

A SYSTEMATIC APPROACH TO MARINE PLASTIC COLLECTION

Goal: Establishing a structured taxonomy



Our main goal was to establish a structured taxonomy to highlight the potential of using machinery and boats for marine plastic waste collection. We wanted to explore how these marine systems and vessels could efficiently gather and process the plastic waste while also considering how to integrate these solutions into the existing infrastructure.

By: Vegard Andersen, Mari Nestli, Herman Snare and Emma Wist at Department of Marine Technology

Plastic pollution in our oceans is a pressing issue, harming marine life and ecosystems. The current solutions, like manual cleanups, are insufficient in managing the vast amount of waste we produce. We urgently need an effective system that combines different existing technologies with the methods used today. Only by doing so can we efficiently collect and manage plastic waste from the ocean. The problem will only continue to grow until we have the ability to collect more plastic than we pollute. Implementing a comprehensive approach is crucial to safeguard marine life, preserve the environment, and create a sustainable future for our planet.

Information

We have developed an interactive tool to determine the best solution for a given area or topography. The model evaluates different marin waste collection technologies on a scale from 0 to 10 for a range of different criteria before providing a final score based on the results.

Performance criteria

- Compatibility with topography [-]
- Biological impact [-]
- Degree of obstruction [-]
- User-friendliness [-]
- Capacity [kg]
- Collection rate [m³/s]
- Energy consumption [kW]
- Product cost [NOK]
- Operating cost [NOK]
- Emissions [kg CO₂/year]

Technology



Cases:



Norwegian coast

- 1 494 tons of plastic emissions every year
- 0.015% of the world's total emissions
- Mainly post-industrial plastic waste originating from the aquaculture industry
- Norway's well-developed and efficiently managed infrastructure effectively handles the volume of plastic waste the country produces
- Topography: Fjords and skerries



Bosphorus strait

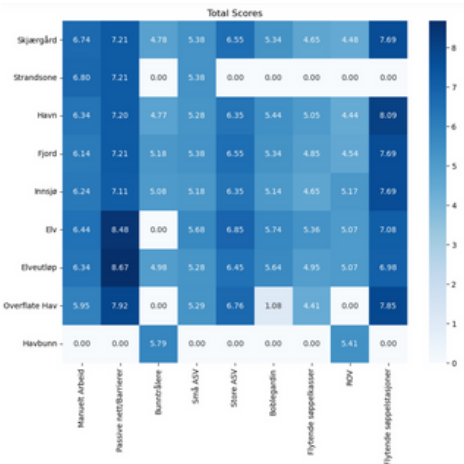
- 4 257 tons of plastic emissions every year
- 0.14% of the world's total emissions
- Mainly owner-less plastic like containers, packaging and plastic bags
- Istanbul grapples with its inadequate and poorly managed infrastructure, which struggles to cope with the substantial volume of plastic waste generated in the city
- Topography: Ocean, strait, lakes and rivers



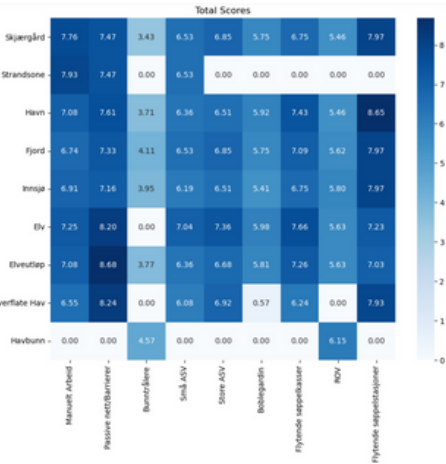
Manila bay

- 124 711 tons of plastic emissions every year
- 10% of the world's total emissions
- Mainly owner-less plastic like containers, packaging and plastic bags
- Underdeveloped and poorly managed infrastructure that cannot handle the volume of plastic waste the country produces
- Topography: Rivers

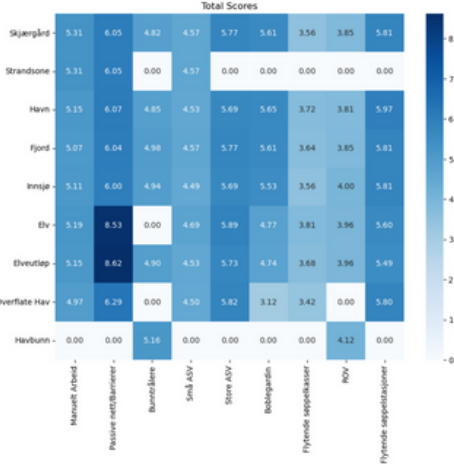
Norway



Manila Bay



Bosphorus strait



- Floating waste stations in populated areas along the Norwegian coast for better accessibility
- Proximity to floating garbage stations facilitates waste disposal, especially in large and dispersed regions
- Motivating effect of floating garbage stations, encouraging the population to participate in the national effort of waste sorting and recycling for a more sustainable future
- Manual teamwork recommended for areas where significant plastic waste accumulates on land, particularly in skerries like Frøya
- Utilizing manual collection and small ASVs for efficient plastic retrieval in rugged terrain and water
- Avoid bottom trawling along the Norwegian coast to protect well-established ecosystems; instead, use ROVs for seabed cleanup
- Opt for a simpler mother vessel as a support ship or lease space on an existing vessel with a route along the Norwegian coast for plastic transportation

- Summer students designed the current system in Manila Bay using a complex mother vessel with six large ASVs towing nets for plastic retrieval in river mouths. To enhance plastic collection efficiency, it is recommended to expand the system with additional subsystems.
- The complex mother vessel should be kept due to the area's lack of infrastructure and its self-sufficiency in fuel from the onboard pyrolysis plant. For more effective plastic collection near river mouths, consider combining large ASVs with bubble curtains.
- Bottom trawling is suitable for certain areas of Manila Bay to collect sunken plastic, and ROVs can be used for thorough seabed cleaning.
- Passive nets and barriers are relevant for river mouths but should be partially deployed to avoid hindering boat traffic, and combining them with bubble curtains improves their efficiency.
- Manual labor may not be essential if ASVs and bubble curtains cover plastic collection, but can be used when plastic gets stuck further upstream in the rivers.

- Passive nets and barriers can efficiently collect plastic waste, capitalizing on the wide and low-traffic nature of many rivers without hindering navigation.
- Implementing floating garbage bins in or around the strait can significantly reduce plastic pollution, addressing the historical issue of it being used as a dumping ground.
- Due to concerns about poor working conditions and human rights violations at the existing plastic recycling station, floating garbage stations become a preferable alternative. The cost/benefit perspective justifies the additional expenses for floating garbage stations, considering the avoidance of human rights abuses and the positive impact on the environment.
- A comprehensive understanding of local conditions and human rights issues is vital in planning plastic waste cleanup initiatives, going beyond tabulated data to address social implications responsibly.
- Combining passive nets, manual labor, ASVs, and bubble curtains enhances the efficiency of plastic waste retrieval systems.