Microplastic Pollution – an Emerging Threat to Gulf of Mannar's Reaf – A Review

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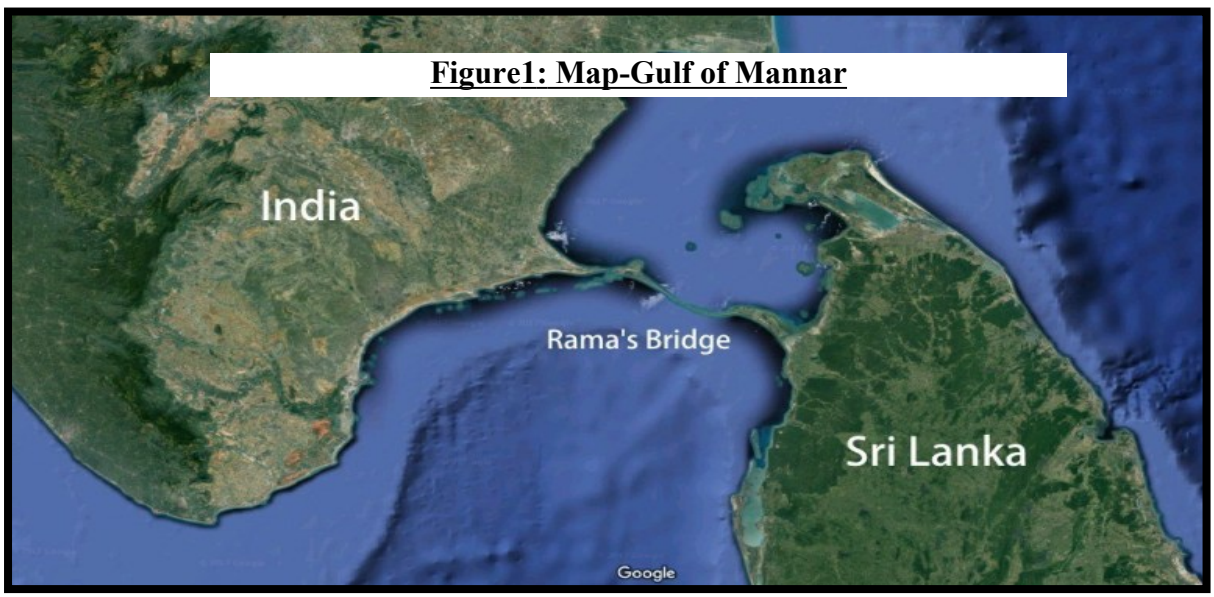
Abstract - The Gulf of Mannar is an Indian coral reef region and also a marine national park. It is 160 kilometers long and covers an area of 10,500 square kilometers, with 21 islands. It is distributed along the coastal area of in between Rameshwaram and Tuticorin. It is a densely populated coastal area with 3600 species of flora and fauna, 117 hard coral species, 52 sea grass species, 290 bird species, 2200 fish species etc. The frequent visitors of this region are sea turtles, sharks, dugong, whales etc. Apart from being a tourist spot, many fisher folks depend on reef for their existence and this place is also a center of some other livelihood. The fishing practices and tourist activities of this region are main source of anthropogenic disturbances like plastic debris. This large portion of marine debris contain non biodegradable bottles, ropes, traps, fiber fishing net etc. These non biodegradable plastic debris are distributed by sea waves or Aeolian activities and also degrades into micro plastics that contains many toxic materials like polyethylene, polypropylene , nylon , polyvinyl chloride , polystyrene etc. These micro plastics are great risks for the marine ecosystem and may completely damage the balance of marine ecosystem as they are mostly hampering at all levels of the food chain. Micro plastics damage clam's gills , interferes Marine photosynthetic algae's growth and oxygen production rate , bleaches' corals by obscuring light and oxygen and marine fishes exposed to polyethylene may suffer from liver toxicity etc. Due to Covid-19 pandemic lockdown from March onwards the pollution has decreased that cause's massive improvement in the coastal ecosystem of Gulf of Mannar. Before lockdown 43% of biodiversity of Gulf of Mannar was degraded due to such plastic deposition and accumulation. But during this lockdown period 51.4% macro plastics, 28 % micro plastic pollution reduced, 22 % fish density, 39 % parrot fish populations and small fraction of coral reef is improving at a modest rate. Thus it could be suggest that proper management practices for conservation with sustainable policies, and awareness building workshop would be helpful to recuperate the biodiversity loss in coastal community of Gulf of Mannar.

Key words – Micro Plastics, Gulf of Mannar, Marine Pollution, Plastic pollution, Coral reef, Biodiversity loss.

I INTRODUCTION

BGulf of Mannar is an Indian marine national park and biosphere reserve which was found in 1989 (Krishna Kumar et al., 2018). This region is highly diverse with marine animals, plants species and so on. It is also a center of livelihoods not for only fisher folks, tourist guides, but also for some other livelihoods (^ab J et al., 2008). But many anthropogenic disturbances are destroying this beautiful region. Among of them micro plastics pollution is a great threat to this area and to its biodiversity (https://oceanconference.un.org/commitments/?id=31814#). Micro plastics are nothing but small fragments (< 5 mm in length) of plastic materials. They contain many toxic materials such as PVC, Polyethylene, polypropylene, nylon etc. (Krishna Kumar et al., 2018)/ (Crawford et al., 2016)/ (^Arthur et al., 2009)/ (Collignon et al., 2014). These plastic materials can destroy the marine ecosystem as they are present at all level of food chain. These micro plastics can kill marine animals by suffocation, infection, laceration etc. (Krishna Kumar et al., 2018)/ (Vidyasakar et al., 2018). But the lockdown for covid-19 pandemic from March onwards has had a positive impact on the ecosystem of Gulf of Mannar. Due to this lockdown pollution has decreased and population of many marine animals and plants species is also increasing (https://www.thehindu.com/news/national/tamil-nadu/lockdown-improved-coastal-ecosystems-of-gulf-of-mannar-says-study/article31746814.ece) Thus it suggests the control over the usage of plastic materials , recycle and reuse , proper management practices and awareness building workshop , pamphlets for making awareness among coastal community , students, tourists etc. Above all of this Government has also an important role to prevent micro plastics pollution and save the ecosystem of not only for Gulf of Mannar but also for whole earth. (Vidyasakar et al., 2018)/ (Thevenon et al., 2014)/ (Boucher et al., 2017)/ (https://oceanconference.un.org/commitments/?id=31814#)(Figure1).

Figure1: Map-Gulf of Mannar



Gulf of Mannar

II. GULF OF MANNAR

Gulf of Mannar is an Indian marine national park and biosphere reserve (protected areas) (Krishna Kumar et al., 2018). It is situated along the coastline of East coast of India and Srilanka [8°46'-9°14' N; 78°9'-79°41' E] (Krishna Kumar et al., 2018)/ (^ab J et al., 2008)/ (^ Gulf of Mannar, Great Soviet Encyclopedia (in Russian).). Gulf of Mannar covers an area of 10,500 square kilometers along with 21 islands. (^ UNDP Project brief: "Conserve and Sustainable- use of the Gulf of Mannar Biosphere Reserve's Coastal Biodiversity". New York, 1994 UNDP Project Brief Achieved, 16 June 2007 at wayback Machine). This region is mainly distributed between Rameshwaram and Tuticorin. This is highly diverse with 3600 species of flora and fauna , 117 hard coral species , 52 sea grass species, 290 bird species ,2200 fish species , mangroves and clam species , pearl banks etc. Many fisher folks depends on the reef associated fishery system for their existence. Apart from being a tourist spot it is also a center of some other livelihoods. (^ab J et al., 2008) (Figure2).

Figure2: Biodiversity of Gulf of Mannar

Table 1: List of Biodiversity in Gulf of Mannar

Overall biodiversity of gulf of mannar

Families	Species
Phytoplankton	126
Zooplankton	360
Foraminifera	51
Sponges	275
Coral	128
Gorgonids	14
Polochaeta	75
Nematoda	9
Crustacea	368
Molluscus	731
Echinodermata	264
Hemichordate	1
Capture fishes	441
Ornamental fishes	100
Sea turtles	5
Sea weeds	147
Sea grass	52
Mangroves	16

III. MICRO PLASTIC

Micro plastics are small fragments of plastic and less than 5 mm in length. When plastic materials are exposed to sun's radiation or ocean then they breaks down into micro plastics. Micro plastics contain several toxic materials. Such as nylon, polyethylene, polypropylene, polyvinyl chloride etc. These toxic materials are very harmful for human, animals, plants and for whole nature (Krishna Kumar et al., 2018)/ (Crawford et al., 2016)/ (^Arthur et al., 2009)/ (Collignon et al., 2014) (Figure 3&4).

Figure 3: Microplastics

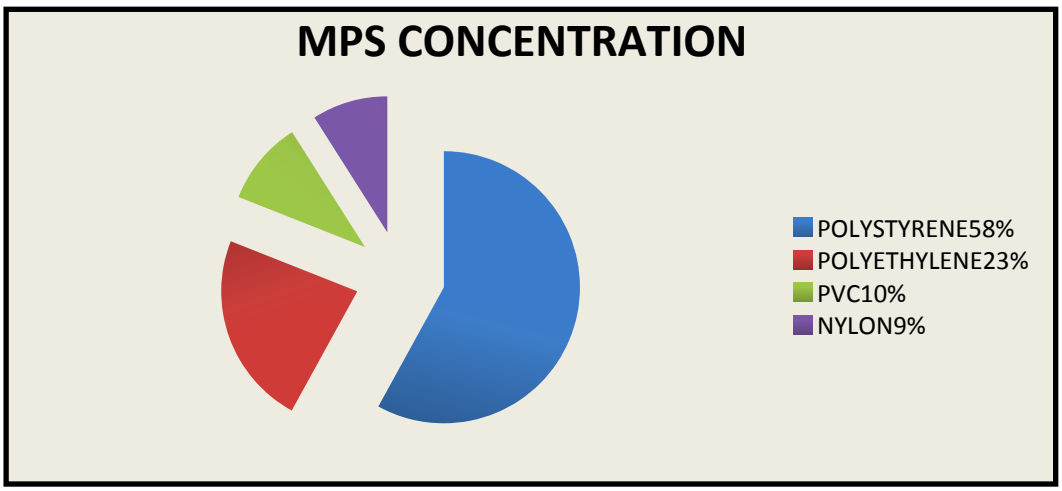


Figure 4: Microplastics Concentration

IV. SOURCE OF MICRO PLASTICS IN GULF OF MANNAR

The consumption of micro plastics has increased during last few decades. The source of micro plastics in the coast of Gulf of Mannar is chiefly regulated by – I) fishing practices and ii) tourist activities. The micro plastics are distributed along the coastal area by two main ways which are – i) sea waves and ii) Aeolian activities (Krishna Kumar et al., 2018)/(Vidyasakar et al.,2018). The large portion of micro debris contains nylon, polyethylene, polypropylene, polyvinyl chloride etc. (Vianello et al., 2013). Among of these materials polystyrene is mainly distributed by Aeolian activities (Vidyasakar et al., 2018) (Figure 5).

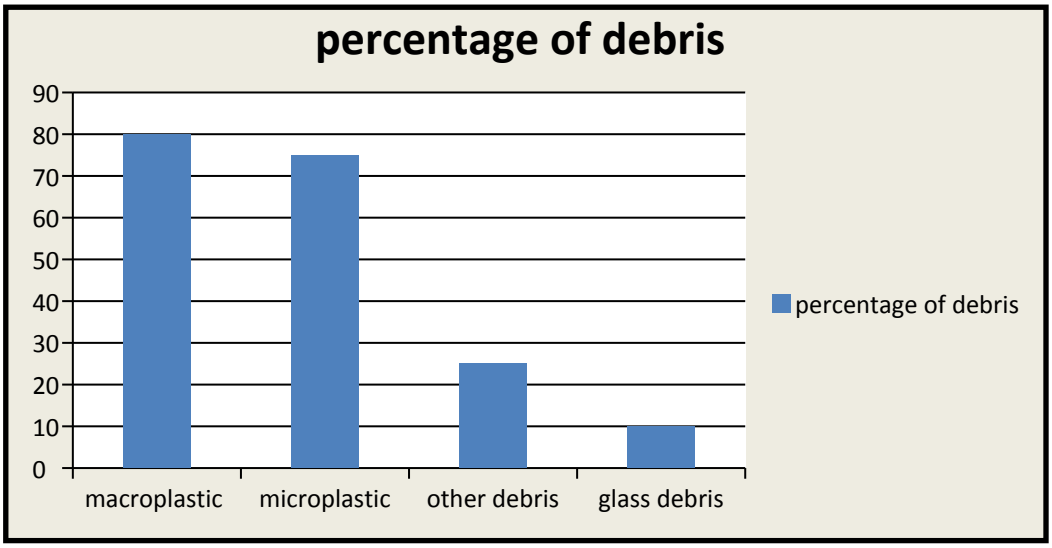


Figure 5: Percentage of Debris in Gulf of Mannar

V. THREATS OF MICRO PLASTICS TO THE ENVIRONMENT OF GULF OF MANNAR

Plastic debris is one type of anthropogenic disturbances to marine ecosystem. The plastic debris degrades into micro plastic debris which hampers the food chain of this region at all level (https://oceanconference.un.org/commitments/?id=31814#) The micro plastics causes suffocation and entanglement of many marine species as sea birds , whales , fishes , turtles , clam's etc (https://www.pewtrusts.org/en/research-and-analysis/articles/2018/09/24/plastic-pollution-affects-sea-life-throughout-the-ocea). They can damage clam's gill (Hughes et al., 1969). interferes Marine photosynthetic algae's growth and oxygen production rate (Shen et al., 2019) , marine fishes exposed to polyethylene may die due to liver toxicity (Rochman et al.,) Also the micro plastics causes the bleaching of coral reefs (Krishna Kumar et al., 2018)/(Vidyasakar et al., 2018). Many marine species dies due to infection, laceration, internal injuries, loss of ability to swim etc. Thus micro plastics can completely destroy the marine ecosystem of Gulf of Mannar completely (https://oceanconference.un.org/commitments/?id=31814#)

VI. IMPACT OF COVID-19 PANDEMIC LOCKDOWN ON MICRO PLASTIC POLLUTION-OF GULF OF MANNAR

The covid-19 pandemic lockdown has positive effect on the coastal ecosystem of Gulf of Mannar from March onwards. Pollution has decreased due to limited industrial activities and human disturbances. Before lockdown approximately 43% of biodiversity of Gulf of Mannar was reduced due to pollution, global warming etc. But during this period of lockdown 51.4% macro plastic and 28% meso & or micro plastic pollution is reduced and the marine biodiversity , water quality is improving again at a modest rate . Density of fish species has increased 22%. The Parrot fish species (Scarus ghobban) population has increased approximately 39% due to absence of trap fishing and human intervention. A small fraction of coral reef is improving too in this lockdown period

((https://www.thehindu.com/news/national/tamil-nadu/lockdown-improved-coastal-ecosystems-of-gulf-of-mannar-says-study/article31746814.ece)

Important initiative to prevent Micro plastics Pollution

- **Uses of plastic materials–**Plastic materials should be used in a controlled way, and recycle and reuse of them can be very effective to reduce microplastics Pollution.

- **Role of associated authorities –**Government, research institutions and industries also need to work for proper redesigning of products, proper usage and proper disposal.

- **Proper management -__**Proper management practices for conservation with sustainable policies is very important.

- **Awareness building –**Awareness building workshop pamphlets can be very helpful to make awareness among coastal communities, students , tourist etc. (Vidyasakar et al , 2018)/(Thevenon et al , 2014)/(Boucher et al , 2017)/ (https://oceanconference.un.org/commitments/?id=31814#)

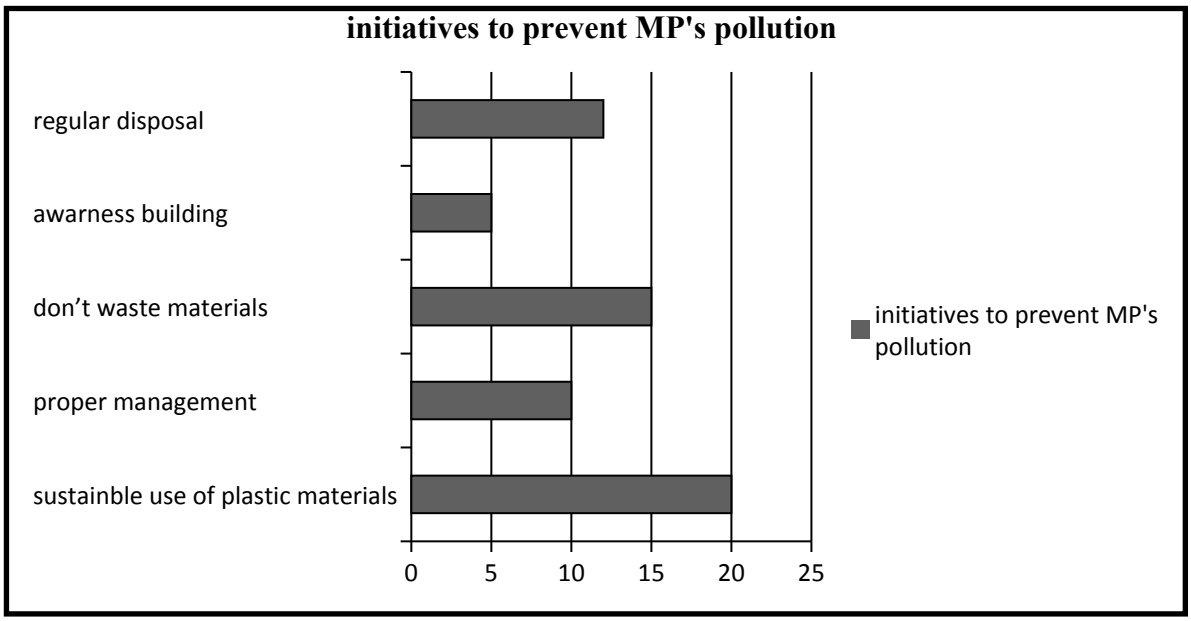


Figure 6: Important initiative to prevent Micro plastics Pollution

VII. CONCLUSIONS

The Gulf of Mannar is considered as one of the world's richest marine biodiversity. This region is globally significant as it gives shelter for many vulnerable marine mammals, dugong, endangered green turtles etc. But the micro plastics pollution is destroying the ecosystem of Gulf of Mannar. If it will continue then one day many species will be lost from this nice world because micro plastics contain many toxic materials that are very harmful for living things and for nature also. But during lockdown period from March (2020) onwards for covid-19 pandemic has reduced micro plastics pollution rate and improved the Biodiversity of Gulf of Mannar. Thus it is suggested that proper use of micro plastics in a controlled

manner, recycle, reuse, Proper designing, proper disposal and awareness building programs and pamphlets can be effective to reduce the rate of micro plastics pollution

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