Climate change and its challenges for the marine environment with special reference to ecological aspects in Bangladesh

Md. Abdul Alim
Department of Law
University of Rajshahi, Bangladesh

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Abstract

Climate change is predicted to have an extremely destructive effect on Bangladesh. Natural disasters may take place even more frequently and be greater in magnitude. A rise in sea levels could submerge a considerable proportion of the country. The legal regulations per specific aspects of maritime law are the priority of lawyers as natural risks like rising sea levels, storm surges, or tsunami waves, the pollution of the marine environment all represent a severe threat to coastal inhabitants. Global climate change will thus not only cause environmental degradation but will drive massive social changes as innumerable people migrate from devastated areas. This might further overstretch inadequate infrastructure and governance mechanisms and will lead both to a collapse in living standards and a rise in social disorder. Thus, the article contributes to the expansion of the current regime whereby using the bay water cooling atomic energy plants prevents its use for fish farming purposes, or an oil spill on the high seas pollutes beaches that are essential for tourism within the coastal zone. Such activities destroy our natural climate and change the water level, and promote ocean acidification, ocean stratification, coral bleaching, change species; distributions and make other biological changes to the sea and littoral including the discharge of ballast wastewater which may carry alien invasive species.

Corresponding author: Md. Abdul Alim
Email address for corresponding author: alimlaw05@gmail.com
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1.1 Introduction

Bangladesh is susceptible to sea-level rise, just like the Maldives, but other effects like drought, cyclones, lightning, and river erosion have made that country even more defenseless. In modern times the increased use of maritime space for various purposes creates problems for the conservation and management of marine life. However, principles, objectives and approaches concerning management and conservation differ and maintaining generic diversity is not properly addressed by the 1982 UN Convention on the Law of the Sea. Scientists who have dealt with the ecological aspects of the conflicted use of the seas, rather than legal and political authorities, have warned of a long-term deterioration of the marine environment. In recent times economists have begun to contemplate the marine environment as a scarce resource.

More than 60 million inhabitants of Bangladesh are directly dependent on aquatic resources. One million people are full time fisher folk and 11 million have taken to part time fishing in the country (BBS, 2010). The fishery sector contributes about 3.4 percent of the total export revenue and employs five percent of the country's total work force. The agriculture sector provides 64.5 percent of the country's

employment and contributes 24 percent of the GDP[i]. The *Sundarbans* alone supply livelihood and regular employment to some 112,000 people.[ii] *Sundarbans* (Bengali for 'beautiful forest') is also the biggest mangrove forest in the world. The *Sundarban*s Forest lies in the vast delta on the Bay of Bengal formed by the super confluence of the Hooghly and Padma rivers, both tributaries of the Ganges, and the Brahmaputra and Meghna rivers (see Figure 1). The forest covers 10,000 km² (3,900 km²) of which about 6,000 km (2,300 mi²) are in Bangladesh. The seasonally flooded *Sundarbans* freshwater swamp forests lie inland from the mangrove forests on the coastal fringe. *Sundarbans* has been listed as World Heritage site and is the most important ecosystem and protective natural barrier against the calamities like tidal surge and cyclone. This contribution of nature would simply be submerged by the rising sea.[iii]

In the past, the absence of law and sovereignty enforcement has led to a growing number of cross-exploitation conflicts. These may include the following: negligent navigation that damages or destroys communication cables; the warming of the sea water used for cooling functions of a nuclear power plant, thus preventing its use for fish farming purposes; an oil spill on the high seas, polluting beaches that are essential for tourism in the coastal zone. Such activities destroy our natural climate. They change the sea level, and contribute to ocean acidification, ocean stratification, coral bleaching, changing species distributions and other biological changes to the sea. A conservationist, William Laurance of James Cook University, said, "There's been a lot of discussion about how global climate change affects ocean acidification, and now there's emerging evidence that the even greater threat is reduced oxygen levels."[iv]

1.2 Climate Change in Bangladesh

Climate change effects are a global warning for low-lying, sea facing, over-populated countries like Bangladesh. The tropical monsoon climate is characterized by high temperatures (about eight months of the year), high summer rainfall, high humidity, and relatively low temperature ranges.[v] Extreme weather events there have already played havoc with the life of the people. They have also caused a shift in migration and poverty patterns. The cyclones strike from the Bay of Bengal in April-May. They bring heavy rains, and are frequently followed by tidal waves, which are particularly destructive in the coastal regions of the country. River flows vary differently, with the peak occurring during July/September. The tidal levels vary considerably in the river delta, and high-low water range variations between various localities depend on the relations between tidal range and river discharge. Nazrul Islam, a Professor of Dhaka University said, "In Bangladesh, we have already conducted research on salinity-resilient crops. We're now doing research on diversification of food in coastal areas"[vi]. Due to rapid climate change, the Bay of Bengal, a north and extended arm of the Indian Ocean, often becomes unruly and brutal cyclone sweeps over the costal belt. Sidr was the strongest cyclone to punch Bangladesh since the cyclone of 1991. After Sidr, Aila brushed away over the coastal region of the country on May 25, 2009. The storm hit the coastal district in Bangladesh. Bangladesh has adopred innovative approaches to fight the effects of climate change and exploits extensive marine resources including floating farms (see Figure 1).

Figure 1. Boat School, Floating Farms: Bangladesh Builds Floating Gardens to fight against Climate Change

1.3 Marine Pollution in Bangladesh

The coastal zone of Bangladesh is shown in Figure 2. The Bay of Bengal and rivers are shown in pale blue, the exposed coast in green and the interior coast in turquoise. Marine pollution is the degradation of water quality, as measured by biological, chemical on physical criteria that can make water unsuitable for desired uses such as bathing, drinking, or fishing, and can have severe effects on the health of humans and animals through contact or ingestion.[vii] The Economic Commission for Europe of the United Nations (UNECE) defines water as being polluted when the condition of the water is directly or indirectly modified. So that is a consequence of the activities of man to such as extent that this water

cannot be used – or to a lesser extent – than it should be naturally.[viii] The toxic chemicals and pesticides are threats to both coastal and marine environment as well as public health.

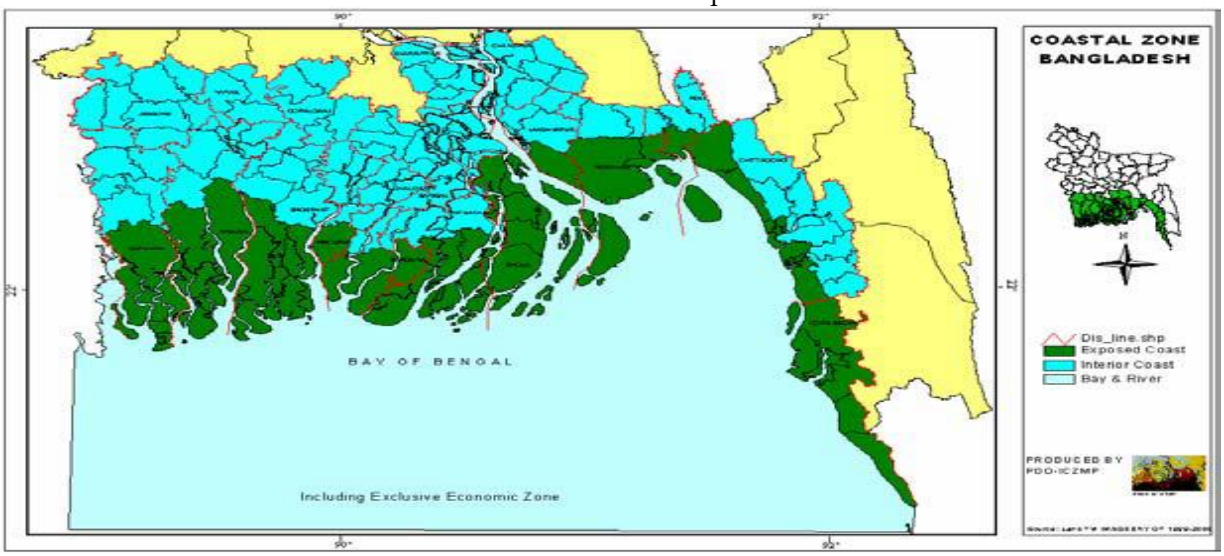

Figure 2. Map of the land part of the coastal zone of Bangladesh, ICZMP, 2004

Pollution is often categorized as point source or nonpoint source pollution. Point source pollution take places when there is a single, identifiable, localized source of the pollution. An example is directly discharging sewage and industrial waste into the ocean. Pollution such as this occurs particularly in developing nations. Nonpoint source pollution occurs when the pollution comes from ill-defined and diffuse sources. These can be difficult to standardize. Agricultural run-off and windblown debris are prime examples. Under climate change projection scenarios low rainfall in the waterless season will be further diminished. As a result, winter and pre-monsoon temperature will increase significantly and thus drought intensity will be further amplified. It will cause a sharp decline in river flow. Salinity will break through inland that will ultimately restrict choice for the most preferred crops. High and moderate level water demanding plants and organisms will go extinct locally.

Polluting materials penetrate the marine ecosystem via a number of pathways, in particular:

- riverine runoff (see Figure 3) mainly lands based pollution from sewage, garbage, fertilizers, pesticides, and industrial pollution
- atmospheric deposition basically pollution from ships by oil, noxious liquid substances in bulk, harmful substances carried in packaged form, sewage, garbage, air pollution, greenhouse gas emissions from ships and harmful aquatic organisms carried by ballast water and introduced by biofouling.
- direct discharges from land and that is offshore hydrocarbon exploration and mining (prospecting, drilling, and transport).
- activities at sea such as unsustainable use and overexploitation of marine resources

Figure 3. Examples of riverine activities which may cause pollution

Sometimes illegal, unreported, and unregulated (IUU) fishing causes marine pollution. The waste of all the industries particularly tannery, textiles, pulp and paper and fertilizer, ship breaking, and so on may be significantly responsible for coastal pollution of Bangladesh.[ix] Bangladesh National Programme of Action has identified fifteen[x] major issues/problems as the main sources of coastal and marine pollution. The issues are as follows:

- Industrial waste (including ship-breaking yards)
- Sewage disposal
- Solid waste management
- Agrochemicals and Persistent organic pollutants (POPs), PoPs, sometimes known as "forever chemicals", are organic compounds that are resistant to environmental degradation.
- Deforestation
- Salinity intrusion
- Rapid urbanization
- Erosion in the coastal zone
- Extraction of coastal resources
- Gas oil and mineral resources
- Shrimp farming
- Coastal fishing and fish processing
- Coastal tourism
- Land use change
- Climate change

1.3.1 Direct Discharge from River to Sea

One common path of entry by contaminants to the sea is river. Pollutants enter rivers and the sea directly from urban sewerage and industrial waste discharges, Bangladesh has many rivers, water bodies and lakes etc. The sources of inland water are under stress because of its large population, poverty, urbanization, and less economic growth. Although the country is blessed with natural water sources, water quality remains a key issue. Sources of contamination and changes in water quality can be mainly characterized as point sources, non-point sources and natural sources which may be point and non-point. In fact, most of these industries are situated in the two major coastal districts, Chittagong (in 8 industrial zones) and Khulna (in 3 industrial zones). Urban runoff and runoff from the construction of roads, buildings, ports, channels, and harbours, can bring soil and particles laden with carbon, nitrogen, phosphorus, and minerals. A survey by the Marine Science Institute of Chittagong University indicated that the water of the coast of *Shitakunda* contains high concentrations of several heavy metals such as mercury, cadmium, lead, chromium, iron etc.[xi] Harmful algal blooms[xii] have been a cause of species of fish, turtles, dolphins, and shrimp to die and cause harmful effects on humans who swim in the water.

1.3.2 Pollution from Ships

Ships can contaminate waterways and oceans in numerous ways. Oil spills can have devastating effects. While being contaminated to marine life, polycyclic aromatic hydrocarbons (PAHs), found in crude oil, are very difficult to clean up, and last for years in the sediment and marine environment. Oil spillages from ships as a result of illegal discharges of oil residues or caused by an accident are another matter of apprehension. The same is true for oil spills originating from offshore activities. However, it is significant to note that land-based sources are by far the largest contributor to oil inputs. *Karnaphuli* River is heavily contaminated in areas close to Chittagong port channel due to expulsion of oil and chemical waste leaked from ships. The speedy and unplanned boost in shrimp culture is also causing anxiety. The use of antibiotics and other chemicals used in shrimp fields is causing pollution in the water, which may harm other aquatic lives. Shrimp culture in Cox's Bazar uses 620 tons of urea annually. It also generates 15 tons of waste daily, which comes into the sea.[xiii]

1.3.3 Plastic Debris

Plastic bottles and other plastic products are most common forms of debris in the coastal water. Marine debris is mainly discarded human garbage which floats on or is suspended in the ocean. Eighty percent of marine fragments is plastic – a module that has been rapidly accumulating since the end of World War II. In the ocean present threats are formed of plastic materials which conclude the life to wildlife and fisheries.

Floating plastic particles photo degrade down to zooplankton sizes, jellyfish attempt to consume them, and in this way the plastic enters into the ocean food chain. Aquatic life can be threatened through entanglement, suffocation, and ingestion. Fishing nets, frequently made of plastic, can be left, or lost in the ocean by fishermen. Known as ghost nets, these entangle fish, dolphins, sea turtles, sharks, dugongs, crocodiles, seabirds, crabs, and other living things, restricting movement, causing starvation, laceration, infection, and, in those that need to return to the surface to breathe, suffocation.[xiv]

Research Questions

In this situation why pollution is continuing and how prevention can be taken? If compensation issues arise, who shall pay? Who can be identified as the responsible person? How can claims be enforced? Have we complied with this duty to protect marine environment and obligation to take measures to prevent and control the marine pollution of the Bay of Bengal (BoB) region?

1.4 Protecting Marine Pollution: Legal Perspective

Ecology is its encompassing and artificial view of nature. Bangladesh owns a diverse set of eco-systems abundant with innumerable life forms despite its relatively small geographical area. This rich biodiversity is contributing significantly to the county's economy and to diversified livelihood sources of her people. Human rubbish, including synthetics and plastics, in the oceans and on beaches is called marine debris. It is one of the world's most ubiquitous contaminants affecting the oceans. In Bangladesh, only a portion of the solid waste generated is collected. It is anticipated that about 9,000 metric tons of human waste are released along the coast from Chittagong and Khulna. It was mentioned that approximately 3.5 million tons of crude and refined oil are imported by Bangladesh, which contributes around six thousand tons of oil to the four hundred thousand tons of annual oil pollution in the Bay of Bengal.[xv] Approximately 1,800 tons of pesticides penetrate the Bay annually. The web-based publication 'World Casualty Statistics' 2011, by IHS Fairplay explains that the largest five ship recycling countries in the world are India, China, Bangladesh, Pakistan, Turkey which recycle 97% to 98% of the world's tonnage.[xvi] Interestingly, of the top three biggest ship-recycling countries, India, and Bangladesh, lie on the Bay of Bengal. It was reported that about 250 kg of polychlorinated biphenyl (PCB) are released from

each ship in the ship breaking yard of Chittagong area. If toxic throw away continues, it will certainly demolish important habitat and biodiversity; compel many wildlife species near to extinction; destroy mangrove forests; cause the whole ecosystem to become unbalanced and obstruct sustainable development. The Ministry of Environment and Forest of the Government of Bangladesh has developed the Environment Policy 1992, formulated and enacted Environment Conservation Act 1995, Environment Conservation Rules 1997, and Environment Court Act 2000. The other national laws are:

- Ports Act, 1908,
- Territorial Water and Maritime Zones Act 1974
- *Coast Guard Ain* 1994 (The Coast Guard Act 1994)
- The Merchant Shipping Ordinance 1983
- Chittagong Port Authority Ordinance 1976

Merchant Shipping Ordinance 1983: Umbrella law regulating shipping and water transport in Bangladesh. This ordinance characterizes the 'Bangladesh Ship' and make necessary provisions for surveying and registration of Bangladesh ship and also details provisions relating to seaworthiness of vessels. This ordinance does not contain any provision relating to marine environment.

Territorial Water and Maritime Zones Act 1974: Section 8 of this Act empowers government to take such measure, as it deems proper for preventing and controlling marine pollution and preserving the quality and ecological stability in the marine environment in high seas adjacent to the territorial waters.

Bangladesh signed many Conventions adopted by UN, and the International Maritime Organisation (IMO) is an international legal regime respecting pollution damage caused by ships. It consists of four international conventions dealing with pollution from oil and hazardous and noxious substances including:

– the International Convention on Civil Liability for Oil Pollution Damage, 1992,

– the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992,

– the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996,

– the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001.

- the Ballast Water Management Convention 2004 which Bangladesh has ratified but has not yet been incorporated into national law.[xvii]

1.5 Ecological Aspects of Water Management

Ecological aspects cover biodiversity of the utilized areas as habitats, maintaining ecosystem services such as habitat, regulating and services provided by various participants in such ecosystems. There are three types of diversity: species, genetic and ecosystem and they have different genetics, habitat, and functions in the ecosystem. A species is a group of genetically discrete organisms that can have offspring. In a species, genetics can vary regarding color, size, and type. In most ecosystems, there are a considerable number of interlocking food chains or webs. In order to know the exposure of any specific part of the ecosystem, it is necessary to measure the movement of the chemical through the food chain.

The environmental scientists who are dealing with the ecological aspects of the seas have deplored that their warnings of a long-term deterioration of the marine environment have had little effect in political and legal arenas. Economists have started to believe the marine environment a scarce resource, and as a consequence, economic theories on the efficient use of scarce resources are becoming relevant to the exploitation of the seas. The legal regulations pertaining to specific aspects of maritime law have been

the concern of lawyers for many years. In fact, maritime law conventions focusing on single issues such as collisions at sea were already being negotiated more than 100 years ago.

natural risks such as rising sea levels, storm surges, or tsunami waves, the pollution of the marine environment represents a serious threat to coastal inhabitants. However, opposite to the first factors mentioned, pollution does not present a direct danger to human life. Societies have recently started to become responsive of marine pollution.

pollution of the sea damages the marine ecosystem irreversibly over long-time scales, endangering a broad spectrum of resources, from seafood to recreational spaces. The struggle against marine pollution involves environmental knowledge within the society, political resolve, and money. Industrial nations, which are also the biggest polluters, are meeting these criteria to some extent, but among them there is no uniform position on marine pollution and is a matter of great loss.

A key issue which affects the Bay of Bengal and Bangladesh is pollution in the Bay of Bengal by invasive species. The main cause of this has been ballast water being discharged by ships. Until 2004, large cargo ships routinely discharged hundreds of thousands of tons of ballast water, taken onboard in another port (with a completely different eco system) thousands of miles away. Recognising this problem, in 2004 the IMO introduced the Ballast Water Management Convention. The programme (see 1.6.4 below) is ongoing and whilst the situation globally is improving the solution is not yet complete.

1.6 Maritime Environmental Protection and Implementation

The Maritime Environment embraces two intertwined environments. The first is the littoral land environment where people and land animals live. The second is the sea itself, home to fish, cetaceans, and the creatures upon which they subsist. Often, the two cannot be disentangled, where pollution at sea comes ashore -such as oil spills – and where animals live in both environments – Polar Bears, for example, which are threatened by the melting Arctic ice. Marine pollution was an apprehension during several United Nations Conventions on the Law of the Sea beginning in the 1950s. In the late 1950s and early 1960s, there were several controversies about dumping radioactive materials off the coasts of the United States by companies licensed by the Atomic Energy Commission, into the Irish Sea from the British reprocessing facility at Windscale. Marine pollution made further international headlines after the 1967 crash of the oil tanker Torrey Canyon, and after the 1969 Santa Barbara oil spill off the coast of California.

Marine pollution was a major area of discussion during the 1972 United Nations Conference on the Human Environment, held in Stockholm. In this year London Convention was taken by the signing of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. The London Convention did not ban marine pollution, but it established black and gray lists for substances to be banned (black) or regulated by national authorities (gray).

1.6.1 Maritime Safety

Transport of hazardous goods by sea is regulated to avoid human injury or damage to ships and their cargo. The International Convention for the Safety of Life at Sea (SOLAS), 1974 deals various aspects of maritime safety and contains in part A of chapter VII mandatory provisions governing the transport of dangerous goods in packaged form or in solid form in bulk. Regulation VII/1.3 prohibits transport of dangerous goods excluding in accordance with the provisions of chapter VII part A, which are enlarged by the International Maritime Dangerous Goods (IMDG) Code.

1.6.2 Marine Environment

The MARPOL Convention[xviii] aims to achieve complete elimination of international pollution by oil and other harmful substance and minimize of accidental discharge of such substances.[xix] Its requirements, regardless of their navigation and member nations are accountable for vessels registered on their national

ship registry. MARPOL is divided into Annexes according to various categories of pollutants, each of which compacts with the regulation of a particular group of ship emissions. These Annexes are listed in Table 1.

All six Annexes have been ratified by the requisite number of nations; and Annex VI, which took effect in May 2005 and has been amended and lastly came into force on 1 July 2010. The country where a ship is registered named as Flag State is responsible for certifying the ship's compliance with MARPOL's pollution prevention standards. Flag State is accountable for enacting domestic laws to execute the convention and promises to comply with the convention, annexes, and related laws of other nations.[xx] One of the difficulties in implementing MARPOL arises from the international nature of maritime shipping. When they find noncompliance with international standards and in according with MARPOL the country refers cases to flag states. It was seen by UN report documented that the response rate from flag states has been very poor.[xxi]

Table 1. List of Marpol 73/78 Annexes

List of the MARPOL 73/78 Annexes

Annex	Title	Entry into force	Objectives
Annex I	Prevention of pollution by oil & oily water	2 October 1983	It specifies tanker design features that are intended to minimize oil discharge into the ocean during ship operations and in case of accidents. It provides regulations with regard to treatment of engine room bilge water (OWS) for all large commercial vessels and ballast and tank cleaning waste
Annex II	Control of pollution by noxious liquid substances in bulk	6 April 1987	It divides substances into and introduces detailed operational standards and measures. The discharge of pollutants is allowed only to reception facilities with certain concentrations and conditions. No matter what, no discharge of residues containing pollutants is permitted within 12 miles of the nearest land.
Annex III	Prevention of pollution by harmful substances carried by sea in packaged form	1 July 1992	It contains general requirements for the standards on packing, marking, labeling, documentation, stowage, quantity subtraction, division, and notifications for preventing pollution by harmful substances.
Annex IV	Pollution by sewage from ships	27 September 2003	It introduces requirements to control pollution of the sea by sewage from ships.
Annex V[xxii]	Pollution by garbage from ships	31 December 1988	It specifies the distances from land in which materials may be disposed of and subdivides different types of garbage and marine debris. The requirements are much stricter in a number of "special areas" but also the most prominent part of the Annex is the complete ban of dumping plastic into the ocean.
Annex VI[xxiii]	Prevention of air pollution from ships	19 May 2005	It introduces requirements to regulate the air pollution being emitted by ships, including the emission of ozone-depleting substances, Nitrogen Oxides (NOx), Sulphur Oxides (SOx), Volatile Organic Compounds (VOCs) and shipboard incineration.

According to MARPOL directives the SECA (Sulphur Emission Controlled Areas) zone is increased day by day and includes the North Sea, Scandinavia, and parts of the English Channel. All of Western Europe's weakness is to the MARPOL directive which proven controversial for shipping and ferry operators across Europe. It is a great concern on environmental damage with larger ferry operators that ship substantial amounts of freight and passenger traffic via these routes affected by IMO standards. [xxiv]

1.6.3 Marine Endangered Species of Fauna and Flora

Climate change will continue to threaten species around the world, whether marine, land or both. The CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The resolution was approved in 1963 with a draft at a meeting of members of the International Union for Conservation of Nature (IUCN).[xxv]

The Convention entered into force on 1 July 1975. Bangladesh ratified the convention in November 1981. The parties state of the CITES has been binding towards it. It regulates the international trade in specimens of selected species to a specific mechanism. All import, export, re-export, and introduction from the sea of species covered by the Convention have to be authorized through a licensing system. Each State party to the Convention is required to delegate one or more Management Authorities responsible of controlling that licensing system. The term ''import'' means to land on, bring into, or introduce into or attempt to land on, bring into, or introduce into, anywhere subject to the jurisdiction of the States. Moreover, it included whether or not such landing, bringing, or introduction constitutes an importation within the meaning of the customs laws of the States.

Throughout the world, habitats are being devastated at an alarming rate, locating many wildlife species in threat of extinction. Threatened and endangered wildlife live around the globe and we're likely to search out some in our own backyard. Critically Endangered species are Cross River Gorilla, Black Rhino, Orangutan, Hawksbill Turtle, Amur Leopard etc.. Some are endangered listed as like Blue Whale, Asian Elephant, Chimpanzee, Galápagos Penguin, Ganges River Dolphin, Green Turtle, Indus River Dolphin, Red Panda, Sea Lions, Whale Shark. Vulnerable species are Gaint Panda, Dugong, Black Spider Monkey, Hippopotamus, Polar Bear etc. and some are more 'threatened', or of less concern.

To defend endangered animals, think both globally and locally. Be familiar with the wild fauna and flora in their many attractive and various forms are an irreplaceable part of the natural systems of the earth which must be protected for this and therefore the generation to come back. We would like to watch out of the ever-growing value of wild fauna and flora from aesthetic, scientific, cultural, recreational, and economic points of view. We the people and therefore the State mechanism should be the best protectors of their own wild fauna and flora. In this regard, international co-operation is crucial for the protection of certain species of wild fauna and flora against over-exploitation through international trade. Bangladesh Government is incredibly much convinced on taking appropriate measures to the current end.

If any dispute arises between two or more Parties with relevancy to the interpretation or function of the provisions of the present Convention shall be subject to negotiation between the parties involved within the dispute. If the dispute cannot be resolved in accordance with paragraph 1 of this Article, the Parties may, by mutual consent, submit the dispute to arbitration, in particular that of the Permanent Court of Arbitration at The Hague, and the Parties submitting the dispute shall be bound by the arbitral decision.[xxvi]

The purpose of the Endangered Species Act in US is defined as following,

a) To provide that ecosystem, s upon which endangered and threatened species depend, may be conserved.

b) To provide a programme for the conservation of such species as declared by the Endangered Species Act.

The Endangered Species Act was enacted to provide for the conservation of domestic and endangered species of wildlife through domestic action and through cooperation with state endangered species conservation programs consistent with the domestic law. Moreover, the US Congress, in enacting the Endangered Species Act, intended endangered species to be afforded the highest of priorities because the question of the existence of endangered species is a major issue. The objective of the Endangered Species Act is to enable listed species not merely to survive but to recover from their endangered or threatened status.[xxvii]

In Bangladesh, with the line of international framework it makes illegal to import into or export from Bangladesh any listed species of fish or wildlife; possess, sell, deliver, carry, transport, or ship any listed species taken in violation; deliver, receive, carry, transport, or ship any listed species in interstate or foreign commerce, or by any means whatsoever in the course of commercial activity; sell or offer for sale in interstate or foreign commerce any listed species; or, violate any regulation promulgated pursuant to the authority. It is unlawful for any person to make or submit any false record, account, or any false identification of, any fish, wildlife, or plant which intended to be imported, exported, transported, sold, purchased, or received from any foreign country; or transported in interstate or foreign commerce.

1.6.4. Ballast Waste Management

Whereas the measures described in the previous section cover deliberate human transfer of endangered species, they do not cover the biggest cause of the transfer of alien species from one ecosystem to another. Ballast water from ships. Since steel ships were introduced, they have carried ballast water. It may be uploaded in one port and discharged in another thousands of miles away. It may contain a variety of biological materials, including plants, animals, viruses and bacteria, species that can cause extensive ecological and economic damage to aquatic ecosystems, along with serious human health issues including death. Scientists first recognized the signs of an alien species introduction after a mass occurrence of the Asian phytoplankton algae Odontella *(Biddulphia sinensis)* in the North Sea in 1903. But it was not until the 1970s that the scientific community began reviewing the problem in detail. In the late 1980s, Canada and Australia were among countries experiencing particular problems with invasive species, and they brought their concerns to the attention of IMO's Marine Environment Protection Committee (MEPC). The problem of invasive species in ships' ballast water is largely due to the expanded trade and traffic volume over the last few decades and, since the volumes of seaborne trade continue to increase, the problem may not yet have reached its peak. The effects in many areas of the world have been devastating. According to the International Maritime Organisation (IMO), quantitative data show that the rate of bio-invasions is continuing to increase at an alarming rate and new areas are being invaded all the time.[xxviii]

The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWC) was adopted on 13 February 2004 and entered into force on 8 September 2017. The status of the Convention on 15 October 2019 was that there were 82 contracting States responsible for 80.94% of world's tonnage. Bangladesh is listed as number 6, in alphabetical order.[xxix] Amendments made in April 2018 formalize an implementation schedule to ensure ships manage their ballast water to meet a specified standard (D-2 standard) aimed at ensuring that viable organisms are not released into new sea areas. They also make mandatory the Code for Approval of Ballast Water Management Systems which sets out how ballast water management systems used to achieve the D-2 standard have to be assessed and approved. The amendments to the BWM Convention were adopted in April 2018. In essence, the schedule for implementation means that compliance with the D-2 standard set out in the Convention will be

phased-in over time for individual ships, up to September 8, 2024. To satisfactorily screen ballast water to prevent alien species being discharged into ne environments necessitates a Ballast Wastewater Management system which costs an average of US $ 5 million to install. The Convention applies to all ships with ballast water capacity and active in international trade greater than 400 gross registered tonnes (GRT) that use ballast water. In the US, the regulations apply to all ships greater than 300 GRT. Certain categories of ships are exempt including warships and those with ballast water in sealed tanks not subject to discharge.[xxx]

Although Bangladesh is a signatory to the 2017/18 International Convention and has ratified it, it does not have any national legislation in place. Neither does India[xxxi] Nor do the Bay of Bengal or, indeed, the rest of the Indian Ocean yet feature among the 'Regional ballast water management requirements. Listed as those with regional requirements are: Wider Caribbean Region; Mediterranean; Northeast Atlantic and the Baltic Sea, and North Sea ballast water exchange areas. The only area closer to the Bay of Bengal is ROPME - Regional Organisation for the Protection of the Marine Environment (ROPME). This affects all ports within the Kingdom of Bahrain, the Islamic Republic of Iran, the Republic of Iraq, the State of Kuwait, the Sultanate of Oman, the State of Qatar, the Kingdom of Saudi Arabia and the United Arab Emirates. This affects all ships entering or wishing to enter those ports, regardless of flag. [xxxii]

A number of studies of the incidence and effects of invasive species in Bangladeshi water have been published.[33] As recently as 2019 an article appeared entitled 'Bangladesh Urgently Need Implementation of Ballast Water Management Convention (BWMC} to Save Our Marine Resources'. Written by M Maruf Hossain, a Professor at the Institute of Marine Sciences in Chittagong, and Sajjid Hasan, it included a summary of the threats which ballast water could pose and the demand that more work needed to be done. The article concluded that following ratification, which has now happened, strong management would be needed at the two ports of Chittagong and Mongla and the new deep seaport at Matarbari. Bangladesh is well within range of 'high risk' ports which are not party to the BWC.[34]

1.7 Conclusion

Biodiversity plays an important role in ecosystem services to maintain and improve human quality of life.[35] Pollution will never be totally eliminated; compensation for pollution damage is an important form of protection the marine environment. Compensation is necessary for environmental restitution, and thus, has a precautionary consequence. The polluter-pays-principle[36], a main concept in environmental law, embodies the concept of compensation. Bangladesh Government has approved the 'Coastal Zone Policy' 2005. This is the time on proper utilization of water resources and prevention of pollution. The State must take comprehensive development policy for the coastal and marine areas of Bangladesh. The policy could focus on the following broad areas:

- Economic development in the coastal areas
- Livelihood uplifting
- Mitigation of risks
- Sustainable management of coastal resources
- Proper land utilization planning
- Taking measures against salinity intrusion
- Rigorous enforcement of the Ballast Water Convention

Agriculture

To achieve sustainable development in agricultural livelihood, the management activities strengthen education, training, and awareness of the local people to appropriate supervision of agricultural

production systems; diversification of cropping systems, agro-forestry and proper application and utilization of agro-chemicals.

Fisheries

To achieve sustainable livelihood, management activities in the fisheries sector would include education, training, and awareness of the neighboring people to concepts of sustainable harvesting, integrated mangrove-aquaculture, shrimp farming, proper application, and utilization of chemicals.

We need a detailed scientific study in urgent to assess the impact of climate change on the country's biological resource in a specific way. On land, prominent areas may be developed above the expected sea water level to make available food and shelter and other environmental requirements to animals living in the sea level rise prone areas, particularly in the *Sundarbans*. The government of Bangladesh, NGOs and international organizations should come forward to provide support to conduct the ecosystem assessment survey to prepare a plan and programmes for the subsequent situation. The Management Authorities in Bangladesh are – Chief Conservator of Forest, Forest Department, Ministry of Environment and Forest, Chief Controller of Import and Export, Ministry of Commerce. The Enforcement Authority in Bangladesh is the Chief Conservator of Forest, Forest Department, Ministry of Environment and Forest. The Scientific Authority in Bangladesh is the Bangladesh Wildlife Advisory Board, Ministry of Environment and Forest. Though enforcement mechanisms are not enough, rather more awareness is required within the rural areas and our civil organization groups for the important conservation issues. Nonetheless, the hopeful thing is young generations are coming forward.

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