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UN OCEAN

STUDY GUIDE

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Welcome letter

Member State Representatives,

It is a pleasure to welcome you all to this edition KIIT International Model United Nations Conference 2018. Our committee, which is a follow-up to the 2017 UN Ocean Conference, shall be discussing two very pertinent agendas, considering the current global dynamics and need for sustainable development for the survival of mankind.

As reported in previous issues of the Ocean Action Newsletter, many important developments related to SDG 14 have taken place since June last year, when the UN Ocean Conference concluded, including: the appointment of the UN Secretary-General's Special Envoy for the Ocean Mr. Peter Thomson; the launch of nine new Communities of Ocean Action to follow-up on the voluntary commitments on SDG 14; the proclamation of the United Nations Decade of Ocean Science for Sustainable Development by the United Nations General Assembly; and the decision of the General Assembly to convene an Intergovernmental Conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.

The agendas for the committee are " *Countering the effects of ocean and coastal acidification on marine ecosystems* " and " *Economic policies and solutions towards reduction of plastic dumping in oceans* ". We have compiled this study guide from a number of documents (thesis papers, published reports, etc.) as part of your research curricula, which should provide a brief outline of the agenda and which also provides a guideline as to how to research for the Model United Nations (MUN). We have covered as many aspects of each sub topic that we felt were the most important in providing a fundamental understanding of situation.

The topic has a lot of intricacies, and has already been discussed enough such that the only thing helpful and effective that is expected from Representatives is a holistic approach to the problem and hence deliberating upon such are new and innovative ideas. This is a gargantuan task, one only expected from true diplomats with a vast knowledge of international politics, or at least the zeal to learn the same. Feel free to ask us for help. We look forward to meeting all of you on the 28th of September .

Regards:

Abhigyan Saha
Chairperson

Farhana Khatun
Vice-Chairperson

The Dais

Abhigyan Saha is a 3rd Year student at the Indian Institute of Science Education and Research Kolkata, India. He is currently pursuing his Integrated Master of Science in Mathematics (Major) and Physics (Minor). He has been MUNing since 2012 when he fell in love with the world of debate, dissent, deliberations and diplomacy. He has thus far participated in nearly 50 Model UNs as a delegate, organising committee member and dais member; including having served as Chairperson in M.U.N.s across India, Nepal, Bangladesh, Kazakhstan and Singapore.

Farhana Khatun is a final year student of the Department of Law, University of Calcutta. She is currently pursuing her graduation in Law. She started MUNing in 2015 due to her interest in International Law and Human Rights Law. She has so far participated in over 20 Model U.N.s as a delegate and dais member in India and Bangladesh.

Topic Area A: Countering the effects of ocean and coastal acidification on marine ecosystems.

A Scientific Approach to the Historical Background

Over the past 250 years, atmospheric carbon dioxide (CO2) levels increased by nearly 40%, from preindustrial levels of approximately 280 ppmv (parts per million volume) to nearly 384 ppmv in 2007 [1]. This rate of increase, driven by human fossil fuel combustion and deforestation, is at least an order of magnitude faster than has occurred for millions of years[2], and the current concentration is higher than experienced on Earth for at least the past 800,000 years[3]. Rising atmospheric CO2 is tempered by oceanic uptake, which accounts for nearly a third of anthropogenic carbon added to the atmosphere[4], and without which atmospheric CO2 would be approximately 450 ppmv today, a level of CO2 that would have led to even greater climate change than witnessed today. Ocean CO2 uptake, however, is not benign; it causes pH reductions and alterations in fundamental chemical balances that together are commonly referred to as ocean acidification.

Because climate change and ocean acidification are both caused by increasing atmospheric CO2, acidification is commonly referred to as the "other CO2 problem". Ocean acidification is a predictable consequence of rising atmospheric CO2 and does not suffer from uncertainties associated with climate change forecasts. Absorption of anthropogenic CO2, reduced pH, and lower calcium carbonate(CaCO3) saturation in surface waters, where the bulk of oceanic production occurs, are well verified from models, hydrographic surveys, and time series data[5].

At the Hawaii Ocean Time-Series (HOT) station ALOHA the growth rates of surface water pCO2 and atmospheric CO2 agree well[6], indicating uptake of anthropogenic CO2 as the major cause for long-term increases in dissolved inorganic carbon (DIC) and decreases in CaCO3 saturation state Correspondingly, since the 1980s average pH measurements at HOT, the Bermuda Atlantic Time-Series Study, and European Station for Time-Series in the Ocean in the eastern Atlantic have decreased approximately 0.02 units per decade[7]. Since preindustrial times, the average ocean surface water pH has fallen by approximately 0.1 units, from approximately 8.21 to 8.10[8], and is expected to decrease a further 0.3–0.4

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1 Solomon et al. 2007
2 Doney & Schimel 2007
3 Lüthi et al. 2008
4 Sabine & Feely 2007, Sabine et al. 2004
5 Caldeira & Wickett 2003, 2005; Feely et al. 2004, 2008; Orr et al. 2005; Solomon et al. 2007 6 Takahashi et al. 2006
7 Solomon et al. 2007
8 Royal Society 2005

pH units[9] if atmospheric CO2 concentrations reach 800 ppmv [the projected end-of-century concentration according to the Intergovernmental Panel on Climate Change (IPCC) business-as-usual emission scenario].

Fossil fuel combustion and agriculture also produce increased atmospheric inputs of dissociation products of strong acids (HNO3 and H2SO4) and bases (NH3) to the coastal and open ocean. These inputs are particularly important close to major source regions, primarily in the northern hemisphere, and cause decreases in surface seawater alkalinity, pH, and DIC[10]. On a global scale, these anthropogenic inputs (0.8 Tmol/yr reactive sulphur and 2.7 Tmol/yr reactive nitrogen) contribute only a small fraction of the acidification caused by anthropogenic CO2, but they are more concentrated in coastal waters where the ecosystem responses to ocean acidification could be more serious for humankind. Seawater carbon dioxide measurements have been conducted since the beginning of the nineteenth century[11] but were sparse until the middle of the twentieth century[12] and particularly until the Geochemical Sections (GEOSECS) (1973–1979)[13] and Transient Tracers in the Ocean (TTO) (1981–1983)[14] programs. Even so, the GEOSECS and TTO measurements were significantly less precise than those of today. Although researchers recognized that the concentration of carbon dioxide in the surface ocean was more or less in equilibrium with overlying atmosphere CO2, they largely dismissed the potential impact on the ocean biota because calcite (the assumed CaCO3 mineralogy of most calcifying organisms) would remain supersaturated in the surface ocean.

Since then, multiple studies revealed several issues that elevate ocean acidification as a threat to marine biota: (a) the calcification rates of many shell-forming organisms respond to the degree of supersaturation[15]; (b) aragonite, a more soluble CaCO3 mineral equally important in calcifying organisms, may become under-saturated in the surface ocean within the early 21st century[16]; and (c) the biological effects of decreasing ocean pH reach far beyond limiting calcification.

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9 Orr et al. 2005
10 Doney et al. 2007
11 Krogh 1904
12 Keeling et al. 1965, Takahashi 1961
13 Craig & Turekian 1976, 1980
14 Brewer et al. 1985
15 e.g., Smith & Buddemeier 1992, Kleypas et al. 1999
16 Feely & Chen 1982, Feely et al. 1988, Orr et al. 2005

Introduction to current scenario

Coral reefs are among the most biologically diverse and economically important ecosystems on the planet, providing ecosystem services that are vital to human societies and industries through fisheries, coastal protection, building materials, new biochemical compounds, and tourism. Yet in the decade since the inaugural International Year of the Reef in 1997 , which called the world to action, coral reefs have continued to deteriorate as a result of human influences . Rapid increases in the atmospheric carbon dioxide concentration by driving global warming and ocean acidification, may be the final insult to these ecosystems. Here, we review the current understanding of how anthropogenic climate change and increasing ocean acidity are affecting coral reefs and offer scenarios for how coral reefs will change over this century. The scenarios are intended to provide a framework for proactive responses to the changes that have begun in coral reef ecosystems and to provoke thinking about future management and policy challenges for coral reef protection.

Food Webs : Since life in the ocean is always food for something else, any increase or decrease in the abundance of a species can have a ripple effect on other species. This is because ocean food webs are complex. Changes in the number of one type of animal can affect the number of animals that feed on it, and so forth. Over several generations, this could have an important impact on the composition of ocean life in the future. Unfortunately, the complexity of ocean food webs and other ongoing environmental problems like climate change make it difficult to predict how ecosystems will reorganize under increased seawater acidity.

Ecosystems : Ecosystems are the complex, large-scale systems formed between living organisms and the environment. Consider one well-known and important ecosystem— coral reefs. Coral reefs host an abundant and diverse array of marine life. Corals themselves are living organisms on which the whole ecosystem depends. Much like a forest on land, corals build their hard stony skeletons over years and years, resulting in a complex habitat that makes a great home for sea creatures.

Coral reefs provide habitat and food for a large variety of marine life, including various sponges, oysters, clams, crabs, starfish, sea urchins, and many species of fish. Coral reefs are among the most biologically diverse and valuable ecosystems on Earth. An estimated 25 percent of all marine life, including over 4,000 species of fish, are dependent on coral reefs at some point in their life cycle.

If ocean and coastal acidification disrupts organisms and food webs, we can expect the ripple effects to result in major changes in ecosystems. The corals in the previous example build their hard stony skeletons out of calcium carbonate. Corals may not form calcium carbonate under increased acidity,

and under severe acidity the coral's skeleton can dissolve. Thus, the effect of increased ocean acidity on one type of organism can have serious consequences for an entire ecosystem, including people. Approximately half a billion people globally depend on coral reef ecosystems for food, coastal protection, and income from tourism and fisheries.

Ecosystem Services :Given the importance of coral reefs, it is easy to see how humans have come to rely on them for key resources, or in other words, ecosystem services. In this case, some ecosystem services provided by coral reefs are fish to eat, protection of coastal areas from storms, and tourism activities like snorkeling and scuba diving. Beyond coral reefs, humans rely on the oceans for a number of ecosystem services:

- Commercial fisheries, shell fisheries and aquaculture
- Recreational fisheries
- Subsistence and traditional shellfisheries and fisheries
- Tourism activities such as snorkeling and scuba diving

Human economies rely on ecosystem services provided by healthy oceans and coasts, but ocean and coastal acidification threaten these services.

Socioeconomic Impacts of Coral Reef Decline :The scenarios presented here are likely to have serious consequences for subsistence-dependent societies, as well as on wider regional economies through their impact on coastal protection, fisheries, and tourism. These consequences become successively worse as [C02] increases, and unmanageable for [C02]atm above 500 ppm. Although reefs with large communities of coral reef-related organisms persist under CRS-A and CRS-B, they become nonfunctional under CRS-C, as wñl the reef services that currently underpin human welfare. Climate change is likely to fundamentally alter the attractiveness of coral reefs to tourists , which is an important consideration for the many low-income coastal countries and developing small island states lying within coral reef regions.

Under-resourced and developing countries have the lowest capacity to respond to climate change, but many have tourism as their sole income earner and thus are at risk economically if their coral reefs deteriorate . For instance, tourism is a major foreign exchange earner in the Caribbean basin and in some countries accounts for up to half of the gross domestic product . Coral reefs in the United States and Australia may supply smaller components of the total economy, but still generate considerable income (many billions of U.S. $ per year) from reef visitors that are increasingly responsive to the quality of reefs. Reef rugosity is an important element for the productivity of all reef-based fisheries, whether subsistence, industrial, or to supply the aquarium trade. The density of reef fish is likely to decrease as a result of increasing post settlement mortality arising from a lack of

hiding places and appropriate food for newly settled juveniles . Regardless of future climate-change influences, the total landing of coral reef fisheries is already 64% higher than can be sustained, with an extra 156,000 km^2 of coral reef estimated as being needed to support anticipated population growth by 2050 . For example, in Asia alone coral reefs provide about one-quarter of the annual total fish catch and food to about 1 billion people .

Climate-change impacts on available habitat will only exacerbate already overstretched fisheries resources. The role of reels in coastal protection against storms has been highlighted in analyses of exposed and reef-protected coastlines . We do not yet have estimates for how fast reef barriers will disappear , but we can anticipate that decreasing rates of reef accretion, increasing rates of bio-erosion, rising sea levels, and intensifying storms may combine to jeopardize a wide range of coastal barriers. People, infrastructure, and lagoon and estuarine ecosystems, including mangroves, sea-grass meadows, and salt marshes, will become increasingly vulnerable to growing wave and storm impacts. Observations of increasingly intense tropical hurricanes and cyclones in all oceans suggest that losses of beach sand from coastal zones are likely to increase .

Further losses may occur lîxjm reduced sand production, formed in many cases by coral reels, as a consequence of ocean acidification and thermal stress on calcareous algae and other sand producers. Beaches are also under threat of erosion from rising sea levels. The combination of these factors will lead to less stable beaches and impacts on other organisms, such as turtles and seabirds that depend on beach habitats for reproduction, as well as leading to economic impacts on tourism and coastal fishing communities.

Previous UN actions

UNESCO

Ocean acidification and its consequences have received growing recognition at international and especially intergovernmental levels[17]. The IOC-UNESCO and the OA-ICC of the IAEA are promoting and stimulating scientific discussions about ocean acidification, in cooperation with several international programmes and projects, e.g. the IOCCP, SCOR and IGBP, which is communicated to policymakers and stakeholders[18]. Further the SCBD recently published an updated synthesis on impacts of ocean acidification on marine biodiversity[19].

Ocean acidification is a relatively new field of study. Despite advances in understanding the impacts of elevated CO_2 concentrations on a wide range of marine organisms, we are still unable to make meaningful projections of impacts on marine ecosystems and fisheries as a whole, or to identify thresholds beyond which marine ecosystems may not recover. Methods must be developed to examine the full ecosystem response to multiple environmental factors.

UNESCO is proud to be a partner of the Tara Oceans expedition, a 3 year mission around the world aiming to understand how the nature and diversity of plank-tonic life will be affected by climate change and acidification. The impacts of plankton on life on earth are so broad that they are highly important for global human security; it is absolutely essential to get a better understanding of plankton ecosystems. The expedition is also collecting data on poorly explored coral reef ecosystems. Check out their progress on the log book.

UNESCO-IOC and the Scientific Committee on Oceanic Research (SCOR) sponsor the International Ocean Carbon Coordination Project (IOCCP), a monitoring and research program. IOCCP focuses on the effect of increasing level CO_2 emissions on ocean and studies the effect of ocean acidification on calcifying organisms and coral growth rates.

17 Herr et al. 2014
18 e.g. IGBP, SCOR, IOC 2013
19 Aze et al. 2014

UNESCO-IOC is co-founder of the Ocean Acidification network, meant to provide a central source of information for ocean scientists on research activities in this area, and co-hosts the main international symposium on this issue, 'The Ocean in a high CO World'. Its purpose is to provide an interdisciplinary forum to assess what is known about ocean acidification and priorities for future research every 4 years.

The primary way to protect the ocean from the threat of ocean acidification is to reduce CO emissions.

Business as usual scenarios for CO emissions could make the ocean up to 150% more acidic by 2100.

This is about common resources that flow through political boundaries: our atmosphere and our ocean. An issue of this magnitude requires a global effort. UNESCO's Intergovernmental Oceanographic Commission (UNESCO-IOC) is keen to play an advocating role for the ocean through the Rio+20 preparatory process, and to encourage Member States to integrate, as far as possible, the importance of the ocean in sustainable development strategies and plans.

UN Ocean Conference

The UN Ocean Conference, held at UN Headquarters in June 2017, brought together more than 4000 participants from governments, the UN system and other intergovernmental organizations, NGOs, academia, the scientific community and the private sector. The Conference resulted in a number of ambitious outcomes, including the adoption of the "Our Ocean, Our Future: Call for Action" declaration, co-chairs' summaries of the seven partnership dialogues that were held during the Conference, and over 1400 voluntary commitments made in support of SDG 14 by various stakeholders. 44 percent of the commitments came from governments, 19 percent from NGOs, 9 percent from UN entities and 6 percent from the private sector.

Delegates from China, Thailand, Indonesia and the Philippines pledged to work to keep plastics out of the seas. The Maldives announced a phase out of its non-biodegradable plastic and Austria pledged to reduce the number of plastic bags used per person to 25 a year by 2019. Several nations announced plans for new marine protected areas. China plans to establish 10 to 20 "demonstration zones" by 2020 and introduced a regulation which requires that 35 percent of the country's shoreline should be natural by 2020. Gabon announced that it will create one of Africa's largest marine protected areas with around 53,000 square kilometres of ocean when combined with its existing zones.

New Zealand affirmed the government's commitment to establishing the Kermadec/Rangitahua Ocean Sanctuary, which – with 620,000 square kilometres – would be one of the world's largest fully protected areas. Pakistan also announced its first marine protected area. Germany's Federal

Minister for the Environment, Nature Conservation and Nuclear Safety pledged to allocate €670 million for marine conservation projects and made 11 voluntary commitments. Nine of the world's biggest fishing companies from Asia, Europe and the US have signed up for The Seafood Business for Ocean Stewardship (SeaBOS) initiative, supported by the Stockholm Resilience Centre, aiming to end unsustainable practices.

The conference resulted in adoption of a 14-point Call for Action by the participating Heads of State. The leaders also pledged their commitment to conserve and sustainably use oceans, seas and marine resources. At the conference, issues ranging from plastic pollution in the oceans, ocean acidification and illegal fishing were elaborately discussed. Formation of a task force on marine litter by the International Solid Waste Association was also announced. The Global Ocean Commission had made recommendations to improve the oceanic ecosystem by checking illegal and unregulated fishing activities; ending harmful subsidies in seas and establishing binding international safety standards.

Mitigation/Adaptation strategies for Ocean Acidification

Reducing CO2 emissions to the atmosphere is the only way to stop ocean acidification. Until permanent CO2 emissions cuts are achieved, adaptation strategies can be enacted at local, national, and international scales to help coastal communities, sustain livelihoods, provide food, protect shorelines, and maintain cultural traditions. The impacts of other stressors on ocean ecosystem such as higher temperatures and deoxygenation, also associated with increasing CO2, will be reduced by limiting enhanced CO2 emissions, too.

Shellfish aquaculture industries already face significant economic losses due to ocean acidification and may benefit from risk assessments and analysis of strategies to reduce the impact, e.g., limit the intake of seawater with low pH, reallocation of hatcheries, selection of larvae stages or strains more resilient to ocean acidification for breeding[20].

Especially on local levels different actions can be conducted to increase the ecosystem resilience to ocean acidification[21]:

- Development of sustainable fisheries management practices;
- Adoption of sustainable management of habitats, increased coastal protection, reduced sediment loading;
- Application of marine spatial planning;
- Establishment and maintenance of Marine Protected Areas that help to manage endangered and highly vulnerable species, communities, ecosystems;

• Regulation and control of localized sources of acidification from river runoff and pollutants such as fertilizers.

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[20] Cooley & Doney 2009, Narita et al. 2012
[21] e.g. Bille et al. 2013, Pandolfi et al. 2011, Rau et al. 2012

Summary Points

• Impacts start at the species level, which will cause changes in food webs and at the ecosystem level, affecting fisheries, aquaculture and hence societies.

• Multiple stressors – ocean acidification, global warming, deoxygenation, eutrophication and over-fishing – and their interactions are creating significant challenges for ocean ecosystems.

• Within decades the changes in carbon chemistry of the tropical oceans may hamper or prevent coral reef growth.

• Large parts of the polar oceans will become corrosive to calcareous marine organisms within decades due to ocean acidification.

• As the ocean takes up more carbon dioxide it becomes less efficient at absorbing this greenhouse gas and hence in moderating climate change.

• Species-specific impacts of ocean acidification have been seen in laboratory studies on organisms from tropical corals to marine snails that are important prey for fish in polar regions.

• Many organisms show adverse effects, for example, reduced ability to form shells and skeletons, reduced survival, growth, abundance and larval development.

• Conversely, there is evidence that some organisms tolerate more acidic conditions and others, such as sea-grasses, may even thrive.

• All species have the potential to adapt, for example, through evolution, or relocation. But the ocean's chemistry may be changing too rapidly for many to maintain a sustainable recruitment.

• We do not fully understand the biogeochemical feedbacks to the climate system which may arise from ocean acidification.

• Predicting how whole ecosystems will change in response to rising CO2 levels remains challenging. While we are able to expect changes in marine ecosystems and biodiversity within our lifetimes, we are unable to make reliable quantitative predictions of socioeconomic impacts. • Socio-economic impacts of ocean acidification are a real concern. For example commercial shell fisheries will have to adapt. Coral reef loss will affect tourism, food security and shoreline protection.

Conclusion:

Opportunities for Management Intervention: The inherent inertia of the atmosphere and of our attempts to mitigate CO2 emissions suggest that reef managers and coastal resource policies must first reduce the influence of local Stressors such as declining water quality, coastal pollution, and overexploitation of key functional groups such as herbivores . These types of action are most likely to assist coral reefs through the decades of stress that inevitably face them. There may be opportunities for using coral restoration to reduce the risk that reefs will shift into a non-coral-dominated state ; however, the efficacy of coral restoration methods to increase mgosity and coral cover remains unclear, and further evaluation of methods is badly needed. With respect to the latter, there is a mismatch between the feasible scale of restoration (hectares) and that of the extent of degradation (many thousands km^2).

Nevertheless, new techniques for the mass culture of corals from fragments and spat may assist local restoration or the culture of resistant varieties of key organisms . At the 100- to 1000- km scale of coral reefs, one of the most practical interventions is to facilitate grazing by fish and invertebrate herbivores. This is likely to play an important role in situations like that of the Caribbean where densities of one important herbivore, the sea urchin Diadema antillarum, were decimated by disease in the early 1980s . Clearly, the improved management of reef fish, especially grazers such as parrotfish, would be expected to result in an improved ability of coral reefs to bounce back from disturbances , as long as other factors such as water quality are not limiting. Unfortunately, with the exception of marine reserves, there is negligible explicit management of herbivores in most countries, but this could be improved by setting catch limits . Diversification of the herbivore guild to include modest densities of invertebrates tike sea urchins will also enhance the resilience of coral reef ecosystems.

Concluding Statements :It is sobering to think that we have used the lower range of IPCC scenarios in our analysis yet still envisage serious if not devastating ramifications for coral reefs. Emission pathways that include higher [C02]atm (600 to 1000 ppm) and global temperatures of 3° to 6°C defy consideration as credible alternatives. Equally important is the fact that IPCC scenarios are likely to be cautious given scientific reticence and the inherently conservative nature of consensus seeking within the IPCC process

. Consequently, contemplating policies that result in [C02]atm above 500 ppm appears extremely risky for coral reefs and the tens of millions of people who depend on them directly, even under the most optimistic circumstances.

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Topic Area B: Economic policies and solutions towards reduction of plastic dumping in oceans

INTRODUCTION

The unmanaged and untreated plastic waste entering the ocean known as plastic waste leakage has emerged as a severe environmental issue significantly jeopardizing marine life and marine ecosystem[22]. In 2006 the United Nations Environment Program made an alarming announcement estimating the presence of approximately 46,000 pieces of floating plastic in every square mile of ocean. The production of plastic crosses 220 million tons every year. Indiscriminate and irrational disposal of plastic imposes severe fatalistic hazards on marine ecosystem killing millions of seabirds and marine animals[23]. In the past the oceans were used as a place for waste disposal of all kinds including, chemical, industrial, radioactive, sewage, trash, munitions etc.[24]

Ever since the 1950s the global economy has produced close to 8.3 billion metric tons of plastic of which only 9% has been recycled and 12% of the plastic have been incinerated and 79% were disposed into the natural environment including oceans or put into landfills. Single use plastic packaging accounted for 42% of total plastic production since 1950s.[25]

Plastics are immune to biodegradation. Plastics cannot be decomposed by microbial organisms unlike other organic matter, which makes it more durable. However plastics can be broken down into smaller pieces by the means of photo-degradation. The process by which the UV rays of the Sun break down plastic into smaller and smaller debris over a long period of time is known as the photo-degradative effect. The UV light from the Sun provides energy for incorporating Oxygen atoms into the polymer of a plastic, making the plastic brittle and eventually resulting in the breakdown of the plastic into smaller pieces. The small pieces or fragments form microplastics.

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22 Merkl, Andreas. Martin Stuchtey. *Stemming the Tide: Long-based strategy for a plastic free ocean* .McKinsey Centre for Business and Environment & Ocean Conservancy. September 2015. https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability%20and%20resource%20productivity/our%20insights/saving%20the%20ocean%20from%20plastic%20waste/stemming%20the%20tide%20full%20report.ashx

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24 Environmental Protection Agency. *Learn about ocean dumping.* https://www.epa.gov/ocean-dumping/learn-about-ocean-dumping

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Microplastics comprise 80% of the plastic pollution found along shorelines. These fragmented plastic pieces are often termed as mermaid's tear and keep on floating in water without being decomposed.

It is impossible to clean these microscopic plastics posing a serious threat to marine life. Dr. Richard Thompson of the University of Plymouth estimates the presence of approximately 100,000 particles of plastics per sq. km. of the sea bed and 300,000 particles of plastics per sq. km. on the sea surface. Fragmentation of plastics by photo-degradation or by wind or wave complicates the situation further whereby plastic becomes microscopic in size, difficult to detect its presence and it removal thereby, yet polluting the oceans and even entering the food chain of marine animals and concomitantly the food chain of humans as well.

SOURCES OF OCEAN PLASTIC

Plastic wastes in ocean have two major sources:

i. *Land-based sources:* Most of the plastic waste in ocean has their origin on land which after being discarded is thrown into the water bodies as waste. Rivers draining into seas carry substantial amount of waste along with them and drain them into sea. Ten rivers, eight of which are in Asia and two in Africa account for close to over a quarter of the plastic waste.

ii. *Sea-based sources:* Some industries directly discharge their waste into the river, sea or ocean comprising of petro-chemical wastes, sewage, sludge, or even radioactive waste.

COMPOSITION AND CLASSIFICATION OF PLASTIC

Plastic is composed of molecules called polymers which in turn is composed of smaller units joined together called monomers. Polymers are classified under two heads: moldable or thermoplastics and non-moldable or thermosets.[26] Further plastics can be subdivided into 8 categories depending on their potential recycle facility. Few plastic items bear a triangular symbol encircling a number inscribed or imprinted on them. The symbol along with the number is an indicator of the type of plastic used for the manufacture of the item thereby informing the process of recycle that is to be employed for the recycle of the particular item. The triangular symbol along with number is called the “recycling code number”, classifying plastics into the following seven categories:

i. **Polyethene Terephthalate** : This is the type of plastic used in the making of water bottles, soda or soft drink bottles, microwave resistant containers and clothes and is recycled extensively.

[26]Guern, Claire Le. *When The Mermaids Cry: The Great Plastic Tide* .Coastal Care, 2009. Updated March 2018. http://plastic-pollution.org/

ii. **High Density Polyethylene** :Although considered a safer plastic it sometimes recyclable but sometimes not. It used for making grocery bags, garbage bags, juice containers, caps of bottles, etc. While the hard plastic of this category is recyclable the thin bags are often not recyclable.

iii. **Polyvinyl Chloride** :It is considered one of the most hazardous plastic used in the making of toys, raincoats, plumbing materials, construction products, food containers, shower curtains, etc. Polyvinyl Chloride has been known to disrupt endocrine system as well cause several other diseases including asthma and allergic symptoms and even certain types of Cancer. These plastics are not normally recyclable except for bottles and containers.

iv. **Low Density Polyethylene** :This category of plastic is considered relatively safer used for making grocery bags, frozen food bags, plastic wraps, squeeze bottles, etc. However the degree of risk posed by this category is still undergoing research.

v. **Polystyrene** :Polystyrene can be used in two forms: solid and foam. Solid Polystyrene is used in making compact disc cases, plastic cutlery or container. Foam Polystyrene is used in making Styrofoam containers, plates, egg cartons, etc. Although recyclable it is a highly expensive process and hence banned in many cities of US. Further it is known to severely impact the red blood cells, kidney and stomach.

vi. **Polypropylene:** This category of plastic is considered a relatively safer plastic used for making medicine container, opaque food containers, straws, rope and outdoor furniture.

vii. **Others** : This category includes all other types of plastic which does not fall under the classification of the above six categories. It includes the highly hazardous polycarbonate used for making Digital Versatile Disc, cell phones, large containers,
optical glasses, etc. It also includes nylon popularly used for making clothes,
ropes, etc. It also includes the newer safer biodegradable plastics.[27]

The formation of micro plastic involves varying lengths of time depending upon the external conditions. Thus plastics on land are fragmented faster than plastic on ocean bed or on the surface of ocean water. Plastics floating on the surface of the ocean or floor of the ocean take much longer time to breakdown into micro plastics due to the lack of sunlight, oxygen and temperature.

Plastic degradation at ocean occurs also due to the action of wind, wave and oxidation. It has been estimated that plastic in ocean takes 450-1000 years to degrade. Photo-degradation plastic may continue even to the molecular level. But even then it remains a polymer and cannot be changed into or absorbed by the microbial organism. In the broader perspective as plastics cannot be naturally decomposed it remains in the ecosystem.

[27] Ocean Portal Team. Dr. Jenna Jambeck, *"Marine Plastics"*. Ocean Find Your Blue, 2018, April 2018. https://ocean.si.edu/conservation/pollution/marine-plastics

CURRENT SCENARIO

Ocean based sources of plastic waste resulting from fisheries or fishing vessels account for less than 20% of the leakage. This put the land based sources of leakage at 80%. Of the total land based sources of plastic wastes entering the sea, 75% leakage result from uncollected waste and 25% come from improper dumping of waste post-collection of waste and lack of proper waste management system. More than 50% of the land-based plastic waste leakage originates from five countries: China, Philippines, Thailand, Vietnam and Indonesia. However 25% land-based sources of leakage occurred outside Asia, maintaining the global status quo of the issue. A 2015 report published in the "Sciences" states that the annually, approximately 8 million metric tons of plastic leaks out across the global economy and enters into the ocean. At this rate, in the absence of any substantial concerted global measure, by the end of 2025, the total amount of plastic waste in the ocean will be close to 250 million metric tons. This will apparently not be manifested with facts and figures as the estimation of waste on shoreline account for only 5% of the actual waste in the ocean. Thus the remaining 95% of the floating waste in the ocean goes unaccounted.

Until 2014, 136 species of marine animals have been found with entanglements.[28] In 2018, more than 200 species of marine animals have been found with entanglements. Deaths from entanglement can lead to the extinction of the highly endangered right whale of the North Atlantic. Plastic entanglement has severe impacts on coral reef as well. Apart from entanglements, plastics have been ingested by marine animals as well as sea birds. More than 700 species of animal have been found with plastic ingestion. Corals entangled in plastic waste become vulnerable to disease either because of infection or smothering. Corals are susceptibility of getting infected by a disease before coming in contact with plastic debris is 4% while the corals susceptibility of getting infected by a disease after coming in contact with plastic debris is 89%. Every year more than 8 million plastic waste leakage into the ocean has catastrophic effects on the marine ecosystem, affecting every species from a zooplankton to turtle and even includes sea birds costing at least $8 billion in damage to marine ecosystem. 80% of the litter present in the ocean comprises plastics. Researchers suggest that plastic disposal at the current rate comprising dominantly single use plastic goods will result in more plastic waste than fishes in the ocean and 99% of the sea birds will have ingested plastic by 2050.

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[28] Parker Laura. *With millions of tons of plastic in ocean, more scientists studying impact.* National Geographic 2014. Published 13 June 2014. https://news.nationalgeographic.com/news/2014/06/140613-ocean-trash-garbage-patch-plastic-science-kerry-marine-debris/

THE ECONOMIC PERSPECTIVE

The impact of plastic dumping in ocean is graver than it apparently appears. The consequences of plastic dumping extend beyond the ambit of the severe environmental pollution and health implications. It has significantly undermined economic prosperity of the region adjacent to the shore lines. It cause substantial economic losses to the Government, the freight companies, various commercial sectors and even to the local residents. The Government has to incur huge expenses in undertaking cleaning programs. The cleaning expenditure for a beach in West Sweden was calculated at approximately $1,550,200 for one year. The Ventanilla government in Peru estimated its cost of cleaning the coastline at $400,000 per year. The Israeli Government in 2017 declared it's cleaning budget for Clean Coast Program at $2.3million.[29] In India the river pollution caused the spread of severe water borne diseases resulting in increased health expenditure.

Commercial as well non-commercial ships have reported significant increase in expenditure in maintaining operability of the ship parts due to increased marine litters and plastic debris. Fishermen in the United Kingdom have also reported economic losses on account of marine debris caught in nets amounting to losses of roughly $4,300,000 to the local market in a year. Further tourism industry also suffers a setback in coastal areas on account of shorelines dumped with plastic and other wastes. The economic loss to a country as a whole is intricately correlated with the consequences in the other sectors and result in huge losses.

Effective economic policies for countering leakages of plastic into the ocean suffer limitations of excessive high cost infrastructure and mechanism involved. The problem is far more strenuous for the cities of developing and least developed countries facing inadequate financing for effective implementation. In such cities more severe problems eclipse the issue of plastic leakage and plastic dumping in oceans leaving it in the backdrop. One of the most effective ways to counter leakage of plastic waste into ocean is to implement an effective waste collection and management system in operation. Effective waste collection involves door to door collection, banning informal waste disposal on roadside dumping grounds, street sweeping, building barricades around coastlines and shorelines to prevent any disposal close to seas and oceans.

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[29] Israel Ministry of Environment and Protection. " *Ministry Triples Budget for Clean Coast Program, Will Invest NIS 8.6m to Clean Undeclared Beaches*" . Updated 5 June 2017

These measures involve huge economic expenses of millions of dollars. Waste collection itself involves investment of millions of dollars. Thus such exorbitant cost discourages the adoption of the measures and prioritizing the issue. Although plastics are usually non recyclable some varieties of plastics are recyclable but the high cost involved in collection, separation and processing such plastic overshadows the outcome obtained which is not much lucrative. Hence Governments do not prefer investing in such operations and opts to discard such waste rather than recycle.

To effectively counter the problem of plastic dumping in ocean it is advisable to plan and build new and effective environment friendly infrastructure. However new infrastructures are always associated with high costs and are a time consuming process starting from the planning and ending with the final completion of the infrastructure building. Further it also involves huge amounts of operation and maintenance cost for future. It must also be borne in mind that the current situation demands immediate actions for countering plastic waste leakage into the ocean.

Taking these factors into consideration it is relevant for the countries to focus on overhauling and improvising the existing infrastructure and invest in less expensive techniques. Countries are even considering aforestation as an alternative and hence clearing dumping grounds to opt for a greener landscape. This would in turn help countering other types of pollution and environmental problems as well and is cost effective. Cost effectiveness and time significantly direct the formulation of economic and legislative policies. Greener infrastructure is both cost effective and can be implemented in lesser time.

Formulation of long term economic policy is always associated with uncertainties of future. The dynamics of environmental and climate changes, the adoption of international legislative policies affecting existing economic policies and rapidly changing nature of the issue of ocean pollution often pose an ambiguity to the final outcome of the long term investment policies. Such argument may be rational from an economic point of view but taking into consideration the future implication of

climate change which predicts an enormous increase in the amount of rainfall the problem is expected to escalate. Hence it is pertinent at this point of time to consider a long term investment to counter the consequences of the potential destruction that is to come, in order to avert an even higher expenditure in the future. Public- private partnership can be really important for such investment.[30]

[30] Axelsson Charles, Erik van Sebille. *"Prevention through policy: Urban macroplastic leakages to the marine environment during extreme rainfall events".* National Center for Biotechnology Information, U.S. National Library of Medicine, 2017. 15 November 2017. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5667635/

ECONOMIC POLICIES TO COUNTER THE PROBLEM OF PLASTIC DUMPING IN OCEANS

Plastic is a consumer good and is a commercial commodity of significant importance for industrial and business enterprises. The cost effectiveness of plastic is difficult to be replaced by any other product in the near future. The lower variable cost results in the lower total cost of a product as well as in the packaging industry. While it the rationale of plastic dependency is evidently profit maximization it is important that commercial enterprises be accountable for the damage caused to the environment due to their profit maximization motive. In order to counter the problem of plastic dumping in ocean, economic policies must be backed by legislative sanctions for effective implementation and well structured guidelines for maintaining accountability for violations of the policies.

i. *Formulating policies for plastic production to a limited quantity depending on the sector and size of industry and directing the use of alternative bio-degradable products:* It is important that plastic production should be curtailed to reduce the menace of plastic pollution. Plastic producers across the globe aim to increase plastic production three times the current production rate over the next five years. Economic policies should be directed towards curtailing the plastic production.

ii. *Strengthening regulatory reforms and incentivizing industries adhering to guidelines for effective treatment of polymer waste released into water bodies:* Strict guidelines should be laid down for effective treatment of industrial affluent from polymer industries as well as other industries. Incentivizing the industries adhering to such guidelines will promote compliance. Incentivizing and penalizing are the two faces of the same coin. When one unit of a sector receives incentives it concomitantly places the other units of the same sector in a position of disadvantage which acts as passive penalization.

iii. *Strengthening fiscal mechanism by imposition of higher rates of taxes and import duty:* Imposition of higher rates of taxes on plastic and at the same time reducing taxes on alternatives to non-biodegradable plastics to reduce plastic dependency and adopt alternative product will enhance revenue alongside countering plastic production. This will not only help in reducing plastic production but simultaneously promote other industries. Many sick industries including like the jute industry can
also be revived. This will further promote cottage industry. Imposition of higher import duty will lead to a fall in the number of import of plastic goods and plastic waste. [31]

iv. *Formulate policies for making the consumer accountable:* Consumer should not be allowed to evade their responsibility to society. Imposition of high costs

for availing the facility of plastic bags instead of using reusable and recyclable bags. Imposition of higher taxes on plastic consumer goods to promote other alternatives should be resorted to.

v. *Increased budget for research and development and infrastructure:* Higher budget should be allocated for the purpose of research and development of newer and cost-effective alternatives to plastics. Increased allocation for building effective infrastructure for treating polymer waste involving less pollution and environment friendly should be considered.

[31]Jensen Nina. *"8 Steps to solve the ocean's plastic problem".* World Economic Forum. 2 March 2018. https://www.weforum.org/agenda/2018/03/8-steps-to-solve-the-oceans-plastic-problem/

GLOBAL INITIATIVES TO COUNTER PLASTIC DUMPING IN OCEANS

Ever since 1973 a number Conventions and initiatives have been adopted to counter plastic dumping in oceans. The first attempt at developing an International Convention for countering marine pollution resulting from plastic dumping began with the adoption of London Dumping Convention in 1972 followed by the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973 and subsequent adoption of more than a dozen of Conventions, Resolutions and Initiatives including the most recent Manila Declaration, Honolulu Strategy and the Global partnership on Maritime Litter.[32]

i. *Global Partnership on Marine Litter:* It is a global partnership of individual, government, non-government organizations, international agencies, private sector and civil societies to contribute in the form of financial support, technical expertise or contributions in-kind. It is aimed at implementing the previous Honolulu Strategy alongside creating awareness and promoting resource efficiency. It was launched in June 2012.[33]

ii. *Manila Declaration:* The Manila Declaration adopted by the United Nations Environment Program in January 2012 is aimed at protection of Marine Environment from Land- based waste by furthering the implementation of the Global Plan of Action. The Manila Declaration recognized the four focal areas comprising of nutrients, sewage, marine litter and physical alterations and destruction of habitats as agreed at the Intergovernmental Review Meeting held in Beijing in 2006.

iii. *Rio+ 20:* At the Rio+ 20 United Nations Conference on Sustainable Development countries prioritized the elimination marine debris by 2025 for the protection of marine environment. The Conference highlighted the importance of the marine life in the context of Sustainable Development and its direct economic implication. It lead to the adoption of target based resolutions for reduction marine debris. The Global Partnership on Marine Litters was also launched at this Conference.[34]

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[32] A selection of international and regional policy agreements targeting marine debris and plastics https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5667635/table/t0005/?report=objectonly

[33] Global Partnership on Marine Litters, UN Environment https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/global-partnership-marine

iv. *The Honolulu Strategy:* The Fifth International Marine Debris Conference co-hosted by the National Oceanic and Atmospheric Administration and the United Nations Environment Program developed a comprehensive framework for a global effort in reducing the impact of land based sources of marine debris entering the seas, sea-based sources of marine debris as well as accumulated debris on shorelines. It aimed at reducing ecological as well as economical impacts of marine debris. The Strategy can be used as a planning tool, collaborating in a common framework and monitoring tool on various levels.

v. *UNEP Global Initiative on Marine Litter:* The initiative effectively provided a framework for conducting activities in regional level for countering the problem of marine litter in cooperation with the 12 participating regional programs on careful analysis of the documents produced by the 12 participating regional programs and made recommendations for the problems associated with marine litters across the globe.[35]

[34]Countries prioritize the elimination of plastic waste in the oceans at Rio +20; Rio+20 UN Conference on Sustainable Development. 21 June 2012. http://www.rio20.gov.br/en/press_room/paises-priorizam-eliminacao-do-lixo-plastico-nos-oceanos-na-rio-20.html

[35]Marine Litter: A Global Challenge; United Nations Environment Program, April 2009 https://euroshore.com/sites/euroshore.com/files/documents/unep_marine_litter.pdf

CONCLUSION

The formulation of effective economic policies to mitigate the issue faced on account of plastic dumping in ocean is highly significant. Economic policies can be formed on the basis of either a restrictive command or a market based economic incentive. Restrictive command involves direct banning of production or restricting the use of any commodity by concise legislations. Market-based economic incentives involve providing incentive or disincentive for promoting certain mechanism. While the former is used for more severe situation for achieving the desired target in a shorter span of time imposing stringent restrictive measures, the latter involves a soft-approach to deal with a less severe problem which can be achieved gradually spanning over a relatively longer period of time. Economic policies aimed at changing behavioral pattern of human activities can significantly help in countering the increased dumping of plastic in ocean.

Reduction in plastic waste will benefit the economy in the long run promoting the development of tourism and fisheries industries, biodiversity and less expenditure incurred in plastic waste management. Countering plastic pollution will lead to improved environment and better quality of living thereby countering other environmental problems as well. While the benefits of economic policies are manifold yet it suffers major hindrance in effective implementation at all levels: global, national and regional. Economic policies often involves huge amount of investment in advanced infrastructure. The non-cooperation from various sectors of the society more specifically the industrial sector imposes impediments in the effective implementation. Uncertainty of future changes in economic policy and environmental conditions discourages investment in long term policies.

Notwithstanding the hindrances associated significant economic measure are inevitable for the resolution of plastic pollution in oceans. The most recent adoption of the “CleanSeas” campaign by the United Nations Environment Program has received the support of 10 countries. The campaign involves taxing single use plastic bags, measure by countries and commercial enterprises to eliminate microplastic and reduce the use of other disposable plastic items. Countries like Indonesia have pledged to reduce their marine litter by 70%. Uruguay has decided to tax its single use plastic

bag and Costa Rica aims at reducing single use plastic bag through education and management. It is significant that a concerted effort is made on the part of every country to formulate economic policies to mitigate the problem faced on account of plastic dumping in ocean.

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