



Health and Environmental Impacts of Plastic Pollution

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Introduction

Plastic has countless benefits due to its known characteristics of being lightweight yet strong, inexpensive, more energy efficient to make than other materials, such as glass and metals. It is malleable and can be molded into all shapes and sizes. They enhance life in many ways such as for packaging perishable goods, preserving food, medical applications, and reducing carbon dioxide emissions. However, these same uses actually can make them harmful to the environment and human health. Plastics started off mainly as long lasting items, but turned more towards single use disposable products. Plastics are very long lasting and durable material. Once in the environment, it undergoes little degradation leading to long-term pollution. The aim of this study is to study the nature of plastic pollution and assess global plastic pollution in order to develop mitigation strategies to effectively reduce sources and risks.

Background

It is imperative to consider impacts of plastic throughout its entire lifecycle. Majority of plastics are extracted from fossil fuels and natural gases, which release chemicals into the air and water. Production facilities also spill a significant amount of pre-production pellets into the ocean during transport. During manufacturing, plastic polymers are typically mixed with additives to reinforce the material, but these chemicals also leach into the natural environment. Current approaches on plastic waste management and use are not sustainable. Incineration of plastic introduces toxic metals and substances into the environment. Landfill capacity for plastic waste is also finite and this type of disposal has harmful effects on the environment and diminishes land resources that could otherwise be of better use.

Objectives and Hypotheses

General Objective

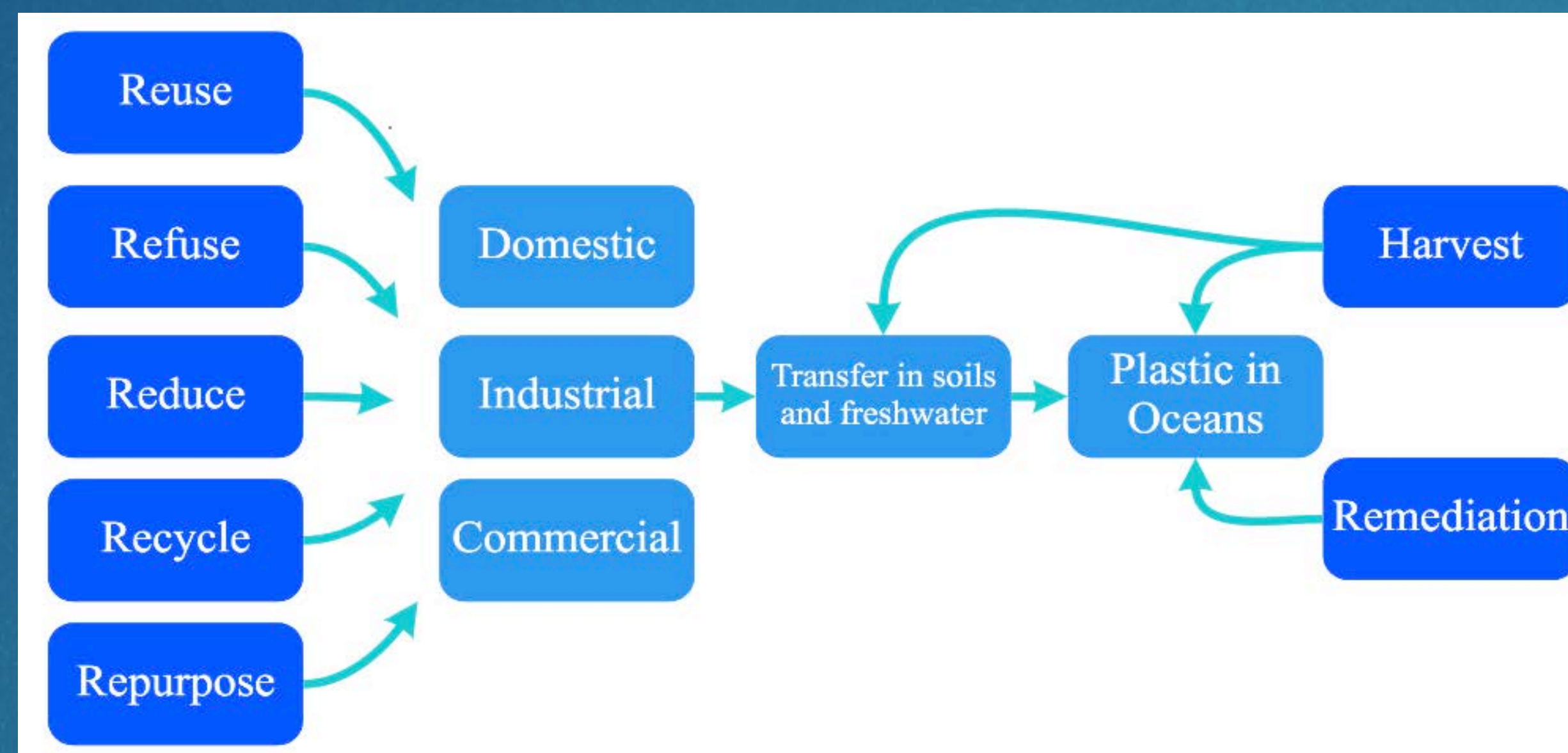
- To study the problem of microplastics
- To evaluate the nature of macroplastics
- To develop mitigation strategies to address plastic pollution

Hypothesis: It is possible to reduce the plastic load in the environment using comprehensive strategies

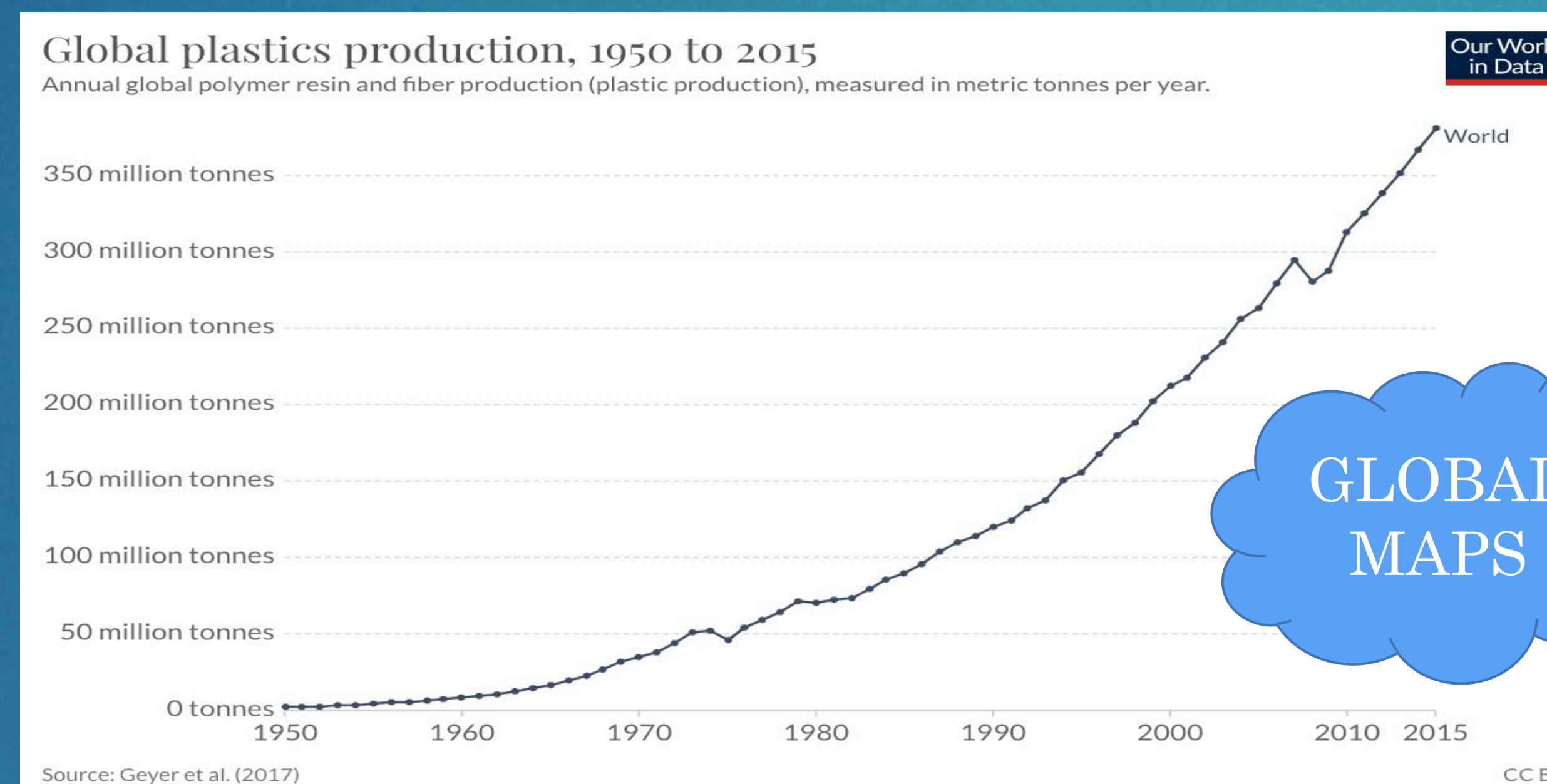
Methods

- Evaluate global distribution of sources of plastic - existing data and global maps
- Literature review - Source- transfer- fate of microplastics
- Table with list of strategies

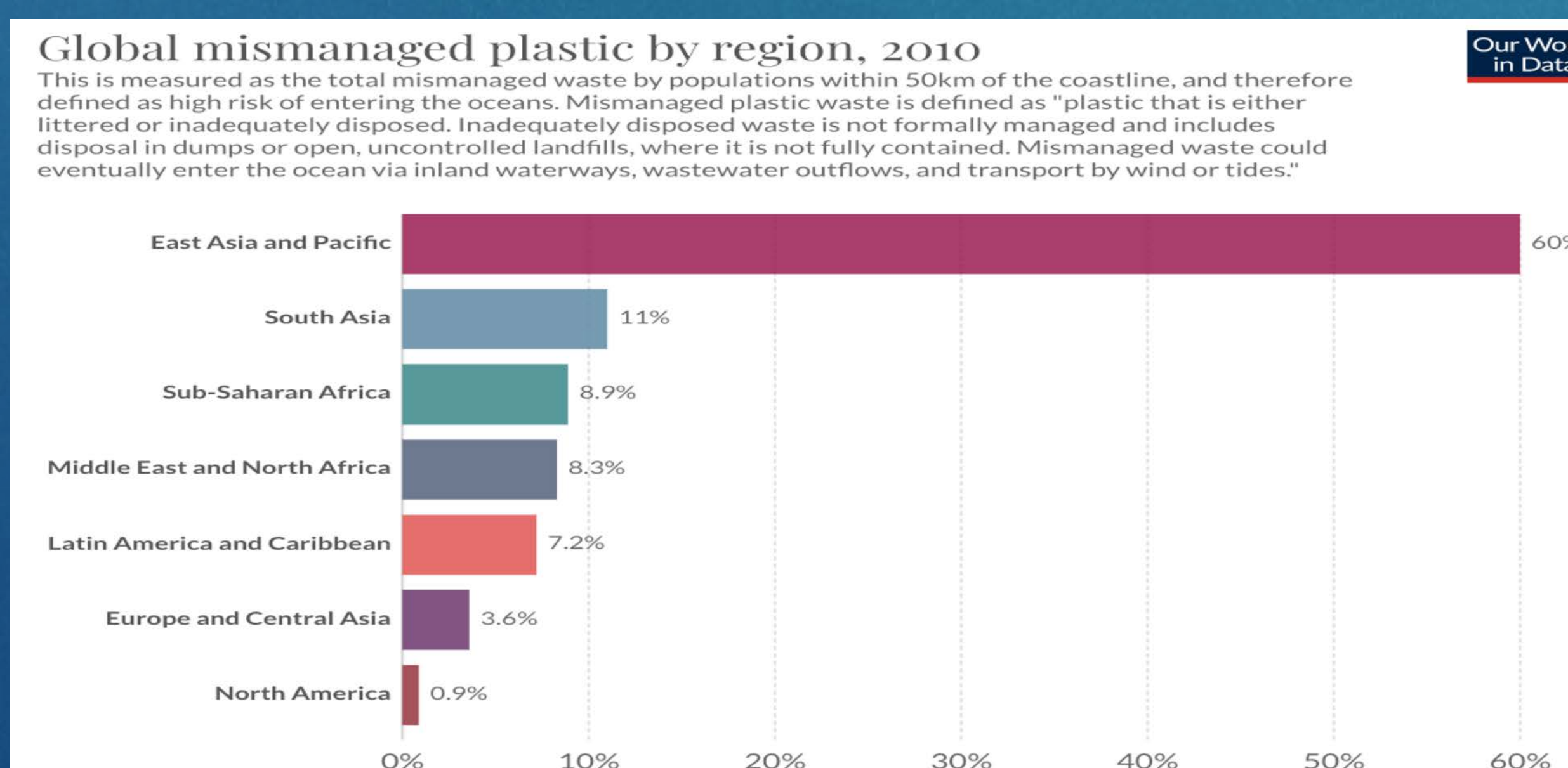
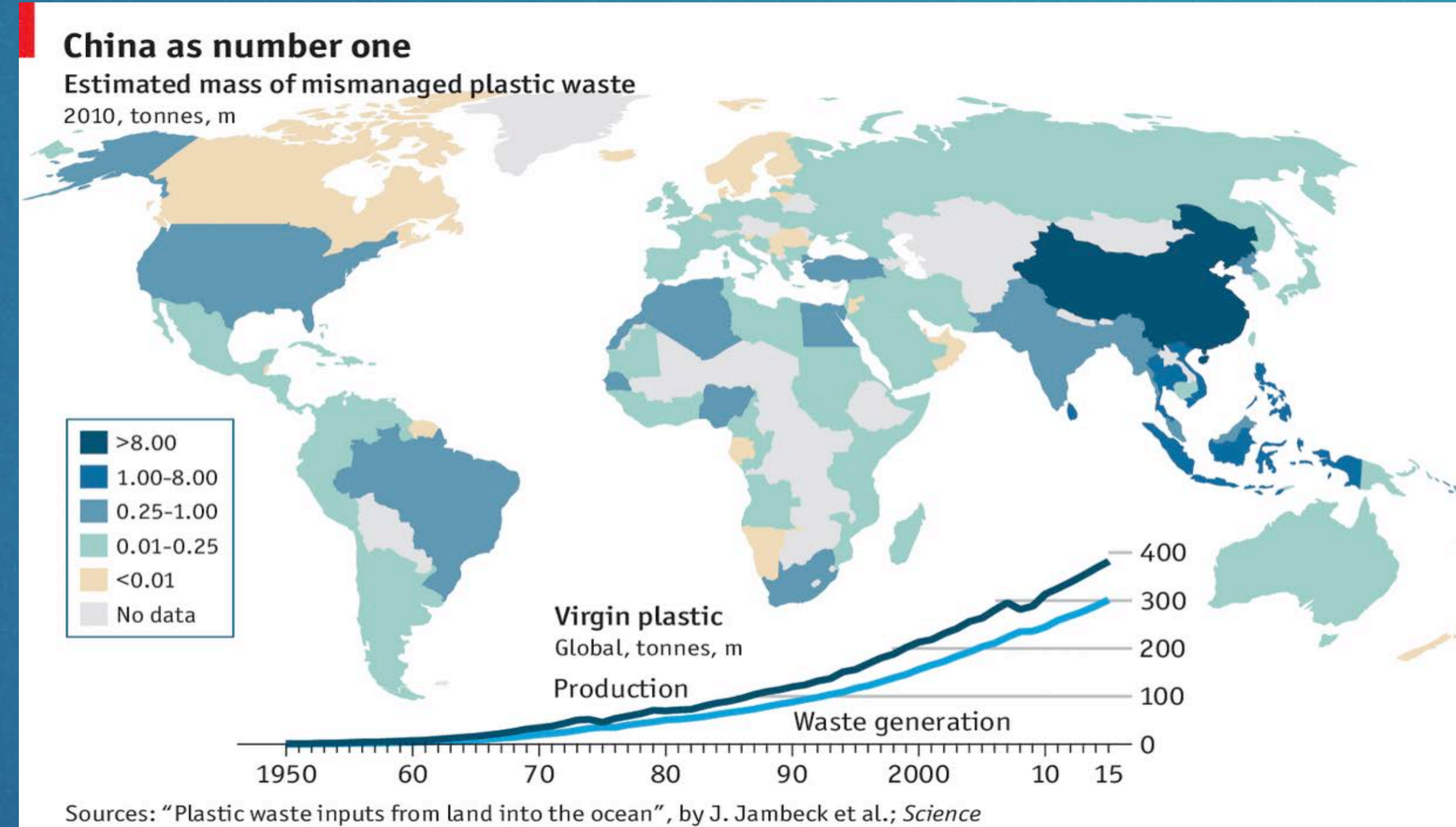
Conceptual Model



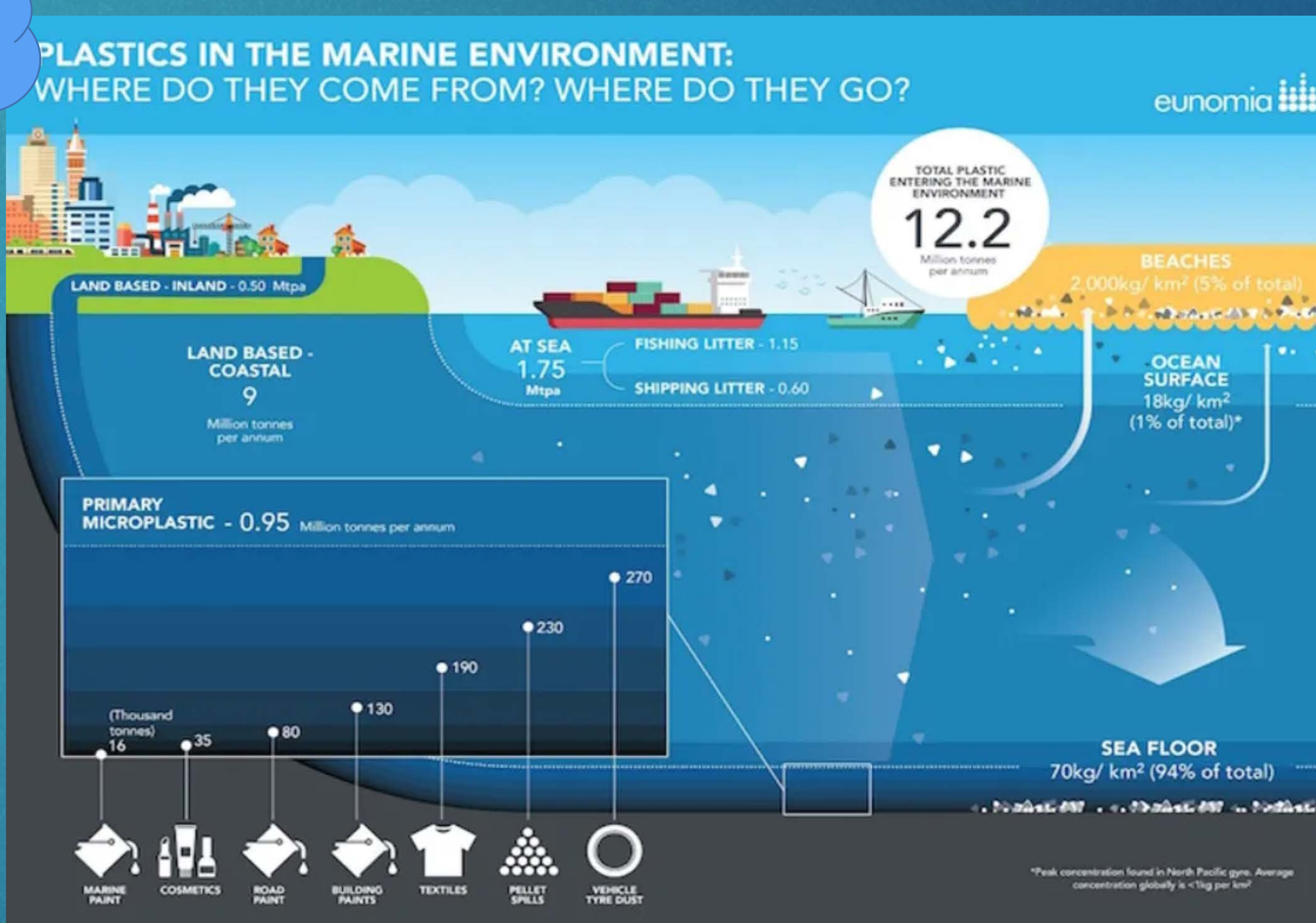
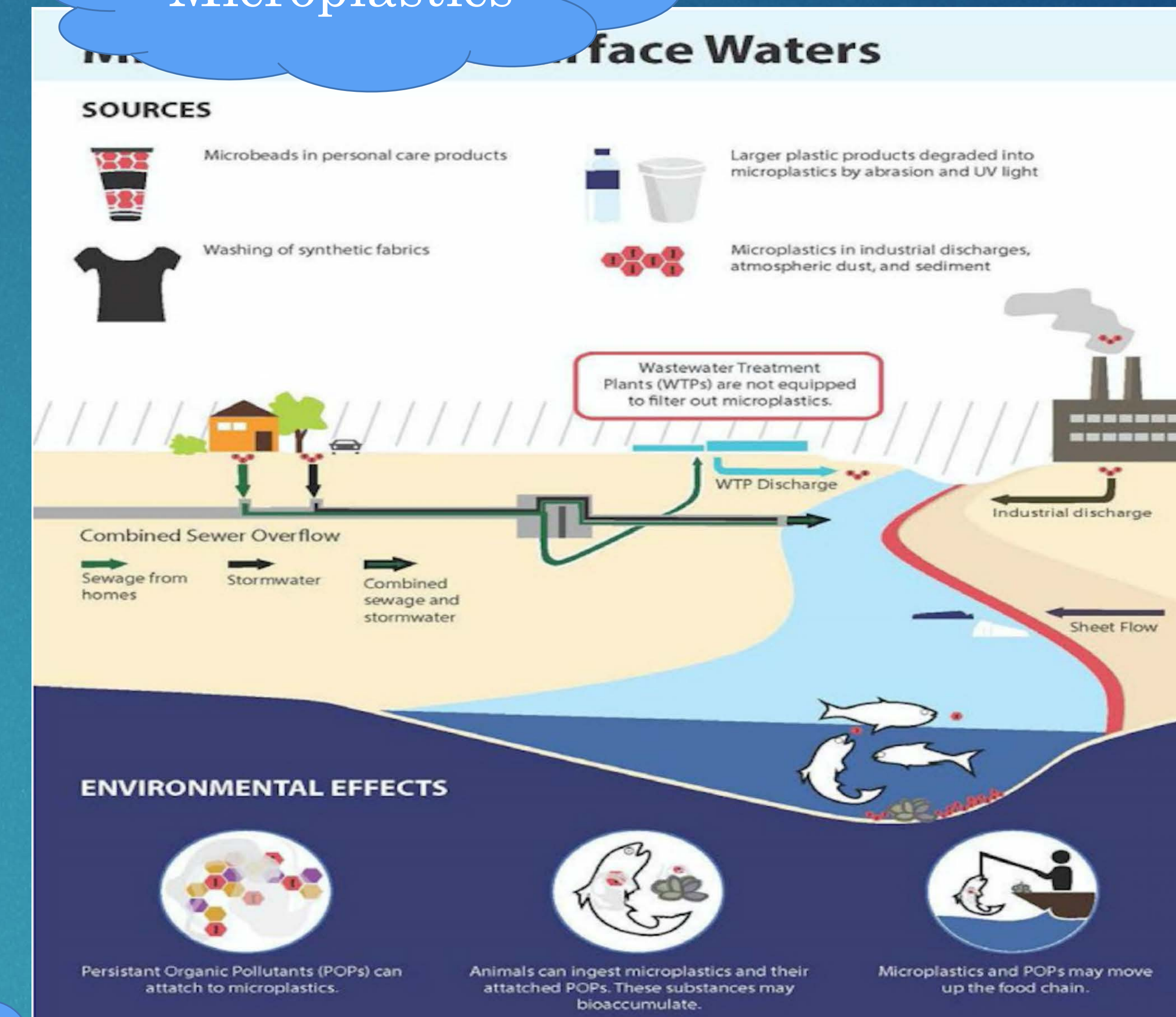
Results & Discussion



GLOBAL MAPS



Microplastics



Mitigation Strategies for Plastic Pollution	Strengths
Policies and Bans Bans on single use plastics such as plastic bags and microbeads in cosmetic products Customers are charged a levy for plastic bags Trade of plastic waste also should be regulated. Policies should enforce producers to make it more transparent that there are chemical additives in their products to ensure safety and use policies to restrict the use of toxic chemicals in plastics	Policy holds a producer accountable for a product even after postconsumption stage, which incentivizes producers to consider the environment impacts of their products and also look for more eco friendly design for their product Strategies should be more widespread and enforced, so that waste management isn't delayed.
Recycling and Reuse Some products are harder to recycle or not recyclable at all because they are mixed with other material as opposed to single polymers Instead of sorting plastic to be recycled, research is being done to find ways to process waste that consists of different types of plastics Some examples include chemical recycling by dissolving the plastic and thermochemical recycling called pyrolysis	Instead of single use, recycling reuses the material multiple times or continuously, which causes less plastic to end up in waste. Research can be done to implement a design for recycling and increase the capacity to recycle. Recycling helps reduce consumption of plastic at its source. In addition to recycling, reusing plastic items such as refillable cup are more sustainable
Biodegradation Plastics that are biodegradable can be an alternative to single use plastics. New research suggests bioplastics derived from metal complexes and can bind to greenhouse gases. New bioplastics are also designed to biodegrade more rapidly under natural environment conditions	Biodegradable plastics are a way to substitute plastics with alternative materials rather than the traditional plastic that does not degrade and accumulates in landfills and oceans. If bioplastics that can bind to carbon dioxide were adopted, then carbon dioxide emissions would also be reduced.
Incineration Incineration does result in unwanted greenhouse gases released into the atmosphere, but it is a way to reduce landfill wastes.	For medical equipment wastes, incineration disposes infectious wastes and keeps biohazards from reaching public health Energy content of plastics is recovered the process
Public Education Public action is needed to reduce plastic use, waste, and littering and this can be done through consistent public campaign, education and outreach programs, and school education on waste management	Consumers need to incentivize to live sustainably and modify their behavior to reduce consumption at its source. The more the public is involved and educated; there will be less demand for single use plastic, less litter, and waste can be handled appropriately.
Collect and Clean up Reducing plastic pollution can begin with global initiative to clean up litter in the environment directly such as at beaches and shorelines Along with clean up, collection capacity needs to be increased and more effective waste collection systems available Catch basin inserts, booms, and separators can all be used to remove and collect new or existing plastic debris in the water	A decrease in waste production and more effective waste collection can make coastal areas cleaner and overall reduce pollution in environment. As a bonus, it will foster more activities such as tourism and fisheries, as well as preserve the ecosystem
Packaging and Labeling Plastic packaging should be simplified and include a clear label to inform consumers to distinguish which package can be recycled or not. Small changes in product packing can reduce the weight of packaging	By having a clearer label, consumers are more informed and plastic is easier to sort. The weight of packaging can be reduced by changing the shape or size of packaging.
Remediation <i>Ideonella sakaiensis</i> is a bacterium that was discovered to be able to secrete an enzyme that can break down plastic <i>Flodin interpunctella</i> wax worms were also found to be able to digest plastics.	These are remediation strategies that can be used against plastic waste already accumulated in the environment.

Conclusions

In order to make a significant impact on plastic pollution, combined worldwide efforts to prioritize interventions are required. Better education to incentivize public action, make alternatives to virgin plastic more mainstream, enforcement and policy, engagement in reusing and recycling, and development of new ways to handle waste are just some strategies that can be used. Future research could be carried out to assess the impact of microplastics on agriculture and food safety. More studies need to be done on microplastics in freshwater reservoirs.

Acknowledgements

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