

# OCEAN PLASTIC POLLUTION: ITS DISASTROUS IMPACTS ON ECOSYSTEM AND SOLUTIONS

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## ABSTRACT

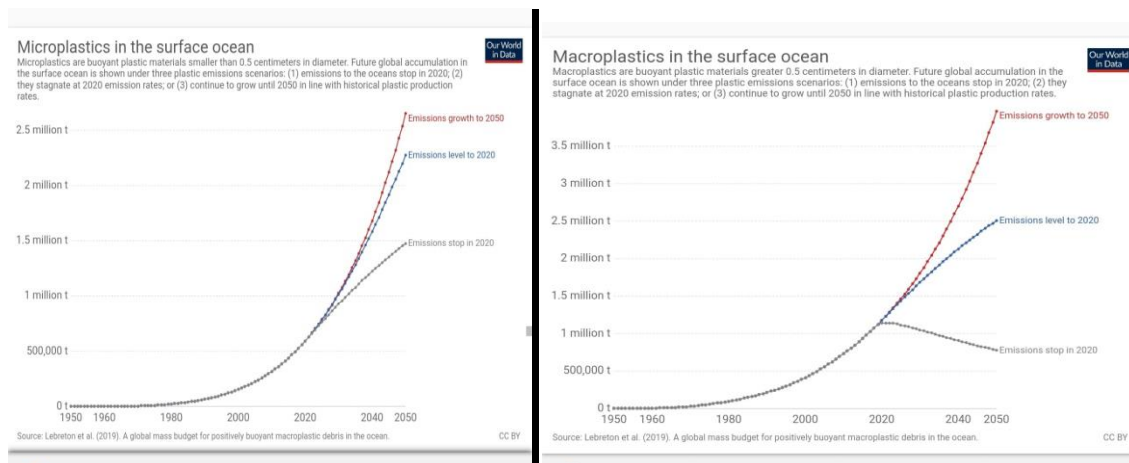
*Since its popularization in the 1950s, plastic use has skyrocketed due to its uses in the field of social health, safety and energy. However, due to plastic's longevity and resistance to decomposition, its widespread use has led to an epidemic of mismanaged waste. There is now 5.25 trillion macro and micro pieces of plastic in our ocean and 46000 pieces in every square mile of ocean weighing up to 269000 tonnes. Plastic pollution has a direct and deadly impact on wildlife. Thousands of seabirds and sea turtles, seals and other marine mammals are killed after ingesting plastic or getting entangled in it. Endangered wildlife like the Hawaiian monk seals and pacific loggerhead sea turtles are among nearly 700 species that eat and get caught in plastic litter. Technology can be used to target hotspots of marine plastic pollution. The inventory is a tool to identify plastic pollution and cleanup technologies. However technology alone cannot solve this issue, prevention has to be carried out by reducing, reusing and recycling. As plastic waste accumulates in our oceans at alarming rates, the need for efficient and sustainable remedial solutions is urgent. The paper introduces ocean plastic pollution, elaborates it causes and treacherous hazards, discusses existing technologies working to solve this grave concern and presents potential sustainable solutions of this hot issue. Above all, innovation and prevention have to work hand in hand and they are the only major key to end this menace.*

## 1. INTRODUCTION

Globally, around 300 million tons of plastic waste is generated annually and most of it ends up being discarded in Oceans and landfills. Oceans act as a large reservoir for plastic pollution. It gets concentrated into our oceans through various means like cargo of the ships, fishing nets and garbage thrown in the sea and inflicts catastrophic effects on the aquatic, marine life and human life. Millions of Marine animals are impacted by the plastic which limits their ability to move, feed etc. Many of them die due to infection and injuries inflicted by plastic consumption.

According to Surfers Against Sewage website (sas.org.uk) 1.5 million tons of plastic was produced

in 1950, which rose to 320 million tons in 2016. This is set to double by 2034. Everyday approximately 8 million pieces of plastic pollution find their way into our seas. There may be around 5.25 trillion macro and microplastic pieces drifting in the Oceans. Plastic constitute 60-90% of all marine detritus. At this rate, by 2050 plastic waste will outweigh all the fish in the Oceans. It is perceived that 700 species of fish, seabirds and marine mammals could go extinct due to plastic pollution. One estimate suggests that at least 267 species worldwide have been affected, including 84% of seaturtle species, 44% of all seabird species and 43% of all marine mammal species. Even the deepest sea creatures can't escape plastic pollution.



This has become a global crisis and there is an urgent need to come up with sustainable remedial solutions to solve this crisis and prevent further contamination of aquatic environment and its effects on the environment.

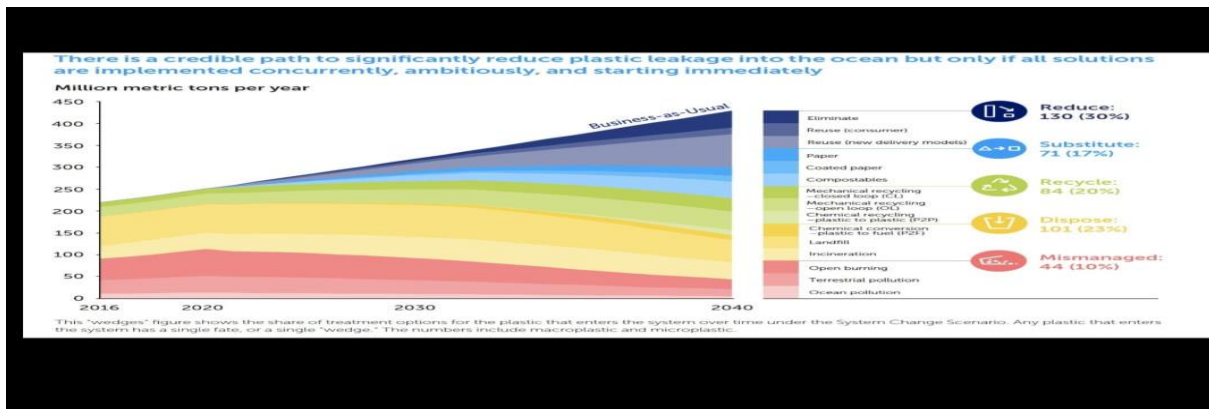
## 2. LITERATURE REVIEW

As plastic waste is accumulating in the ocean at alarming rate, there is an urgent need for efficient solutions. The best solution is incorporating the 3Rs in our daily lives (reduce, reuse, recycle) and holding worldwide movements and campaigns to spread awareness about its deleterious environmental impacts and completely end its production and replace it by other environment friendly means. Other solutions include development and mobilization of technologies working to combat ocean plastic. Presently, there are very few players in ocean plastic removal and biodegradation and their success rate is very low, around 40-50%. Ocean plastic pollution is a global tragedy for our ocean and sea life. It has a pernicious effect on aquatic life and leads to death of numerous sea creatures. Therefore, it is mandatory to immediately come up with a solution to solve this predicament. Although reducing, reusing and recycling plastic is the best way to tackle this crisis and to prevent further escalation of plastic pollution, it cannot annihilate the already prevailing plastic litter in the ocean which encompasses about 80% of all marine debris from surface water to deep sea sediments. Other efforts have been made at international and regional levels to address further

escalation of marine pollution e.g. The London Convention and the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships (MARPOL). Several other technologies and methods are developed to remove the already existing plastic from the oceans like the use of satellite imaging and machine learning to assist in cleaning up 5 trillion pieces of plastic trash found in world's ocean garbage patches and it is estimated that 50% of it could be captured within 5 years e.g. The European space agency uses this method to focus cleanup efforts. There is wide use of AI to solve this issue. The Ocean Cleanup is yet another non profit organisation working on this global issue. Boyan Slat's "OCEAN CLEANUP PROJECT" aimed to clean the largest garbage patch of the world "the Great Pacific Garbage Patch" located between Hawaii and California, initially used giant fishing net (or scoop) for plastic, but was soon changed to fixed boom due to its massive cost. The fixed boom was later changed to floating boom at the surface of the water and skirt hanging beneath it. The floater provides buoyancy while the skirt prevents debris from circumventing underneath and leads it into the retention system. The technology has achieved very little success and is highly expensive and time consuming with a very low efficiency rate. It only collects the plastic from the ocean and does not degrade it and hence it remains in the environment and leads to carbon emission and by-catch, moreover there is risk of inducing harm to marine life. Norwegian Technology is yet another technology which cleans the oceans from plastic pollution and recycles plastic waste. Clean Sea

Solutions, a Norwegian company has developed Clean Sea Robot, an aqua drone which sweeps up the plastic waste from the ocean surface with the help of computer vision and remote sensing. The collected debris is stored on board and emptied in a dedicated docking station. This technology again can be used only on a small area and not cost

effective. It also does not degrade the plastic. More methods have been developed but every one has several detrimental effects on the environment in one way or the other therefore immediate alternatives to end/reduce global ocean plastic is required.



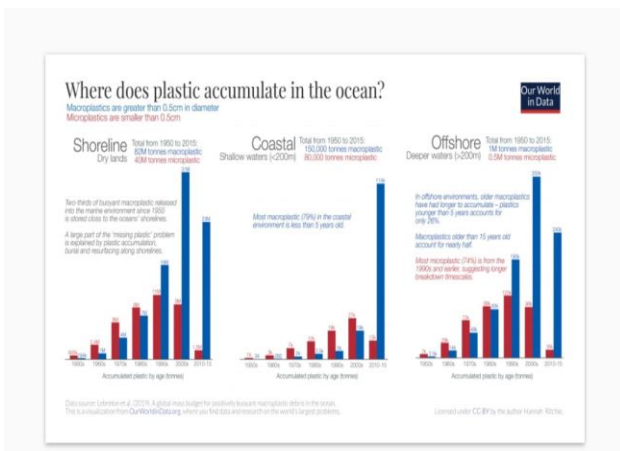
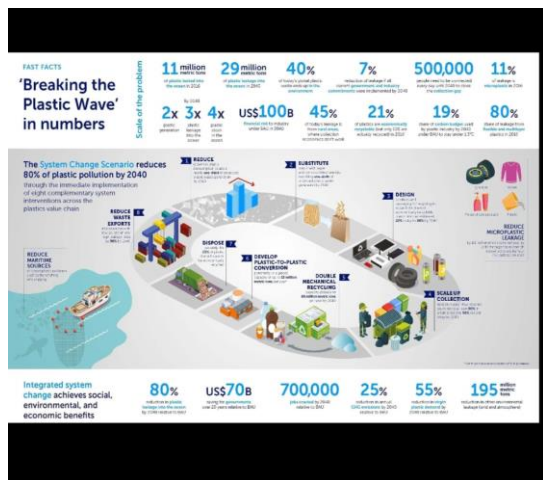
### 3. PROPOSED FURTHER RESEARCH

We plan to form a venture which aims to cleanse our oceans of plastic pollution which causes umpteen number of problems to the aquatic and humans life and therefore affecting the environment severally. Our venture aims to use an ingenious concept to solve this global issue by using plastic eating wax worms (*Galleria Mellonella*) to degrade majority of plastic litter present in oceans across the world. Our team came up with this idea after we read an article (source: [nationalgeographic.com](http://nationalgeographic.com)) about the accidental discovery of plastic eating insects by Federica Bertocchini, a development biologist at the University of Cantabria in Spain. She first noticed the possibility while cleaning her backyard of beehives when she extracted some vexatious wax worms from the bee hives and placed them in a plastic bag. After an hour she noticed holes in the bag and was quick to realise the special property that these wax worms possessed. It was concluded that since they sustain on wax they might have developed an enzyme that could degrade plastic since wax and polyethylene have chemically similar structure consisting of long carbon chains. After further research it was found out that *Galleria Mellonella* embodies an enzyme present in its guts was responsible to convert polyethylene into ethylene glycol. Conduction of further experiments

revealed that each worm created an average of 2.2 holes per hour in polyethylene plastic overnight. 100 wax worms degraded 92 milligrams of plastic. At this rate it would take the same 100 wax worms approximately 1 month to completely degrade 5.5 grams of an average plastic bag. This rate of degrading plastic was a lot quicker than any other organisms known to execute the same task. Our venture plans to use this property of *Galleria Mellonella* to solve the global crises of ocean plastic. These wax worms would be extracted from bee keeping facilities where they act as pests and inflict harm to the apiary industry, thus curbing any further damage. The captured wax worms would then be carried to the concentrated regions of ocean garbage patches e.g. The Great Pacific Garbage Patch which consists of more than 1.8 trillion pieces of plastic weighing around 80000 tons, The North Atlantic garbage Patch which has a density of 200000 pieces of trash per square kilometre etc. The worms would be stored in the different storage facilities near the concentrated regions, from where drones would be utilized to take them to the final destination. A suitable binding agent (e.g. Loctite Vinyl - Plastic Flexible adhesive which is water proof and creates a flexible bond that would not breakdown from sunlight or UV exposure) would be used to bind the loose plastic litter drifting on ocean over an extensive area to convert it into a rock solid mass of

garbage. Additionally drones would be used to first spray binding agent and then wax worms on the concentrated regions of the garbage patch. The use of drones makes the project labour and energy inexpensive and also cost effective. This will also save time taken to spray through any other means. There would be no need to extract plastic from the ocean since its bio degradation would take place in the ocean itself over a period of time. Another

advantage to the use of wax worms is that they are raised for the sole purpose to be used as fish bait. Therefore serving several purposes of bio degrading the plastic and then acting as fish bait and preventing harm to the bee hives by removing it from them. So the same plastic litter which used to cause death and injury to the marine life would no longer do the same, instead the wax worms used in the project would help in flourishing marine life.



However this is just a theoretical idea and hence practical research has to be carried to answer several questions like what will be the environmental impact of introducing trillions of invasive species (G. MELLONELLA) on oceans and crops? What is the effectiveness of degradation rate compared to amount of plastic in ocean? Will it be efficient? What is the impact of degradation process on water (toxicity, development of microorganisms etc.)? What is the environmental impact of binding agent? How effective is it? Is it suitable for microplastics? What is the effect of ethylene glycol on marine ecosystem? Therefore we propose to carry further research and development to get answers of several such questions and to prove its feasibility. With further research, we can also plant the enzyme/bacteria strain causing plastic degradation on E.coli bacteria or phytoplankton while keeping in mind the fact that DNA modification doesn't destroy the balance of ecosystem.

**4. CONCLUSION**

Millions of pieces of micro and macro plastic get accumulated into the ocean everyday. Ocean plastic pollution has wide spread and extreme effect on aquatic life and kills thousands of seabirds, fish, turtles etc. Samples taken by scientists at the Scottish Association or Marine Science of the Western Isles found that 48% of the creatures found at a depth of 2000m had plastic in them (source: azocleantech.com). A UN Ocean Conference report from 2017 also stated, "Every year about 100000 seabirds and 100000 marine mammals die from contact with our plastic waste". Human life also gets affected indirectly when they consume the seafood affected by the plastic pollution. Plastic toxins cause hormonal abnormalities and developmental problems in living organisms. Several emerging technologies and remedial solutions are being worked on to end this menace. However, their success rate is meagre and have severe impacts on

environment. Technology alone cannot end ocean plastic. Therefore, we as children of mother earth have to immediately take responsibility to prevent further escalation of this global crisis. This can be done by spreading awareness in our neighbourhood,

replacing plastic used in our daily lives by other eco friendly means, using sustainable means like recycling, reusing and reducing. A big difference can only be created by a series of small changes.

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