The Bay of Bengal: A Forgotten Sea

The Proceeding of the Symposium on the Bay of Bengal

Yangoon, Myanamar, 4 February 2016

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4 Feb 2016
Yoma Hotel Yangon
Myanmar

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Acknowledgement

This is the proceedings of the Symposium on the Bay of Bengal: Assessment of Environmental Problems" held in Yangon on the 4th February 2016. The editors and the Ramsar Center Japan (RCJ) would like to extend their heartfelt thanks to the authors and participants for their active and responsible engagement in the conceptualization and further development of issues facing the Bay of Bengal. Our thanks are also due to the Keidanren Nature Conservation Fund for its generous support to the promotion of the BoB as a study area.

The Editors

Acronyms

BEIC	= British East India Company
BoB	= Bay of Bengal.
BOBLME	= Bay of Bengal Large Marine Ecosystem
BOBP-IGO	= Bay of Bengal Program – Inter-governmental Organization
IOC	= Inter-Governmental Oceanographic Commission (of UNESCO)
IUCN	= International Union for Conservation of Nature
MedWet	= Mediterranean Wetlands Initiative
MOEF	= Ministry of Environment & Forestry
MPA	= Marine Protected Area
NGO	= Non-Governmental Organization
NOAA	= National Oceanic & Atmospheric Administration
OUS	= Outstanding Universal Value
PHC	= Petroleum Hydrocarbon
RCJ	= Ramsar Center Japan
SAARC	= South Asian Association of Regional Cooperation
USM	= Universiti Sains Malaysia

Photo Credit**:** The photo on the cover page is from the presentation of Durga P. Das, India.

Take Home Message

3. The Symposium on the Bay of Bengal: *Assessment of Environmental Problems* was held at Yangon on the 4th February 2016. About 22 participants from 9 countries (Bangladesh, India, Indonesia, Japan, Malaysia, Mynamar, Nepal, Philippines and Thailand) attended the symposium. The list of the participants along with their designation and institutions is annexed as **Annex I**. It was chaired by Reiko Nakamura and moderated by Bishnu B. Bhandari. The Symposium began with a short welcoming remark from Bishnu Bhandari followed by his presenting a paper titled "*The Bay of Bengal: A Forgotten Sea*". The other three papers were from Sanowar Hossain, Durga P. Dash and Htun Paw Oo on Bangladesh, India and Myanmar respectively. Four other supplementary presentations were made by participants from Bangladesh, Thailand, Malaysia and Indonesia. The detailed program of activities is presented in **Annex II**. The powerPoint presentations are included in **Annex III**.

Each presentation was followed by a question & answer session. After the presentation, open discussion was held to collect the participants' opinion and suggestions for the promotion of the conservation of the Bay of Bengal as larger wetland system.

The brief summary of the floor discussion is presented below in two parts; observations and suggested actions.

Observations

1. The nature of the issues, problems and livelihood are similar in the coastal area of the Bay. Only it varies in magnitude.
2. The ultimate goal should be to make the Bay of Bengal a healthy ecosystem. And we need to develop a catchy title for the purpose of procuring funds.
3. In the first stage only the coastal countries -- Bangladesh, India, Indonesia, Malaysia, Myanmar, Sri Lanka & Thailand -- should be targeted. Upon the assessment, the second stage should be launched to include countries like Maldives, Nepal, Bhutan and China.
4. Bringing all the countries and stakeholders under the same platform of the Bay of Bengal should be the goal of our future initiative.
5. Trans-boundary issues should be taken into consideration while embarking on the study of the Bay of Bengal. The study should adopt a human-centered approach.
6. In the future, it would be realistic to organize the future workshop in Sri Lanka or Andaman & Nicobar Islands.

Actions Suggested

The following are the action suggested for initiating studies and works in the Bay of Bengal.

1. Compile the papers and put it in the RCJ Website
2. As much as possible conduct action research on major issues facing the Bay of Bengal.
3. Document all the available literature, along with an annotated bibliography
4. Prepare an inventory (directory) of major wetlands, Ramsar sites, experts, NGOs, CBOs, universities and research institutions
5. Conduct action research on biological diversity of the Bay area
6. Undertake participatory action research on life and livelihood of communities and developing their capacity and community resilience

7. Focus on biological diversities, particularly fisheries, birds, turtle and endemic flora and fauna
8. Develop a mechanism of establishing an informal network of Ramsar sites which are at or near the coastal area of the Bay of Bengal
9. Raise the profile of the Bay of Bengal through awareness raising and capacity building of local people, especially the wetland dependent communities.

The symposium was closed with a unanimous recommendation that efforts be made to procure funds so as to undertake various studies including awareness raising, capacity building, needs assessment and action research.

(1) The Bay of Bengal: A Forgotten Sea[1]

Bishnu B. Bhandari[2]

Abstract: The Bay of Bengal is the world's largest basin. It houses Palk Straits, Andaman & Nicobar Islands, Gulf of Mottama, Gulf of Manar, Mergui Archpelago, Andaman sea and some part of the Strait of Melaca. From the 10th century, it has been called the Bay of Bengal after the name of Bengal. Historically, the Bay is the highway for millions of emigrants. In a span of 100 years (1840-1940) about 30 millions of people crossed the bay to Sri Lanka, Malaya and Burma for employment. At one time 140 thousand refugees embarked on a long march from Rangoon to India. World War II was the turning point. The area houses some endangered animals such as dolphin, sea cow, whale and sea cucumber. The major concern is the rise of sea level. The prevailing environmental hazards are water pollution, shipbreaking, planetary warming and loss of critical habitats. The Bay is surrounded by 13 Ramsar sites from five countries. The area could be a venue for the conservation through the work of the interdisciplinary efforts.

Keywords: Bay of Bengal, Wetlands, Wetlands, Sustainable Development

Introduction

The Bay of Bengal (BOB or the Bay) has again emerged as a region of strategic and political importance. It is simply a "stretch of Sea from the India Ocean to the Pacific" but it is at the heart of global history" (**Amith, 2013**). This is an area of competition between India, China and the US for influence in Asia. After the political revolution of the 1950's, again the oversea movement emerged as construction and plantation boomed in Malaysia in 1980's. The ecologist call it as a large marine ecosystem, whereas as the student of wetlands look at it as a huge wetland, housing a exceptionally rich aquatic diversity, a source of livelihood of millions of people in the coastal area, and the habitat of globally threatened fauna such as the Royal Bengal Tiger in Sundarbans, Leather Sea Turtle, Malayan Box Turtle, Saltwater crocodile in the Great Nicobar Biosphere Reserve, the nesting of the Ridley Sea Turtle in Odisa and other marine life such as whale, hogfish, school of dolphins, Tuna and the Irrawaddy Dolphin. Plus the area has so many coral reefs, estuarine, fish spawning and nursery areas and mangroves.

Francis Day, an English fishery officer (1873: 12) observed in 1873 that the water around the Mergui Archipelago off Burma's coast "literally alive with fish". R. Sivasubramaniam (1853) reported the biological richness of the Bay as follows - demersal species 215, pelagic 65, cartilaginous 40 species along with shrimps, yellowfin and skipjack tuna.

The paper is an attempt to look at the Bay of Bengal from the perspective of the "principle of the wise use of wetlands". The paper begins with the description of the location of the area, its history, general environment and hazards and some opportunities for its conservation including its coastal area.

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[1] Paper presented at the "Symposium on the Bay of Bengal: Environmental Issues, Problems and Opportunities" 4 Feb 2916, Yangon, Myanmar (Organizer: Ramsar Center Japan)

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The Geography

The Bay of Bengal is the world's largest triangular basin in the Indian Ocean. It is not only the largest basin but also one of the 64 Large Marine Ecosystems in the world. It is an enclosed sea – an arc stretching from the southeastern edge of India, up and along the coasts of Bangladesh and Myanmar and down to the western coast of Thailand, Malaysia and Indonesia.

The Bay is bordered in the east by western coast of Myanmar including the Gulf of Mottama and western coast of the Isthmus of Kra including Phuket of Thailand or the Andaman Sea. Its western border is marked by the eastern coast of India. The northeast coast of India, entire south coast of Bangladesh (mouth of Ganges) and northwest coast of Myanmar makes its border to the north. Kanya Kumari of India, Dendra Head of Galle of Sri Lanka and the northern edge of Aceh of Sumatra (Indonesia) and Penang Island of Malaysia in the Gulf of Malacca mark its southern border. Major characteristics of the Bay of Bengal are given in Box A.

Box A: The Bay of Bengal at a Glance

1. **Basin countries**: (1) Bangladesh, (2) India, (3) Indonesia (4) Malaysia, (5) Myanmar, (6) Thailand, and (7) Sri Lanka (Wikipedia)
2. **Surface area** = (2.2 million km^2) (Precisely 2,172,000 km^2)
3. **Average depth** = 2,600 meters
4. **Maximum depth** = 4,694 meters
5. **Important animals** = Coral reef, tropical Dolphins, Sharks, Dugongs (swim in sea grass), Olive Ridley Sea Turtle, Game fish (Tuna and Marlins), rare Irrawady Dolphins, (From Wildlife Conservation Society)
6. **Major rivers** = Kaveri, Krishna, Godawari, Ganga, Brahmaputra (India), Ayeyarwaddy (Myanmar)

The Bay houses many straits, gulf, islands, Isthmus, archipelagos and mouths of the rivers. such as the **Strait of Malacca** (in between Malaysia and Indonesia), **Dondra Head** (southernmost part of Sri Lanka and has the tallest lighthouse of Southeast Asia), mouths of many major rivers, Andaman Sea, Penang Island (Malaysia), Isthmus Kra (Thailand), Palk Strait and Gulf of Mannar (between Sri Lanka and India), Gulf of Mottama (west Myanmar). Others are;

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- Myeik Archipelago is the former Mergui Archipelago. This is an unexplored sea and is inhabited by the Moken Peoples. These peoples are nomadic in residence and have sea-based life. They are good for sea diving and can hold their breath longer than other peoples.

- The Gulf of Mannar lies in between India and Sri Lanka. It is one of the richest coastal region. The area houses some 117 species of coral species. The sea turtle, sharks, dugongs and dolphins are some frequent visitors. The dolphin, Dudong (sea cow), whale and sea cucumbers are the endangered species. For the protection of the resources, there is a Gulf of Mannar Biosphere Reserve.
- The Andaman & Nicobar Islands has about 750 islands and only 38% are presently inhabited. Previously, the place was an isolated prison for the freedom fighters of India but now has been transformed into "an Emerald Island" for tourists. Mahatma Gandhi Marine National Parke, which is close to Port Blair is famous for the Degong (sea cow).

The Asian monsoon animates the Bay of Bengal. It determines every aspect of life – nature, human society and culture. Mansoon means water. The monsoon stretches from the Arabian area up to Southern China and down to the northern tropics of Australia. During April to September monsoon winds move from Southwest to Northeast whereas from April to September it moves from Northeast to Southwest. The monsoon means heavy rain. It sets the rhythm of agriculture across the part of South Asia, Southeast Asia and East Asia.

The Bay in Different Languages

According to the Wikepedia, the free Encyclopedia, this body of water is referred to as **Mahodadhi** (literally great water receptacle) in ancient Sanskrit literature while it appears as *Sinus Gangeticus* or *Gangeticus Sinus*, meaning the "Gulf of the Ganges" in ancient maps. The other Sankrit names of the Bay of Bengal are "Vangopasagara" (Saskrit: j8=uf]k;fu/, lit. Bengal's Bay), also simply called as "Vangasagara" (Sanskrit: j8=u;fu/, lit. Bengal Sea) and "Purvapayodhi" (Sanskrit: k"j}kof]l3, lit. Eastern Ocean). Only in the 10th century, it was known as the Bay of Bengal, after the name of Bengal.

The Bay was, for many countries and for many languages, known as the "Chola Sea" or "Chola Lake". The Portugese gave it the name of "Golfo de Bengala". In Hindi, it is called Bangal,Ki Khadi" or in Nepali " Bangalko Khadi". In English, it is known by different names such as South Asia, Southeast Asia, which emerged after World War II. Colonists named the Bay as "Further India, the Indian Archipelago or simply the Other Side of the Bay". For Chinese, it was *Nanyang* or the "Southern Ocean" (Amrith, 2013). Some called it the British Lake.

The Bay of Bengal in History

The tracing of the history of the Bay shows that Asia fell in the control of European colonists at the end of the 15th century and became the arena for the competition with themselves and Asian powers. In the 17th century, the Portuguese advance was reversed by the joint forces of the Dutch and the English. In the 18th century, the English, the Dutch and the French East India Company had put a foothold here through the establishment of the "factory". The British started sending their troops, garrison, legal code and officials and dominated the Bay area.

In the second half of the 19th century, the British Empire envisioned a grand design of developing rubber plantation in Malaysia, rice in Burma, coffee and tea in Ceylon. This plan was supported by imperial capital and Asian labor, especially of India. In the implementation

of the plan, the British authority mobilized the emigration of almost 30 million (some say 28 million) workers between 1840 and 1940 that crossed the Bay of Bengal from India to Malaysia, Burma, and Ceylon. Only about 2 million of them travelled back and forth. There was always a circular migration around the Bay. Historically also it is important to note that about 140,000 refuges embarked on the long march from Rangoon to India in the late 1930's. On the way, many died of exposure, exhaustion, starvation, heart failure and amputation. Indeed, the Bay was the home of the world's biggest emigration.

This vast political and economic connection fell apart when World War II took place in the early 1940's. World War II was the turning point for political, economic and cultural connection in Asia. The British Empire collapsed and new nation states emerged, where the issue of citizenship and belongingness was prominent. These nation-states began to exploit internal resources and internal labor. The sea was of no concern for them. Thus the Bay was simply a "forgotten sea" in the 1960's.

Environmental hazards at the Bay

The massive exploitation of natural resources took place to feed the imperial factories. Forests were cleared, mines were excavated and gases were extracted out. The new nation-states, triggered by growing population and intensive land clearance, diverted their attention to the exploitation of natural resources and establishing factories in the region. And the factories, in turn, emitted greenhouse gases. The accumulation of greenhouse gases at the atmosphere was the major cause of global warming (or planetary warming) and its direct effect was on the sea, i.e. the rise of sea level. For example, a meter rise of sea level can inundate a half of Bangladesh and a large area of coast in the littoral zone. This is a singular ecological issue that concerns all of us. This is the reason why the region is again at the heart of international community. It has successfully drawn their attention. This warrants their concentration, cooperation and collaboration for its sustainable development. Global warming (or climate change) has been frontier for immediate action. Along with its biological richness and strategic importance, the Bay region manifests many environmental problems, the important ones are briefly summarized below.

(1) Water pollution: The Bay receives about the $4/5^{th}$ of total pollutants that spill into the area coming from 7 rivers, important cities that ring the littoral area. These cities were the departure points for millions of journeys in the age of sails and steams. In fact, the area is a sink of organic and inorganic wastes of the area. Every day the Bay receives (ingests) a notorious cocktail of refuse, trash, garbage, organic matter, nutrients (including nitrogen, pesticides from agricultural fields), metabolized drugs, medical waste, cytotoxic, antibiotic, hormone-mimicking materials, bacteria, virus, worms, chemicals (detergents, fertilizer runoff) and a large quantity of sediments.

Storm and flood surges fan out these pollutants to sea. Also a huge quantity of plastic float out to the sea.

(2) Decline of critical habitats

The critical habitat such as mangroves, coral reef and estuaries are declining and deteriorating in the Bay area due to overfishing, loss of sea turtle and so forth. The impact is in both terrestrial and aquatic species due to the following.

- The coast line is shifting due to deforestation and human encroachment to the mangrove swamps for shrimp and other aqua-cultural activities. The mangroves are good for both trapping and boding sediments, and for stabilizing soils. In addition, the mangroves excel in creating land where there once was sea.
- World's river deltas are shrinking at up to 4 times the rate at which sea levels are rising. The main cause is human intervention (large dam, reservoir, diversion, pumping, natural drying out etc.). The human interventions have broken "the critical links between channels and their floodplains". This disconnection makes, firstly, the delta devoid of necessary sediments, which are the source of both of their sustenance and replenishments. The soil, silt and sediments are transported away from the critical habitats by surging flood and cyclone. Secondly, it makes the rivers weak to infiltrate the displaced sediments because the dams trap and keep sediments at the reservoirs. The shrinkage (subsistence) is also due to their compaction, which is caused by over-extraction of groundwater, oil and gas from offshore drilling.

(3) Hazards of shipbreaking[3]**:** The Bay receives the discarded hulks of the world's unwanted ships. The industry has both beauty and horror. Some 80% of shipbreaking industry is located in Bangladesh, India and Pakistan. Chittagong alone of Bangladesh houses one of the world's unwanted ships. Some 30 thousand people are employed in this trade. This is the beauty of the industry. The other side is that the shipbreaking industry is one of the most dangerous occupations in the world. People have to work and wade into toxic and oily sludge to take the parts of the ships. Every day the workers inhale dangerous chemicals including lead and asbestos.

(4) Planetary warming

The world's oceans are likely to rise due to planetary warming, the causes being both global and cumulative. The accumulation of greenhouse gases since the industrial revolution heats up the Earth. The ice and the snow become the first victim. Thus ice-melt pour into the ocean. IPCC estimates that globally the sea level will rise between 19 and 59 centimeters by 2100. Some scientists estimate that sea level will rise, not in centimeters but in meters.

- The first effect is that sea level will rise globally. Though the Bay accounts for a small portion of GHG emission, should the water rises, it is likely to be the world's most affected region. The Bay faces a 2,350 kilometers of Indian coast. The region depends on the life of the sea for nutrition, winds and currents. About 450 km long coastal area of Andra Pradesh is under "very high risk" from rising waters. In this regard Bangladesh is the most vulnerable to sea levels as it is low-lying and densely populated country. Besides, recent studies show that the Himalayan region (the Third Pole) is warming faster than the global average.
- The other effect of planetary warming is that climate extremes will occur more frequently around the world. The extreme will be more frequent, erratic and devastating in the coming years. The most horrible threat to the Bay and its coastal

[3] This industry began in Chittagong due to climate-related hazards. In the 1960's, one of the notorious cyclone Bay blew a 20,000 ton tanker off course and onto the beach in Chittangong. This opened the door for generating income for the local communities. They used their ingenuity to recycle the ship's components.

people is storm as the area is hotbed for generating tropical cyclones. The tumult is set to increase in the future. The horror of the 2008 Cyclone Nargis in the delta of the Ayeyarwaddy in Myanmar can be summarized as follows – like a bucket of water sloshed over an ink drawing, nearly 85,000 people dead, tens of thousands more missing, up to 2 million displaced, houses and vegetation wiped out and so forth.

- The other effect is the erratic monsoon that will result in drought and flooding. Average rainfall is likely to decline, while the incidence of abnormally powerful storms will increase.
- Still other effect is that the displacement of the people (climate refuge) by rising waters is virtually certain. It is likely that the number of climate change is likely to loom larger and larger in the future, especially climate-induced hazards, climate cyclical volatility and like *El Nino*.
- In 2004, a rupture more than a hundred km wide occurred on the floor of the Andaman Sea, causing a massive underground earthquake at magnitude of 9 Richter Scale – a devastating Tsunami that swept across the Indian Ocean. About a quarter million of people died. This is the Tsunami that took its tool.

Ramsar sites along coastal rim

Ramsar sites along the coastal area of the Bay (at south straight line from the Bundala of Shri Lanka to Princess Siridhorn Wildlife Sanctuary). The area houses some 13 Ramsar sites from 5 countries along the rim of the Bay. For example, Bangladesh and Myanmar have one site each, for example (1) Sundarbans Reserve Forest in Bangladesh and Moeyungyi Wetland Wildlife Sanctuary in Myanmar. India and Thailand have 5 sites each. The five sites that are in or near the Indian coastal area are (1) Point Calimere Wildlife and Bird Sanctuary, (2) Kolleru Lake, (3) Chilika Lake, (4) Bhitarkanika Mangroves, and (5) East Calcutta Wetlands. The coastal wetlands that are in the Bay area include (1) Kaper Estuary-Laemson Marine NP-Kraburi Estuary, (2) Ko Ra-ko Phra Thong Archipelago, (3) Pang Nga Bay Marine National Park, (4) Krabi Estuary, and (5) Had Chao Mai Marine NP- Ta Libong Island Non-hunting Area – Trang River Estuary. The Ramsar sites that is in the coastal area of the Bay in Sri Lanka is Kumana-Kudimbigal Wetland Cluster.

Some Opportunities

The Bay is a shared area surrounded by 7 countries (India, Bangladesh, Sri Lanka, Myanmar, Thailand, Malaysia and Indonesia), millions of people dependent on its resources in the coastal area and the competition between Asian power like India and China for access to resources, sea lanes and politico-cultural influences. Thus, the Bay provides a new hope and spirit for the region. It could be a new spirit of cooperation and conflict which may even provoke "water war" in the region. The stark issue is how to manage it sustainably.

A cursory look at the present situation of the Bay offers us a multitude of opportunities for its sustainable development. But it does not mean to say that the area does not have any issues and constraints. It does have many issues and opportunities at the offing, some of which are briefly touched upon below.

1. Develop a network of the Ramsar sites that are at its coastal area to exchange experiences, constraints and success stories of the wise use of resources. This network may help them develop a common agenda for the management and conservation of the Bay of Bengal.
2. Replicate the model of MedWet (Mediterranean Wetlands Initiative) of Ramsar Convention that has been successful for the wise use of wetland resources in the Mediterranean Sea in Europe. The experiences from the MedWet would be quite useful in the management of the Bay of Bengal. Or, the experience from the Wadden Sea would be quite useful for the Bay area as some organizations like the Bay of Bengal Program – Inter-governmental Organization (BOBP-IGO) and Inter-Governmental Oceanographic Commission (IOC) of UNESCO are already there on the ground in the Bay area. Learning from, and application of, these models can help shape the environmental situation of the area.
3. Develop an informal network of relevant stakeholders in the conservation of the Bay and its resources, firstly bringing wetland organizations together and then other stakeholder including those which are interested in wetland but outside the Ramsar family..
4. Conducting exploratory studies of the Bay, its natural as well as marine resources.

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(2) Problems and Opportunities in the Bay of Bengal: An Example from Bangladesh

Sanowar Hossain[4]

Abstract: The coast line of Bangladesh is about 710 km long. More than 118,813 sq km of the Bay falls in territorial sea and exclusive economic zone of Bangladesh. Bangladesh being a first line littoral state of the Indian Ocean has a very good source of marine resources from the Bay of Bengal. A total of, 442 marine and 76 species fish from estuarine waters were recorded from the sea and mangroves. Almost 30 million people directly or indirectly depend upon marine fisheries industries for their living. Highly commercial fishes include some 100 species. The coastal zone contains distinctive development opportunities that can be instrumental in reducing the vulnerability and poverty of coastal community and can contribute significantly to the development of Bangladesh as a whole. Major threats to biodiversity are post larvae collection of shrimp and colossal loss of biodiversity, coastal and marine pollution, ship breaking in the beaches, impact of coastal aquaculture on environment, natural disasters, sea level rise, persistent organic pollutants etc. Maritime experts have been warning that Bangladesh's marine fish will be threatened in future with uncontrolled use of modern technologies and trawlers. In fiscal year 2007-08, nearly 497,000 metric tons of fish were caught from the Bay of Bengal. That number rose to 589,000 metric tons in fiscal year 2012-13. Over 200 commercial fishing trawlers remain engaged throughout the year. A coordinated protection and conservation measure is required for reflecting the scope from the national and international legislation and for strengthening of the institutional capacity in coordinated management.

1. The Bay of Bengal

The Bay of Bengal is a northern extension of the Indian Ocean, positioned between India and Sri Lanka in the west, Bangladesh to the north, and Myanmar (Burma) and the northern part of the Malay Peninsula to the east. It's approximately 1,000 miles (1,600 km) wide, with an average depth near 8,500 feet. The maximum depth is recorded at 15,400 feet. Bangladesh, India, Indonesia, Malaysia, Myanmar, Sri Lanka, and Thailand are the countries bordering the Bay of Bengal (BOB). It occupies an area of 2,172,000 km

The BOB is the largest among 64 bays in the world and an estimated 1.4 billion people live along its coastline in Bangladesh, India, Thailand and Myanmar. In Bangladesh, nearly 30 million people are directly dependent on oceanic activities like fisheries and commercial transportation for their livelihood.

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The two successive UN tribunal awards have established Bangladesh's sovereign rights on more than 118,000 sq km of maritime territory, 200 nautical miles (nm) of Exclusive Economic Zone and 354 nm of continental shelf. The peaceful resolution of maritime discords has opened a golden opportunity for Bangladesh to explore and exploit the vast resources in the Bay of Bengal.

The Sunderbans bordering the Bay of Bengal is the largest single block of tidal halophytic mangrove forest in the world. Cox's Bazar, the longest stretch of beach in the world and two other beaches are Kuakata and St. Martins Islands.

The management of coastal and marine biodiversity in Bangladesh is its responsibility and also an exclusive task of the whole neighboring nations of the BOB and Indian Ocean rim countries. The BOB is prone to severe natural disaster, such as cyclones, storm surges and floods. In combination with other natural and man-made hazards, such as erosion, the high arsenic contents of ground water, water logging, water and soil salinity and various forms of pollution, these disasters have made coastal dwellers very vulnerable and slowed down social and economic developments (Maruf, H 2004). Bangladesh does not have much knowledge about marine bio-technology, unlike India which has advanced knowledge in this field. An overview of the status of BOB is presented in Box A.

Box A: An overview of the Bay of Bengal

Location: South Asia
Position: The Bay of Bengal is a northern extension of the Indian Ocean, positioned between India and Sri Lanka in the west, Bangladesh to the north, and Myanmar (Burma) and the northern part of the Andaman-Nicober to the east.
Coordinates: 15°N 88°E15°N 88°E: 15°N 88°E15°N 88°E
Primary inflows: Indian Ocean
Basin countries: India, Bangladesh, Thailand, Myanmar, Indonesia, Malaysia, Sri Lanka.
The Bay occupies an area of about 2.2 million sq km.
Maximum length: 2,090 km (1,300 mi)
Maximum width: 1,610 km (1,000 mi)
Surface area: 2,172,000 km^2 (839,000 sq mi)
Average depth: 2,600 m (8,500 ft)
Maximum depth: 4,694 m (15,400 ft)

Note: Geographically it is a source of water, salt, energy, fish, minerals, transport, and business and so on. Numerous large river systems drain into its waters, including the massive Ganges and Irrawaddy.

2. Coastal and Marine Biodiversity

The coastal zone contains distinctive development opportunities that can be instrumental in reducing the vulnerability and poverty of coastal communities and can contribute significantly to the development of Bangladesh as a whole. The marine resources include oil and gas, fisheries, ship building, ship breaking, salt collecting, tourism etc. According to primary assessment made by Bangladesh, a few trillion cubic feet of gas is deposited in its maritime zone.

In recent years, Bangladesh coastal areas received international attention due to its high potential for exploitation of both onshore and offshore natural gas. The coastal zone also contains several ecosystems that have important conservation values. The world's largest uninterrupted stretch of mangrove system, the Sunderban, has been declared World heritage site in 1997, whereas coral ecosystems are found around St. Martin Island. These ecosystems are not only biodiversity hotspots, but they also provide the ecological foundation for an important common property resource.

The Royal Bengal Tiger, for which the Sunderban is the last remaining natural habitat, the Otter, Squirrels, Wild Boar, and in rivers and the sea, a number of dolphin species are reported. Not much inventory work has been carried of invertebrate fauna. Some species such as the Giant Honey bee, Mud crab and various shrimps are studied intensively because of their relation with human activities. It is well known that the number of insect species is high.

The IUCN Bangladesh Red Data Book (2000) has listed 442 marine fishes, 22 amphibians, 17 marine reptiles, 388 resident birds, 240 migratory birds, and 3 species of marine mammals in Bangladesh. According to the Red list of IUCN, 2001 among the marine and migratory species of animals, 4 fishes, 5 reptiles, 6 birds, and 3 mammals are threatened. The recent discovery of nearly 6,000 rare Irrawaddy dolphins in the mangroves of Bangladesh, on the edge of the Indian Ocean, highlights the importance of the country's marine environment and the need for more research into the status of its threatened species

1. Crabs: As many as 50 species of crabs have so far been identified in the coastal and marine habitats of the Bay of Bengal of which 11 are purely marine. Only three species are reported to be commercially important. The mud crab, *Scylla serrate* is abundantly available and is reported to be suitable for coastal aquaculture.

2. **Mollusks, bivalves and reptiles:** Mollusks of a variety of forms are available in the Bay of Bengal and adjacent areas. They include bivalves, clams, oysters, scallops, snails and slugs, cuttlefish, squids, octopuses, etc. Ahmed reported 301 species of marine mollusks in Bangladesh. However, very little is known about their biology, occurrence, production and management.

3. **Shrimps:** Besides the large number of fish species, the mangroves also support many species of shrimps with high commercial value. These include 24 species of shrimps belonging to five families However, the tiger shrimp, *Penaeusmonodon*, outstands the other in terms of its commercial importance and availability. The bottom trawling industries of Bangladesh aims mainly to catch shrimps, particularly *Penaeusmonodon*.

4. **Turtles (Globally significant):** Sea turtles are significant bio-indicators of the world ocean environment. Saving these magnificent animal we can in fact protect our ocean life. Scientists recognize 7 living species of sea turtles under 6 genera like Olive ridley (*Lepidochelysolivacea*), Green turtle (*Cheloniamydas*), Loggerhead (*Carettacaretta*), Leatherback (*Dermochelyscoriacea*), Hawksbill (*Eretmochelysimbricata*), Kemp's ridley (*Lepidochelyskempii*), Flatback (*Natatordepressa*s). Sadly, sea turtle face many dangers as they travel the seas - like getting caught in fishing gear meant for other animals, the loss of nesting and feeding sites, directed hunting and pollution. They laid the eggs on sea shore but the eggs are damaged not only by wild animals like dogs and foxes but also by the tribal people who collect the eggs and sell in the market.

5. **Mangrove biodiversity:** The coastal region houses several mangrove ecosystems. Mangroves are available in the form of natural forests Sunderban and forests together covering about 50% of the forest area of Bangladesh. The Sunderban Mangrove forests and other parts of coastal area support a wide range of mammals, birds, amphibians, reptiles and crustacean.

The Surdarban is a unique ecosystem and provides great opportunities in a number of ways. Global mangroves are calculated to be just over 1, 80,000 km^2, a small area compared to other forests. Bangladesh is the 8th country in the world, which possess a vast mangrove forest. This is the place where the mainland Bangladesh meets the Bay of Bengal, making the area a globally unique ecological niche. The Sunderban mangrove forests provide timber, pulp wood, fuel-wood and raw materials for industries. The major commercial timber/wood species of Sunderbans are Sundri, Gewa, Keora and Goran. It is mentionable here that the World Heritage Convention (WHC) declared "Sundarban as natural and cultural site of outstanding universal value". It is also included for selection of 7 wonders of the world. In total there are 334 species of plants, 400 spp. of fishes, 53 spp. of reptiles, 315 spp. of birds and 50 spp. of mammals. There are 283 species of finfish in Indian Sunderban and 222 species of finfish in Bangladesh Sunderban. Marine biodiversity includes 100 species of shellfish community, 15 species of shrimps, 8 species of prawn, 1 species of lobster, 5 species of crabs, 3 species of snails, 22 species of mussels and shells, 4 species of cuttlefish and squids (MOEF, 2002).

6. **Marine fish species:** Bangladesh is very rich in fish and shrimp species biodiversity. A total of 442 marine and 76 species fish from estuarine waters were recorded by IUCN Bangladesh (2000). The marine list, however, contains 73 species whose distribution includes estuaries as well. MOEF (2002) surveys made 87 new records from the St. Martin's Island. Thus the present total would be 529 marine and 149 estuarine fish species. However, many of them are not of commercial importance (Amin &Kawsar 2003). There are about 100 commercial species of which 20 fish families are highly commercial, contributing about 82-87% of the total demersal exploitation

7. **Sea weeds:** Only St. Martin's Island has favorable substrata of the growth of seaweeds. A preliminary survey of this Island and of the Sunderbans area revealed the occurrence of nearly 200 species of seaweeds. There are also 160 taxa of marine phytoplankton in the Bay of Bengal.

8. **Shellfish:** In addition to finfish Bangladesh also has a rich diversity of shellfish. About 36 species of shrimps have been recorded from the marine water of Bangladesh. With a recent record a total of 63 shrimp and prawn from inland and marine. The shrimp and prawn culture sector of Bangladesh is seen as having become very important in economic terms contributing significantly to foreign exchange earnings and employment generation in rural areas. About 600,000 coastal people are directly employed in this industry. In addition to the finfish and shrimps, more than 300 mollusk species are recorded from Bangladesh. Two species of Trochus are recorded from the St. Martin's Island, which are depleted worldwide. Octopus and cuttlefish (sepia) occur in deep waters of the Bay and are exportable commodities.

3. Socio-economic and Livelihood support

- Reduce vulnerability to natural hazards, climate variability and climate change, and increase climate resilience

- Improve the living and working conditions of coastal fishing communities
- Medicines such as cod liver oil, cosmetics and toiletries can be produced with marine resources but Bangladesh lacks investment in the sector.
- In Bangladesh, nearly 30 million people are directly dependent on oceanic activities like fisheries and commercial transportation for their livelihood.
- Empower coastal people to participate in, and benefit from, sustainable development practices
- Mainstream gender into fishery and environment management decision making. The BOB is supporting thousands of coastal community for resources like: oysters, snails, corals, mangrove forest, Nipa palm, honey collection, fry collection, fuel materials etc. Among them fisheries are the most important natural source for thousands of coastal community who depends on it for their livelihood and are the source of protein for the entire country. Loita and Chury dry fishes are from the Bay of Bengal that are available in whole country and Rup Chanda fishes are the most delicious fish that are available in all five star hotels in Bangladesh. Statistics of Bay of Bengal fisheries are given below
    - Food for approximately 400 million people
    - About 4% of the value of the world`s catch($ 4 billion)
    - Annual production for 6 million people
    - Livelihoods for 4.5 million people
    - Approximately 2.2 million fishers
    - Approximately 460,000 fishing crafts

4. Environmental Pollution

1. Air pollution: Air pollution that covers much of South Asia and the Indian Ocean, every year between January and March and possibly also during earlier and later months, hangs over the Bay of Bengal. It is considered to be a combination of vehicle exhaust, smoke from cooking fires, and industrial discharges.

2. Water pollution: The major transboundary issues relating to pollution and water quality are: (1) sewage-borne pathogens and organic load, (2) solid waste/marine litter, (3) increasing nutrient inputs, (4) oil pollution persistent organic pollutants (POPs) and persistent toxic substances (PTSs), (5) sedimentation and (6) heavy metals.

3. Water pollution by leakage of oil tanker: Recently leakage of oil tanker close to Sundarban spread whole Sundarban area and its impact on flora, fauna and soil. How many flora and fauna have been damaged is yet to be assessed.

4. Coastal and Marine Pollution: Municipal waters, industrial pollution, oil pollution, ship breaking, impact of coastal aquaculture on environment, natural disasters, sea level rise, and persistent organic pollutants are transboundary problems. And they are harmful to coastal and marine biodiversity (Maruf, H 2004).

5. Disaster of the Bay of Bengal

1. Tropical storms and cyclones seasons: A tropical storm with rotating winds blowing at speeds of 74 miles (119 kilometers) per hour is called a cyclone when they originate over the

Bay of Bengal; and called a hurricane in the Atlantic. Between 100,000 and 500,000 residents of Bangladesh were killed because of the 1970 Bhola cyclone.

2. Cyclone Sidr: Cyclone Sidr has a very severe cyclonic storm that resulted in one of the worst natural disasters in Bangladesh. It took a tool of 10,000 in November 2007. Cyclone Sidr is a tropical cyclone that resulted in one of the worst natural disasters in Bangladesh. Coastal districts faced heavy rainfall as an early impact of the cyclone. Total damages came close to $450 million. Storm surges reaching up to a height of 3 meters (9.8 ft) were reported in the coastal areas of north, triggering panic among the fishing community.

3. Cyclone Aila: Cyclone Aila also known as Severe Cyclonic Storm was the second tropical cyclone of the 2009 North Indian Ocean cyclone season. A relatively strong tropical cyclone, it caused extensive damage in India and Bangladesh. As of 27 May 2009, 330 people were killed by Aila, and at least 8,208 more are missing, while about 1 million people became homeless. In Bangladesh, an estimated 20 million people were at risk of post-disaster diseases due to Aila. The damage is assesses at $552.6 million (2009 USD).

6. Climate Change and its Impacts on Marine Fisheries

From January to October, the current is northward flowing, and the clockwise circulation pattern is called the "East Indian Current." The BOB monsoon moves in a northwest direction striking the Nicobar Islands, and the Andaman Islands first at the end of May, then the North Eastern Coast of India by end of June.

Climate change has direct and indirect adverse effect on fish flora and fauna for their reproduction, migration and survival. Therefore, reproductive cycle is a harmonious process interlinked with environmentally mediated routine of various aquatic ecosystems. In such case any adverse environmental condition might affect the natural reproduction process of marine fish population and ultimately hinder the recruitment in a stock through spawning. Similarly, fish migration might be hampered due to negative impact over the situation. Hilsa is the national fish of Bangladesh. It contributes to 13-14% (290,000 mt, Tk 6,000 million, 1.3 % of GDP) of total fish production of Bangladesh. During last two decades Hilsa production from inland water declined about 20%, whereas marine water yield increased about 3 times. Major Hilsa catch has been gradually shifted from inland to marine water. Hilsa fish ascend for spawning from sea into estuaries and most of the river systems of Bangladesh.

8. Threats to BoB

- Major threats to the BOB can be summarized as follows; (1) post larvae collection of shrimp and colossal loss of bio-diversity, (2) coastal and marine Pollution ,(2) ship breaking in the beaches, (3) impact of coastal aquaculture on environment, (4) natural disasters, (5) sea level rise, (6) persistent organic pollutants.
- On December 9, 2014, a wrecked tanker released approximately 94,000 gallons of heavy fuel oil into the Shela River, which runs through the Sundarbans, the sprawling and remote mangrove forest shared between India and Bangladesh in the Bay of Bengal.

- Now another shipping disaster is unfolding, as a capsized cargo vessel, *Jabalenoor,* leaks 200 tones of potash fertilizer into the Sundarbans' Bhola River, southeast of the earlier oil spill.
- A UNESCO World Heritage site, the Sundarbans is home to the critically threatened Royal Bengal Tiger and rare Irrawaddy Gangetic dolphins.
- The overexploitation of fisheries are due to;
    - Environmental degradation
    - Numerous anthropogenic activities: such as over-fishing of inshore fisheries, indiscriminate catching of juveniles, construction of barrages and dams
    - Extensive use of pesticides
    - Water pollution and siltation
    - Open access to fishing grounds
    - Government emphasis on increasing fish catches
    - Inappropriate government subsidies provided to fishers
    - Increasing fishing effort, high consumer demand for fish, including for seed and fishmeal for aquaculture
    - Ineffective fisheries management and illegal and destructive fishing
    - Decline in the overall availability of fish resources
    - Changes in species composition of catches
    - The high proportion of juvenile fish in the catch and
    - Changes in marine biodiversity, especially through loss of vulnerable and endangered species.

However, the increase in the human population and consequent increases in the demand for fish is intensifying pressure on fishery every year.

9. Degradation of Critical Habitats

The Bay of Bengal is an area of high biodiversity, with a large number of endangered and vulnerable species. The major transboundary issues relating to habitats are:

1. The loss and degradation of mangrove habitats
2. Degradation and
3. The loss of, and damage to, sea grasses.

The transboundary nature of these major issues is that all three critical habitats occur in all BOBLME (Bay of Bengal Large Marine Ecosystem) countries. Coastal development for several varying uses of the land and sea are common in all BOBLME countries. Trade in products from all the habitats is transboundary in nature. Climate change impacts are shared by all BOBLME countries. The main causes of the issues are:

- Food security needs of the coastal poor
- Lack of coastal development plans
- Increasing trade in products from coastal habitats
- Coastal development and industrialization
- Ineffective marine protected areas and lack of enforcement
- Upstream development that affects water-flow, intensive upstream agricultural practices and increasing tourism.

8. Trans-boundary issues affecting the BOB marine ecosystem

A transboundary issue is defined as an environmental problem in which either the cause of the problem and/or its impact is separated by a national boundary or the problem contributes to a global environmental problem and finding regional solutions is considered to be a global environmental benefit. The major transboundary issues relating to habitats are:

- Loss and degradation of mangrove habitats
- Degradation of coral reefs and
- Loss of, and damage to, sea grasses.

Sewage and organic discharges from the Ganges-Brahmaputra-Meghna River are likely to be transboundary. Plastics and derelict fishing gear can be transported long distances across national boundaries. Differences between countries with regard to regulation and enforcement of shipping discharges may drive discharges across boundaries. The main causes of the issues are:

- Increasing coastal population density and urbanization
- Higher consumption, resulting in more waste generated per person
- Insufficient funds allocated to waste management and
- Numerous rivers flow into the bay, which contains several important ports.

The Bay abounds with coral reefs, tropical dolphins and sharks. Endangered olive ridley sea turtles nest on the Indian beaches, and big game fish like marlins and tuna swim on its waters. In the Sundarbans mangroves of Bangladesh, a huge population of rare Irrawaddy dolphins survives.

The major transboundary issues relating to shared fisheries are: fishing overlaps national jurisdictions, both legally and illegally – overcapacity and overfishing in one location forces a migration of fishers and vessels to other locations.

Gas pipeline transmission is another significant factor related to the geopolitical arrangement of the Bay of Bengal. From the deep sea source we can collect valuable gas through establishing pipeline. That will contribute a lot in our energy sector. As a result the ongoing electricity problem will be solved and the burden over the population shall reduce. On the other hand our industries could function without any interruption. In these days industries have to use oil-run generators. To prevent such waste of money, immediate gas transmission is very important.

9. **Conflicts**

There are conflicts between large scale and small-scale fishermen. Poverty, unsustainable fishing practices and a decline in income from fisheries are contributing to a crisis. Addressing this crisis requires the coordinated effort of the 7 countries bordering the BOB. Other economic activities in the BOB are tourism, mining of coral and sand for construction.

10. **Bangladesh's Blue Economy Dialogue**

There are a number of reasons for Bangladesh to harness the ocean.

First, nearly 30 million people in the country obtain their livelihood from the sea through fishing. The fishing sector is poorly developed and Bangladeshi fishermen venture as far as only 40 nautical miles from the coast and therefore deep sea fishing capability is underdeveloped.

Second, the sea offers Bangladesh connectivity at the domestic level and with international markets for export and import of goods.

Third, the offshore mineral resources such as oil and gas can contribute to Bangladesh's economic wellbeing.

SAARC leaders acknowledged the "manifold contributions of ocean-based Blue Economy in the SAARC Region and the need for collaboration and partnership in this area".

11. **Governance**

- Increase political priority for the management of marine living resources, habitats and water quality
- Effective enforcement of laws and regulations and increased compliance
- Increase consistency and stability in policies and priorities
- Stronger coordination and cooperation
- Integrated planning across various levels of governance
- Improve local stakeholders' participation

9.3. Ecosystem Health, Major Step to Conserve the BOB

- Marine protected areas for biodiversity conservation and fishery management
- Restoration and conservation of degraded, vulnerable and critical habitats
- Reduction of discharge of untreated sewage and wastewater
- Reduction of solid waste and marine pollution
- Reduction and control of nutrient loading
- Nutrient modeling and ecosystem health card reporting

10. Conclusion

Some scanty work has been done on marine fauna and flora of the BOB for its exploration and exploitation. No systematic work on coastal and marine biodiversity of the BOB and its Bangladesh coast so far has been done. Not much inventory work has been carried of invertebrate fauna on both coastal and marine environment.

One thing we should never forget that millions of people's life across regions depends on the BOB. That's why we must not limit our activities of taking geopolitical facility from the Bay. In return, we must work together for protecting its environment, protect its ecology and forest areas like Shundarbans and other related cases.

Recent ban on collecting shrimp fry from natural sources can be considered a timely step in preventing massive destruction of shrimp and other fish population. However, such measures must take into account the socio-economic conditions and should have proper guidelines for rehabilitation of the poor fisherfolk. The government authorities should critically attend the opinions of the experts and should support the research facilities in order to get better resource exploitation to keep pace with the increasing demand for fish in the new century.

All countries are experiencing difficulties in implementing fisheries management, especially the ecosystem approach to fisheries. The BOB countries contribute significantly to the global problem of loss of vulnerable and endangered species.

Bangladesh wants to form a group comprising regional littoral states to cooperate in blue economy. These states are Bangladesh, India, Thailand, Myanmar, Sri Lanka, Indonesia and Malaysia.

Fishing is another area where both Bangladesh and India can cooperate as the former lacks deep sea fishing capacities. “Bangladesh has the sovereign right to fish in up to 200 nautical miles but the vessels can go up to only 40 nautical miles". The deep sea has massive untapped fishing resources but Bangladesh has been unable to tap it.

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(3) Community Hint on the Conservation of Biodiversity of the Bay of Bengal

Tapas Ranjan Chakraborty[5] & Dr Sanowar Hossin[6]

Abstract: About 710 km long coast line and 200 nautical miles seaward of the Bay of Bengal supports around 529 marine and 149 estuarine fish, around 500 birds, 35 reptiles and 45 species of mammals. Nearly 6,000 Irrawaddy dolphins are in the Sundarbans mangrove forest and adjacent waters of the Bay of Bengal. The coastal community who is dependent on the marine and coastal resources has faced the decline of fish population. Destruction of mangrove, loss of biodiversity and sea side erosion are the main problems. Community participation in conservation is a must for sustainability and socialization. Marine ecosystem is subject to trans-boundary planning. Ecosystem conservation needs to consider aspects from breeding biology of the species to the market price. The characters of a 'good participatory conservation model' should be specified by the community, scientists, practitioners and policy makers for the wellbeing of the Bay of Bangle.

Keywords: Bay of Bangle, Biodiversity, Conservation, Planning, Sustainability

Introduction

The Southernmost part of Bangladesh is bordered by about 710 km long coast line of the Bay of Bengal, which has the continental shelf of up to 50 m depth with an area of about 37,000 km2. The Exclusive Economic Zone of Bangladesh lies from the base line to 200 nautical miles seaward. A humid monsoon climate with moderate rainfall 1638-3558 mm and high air temperatures 19-330 C prevail in the coastal belt. Surface water temperature varies from 22.8-32.90 C in the Bay of Bengal and the surface salinity varies from 10-29 ppt. The salinity increases rapidly with depth in the upper 20-30 m. The primary productivity of the Bay is very high during northeast monsoon, 0.15-1.45 cm^2 /day. Tides are semi diurnal showing two high and two low waters during a lunar day. Wave height in the marine water of Bangladesh varies from 6.5 to 9.5m. It is prone to severe natural disaster, such as cyclones, storm surges, and floods. In combination with other natural and manmade hazards, such as erosion, the high arsenic contents of ground water, water logging, water and soil salinity and various forms of pollution, these disasters have made coastal dwellers very vulnerable and slowed down social and economic developments.

Methodology

The state of the biodiversity in the papers is based on literature review and the community recommendations came out from three community consultations conducted during February

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to July 2015 in Dhalghata village under Moheshkhali Island of Cox's Bazar District, located in south-eastern coastal region of Bangladesh between 21°28´ N and 21°32´E. Consultations were participated by 27 male and 11 female in total.

Coastal and marine biodiversity

The recording of the biodiversity of the Bay of Bangle has made notably for the coastal ecosystem, not at that extend. Biodiversity of the Sundarbans and the Cox's Bazar-Teknaf peninsular has been recorded by different academic and development interventions.

Coastal biodiversity

A total 453 species of birds, 42 species of mammals, 35 reptiles and 8 amphibian species for the coastal zone as a whole; for the renowned Royal Bengal Tiger (*Panthera tigris*) the Sunderban is the largest remaining natural habitat; Otter (*Lutra species*), Squirrels (*Collosciurus pygerythus, Funambalus pennati*), Wild Boar (*Sus scrofa*), and a number of dolphin species are also found. A total of 301 species of mollusks and over 50 species of commercially important crustaceans have been recorded so far in the coastal zone and the Bay of Bengal. About 46 species of coastal wildlife are endangered; 5 mammals, 25 birds, 1 crocodile, 8 turtles, 4 lizards, 1 snake and 2 frog.

Marine biodiversity

About 442 marine and 76 species fish from estuarine waters were recorded by IUCN Bangladesh in 2000. The marine list, however, contains 73 species whose distribution includes estuaries as well. MOEF (2002) surveys made 87 new records from the St. Martin's Island. Thus the present total would be 529 (442+87) marine and 149 (76+73) estuarine fish species. However, many of them are not of commercial importance (Amin & Kawsar 2003). There are about 100 commercial species of which 20 fish families are highly commercial. About 36 species of shrimps have been recorded from the marine water of Bangladesh. A total of 66 coral species were recorded, of which 19 are fossil coral. 36 living coral and the rest are under 6 families of sub class octocorallia. A total of 3 species of lobsters were recorded from the St. Martin's Island. (Tomascik, 1997). A new census conducted by the Wildlife Conservation Society (WCS) and other groups has revealed nearly 6,000 Irrawaddy dolphins in the Sundarbans mangrove forest and adjacent waters of the Bay of Bengal—an area where little marine mammal research has taken place up to this point. Five turtle species are found in the marine water of Bangladesh viz., olive ridley turtle, green turtle, hawksbill turtle, loggerhead turtle and leatherback turtle. Olive ridleys, green turtles are common while hawksbills are rare. There was an unconfirmed record of loggerhead. Leatherback turtles are seldom encountered and with no known records of nesting, in Bangladesh (Marinelife Alliance).

Table 1: Coastal and Marine Biodiversity

Category	Species #
Sponges	3
Corals	66
Mollusks	336
Shrimp/Prawns	56
Crabs (Marine + Freshwater)	16
Lobsters	3

Fish	442
Amphibians	22
Reptiles	17
Birds	628
Mammals (Inland)	42
Mammals (Marine)	3

Major threats to biodiversity

The population of the marine biodiversity has declined sharply due to environmental degradation and numerous anthropogenic activities such as over-fishing of inshore fisheries, indiscriminate catching of juveniles, construction of barrages and dams, siltation, extensive use of pesticides, pollution etc. However, increase in the human population and consequent increases in the demand for fish & fishing pressure is intensifying every year. This is believed to have caused over fishing of all stocks and populations of fishes and prawns by the use of even banned gears and methods. Collection of shrimp fry and soft shell crab is causing loss of post larvae, juveniles and pre-adults of many other species. For example, in the coastal Sundarbans area estimation provides that 97% of the shrimp fry and finfish larvae are destroyed or thrown on the land during the collection of only 3% seed of tiger prawn for shrimp culture. Thus during wild collection of 1 million *P. monodon*, an estimated annual loss of 75.75 million non- target fin and shellfish larvae occurs. Municipal waters, industrial pollution, oil pollution, and ship breaking are causing chemical and thermal pollution. An oil spill that occurred on 9 December 2014 at the Shela River in Sundarbans resulted spread oil over of a 350 km2 (140 sq mi) area in 17 December. The oil spread to a second river and a network of canals in Sundarbans, which blackened the shoreline. On 13 December 2014, a dead Irrawaddy dolphin was seen floating on the Harintana-Tembulbunia channel of the Shela River. However, it was not confirmed that the dolphin's death was caused by the oil spill. According to the local residents, few dolphins have been seen in the area since the spill. On 18 December 2014, two dead otters were recovered from the Shela River by forest department workers. An autopsy of the two otters confirmed that they had died from ingesting oil. The otter is considered to be an endangered species.

Problems identified by the community

The conservation problems and the effect of loss of the biodiversity were consulted with the community who mainly work in the sallow sea for the livelihood. The finding is as follows:

Problem	Causes	Effect	Solution
Fisheries population has declined in sea.	• Trawling in shallow sea. • Using kom, current, Tana and Pocket net for fishing • Mother fish harvesting • Shrimp fry collection. • Catching Jatka	• Unemployment among the fisher. • Less supply & higher price of fishes. • Financial crisis. • Increased rate of sea side	• Banning collection of shrimp fry/mother fish and using destructive fishing nets. • Ban on harvesting year round • Trawlers without license not allowed to fishing

	• Catching marine turtle. • Increase in the number of fisher & boat. • Fishing round the year. • Disturbance in fish habitat. • Over harvesting of sea shells. • Lack of knowledge on the importance of sea resources.	erosion due to over harvesting of sea shells. • Fishermen are to go into deep sea & stay longer period for catching fish.	• Planting mangrove in sea side area. • Alternative income generative activities for fisher in fishing ban • Create safe breeding ground for turtle. • Create awareness to check excessive harvesting of sea shell. • Enforce fishing laws strictly.
Destruction of the mangrove forests.	• Creating new salt and shrimp farm by cutting mangrove. • Over use of mangrove wood as cocking fuel • Encroachment of mangrove forests by local elites.	• Decrease of fish habitat. • Increase of natural disaster. • Decreasing number of migratory birds during winter. • Tidal waves hit the villages directly. • Insects population increased	• Collecting mangrove seedlings from existing mangrove area and create new mangrove plantation in adjacent areas. • Mangrove nursery should be setup in the area. • Enforce laws strictly to preserve the existing mangroves.
Decreasing number of birds and wild animals	• Lack of trees and bushes. • Destruction of mangrove forests. • Natural disaster. • Destruction of eggs of different birds. • Lack of food for animal • Lack of awareness for conserving wild animals and birds.	• Loss of natural beauty and biodiversity. • Increased attack of insects in human habitat.	• Save the existing mangrove. • New plantation. • Create safe bird/ animal habitat and sanctuary • Stop illegal killing. • Gradually reduce the harvesting of sea shells. • Formation of local conservation group • Create Awareness of people to conserve them.
Sea side erosion.	• Changing direction of the sea tide. • Lack of trees. • Absence of mangrove forest in most side of the island.	• Loss of agricultural land and villagers households. • People are to change their place of residence frequently. • Poorer people are facing financial crisis	• Plantation of bushy plan on the sand. • Stones/ concrete bolder should be set at the sea side areas.

Solutions suggested by the community

- Mother fish and fish fry collection should be banned
- Fisheries related law should be enforced properly
- Trawling should be banned in the shallow sea
- Fishing should be banned during fish breeding season (Asar, Sravan, Bhadra)
- Increase mangrove plantation
- Create public awareness about importance of fisheries resources
- Alternative income generation for the fishermen
- Awareness raising among the community about effect of bird or animals.
- Increase plantation of mangrove & protection of mangrove forest.
- Law enforcement against illegal catching & hunting of bird

Discussion and conclusion

Community participation in conservation is a must for the sustainability and socialization. Community in and for a marine ecosystem are not traditional. More over in aquatic ecosystem natural barriers are limited in number. Marine ecosystem is subject to trans-boundary planning. Considering the characteristic of the ecosystem and the biodiversity for a conservation plan of marine biodiversity requires number of things from breeding biology of the species to the market price.

Number of good practices is around the sea and the coast line. A review of those good practices can be done to identify the characters of a 'good participatory conservation model' for the local community who are dependent on the resource. Moreover climate change is an area to consider and many things are new where the experiences and data are really a few. A compilation of climactic data for the Bay of Bengal has to make for the use of the community, planners, policy makers, activitists and scientists.

Policies and regulation in the countries that have boundaries with the Bay of Bangle are not less in numbers. But it is time to have a close look if we can address the issues related to community, climate change, geo-political dynamics, etc. for a just and sustainable use of the resources specifically, the biodiversity.

The sustainable development goal has rightly considered the marine ecosystem in the right time. The scope within the Sustainable Development Goal needs to be explored and responded accordingly.

Conservation education at the mass level plays very important role. Mass education includes not only a form of formal session of events but also the forms of self-understanding. Tourists need to be included as the target community for the conservation education.

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(4) Coastal Pollution along the Bay of Bengal

Durga Pd. Dash[7]

Abstract: Pollution in Bay of Bengal (BoB) is causing degradation of the natural quality of the coastal environments in India and the trends are expected to increase. Polluted runoff entering waterways from diffuse land-based activities is the leading cause of water quality degradation. **Non-point source** pollution includes runoff from agricultural and forestry land, storm water runoff from urban areas and discharges from on-site sewage disposal systems. As rain water picks up pollutants such as sediments, nutrients, organic matter, bacteria, oils, metals and other toxic chemicals and transports them to coastal creeks, rivers, bays and estuaries. As such the pollution has also contributed to coral reef degradation, fish kills, sea grass bed declines and algal blooms. Polluted runoff can cause both ecological and human health impacts. Increases in polluted runoff have been linked to a loss of aquatic species diversity and abundance, including many important commercial and recreational fish species. **Point sources** include sewer out-falls, concentrated animal feeding operations, sanitary sewer overflows, storm water, oil spills, industrial discharges, discharge from boats, and dumping of ballast water from ships. The increased pollution from oil pollution, persistent organic pollutants and persistent toxic substances, sedimentation, heavy metals, sewage and organic discharges from the Ganges-Brahmaputra-Meghna rivers. High nutrient discharges from rivers could intensify large scale hypoxia. Atmospheric transport of nutrients is inherently transboundary. The other sources are persistent organic pollutants, persistent toxic substance, mercury and organo-mercury that are transported long distance with sedimentation and most heavy metal. The main causes of the issues are increased coastal population density and urbanization causing higher consumption, resulting in more waste generated per person, insufficient funds allocated to waste management, industrialization and proliferation of small industries.

Introduction: The coast is a zone or strip of land extending from the coastline, which borders the sea to where the land rises to inland. Its limit is marked by the level of high tide. The coastline is the triple interface of air, land and sea. The definition of coastal pollution by the World Health Organization goes like this **"***The introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects such as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities*.**"** Majority of the anthropogenic activities are conducted in the coastal zones or within the river catchments that releases pollutants to coastal zones. The consequence of these activities – agriculture or industrial activity, transport and commerce, power generation or urban development results in an inevitable release of pollutants. These pollutants include nutrients, sediments, organic chemicals and xenobiotics, metals etc. that ultimately end up in the seas.

The Bay of Bengal, the largest bay in the world, forms the northeastern part of the Indian Ocean. Roughly triangular in shape, it is bordered mostly by India and Sri Lanka to the west, Bangladesh to the north, and Myanmar (Burma) and the Andaman and Nicobar Islands to the

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east. The Bay of Bengal occupies an area of 2,172,000 square kilometres (839,000 sq mi). A number of large rivers – the Ganges and its tributaries such as the Padma and Hooghly, the Brahmaputra and its tributaries such as the Jamuna and Meghna, other rivers such as the Ayeyarwaddy River, Godavari, Mahanadi, Krishna and Kaveri flow into the Bay of Bengal. The important ports are Chennai, Chittagong, Kolkata, Mongla, Paradip, Tuticorin, Visakhapatnam and Yangon.

Coastal zone: Coastal zone along Bay of Bengal is a dynamic area with many cyclic processes owing to a variety of resources and habitats. Coastal plains and seas include the most taxonomically rich and productive ecosystems on the earth. Mangroves forests are over 20 times more productive than the average open ocean. Estuaries, salt marshes and coral reefs are 5 to 15 times higher and shelf seas and upwelling zones 2 to 5 times higher. These enhanced rates of primary production result in an abundance of other life forms including species of commercial importance. Although occupying only 8% of the total surface, ecologically important areas account for 20-25% of global plant growth. The coastal region is a place of hectic human activity owing to urbanization and industrialization resulting in human interference of rapid development. In recent years, the coastal ecosystems are highly disturbed and very much threatened, encountering problems like pollution, siltation, erosion, flooding, salt water intrusion, storm surges etc.

Coastal pollution: Coastal pollution is a change in the physical, chemical and biological characteristics of water & sediments. It causes degradation of the natural quality of the coastal environments and affects the health and survival of all forms of life. Coastal pollution is a major problem in developing countries and the trends are expected to increase.

Table 1: Types, Causes and Impact of Pollution in the Coastal Zone

Major pollutants in coastal and marine environment	**Causes of Coastal Pollution**	**Industries responsible for coastal pollution**	**Impact of pollution on coastal ecology**
Oil Sewage Garbage Pesticides Toxic chemicals Heavy metal Radioactive waste Thermal pollution Nutrients	Population growth Urbanization Industrialization Domestic waste Industrial effluents Agricultural runoff Shipping activity Offshore exploration & exploitation Infrastructural development	Fertilizers Sugar Textiles Chemicals Mines and minerals Pulp and paper Leather tanneries	**Corals Reefs** – loss due to anthropogenic stress, collection and recreational activities **Mangroves**– degradation due to over exploitation **Fisheries**– decline in catch rate due to overfishing and overdependence on trawlers **Biodiversity-** micro organism**,** plankton, benthos**,** mammal are affected **Beaches**– reduction in benthic organisms due to oil pollution

Source: ????

Table 2: Inflow of pollutants in the coastal area in India

Sl No.	Input / pollutant	Quantum - Annual
1	Sediments	1600 million tonnes
2	Industrial effluents	$50 \times 10^6 m^3$
3	Sewage - largely untreated	$1.41 \times 10^9 m^3$
4	Garbage and other solids	34×10^6 tonnes
5	Fertilizer - residue	5×10^6
6	Synthetic detergents - residue	1,30,000 tonnes
7	Pesticides - residue	65, 000 tonnes
8	Petroleum hydrocarbons (Tar balls residue)	3,500 tonnes
9	Mining rejects, dredged spoils & sand extractions	0.2×10^6 tonnes

Source: ????

According to the National Oceanic and Atmospheric Administration (NOAA), 80% of pollution to the marine environment comes from the land, which occurs as a result of runoff. This includes many small sources, like septic tanks, cars, trucks, and boats, plus larger sources, such as farms, ranches, and forest areas. Millions of motor vehicle engines drop small amounts of oil each day onto roads and parking lots. Much of this, too, makes its way to the sea. Some water pollution actually starts as air pollution, which settles into waterways and oceans. In some areas, this pollution is so bad that it causes beaches to be closed after rainstorms. The flow chart (Figure 1) is based on the path way of entering nutrients and pollutants in coastal and marine environment.

Sewage, domestic waste & municipal waste in the Bay

Raw sewage being dumped into the ocean happens on a regular basis. The oceans are vast and can break down this vile liquid, but it still causes many adverse effects on marine life causing the coastal environment pollution. Sewage or polluting substances flow through sewage, rivers, or drainages directly into the ocean. This is often how minerals and substances from mining camps find their way into the ocean. The release of other chemical nutrients into the ocean's ecosystem leads to reduction in oxygen levels, the decay of plant life, a severe decline in the quality of the sea water itself. As a result, all levels of oceanic life, plants and animals, are highly affected. Domestic sewage and industrial effluents are released in the water courses along the Bay in untreated or partially treated form. These, of course, add a mixture of pollutants which include, among others, certain toxic heavy metals and metalloids.

These, naturally, add environmental pollution in coastal areas along the Bay of Bengal. Sewage and organic discharges from the Ganges-Brahmaputra-Meghna rivers are likely to be trans-boundary. High nutrient discharges from rivers could intensify large scale hypoxia. Atmospheric transport of nutrients is inherently trans-boundary.

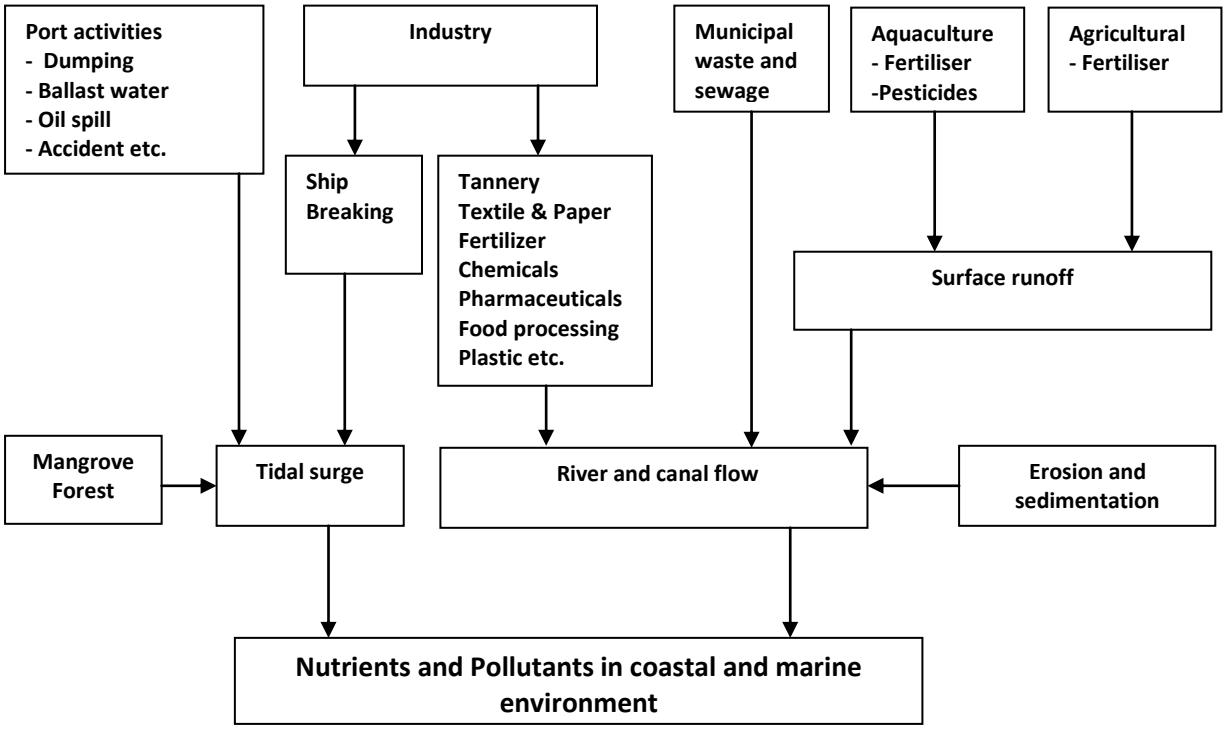


Figure: Pathways of entering pollutants and nutrients

Nutrient loading, agricultural runoff and eutrophication

While nutrients are chemicals essential for the growth of organisms, nutrient pollution refers to the contamination by excess inputs of nitrogen and phosphorus into aquatic systems. Over the last few decades since the era of intensive agriculture, the dependence on nitrogen and phosphorous fertilizers to enhance agricultural productivity has led to massive increase in the production and application of fertilizers to farm land. The often inefficient use of this fertilizer has led to substantial run-off and release of nutrients to the waterways ultimately reaching the oceans. The resulting nutrient enrichment has contributed to coastal eutrophication, degradation of water quality and coastal habitats, and increases in hypoxic waters, which in turn has undermined the services and livelihoods supported by the biologically rich marine and coastal ecosystems. Agricultural nutrient loading to coastal waters is during rains/floods. Nutrient leakage from sediment transport and upwelling, fisheries, aquaculture and livestock farming is also high, especially in areas of intensive aqua-farming.

This nutrient enrichment, eutrophication, initially stimulate growth of phytoplankton, microalgae and macro-algae, which in turn can lead to other impacts such as:

- Loss of sub-aquatic vegetation as excessive phytoplankton, microalgae, and macro-algae growth reduce light penetration.
- Change in species composition and biomass of the benthic (bottom-dwelling) aquatic community, eventually leading to reduced species diversity and the dominance of gelatinous organisms such as jellyfish.
- Coral reef damage as increased nutrient levels favour algae growth over coral larvae.
- A shift in phytoplankton species composition, creating favourable conditions for the development of nuisance, toxic, or otherwise harmful algal blooms.

- Low dissolved oxygen and formation of hypoxic or “dead” zones (oxygen-depleted waters), which in turn can lead to ecosystem collapse due to mass fish kills.

Heavy metal pollution and sedimentation

Heavy metals from natural and anthropogenic sources continuously enter the ecosystems mainly through aquatic ecosystem. This indirectly affects the aquatic biota due to their toxicity. Many of the metals (Co, Cu, Mn, Fe and Zn) are essential trace elements for aquatic organisms and are involved in biochemical processes such as enzyme activation. But mostly if these elements exceed the limit can cause toxic effects. The most basic property of heavy metal is that they are bio-available and are indestructible having toxic effects on living organisms when they exceed a certain concentration limit. The high metal concentration may be originated from anthropogenic sources such as **waste incineration, vehicle operations, combustible consumed fertilizer use,** which likely come from the upper basin of the system that flow into the wetland. Evaluation of important and valuable mussels is necessary prior to the future development of industries or power plants near the marine environment. A realistic assessment of metals as toxicants in man’s environment is essential to establish meaningful pollution guidelines.

The Bay of Bengal used to be deeper than the Mariana Trench, the present deepest ocean point. The Ganga–Brahmaputra River deposits nearly 1000 million tons of sediment per year. The two rivers currently contribute nearly 8% of the total organic carbon (TOC) deposited in the world's oceans. Due to high TOC accumulation in the deep sea bed of the Bay of Bengal, the area is rich in oil and natural gas and gas hydrate reserves. Further south of Bengal, the Mahanadi, Godavari, Krishna and Kaveri Rivers are the major rivers that flow from west to east in the Indian subcontinent and drain into the Bay of Bengal. Many small rivers also drain directly into the Bay of Bengal; the shortest of them is the Cooum River at 64 km (40 mi).

Major coastal activities leading to coastal/marine pollution in Tamilnadu along BoB are presented in Table 3 below.

Mercury hazards: poisoning the coastal environment

Mercury is poisonous in all forms - inorganic, organic or elemental. Methyl mercury is a neurotoxicant: it can damage the developing brain as it crosses the placental and blood-brain barriers easily. The threat to the unborn is, therefore, of particular concern. It can also trigger depression and suicidal tendencies, paralysis, kidney failure, Alzheimer's disease, speech and vision impairment, allergies, hypospermia and impotence.

Mercury, a very toxic and dangerous substance, has severely contaminated land, water, air and the food chain throughout India. Lead in water comes from industrial, mines and smelter discharges before being deposited in the sediment sinks. Industries, which contribute to mercury pollution in India, are coal fired plants viz. thermal power plants, steel industries and cement plants. Plastic industry (mercury is used as a catalyst), pulp and paper industry, medical instruments and electrical appliances, certain pharmaceutical and agricultural product accounting for additional consumption of mercury. India consumes 75 million tons of coal every year in various thermal power plants. Coal contains mercury and its combustion as a source of energy is often cited as significant source of mercury emission. Mercury levels are reported to be extremely high in the working environment of these industrial processes including thermometer factories, and even medical practices such as dental clinics. The effect of mercury on human health and the working environment in the industry has not been taken

seriously by Management. The hazardous working conditions and dangerous waste management practice is still continuing in several industries related to mercury

Table 3: Activities leading to coastal pollution

S. No.	Activities	Places
1	Discharge and disposal of domestic wastes	Chennai, Pondichery, Cuddalore, Tuticorin
2	Discharge and disposal sewage and industrial wastes	Chennai, Pondichery, Tuticorin, Kayalpattinam
3	Harbour activities and maritime transport	Chennai, Cuddalore, Nagapattinam, Tuticorin, Colachel, Vallinokkam
4	Fishing activities	Throughout the coast
5	Oil exploration, production and refining	Chennai, Cauvery delta, Nagapattinam, Palk- Strait
6	Recreation and tourism	Chennai, Pondicherry, Tranquebar, Rameswaram, Thiruchendur and Kanyakumari
7	Salt production	Kovalam, Marakkanam, Vedaranyam

Mercury contamination in water in India is verging on an alarming situation due to discharge of industrial effluents containing mercury ranging from (0.058-0.268 mg/l) against 0.001mg/l. as per WHO and Indian standards.

- About 0.20 kg of mercury is lost per ton of caustic produced thereby creating serious pollution causing adverse effect to biological system.
- Mercury levels in water near caustic chlorine industry has been reported as high as 0.176 ± 0.0003 mg/l. in water and 596.67 ± 25.17 mg/kg dry wt. soil against the prescribed limit of 0.001 mg/l. in water and 0.05 mg/kg in soil.

Petroleum hydrocarbon (PHC)

PHC concentration was monitored in water of estuaries, ports, and coastal transects in East Coast of India. The highest concentration was observed at **Haldia** port (1.60–20.11 μg/l) due to the impact of hydrocarbon discharges from nearby oil refinery, petrochemical industries, handling of crude oils, etc. **Hoogly** estuary recorded higher values of PHC (1.17–18.50 μg/l) due to the influence of industrial wastes, land runoff, and port activities. The principal cause of marine pollution with oil is shipping. Ocean is polluted by oil on a daily basis from oil spills, routine shipping, runoffs and dumping. Oil spills make up about 12% of the oil that

enters the ocean. The rest come from shipping travel, drains and dumping. Oil spills causes a much localized problem but can be disastrous to local marine wildlife such as fish, birds and sea others. Oil cannot dissolve in water and forms a thick sludge in the water. This suffocates fish, gets caught in the feathers of marine birds stopping them from flying and blocks light to photosynthetic aquatic plants.

India, with the longest coastline of 5,423 km contributes around 50 billion litres of industrial effluents, 30 billion litres of sewage, 5 million tons of fertilizer residues, 3,500 tons of petroleum hydrocarbons and 0.2 million tons of mining rejects, dredged spoils and sand extractions ultimately cause the environmental pollution.

Pollution hotspots along the Coast

Calcutta: The Hoogly river carry effluents that have contaminated fish and shell fish with heavy metals such as Ni, Cu, Cd and Zn. Highest concentration was observed at **Haldia** port due to the impact of hydrocarbon discharges from nearby oil refinery, petrochemical industries, handling of crude oils and the sediments have observed up to 10 ug/g of pesticides. These river waters are contaminated by e-coli, shigella, salmonella and other human pathogens - indication of severe sewage contamination.

Chennai: The levels of hydrological pollution of Chennai coastal zone in the south-eastern part of India have been increased in the recent years by an uncontrolled disposal of wastewater and pollutants due to human activities. Based on detailed examination, four sites including Cuvum estuary, Adyar estuary, Kannikoil and Bharathiyar nagar are identified as highly venerable zones because of receiving a large quantity of municipal and industrial wastes. To reduce severe pollution levels in these areas it is therefore necessary to design and construct the submarine pipeline system to transport and disperse such a large quantity of waste materials to the deep open ocean areas

Tamilnadu: Coovum River is a live example of toxic metal pollution. The water has almost no dissolved oxygen, and instead there are traces of heavy metals like copper, besides sewage and sludge. Apart from this, the microbial load of the river also has gone risen far above the optimum levels. This is of great concern, because it has a negative impact on our surroundings. It can be the breeding grounds for several infectious disease causing pathogens. If this river is going to pollute at this rate, without any measures it will result in several health and environmental issues. Necessary steps should be taken to stop polluting these waters and steps to clean the Coovum River should be taken.

Andhra Pradesh: Visakhapatnam along the east coast region is highly polluted by eutriphication and several port activities. Excessive use of chemical fertilizers, containing high nitrogen quantity ultimately leaches and drains into the coastal zone through rivers and rivulets causing environment pollution along the BoB.

Odisha: Coastal environment is being polluted by nutrient loading like phosphorus from fertilizer industry in Paradip coastal region. Industrial pollutants drain into the BoB through Brahmani river causing vulnerability to Mangrove ecosystem in Bhitarkanika Ramsar site.

Suggestions to protect marine environment

Improved and sustainable steps should be taken to reduce the environmental pollution in the coastal region along the BoB. Proper industrial planning and the safe disposal of ship oil, industrial and urban waste can reduce the high levels of pollutants into coastal ecosystem and would save our enormous coastal resource of the country. Land-based pollution should be minimized through imposing proper regulations and recycling of waste materials. Specifically the sources of pollution, quantity, and their causes should be identified and possible management measures should be developed. Standard and uniform data on pollution status of the BoB should be developed and compared with the data of neighboring regional sources. Research should be undertaken to know the bioaccumulation and relation of pollution with estuarine and brackish water fisheries. Reliable statistic on fish catch, landing, species composition and seasonality should be generated for sustainable management of the BoB. Capacity building of the BoB's fishers should be developed and integrated for resources management and protect environmental degradation.

(5) Status of Coastal Zone Management in Myanmar

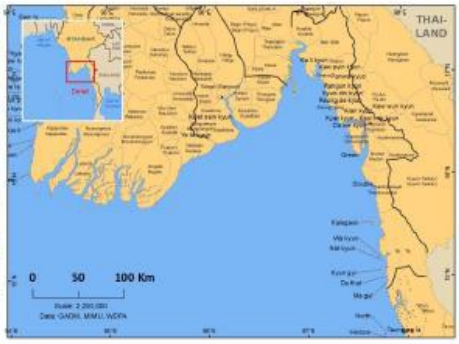
Htun Paw Oo[8]

1. Background

Coastal zone of Myanmar is in the Bay of Bengal with Bangladesh, India and Thailand. The three coastal zones of Myanmar consist of Rakhine Coast, Ayeyarwady Delta and Tanintharyi Coast. The Rakhine Coast, 740 km, deltaic coastal zone, 460 km and is outlets of the three major rivers including Ayeyarwady, Sittaung and Thanlwin. Tanintharyi Coastal area has the longest coastline stretching over 1,200 km from the Gulf of Mottama to Pakchan River which is bordered with Thailand. It is fringed in southern part by the Myeik Archipelago and is also home to more than 1,700 inshore and offshore islands.

Myanmar has a tropical to subtropical monsoon climate. The mean annual rainfall is around 2,350 mm. Annual rainfall can be as high as 4,000-6,000 mm along the coastal reaches and in the mountains of Rakhine and Tanintharyi, and ranges between 2,000-3,000 mm in Ayeyarwady Delta.

1-A Rakhine Coast



1-B Ayeyarwady Delta

1-C Tanintharyi Coast

2. Key coastal habitats

With a coastline of over 2,400 km, Myanmar possesses complex and diverse ecological and socio-economic systems. Coral reefs, sea grass beds and mangroves flourish mainly in the Myeik Archipelago. Estuaries and mud flats are common in the Ayeyarwady delta. Mangroves cover an estimated area of 467,330 ha making Myanmar the fourth largest mangrove coverage in Asia, after Malaysia, Bangladesh and Papua New Guinea. The majority is located on Ayeyarwady floodplains, with the remainder in Tanintharyi and a lesser portion in the Rakhine Coast. Species distributions and compositions of mangroves differ amongst the three coastal regions.

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Mangroves: Mangrove ecosystems contribute a wide range of goods and services to the coastal population, particularly as charcoal and firewood for cooking, timber for construction, nurseries and artisanal fisheries. The role of mangroves in protecting coastal lands, settlements and infrastructure against the effects of cyclones and tidal surges is also well-recognized. However, over the past three decades more than half of mangroves have been undergoing over-exploitation, illegal felling, agricultural expansion and conversion to fishponds and shrimp ponds.

Mangrove coverage estimated in 2010 has significantly decreased in the past three decades. The depletion and degradation of mangroves is comparatively greater in Ayeyarwady region than in other areas due to higher population, easier accessibility to the forest and the devastated impacts of Cyclone Nargis.

Coral reefs: Coral reefs in Myanmar remain largely unexplored and the species diversity and health of this ecosystem is poorly known. Rakhine and Tanintharyi coastal areas, in particular offshore island of Myeik Archipelago, are the most favorable grounds for both hard and soft corals. Research studies including master and doctoral degrees theses identify a wide range of coral species, from 51 in 1972 to 512 species in 2014. However, Myanmar coral reefs have declined due to prolonged exposure to blast fishing, illegally small-meshed fishing nets and unregulated marine product resource extraction.

Fisheries: Fishery resources in Myanmar waters are approximately 470 species of marine fishes including 67 commercially important pelagic species, and13 crustacean species. Three species are listed as Endangered in the IUCN Red List of Threatened Species including Hilsa shad (*Tenualosailisha*), Indian threadfin (*Polynemusindicus*), and four-finger threadfin (*Eleutheronematetradactylum*). Each of these species is greatly harvested for food along the coasts of Myanmar, and the regional stock of Hilsa is overfished throughout its range.

According to the Marine Fisheries Law, Myanmar marine fisheries were partitioned into inshore (coastal) and offshore fisheries, which used a fixed spatial reference for administration. Inshore fishery includes areas that are within five nautical miles from shore along the Rakhine coast and ten nautical miles from shore for the Ayeyarwady and Tanintharyi coasts. Fisheries products are exported alive, fresh frozen or chilled and processed. Border trade system, particularly with China and Thailand, has been the major transaction mode for Myanmar fisheries export.

Production of marine fish through aquaculture is relatively small compared with production of shrimp from aquaculture or production of wild caught marine fish. Aquaculture is practiced largely in freshwater and brackish water along the coastal area but on a limited scale in sea water. Considering the continuing deterioration of fish habitat and inland fish stocks together with high foreign demand for food fish of high-value species such as shrimps, sea bass (*Latescalcarifer*) and groupers (*epinephilusserranidae*), the government has encouraged the industry to increase total fishery production through culture-based fishery. As a result, there is a need to develop environmental-friendly aquaculture, sustainable aquaculture as well as conservation measures for mangrove resources.

Port extractive industries: Spreading across the entire coastline, there are currently nine ports that serve coastal and seaborne trade. These are Sittwe, Kyaukphyu, Thandwe, Pathein, Yangon, Mawlamyine, Dawei, Myeik and Kawthoung. The coastal area of Yangon Division

remains highly important for Myanmar's port facilities. Thilawar, a newly built port is crucial for the development of the nation's expanding trade under the market-oriented economic system.

Extractive Industry: There are a total of 101 blocks set aside for oil and gas exploration in Myanmar including 48 offshore blocks. In January 2012, there were 12 foreign oil companies working in 27 offshore blocks: 10 off the Rakhine Coast, 12 near the Gulf of Mottama and 5 off the Tanintharyi Coast. Oil and gas industries account for about 50% of government revenues but have a relatively small impact on local employment or local economy. Sand is currently being mined from river bottoms as well as the sandy sea floor in Myeik Archipelago. The product is exported to Singapore for construction use and land reclamation. There has been limited information on the operation of this industry and the extent of impact these operations may have on deep water and near-shore ecosystems. Even so, other countries including Indonesia and Malaysia have enacted bans on the industry due to environmental concern and potential threats.

Marine and Coastal Tourism: Tourism is one of the fastest-growing industries in Myanmar, especially since 1996. The number of tourists visiting Myanmar has demonstrated a growing trend and it was estimated that the number of tourists would be estimated about 5 million on March 2015. It is expected that the country will experience a rapid coastal tourism development as a result of overall economic development. There has been a substantial growth in tourist visitation to the southern islands of Myeik Archipelago through the Kawthoung border point.

3.Challenges

Myanmar has a population of 51.4 million people. The country has a moderate population density of 76 people per sq km. Myanmar as a nation is unlikely to face a problem of overpopulation, but records from the Ministry of National Planning and Economic Development and Central Statistical Organization indicate high and rising human population pressure in coastal and delta areas.

Information for the livelihoods and living standards of the coastal population is very limited. The majority of the coastal communities depend upon fisheries and agriculture, with minority live on tourism and industrial development. Other economic activities include logging, hunting, snails collecting, aquaculture and fishery industry. A number of coastal communities suffer from poverty and a lack of viable livelihood options.

Population growth accompanied by increased resource utilization as well as the ever-increasing demand for resources from neighboring countries have put biodiversity in Myanmar under severe pressure. The country remains one of the ten countries in the world with the largest annual net loss of forest area and among the five countries (Brazil, Indonesia, Myanmar, Nigeria and United Republic of Tanzania) (FAO, 2015). Mangroves were degraded and have decreased due to over exploitation of forest products and conversion to agricultural land. When paddy yield declined, land was converted for shrimp farming. When shrimp farming was affected by increased acidification and water pollution, people encroached into another mangrove area for repeating the process of mangrove exploitation. In Tanintharyi Region, palm oil concessions have been granted in large forest areas and rubber plantations have almost doubled in coastal areas from 1990 to 2010.

Overexploitation of mangroves for fuelwood and charcoal production: Mangroves, in Ayeyarwady Region in particular, have been degraded because of overexploitation of fuelwood for Yangon cities and towns in adjacent areas. In Rakhine State and Tanintharyi Region, mangroves are in better condition although there are increasing needs of fuel-wood from Yangon city to meet an annual demand of 700,000 tons. In addition to household consumption, fuel-wood and charcoal are supplied to cottage industries, restaurants and tea shops.

Overfishing: The introduction of trawling in the 1970s and use of advanced fishing gears are likely to increase pressure on fish resources in Myanmar waters. Overfishing has been persistent due to several reasons involving an increasing demand of fish for local consumption, high dependency of artisanal fisherfolk upon coastal waters for their livelihood, and a large number of fishing boats from neighboring countries. By 2006, the last year for which figures are available, Myanmar's fishing vessels were catching on average just 86 kg of fish an hour. To compensate fishers with equal amount of catch as previous, fishing days has been allowed to fish in one trip at sea for fishing vessels from 25 days to 90 days per trip. That allows fishers to maintain their total catch and transport their products to the nearby landing sites.

Climate change and natural disaster: The 2008 Cyclone Nargis caused over 140,000 casualties and catastrophic destruction of vast mangrove areas in Ayeyarwady Region, impacting food security of coastal communities. In the coastal and marine regimes, frequent and intense storm as well as strong wind and wave can have direct effect in fisheries both inshore and offshore. Coastal zones especially areas interspersed with tidal waterways like the Ayeyarwady Delta may face permanent inundation due to sea level rise. The highly productive deltaic and low-lying coastal rice/local crop cultivation areas will also be exposed to increased salinity and coastal erosion. As climate change impacts could severely undermine economic growth in Myanmar, the formulation and implementation of policies on climate change adaptation is vital for sustainable development.

4. Integrated management concept

Initiatives on Integrated Resource Management and Integrated Mangrove Management have been practiced in Ayayarwady Delta in since 1998 and 2003 during the Ayeyarwady Mangrove Project (FD/UNP/FAO) and Integrated Mangrove Management through Community Participation Project (FD/JICA). It was noted that the following strategies have been guided in these approaches:

- To rehabilitate mangrove resources
- To manage the remaining and rehabilitated mangrove resources for sustainable use
- To sustain production of cultivation and forest areas
- To be compatible with mangrove resources and socio-economic activities.

Constraints to coastal management: There has been no separate policy or legislation pertaining to management of the coastal resources. Agricultural production in coastal zones is carried out by farmers through agriculture supervision committee and the Department of Agriculture, while fisheries management through the Department of Fisheries and mangrove forest management through the Forest Department. Key challenges in this context are the absence of appropriate integrated planning, collaboration and coordination mechanisms in policy making level.

The causes of biodiversity loss and unsustainable use of coastal and marine resources in Myanmar are correlated with a number of aspects involving: limited knowledge and understanding; capacity constraints; lack of environmental safeguards; undervaluation of resources; lack of comprehensive land-use policies and plans; gaps in legislations and weak enforcement; poverty and subsistence needs; lack of grassroots support for conservation; and global climate change.

There are a number of reports, documentation and research studies in relation to various aspects of the Myanmar coastal ecology and environment; however a review of published studies shows that there is still much to improve the understanding of the current state of Myanmar coastal and marine resources. Research is required as a critical component to identify threats to the ecosystems and responses to the issues and constraints through effective conservation and management. Having limited and outdated biological or ecological baseline data means that there is nothing upon which to base management decisions such as zoning, extraction quotas, usage types or even population models. In the absence of reliable survey data, it is not possible to undertake Integrated Coastal Management or Marine Resource Management. In Myanmar, knowledge is not adequately available, shared and used for informed decision making on the value of biodiversity and coastal ecosystems. Coastal and marine ecosystems are undervalued, and thus must be analyzed. In-country capacity to conduct research, particularly at universities, needs to be improved.

The highly productive deltaic and low-lying coastal rice/local crop cultivation areas will also be exposed to increased salinity and coastal erosion. As climate change impacts could severely undermine economic growth in Myanmar, the formulation and implementation of policies on climate change adaptation is vital for sustainable management of coastal resources.

Inadequate Capacities: Capacity inadequacies along with minimal allocation of capital for the management of coastal and marine resources are major barriers to combat persistent illegal activities and unsustainable practices in Myanmar coastal zones. Government institutions responsible for conserving biology and managing Marine Protected Areas (MPAs) often suffer from shortages of financial resources and technical expertise. Illegal activities such as logging and destructive fishing have been persisted in the Park boundaries. Similarly fishery sector has limited staff and budget to regular patrol and interdict or arrest illegal fishers in the offshore areas of Myanmar Economic zone, except in partnership with the Myanmar Navy or Army Coastal Defense. Such limitations result in on-going dynamite fishing and unknown outcome of policy implementation such as the licensing system and banning of trawl fishing and importantly, bribery. The current constraints however represent opportunities for NGOs and academic institutions to play a role in strengthening the capacity of key government institutions responsible for conservation.

5. Recommendations

Myanmar has been a member of Mangrove for the Future programme since 2014. The Ministry of Environmental Conservation and Forestry initiated to establish a national level committee for coastal resource management.

- Develop a guidelin for national coastal resources policy, legal and institutional frameworks. This is the need of the time.
- Incorporate the latest knowledge of climate change into coastal area development policy and planning process.

- Promote the implementation of ecologically sustainable development activities in coastal areas. Recognize and solve problems and conflicts of coastal resources competition among a multitude of users.
- Promote coordination with all relevant national and international institutions for the conservation, management and research of coastal resources such as mangrove, coral reefs and sea grasses and so on. Review and accept scientific advice and integrate this knowledge into the preparation of natural resource management plans.
- Strengthen infrastructure support systems, alternate livelihood programs and basic health and education services on a priority basis.

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(6) Thailand's Ramsar Sites and Isthmus of Kra

Sansanee Choowaew[9]

Bordering the Bay of Bengal, Thailand has at least 5 Ramsar Sites, namely (1) Laem Son National Park, Kraburi Estuary, and Kapur Canal Outlet in Ranong Province; (2) Krabi Estuary in Krabi Province; (3) Phang Nga Bay National Park in PhangNga Province; (4) Had Chao Mai Marine National Park, Mu KoLibong Non-Hunting Area, and Trang Estuary in Trang Province; and (5) Ko Ra and Ko Phra Thong Islands in Phang Nga Province. All these 5 Ramsar Sites contain various diverse and important types of wetland ecosystems (e.g. one of the oldest and best mangrove forests of Thailand, ancient mollusk fossil areas, habitats of dugongs, sea-turtles, and birds) and thus have very high values for biodiversity conservation, fisheries, and ecotourism. In addition, the Isthmus of Kra, the narrowest part of the Malay Peninsula (only 50 km from the Andaman Sea on the West to the Gulf of Thailand on the East), is another unique ecosystem and landscape in Kraburi District of Ranong Province, having Kraburi River, a natural boundary between Myanmar and Thailand, flowing into the Bay of Bengal.

The idea of short-cutting of shipping distance and times between the Andaman Sea and the South China Sea was of interest since Ayutthaya Period and has been of almost all governments' interest since the 1990s. 'Kra Canal' was the first proposed spot due to its shortest distance. However, due to the landscape, geography and geomorphology, proposed locations have changed. The feasibility studies of 'Thai Canal' instead of 'Kra Canal' were carried out since the 1970s. At least 12 locations/options/routes have been proposed and discussed. All are strategically important, having different geomorphology and distances. Issues considered among proponents of new shipping route options include shorter shipping distance and time, lower shipping cost, less use of energy, economic benefits, and potential for economic development. Issues raised by opponents include political stability, social change, regional conflicts, shipping demand and traffic, investment cost and benefit sharing, transparency of feasibility studies and environmental impacts assessment, importance of public participation in decision-making, canal management, and especially environmental/ecological concerns.

Key issues of environmental/ecological concerns are immediate and long-term threats to Ramsar Sites, Biosphere Reserves, Protected Areas, and many other important coastal/inland wetlands especially Songkhla Lake; effectiveness of environmental impacts assessment and mitigation measures; and ecological impacts during pre-, during-, and post-construction periods as well as pollution of all forms and biodiversity loss. Decision making has not been made now and may not be materialized in the near future under the political turbulence and ineffectiveness of environmental impact assessment mechanism.

Mega-projects such as 'Thai Canal Project' have raised public awareness of the values and importance of the existence and maintenance of naturally healthy ecosystems bordering the Andaman Sea and the Bay of Bengal. At present, the Bay of Bengal and her wetland ecosystems have been already being facing with various human and natural threats. All countries bordering the Bay of Bengal should join hands and initiate collective conservation efforts. For example, a network of communities surrounding Ramsar Sites on the Bay of

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Bengal of each country should be established. Collective efforts and activities such as wetlands inventory and status monitoring/surveillance are possible.

(7) Straits of Malacca and Penang

Mashhor Mansor[10]

The Bay of Bengal has been an important route to the Straits of Malacca and Penang plays a crucial role as a major port since 1876.

Since 1876 Penang had been colonized by the British through its British East Indian Company (BEIC). Sir Francis Light was the founder of modern Penang and obtained the Penang from the Sultan of Kedah. The location is at the tip of Straits of Melaka which connected to the Bay of Bengal. The island was a suitable location for a port. Ships from coastal areas along the Bay of Bengal could easily travel through Penang. From Penang the ships can travel through the Straits of Melaka and subsequently reach China through the South China Sea.

From as early as 1st Arab traders had travelled through the Bay of Bengal to reach South East Asia. The first European nation was Portugal followed by the Dutch and the British respectively. Evidently, the Malay cultures were greatly influenced by the ancient East-West maritime trade. Penang came into contact with India since late prehistoric times. It can be considered as a gate way from the Bay of Bengal to Malaya and Singapore.

Based on Leng (2009) there were two major components that Penang was a successful Asian Entrepot where it was the hub and the point of contact and interaction for the sub-region in the north strait of Melaka and the networking not only within the sub-region but the wider world beyond the South Asian region.

Langdon (2015) stated that about two centuries ago, Penang had been elevated the fourth most important settlement of the British East Indian Company. Therefore Penang was part of the Indian territories. This is because of the expansion of international trade networks linking Europe with India, Malaya and China. Penang was pointed out to be the future growth of the British Empire in the east.

Eastern part of Bay of Bengal is included in Indochina bioregion. The region covers Myanmar coastal zone, Thailand coastal zone and northern part of Peninsular Malaysia. Penang is in between Indochina bioregion and Sunda Shelf bioregion. Evidently ecoregions are usable to make suitable planning conservation planning units at regional and global scales. Bioregion is therefore defined by Ricketts *et al*. (1999) as cluster of ecoregion that share a similar biogeographic history and share many genera and families of plants and animals.

Penang capital city, George Town was accorded as UNESCO world heritage centre on the 7 July 2008. It was developed over 500 years of trading and cultural exchanges between East and West in the Straits of Malaka. The socio culture due to the influence of various cultures from Asia and Europe has a significant impact on the town history. The unique architectural and British influence on cultural township reflected a town in Britain.

The historic city of George Town met the criteria of Outstanding Universal Value (OUS) as defined by the UNESCO World Heritage Committee. This is based on values which are

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universally recognized as crucial having influenced on human cultures. It is a living testimony to the multi-culture heritage and tradition of Asia.

The old name of George Town was Tanjung Penaga. It was name after a tree Penaga (Ca*lophyllum inophyllu*m). George Town has been ranked as the most liveable city in Malaysia and eight most liveable cities in Asia. During the colonial times, besides Europeans, there were communities of Siamese, Burmese, Filipino, Ceylonese, Eurasian, Japanese, Sumatran, Arab, Armenian and Parsee. Muslim made up of 45%, Buddhism 36%, Hinduism % and Christianity 5%.

Penang has been a popular international and domestic tourist destination. It is known for its rich heritage, multicultural society and its vibrant culture. The hills, parks, beaches, shopping and foods are part of the attractions. Penang is also famous for its foods. It is known as the food capital of Malaysia. The seafront promenade provides delightful and high end cuisine.

Penang is always ahead in Malaysian education. Penang Free School (1816) is the oldest English school in Asia. St. Xavier's Institution (1852), Convent Light Strait (1852) is the first school for girls in Malaysia. Methodist Boys' School (1891) and Methodist Girls' School (1891). The first Prime Minister of Malaysia, Tunku Abdul Rahman was educated at Penang Free School and the fifth Prime Minister of Malaysia was educated at Methodist Boys School. There are also a few international schools such as Dalat International School, Tenby International School and Prince of Wales International School.

The Universiti Sains Malaysia (USM) one of the top ranking universities in this part of the world is in Minden. Muka Head is a field station for USM and it is in Penang National Park. Several renowned universities have utilized the field station for their field researches.

Penang National Park with an area of 2,562 ha is one of the smallest parks in the world. It was gazetted in 2003 at the north western tip of the island facing the Bay of Bengal. It is the site to observe brahminy kite *(Haliastur indus*), green turtle (*Chelonia mydas*) and Irrawaddy dolphin (*Orcaella brevirostris*).

The most popular beaches in Penang are located at Tanjung Bunga, Batu Ferrighi and Teluk Bahang. The prime hotels lining along the beaches attracted tourists especially from Europe. The historical landmark in George Town is Fort Cornwallis. Penang Botanical Garden is a home of wild monkeys and Penang Hill is a hill station.

The natural ecology of Penang is comprised of tropical rainforest, mangroves, coastal beaches and rocky shore. There are pocket of secondary forest left over from rubber plantations. The highest peak Western Hill which is 833 m and the famous Bukit Bendera 732 where farmer British residents enjoyed the cool air. There is a funicular rail to the peak of the hill and the Bay of Bengal can be detected during the clear weather.

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(8) Coastal Resources of Aceh, Indonesia

Mr. Onrizal[11]

1. The coastal area of Indonesia is about 95,161 km. The area is tectonically most vulnerable to natural hazards, especially earthquake and the Tsunami.
2. Aceh Province is located at the westernmost end of Indonesia and to the north and the west it borders the Malaka Strait, to the west the Indonesian Ocean, and to the south the province of North Sumatera.
3. The area is highly vulnerable to tsunami, the recent ones being Indian Ocean Tsunami (26 Dec 2004) and Nias Tsunami (28 March 2005)**.**
4. The forested land of Aceh is as follows.
    - Primary dry forest (1,417,000 ha.)
    - Secondary dry forest (1,179,000 ha)
    - Primary swamp forest (1,000 ha)
    - Secondary swamp forest (117,000 ha)
    - Secondary mangrove forest (24,000 ha)
    - Plantation forest (269,000 ha)
5. The non-forested land could be categorized as follows.
    - Shrub land 3,000 (ha.)
    - Plantation 246,000 (ha.)
    - Dry farm land 374,000 (ha.)
    - Dry farm land and shrubs 951,000 (ha.)
    - Transmigration area 11,000 (ha.)
    - Rice field 44,000 (ha.)
    - Aquaculture ponds 36,000 (ha.)
    - Mining 7,000 (ha.)
    - Settlement area 29,000 (ha.)
    - Bodies of water 10,000 (ha.)
6. Biodiversity: The status of flora and fauna of the Aceh, according to the UML Database (2002) is as follows.
    - More than 4,500 species of vegetation
    - 434 species of birds
    - 392 species of mammal
    - 171 species of herpetofauna (amphibians & reptiles)
    - 350 species of insect, and
    - 81 species of fish
7. Habitat of large mammal, such as
    - Coastal peat swamp forest is the good habitat for the critically endangered Sumatran orangutan, which is endemic to Northern Sumatra.
    - Sumatran tiger, Sumatran rhino and Sumatran elephant are endemic to Sumatra.
8. Most of mangrove forests were converted into aquaculture ponds prior to the Tsunami.
9. Kuala Cangkoi now has good coverage of mangroves. Previously it was almost nude.

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Annex I: Participant, Position & Organization

Name	Position	Organization
1. Amado Torentino	Consultant	Environmental Law, Philippines
2. Atsushi Tanabe	Graduate Student	Kumamoto University, Japan
3. Bishnu Bhandari	President	Nepal Wetlands Society, Nepal
4. DurgaPrasad Dash	Secretary	Palishree, India
5. Emiko Nagakura	Communication Officer	WIJ, Japan
6. Hide Nakamura	Consultant	EnVision, Japan
7. Htun Paw Oo	Environmental Consultant	Myanmar Forest Association
8. Mashnor Mansor	Professor	University of Science, Malaysia
9. Misato Ohara	Researcher	INTEM Consulting
10. Onrizal	Faculty	University of Sumatera Utara, Indonesia
11. Reiko Nakamura	Secretary-General	RCJ, Japan
12. Ryoka Ago	Student	Ritsumeikan University
13. Sanowar Hossain	President	Bangladesh POUSH
14. Sansanee Choowaew	Professor	Mahidol Univeristy, Thailand
15. Shiina Suzuki	Graduate Student	Sophia University, Japan
16. Shimpei Iwasaki	Prof.	Fukuoka Women's University
17. Simaba Chan	Official	Birdlife International Tokyo
18. Takayuki Musha	Vice President	RCJ, Japan
19. Tamotsu Kameyama	Vice President	RCJ, Japan
20. Tapas Ranjan Chakraborty	Researcher	OXFAM, Bangladesh
21. Thant Zin Tun	Researcher	FFI Mynamar
22. Yoshiro Natori	President	WIJ, Japan

Annex II: Program of Activities

Date: 4th Feb 2016 **Time: 8:25 -11:33 am**

Venue: Yoma Hotel Yangon

When	Who	What
Chair Person: Reiko Nakamura		**Rapporteur**: Bishnu Bhandari
08:25	Opening remark	Bishnu B. Bhandari
8:29-8:56	Dr. Bishnu B. Bhandari, Nepal	The Bay of Bengal: A Forgotten Sea
8:59-9:26	Mr. Sanowar Hossain, Bangladesh	Problems and Opportunities in the Bay of Bengal: An Example from Bangladesh
	Mr. Tapas Ranjan Chakraborty	Community Hint on the Conservation of Biodiversity of the Bay of Bengal
9:29-9:56	Mr. Durga P. Das, India	Coastal Pollution Along the Bay of Bengal
	Mt Htun Paw Oo	Status of Coastal Zone Management in Myanmar
	Sansanee Choowaew	Thailand's Ramsar Sites & Isthmus of Kra
	Mashhor Mansor	Strait of Malacca and Penang
	Onrizal	Coastal Resources of Aceh, Indonesia
44 min.	How to move ahead?	Open discussion
11:10-11:20	Dr. Bishnu B. Bhandari	Wrap up of the symposium
11:20-11:33	**Chairperson's Closing**	

Note

1. The time slot for the presentation was 20 min, followed by a 10-minute floor discussion.
2. The papers were circulated digitally to the participants about a week before.
3. The authors brought their presentation file along with them.