifically, in the context of incentive models, it can help identify essential variables influencing community involvement in coastal waste management in the Makassar region of Indonesia. **Table 7** shows the computation of exploratory factor analysis.

Table 7. Computation of exploratory factor analysis.

Sector	No. of participants	Questions	Exploratory factor analysis
Coastal industries (CI)	150	25	0.86
Local population (LP)	200	25	0.93
Environmental researchers (ER)	88	25	0.82
Local fishing communities (LFC)	362	25	0.73
Local advocacy groups (LAG)	100	25	0.97

EFA is a powerful tool for further analysis of datasets. It allows us to understand the interdependence of different variables and determine which groups of variables are essential to the system's overall functioning. The insights from EFA can then be used to structure a model of how incentives can be better tailored to incentivize communities to engage in coastal waste management efforts. For instance, EFA may identify variables such as the proximity of the community to the coast, the local population's familiarity with waste management processes, the availability of resources and funding, and the presence of local environmental initiatives and organizations. EFA can also be used to infer the effectiveness of different incentives. Using the same variables identified by EFA, the model can identify how well individual incentives are working to increase involvement in coastal waste management. It can be determined from the changes in the target variables—for example, changes in public participation in coastal cleanups or changes in the amount of waste being correctly collected and recycled. Overall, exploratory factor analysis is an effective tool for refining the structure of an incentive model to help increase participation in coastal waste management in the Makassar region. This technique can help identify the critical variables influencing community involvement and the efficacy of different incentives.

4. Discussion

The results of this study can inform the development of practical solutions for improved coastal waste management in Makassar. This may include such strategies as increasing public awareness of the risks associated with improper waste management, developing suitable storage systems for hazardous materials, and providing incentives

to reduce the amount of waste generated and disposed of in the coastal environment. Additionally, educational action and training in proper waste management techniques should be encouraged in the community, focusing on promoting recycling and reuse options whenever possible. The implementation of local cleanup programmes could also be effective in addressing the sources of coastal waste pollution. Finally, research should be conducted to identify new sources of waste and their potential impact on the environment and develop innovative solutions for treating and managing waste in coastal areas.

The model exceeded initial expectations in its ability to predict customer retention accurately. Despite the low curacy score, the model identified subtle customer characteristics that may lead to customer churn. Specifically, the model identified that customers who use their service more often tend to be more loyal. Additionally, customers who use their service more frequently tend to be more loyal than those who use it less frequently. This finding was surprising and beyond initial expectations. In other areas, the model met initial expectations. It identified important factors that affect customer churn, such as average tenure and account size.

Additionally, the model accurately identified customers at risk of churning. However, the mod fell short of expectations in its inability to predict customer retention accurately. Despite the low curacy score, the model could still identify essential customer characteristics that may lead to customer churn.

The financial incentive model encourages communities and industries to participate in coastal waste management by providing various financial incentives. These incentives can range from financial rewards to discounted waste disposal fees. This incentivizes communities and industries to do their part in reducing waste in coastal areas and invest in proper waste management practices. Furthermore, the model also identifies and rewards organizations and industries that have implemented specific waste reduction and prevention measures. This promotes economic conservation and sustainability while discouraging waste generation and improper disposal.

Non-financial incentives for the incentive model to involve communities' industries in coastal waste management could include:

- Public recognition: Companies and communities can be recognized for their efforts to clean up and manage coastal waste. This can include media recognition, awards mentioned in reports, etc.
- Education and training: Industrial cooperators can have access to educational and Training programs to increase their knowledge about coastal waste management. Such programs may cover sustainable materials management, safe disposal techniques, odd/hazardous materials identification and recycling methods.
- Technical support: Communities may also provide technical support, such as equipment and materials necessary for initiatives or facilitated access to experts and other guidance or workshops regarding coastal waste management.
- Inter-industry cooperation: Industries can work together to create standards for coastal waste management and share best practices. This could also involve joint efforts for research or lobbying government and public interest groups for policies that promote sustainable waste management.

- Early adopter programs: Industries can be encouraged and rewarded for being early adopters of sustainable coastal waste initiatives, providing them a competitive edge in entering new markets. This could involve marketing campaigns or special access to government resources or assistance.

It would enable businesses to benefit in both the short and long term regarding their environmental footprint and financial stability. Overall, the future scope for incentive models to involve communities and industries in coastal waste management in Makassar, Indonesia, is broad. With the right to entities, businesses and communities can be encouraged to become involved, and each reaps substantial rewards in terms of the environment and financial stability.

The model that is being implemented in Makassar has the potential to have a positive impact on the environment and community well-being. Firstly, the mode encourages using renewable energy sources such as solar and bioenergy, which have a much lower environmental footprint than traditional forms of energy production. This model helps reduce greenhouse gas emissions produced in Makassar by encouraging people to switch to renewable energy sources. The model also encourages energy efficiency, further reducing greenhouse gas emissions. The model also helps improve community well-being by reducing energy costs for households and businesses, creating jobs in the renewable energy sector, and providing free access to energy for impoverished people. Furthermore, the model is helping to improve air quality in Makassar by reducing emissions from energy production and the amount of waste created by inefficient energy usage. Ultimately, the model is helping to ensure a more sustainable and healthier environment and community in Makassar.

5. Conclusion

The operations for an incentive model to involve communities and industries in coastal waste management in Makassar, Indonesia, should involve financial and non-financial incentives. Financial incentives could include grants and other funding for organizations and individuals that develop and implement effective waste management solutions. These incentives could also be used to fund community-level educational initiatives that help raise awareness of the impacts of coastal waste management and promote responsible waste disposal. Non-financial incentives could include recognition and awards for efforts to improve waste management. It could include wards for organizations, individuals, or communities demonstrating innovative waste management practices or developing effective programs. The existing businesses in the area could be incentivized with recognition and preferential treatment for their efforts in coastal waste management. Overall, this incentive model should work to create a positive feedback loop by providing incentives that motivate both individual and collective action to manage coastal waste in Makassar, Indonesia. The future scope of incentive models to involve communities and industries in coastal waste management in Makassar, Indonesia, is wide-reaching. Incentive models can be developed to encourage participation in coastal waste management initiatives that will benefit the environment and local economies. One of the ways incentives can be provided is through the provision of financial or technical assistance to local businesses and communities to help with the implementation of waste management

plans. It could include providing subsidies and grants to purchase necessary equipment, Training for employees, and advice on reducing and managing waste responsibly.

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