**Environmental Impact Assessment**
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**Lecture – 03**
**State of Global Environment (Oceans and Coasts)**

Welcome to the course Environment Impact Assessment. In the previous session, we saw how human activities have generated emissions and altered the air around us. Today we will look at the status of oceans and coasts. We will follow Chapter 7 of the Global Environment Outlook 6 by the United Nations Environment Program.

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So, accordingly, our coverage will include the extent of problems in oceans and coasts. We will look at the significance of oceans and coasts on human life and look at this from an Indian context as well. We will understand the concept of a healthy ocean. Moreover, we will talk about the challenges for sustainable use and management of marine and coastal ecosystems. Plus issues that focus on tropical coral reefs, fishing, debris, sand mining, deep sea mining, and ocean noise.

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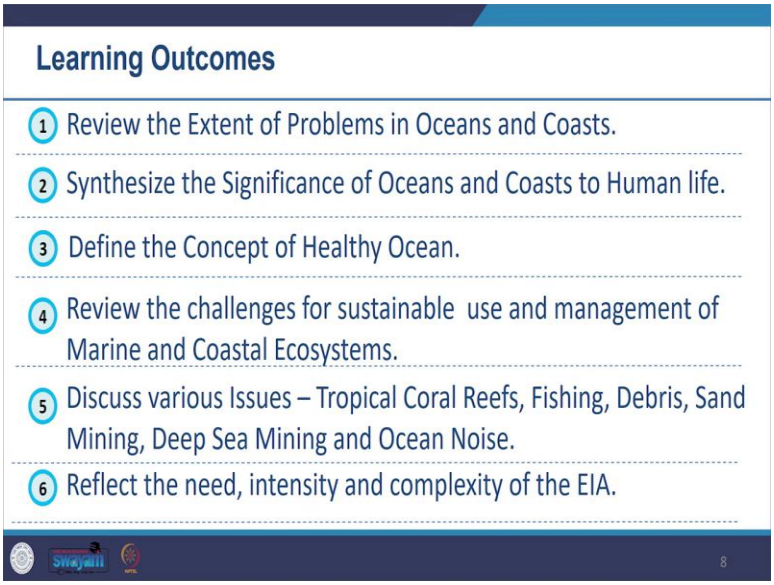


So, the expected learning outcomes from you after completion of this session include you should be able to review the extent of problems in oceans and coasts. You should be able to synthesize the significance of ocean and coast in human life and you should be able to also see it from the Indian context. You should be able to define the concept of a healthy ocean. You should be able to review the challenges of sustainable use and management of marine and coastal ecosystems. You should be able to discuss various issues related to tropical coral reefs, fishing, debris, sand mining, deep sea mining, and ocean noise. And most importantly you should review all these and understand the contextual perspective of Environment Impact Assessment as we proceed. So, we are learning this in the background of EIA. So, you should be reflecting on it.

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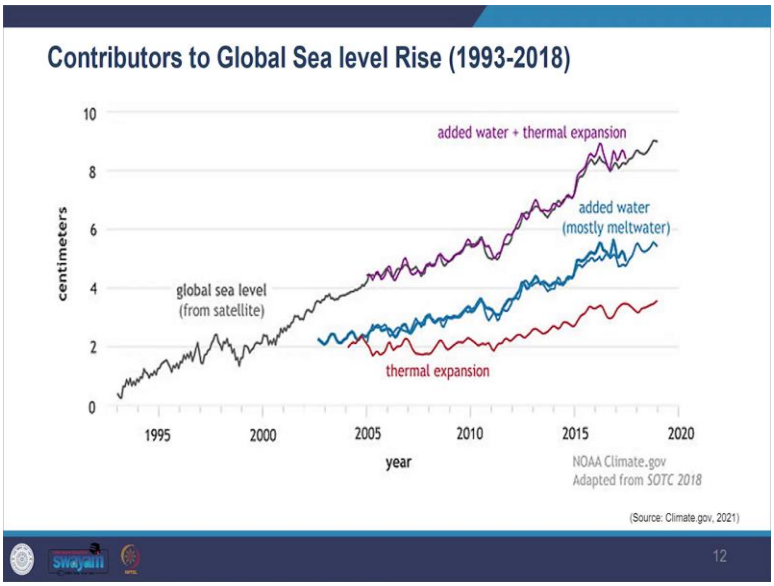


As we know our activities are also influencing the health of the world's oceans. We will first look at the extent. We observe that as per the Global Environment Outlook Report, more than 80 percent of marine pollution comes from our land-based activities. We see that there is a rapid change in entire marine ecosystems. There are frequent coral bleachings and notable sea level rise. We also note that global warming is causing changes in ocean chemistry and many oceanic processes and it is threatening many species of marine animals that cannot cope with higher temperatures. Furthermore, excessive fishing is a serious problem in many parts of the world. The rise of sea levels caused by global warming is a growing concern for our coastal population. For example, many pesticides and nutrients used in agriculture eventually reach the coastal waters which causes oxygen depletion that kills marine plants and shellfish.

Moreover, we see that factories and industrial plants discharge sewage and other runoff into the oceans. We also know about oil spills that pollute oceans. We also know about air pollution. Air pollution is said to be

responsible for almost one-third of the toxic contaminants and nutrients that enter coastal areas and oceans. Moreover, invasive species such as poisonous algae, cholera, and countless plants and animals have entered harbors and destroyed the ecological balance. The United Nations Food and Agriculture Organization, we see that it estimates that 31.4 percent of fish stocks are either fished to the capacity to the maximum capacity or over-fished.

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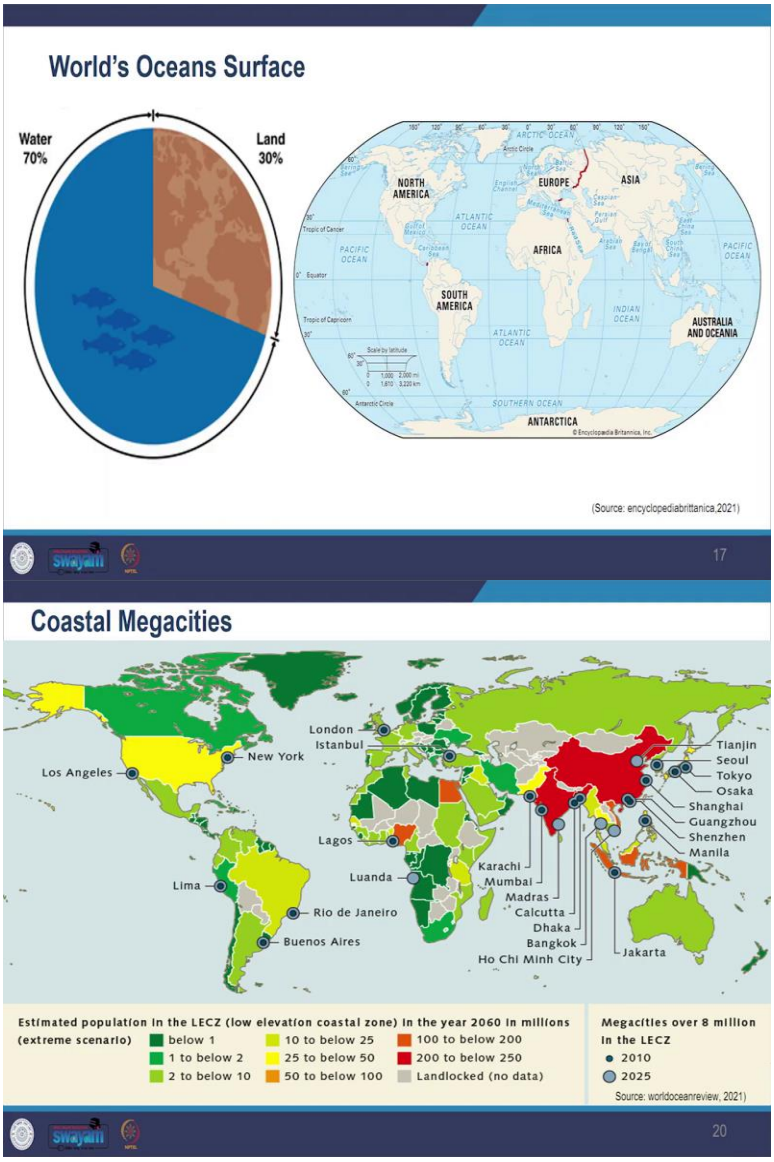


Let us now look at the geographical extent of the problem. The world's ocean comprises more than 70 percent of the earth's surface. As per the report more than 1.9 billion people lived in coastal areas in 2010 and we see that the number is expected to reach 2.4 billion by 2050. So, 2.4 billion people will be affected by the change we are talking about. That is a huge number we are looking at in these areas. 20 of the 30 Megacities are located on the coast. So, you see the number here and these megacities are expected to increase in population faster than non-urban areas. So, here even increase will also happen faster.

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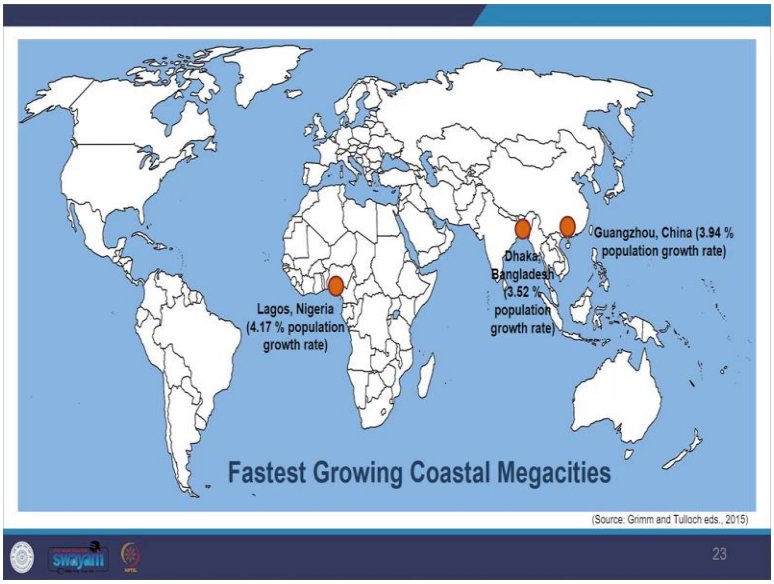


The three fastest-growing coastal megacities as we see examples include Lagos in Nigeria, Guangzhou in China, and Dhaka in Bangladesh. So, think deeply about the risks involved in these changes that our activities are causing.

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And now let us see why the oceans are important to us. In the report, it is narrated that the health and livelihoods of many people are directly linked to the ocean through its resources. So, when we look at the resources, resources such as seafood, and important aesthetics cultural, and religious benefits it provides. Seafood provides at least 20 percent of animal proteins supplied for 3.1 billion people globally as per the Food and Agriculture Organization of the United Nations. The income we generate from the tourism industry is because of this benefit which we see.

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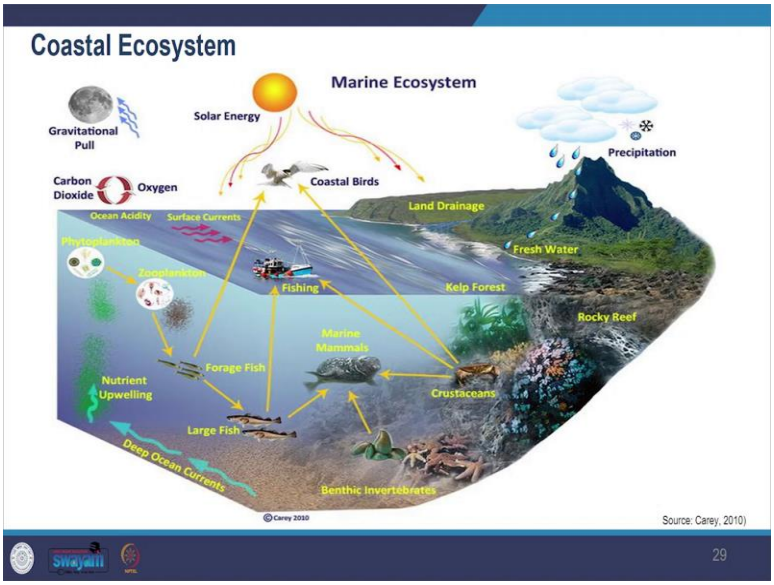


And as the report suggests it has severe consequences for the economically disadvantaged coastal areas and communities because such areas will be more vulnerable to these changes and losses. Coastal ecosystems also provide numerous environmental benefits such as coastal stabilization, and regulation of coastal water quality and quantity. We also see biodiversity and spawning habitats for many important species happen here.

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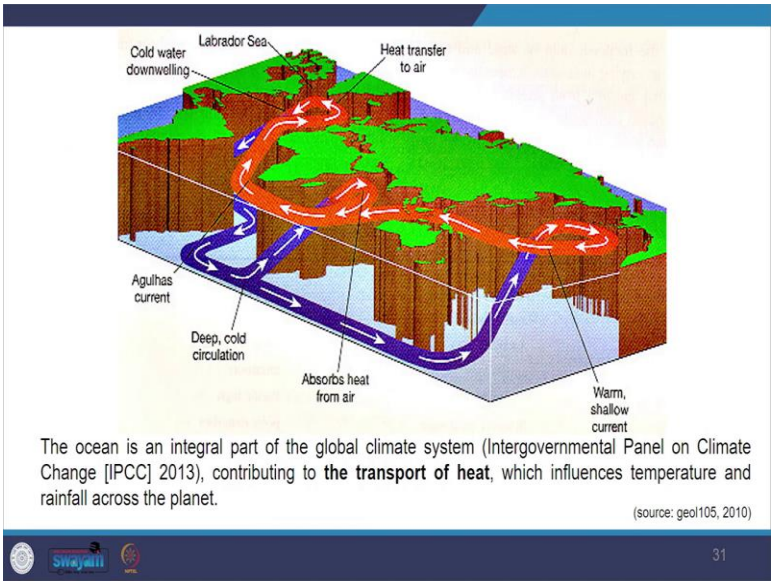


The ocean is an integral part of the global climate system as per the Inter-government Panel on Climate Change. The ocean contributes to the transportation of heat which influences temperature and rainfall.

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The report also provides evidence that about 50 percent of the primary global production occurs in the ocean. We get economically important resources such as aggregates, sand, renewable energy, and biopharmaceuticals from these resources.

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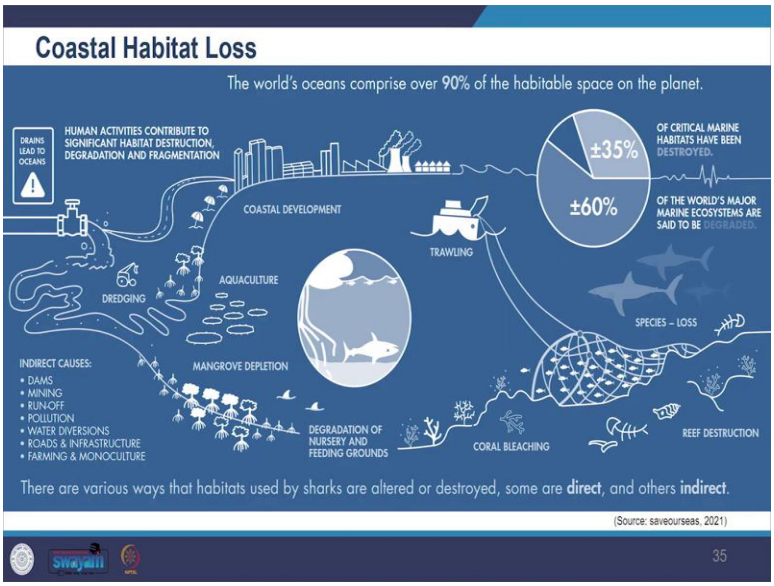


However, it is important to see that, because of human activities and the drivers that we had discussed before the health of marine and coastal ecosystems is deteriorating. Pollution, climate change, overfishing, and loss of habitat and biodiversity are costing the health of marine and coastal ecosystems. This eventually affects us, the people. It affects our livelihoods and many indirect benefits that the ocean gives to us.

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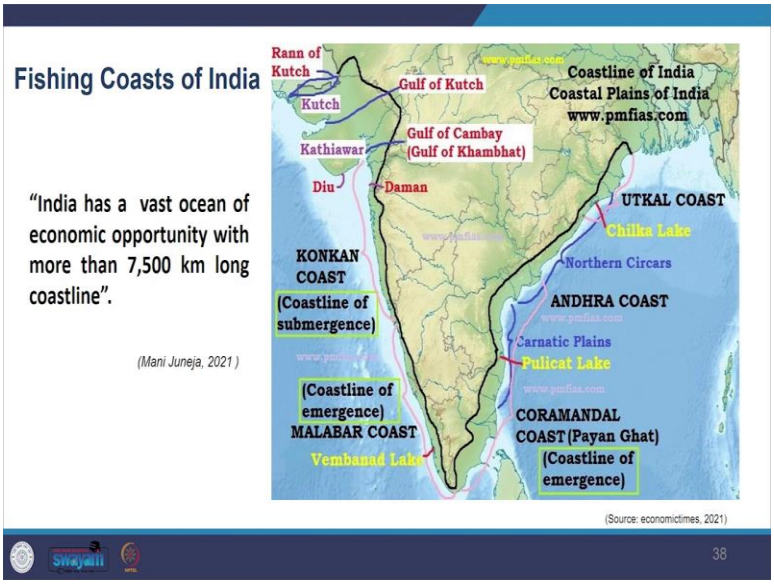


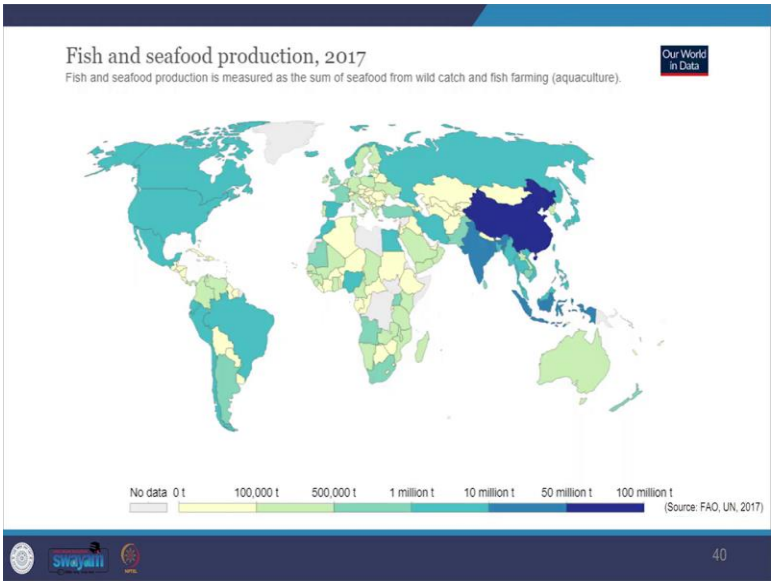


If we consider India, now we look at India, Mani Juneja 2021 wrote for TERI that India has a vast ocean of economic opportunity with a more than 7500-kilometer-long coastline. We see that 95 percent of the transportation needs of businesses are met by this water-based economy. And this water-based economy contributes around 4 percent to GDP. India is also the third fish-producing and second-largest aquaculture fish-producing country in the world. The country has the potential to engage a large workforce and has been doing so for the past many decades at least in sectors such as fishing, aquaculture, fish processing, marine tourism, shipping, and port activities. Now, engagements we see further engagements in new sectors such as offshore wind, marine biology, and biotechnology. And other activities like shipbuilding and shipbreaking are also rising extensively. So, all these activities are coming up.

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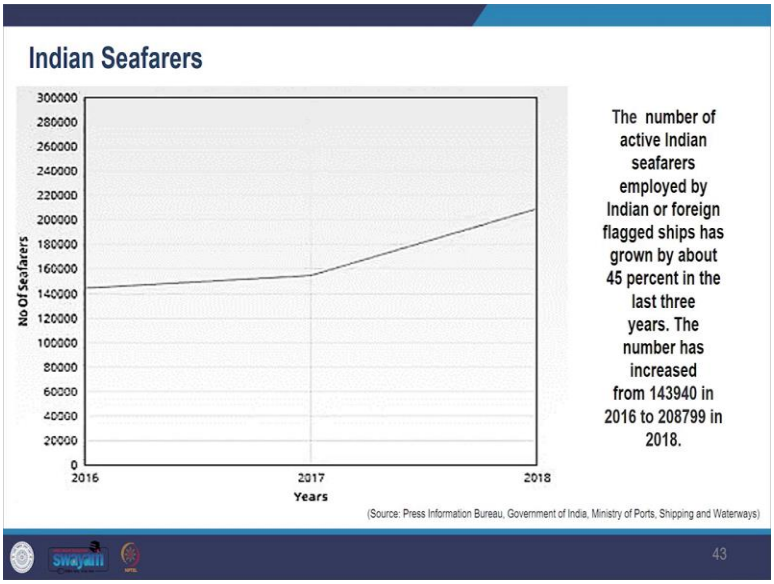


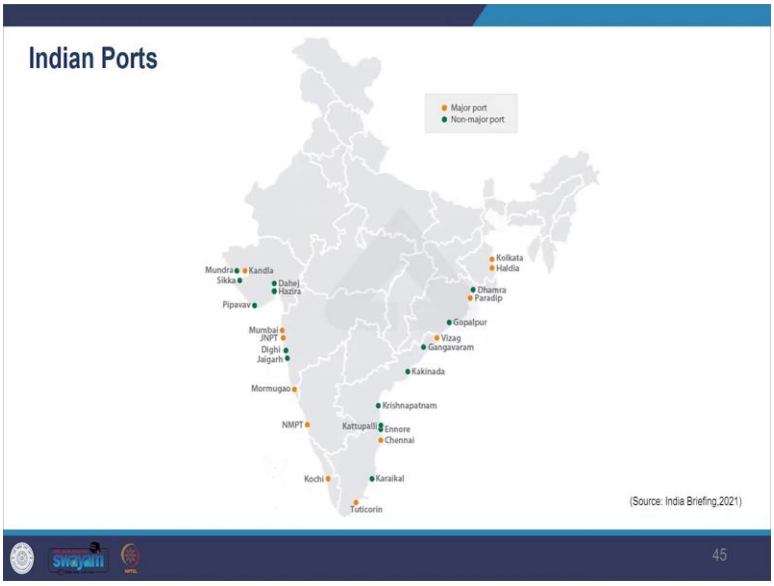


The fishery sector alone provides livelihood to about 16 million fisher folks. So, you see the range of employment it generates—and fish farmers at the primary level and almost twice the number along the value chain. The shipping sector is also one of the key livelihood providers in the water-based blue economy as India has one of the largest merchant shipping fleets among the developing countries.

We also see the number of Indian seafarers who are employed on Indian and foreign-flagged vessels crossed over 2 lacs in 2018 and shows an unprecedented increase of 35 percent over the previous year. We also see seaports are a large source of employment. And unlike India's major ports jobs in smaller ports have increased over the years. In the past 5 years, smaller ports have edged out the major ports in the growth of cargo volumes as well. So, they are increasing drastically.

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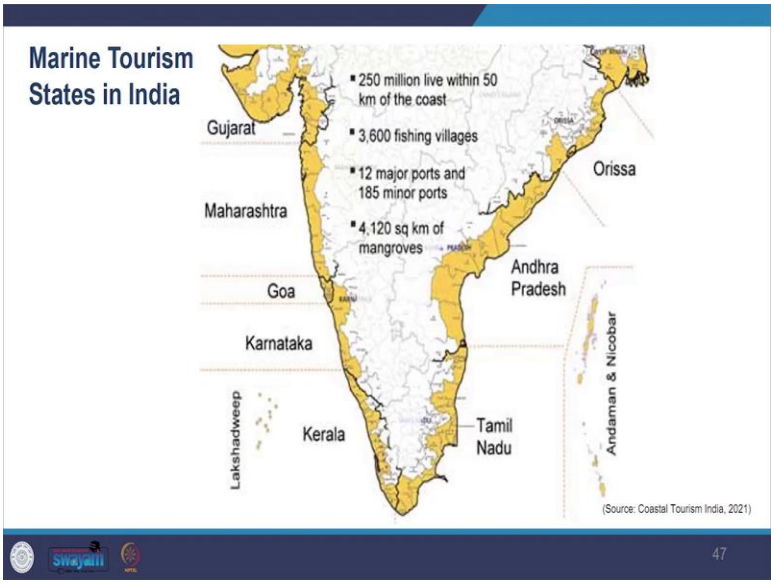


We further see marine tourism is also a sector that has been one of the fastest growing globally and in India. Particularly in coastal states like Kerala, Karnataka, and Tamil Nadu, coastal tourism has contributed largely to both the state's economies and livelihood. For example, we can see in Kerala the total number of jobs created directly and indirectly by the sector between 2009 and 2012 in this period was around 23 percent of the total employment. That is a huge proportion we are looking at. So, a review of these facts as per the TERI writing shows our dependency on the oceans and coasts and at the same time the environmental risk we face as a nation.

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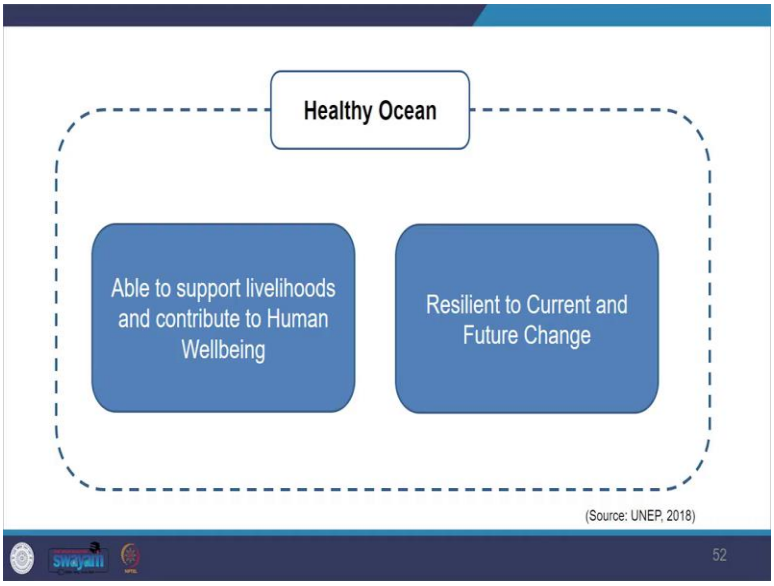


Now, let us see what a healthy ocean means to us conceptually. As provided by UNEP, by definition a healthy ocean is one in which the basic ecosystem functions and structure are intact and integral, thereby basic ecosystem can support livelihoods and contribute to human wellbeing. The ecosystem is resilient to current and future changes. Marine and coastal ecosystems must be functioning and used within their environmental limits. They should be used in a way that no severe or irreversible harm is done to the system. Such careful utilization will allow us to continue to take full benefit of the ecosystem.

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However, despite this, we see there are challenges to sustainable use and managing the marine and coastal ecosystems. We see that as per the report, there are competing pressures on natural resources. There are many users of the resources. There are complexities of governance. The marine and coastal ecosystems do not follow any governance. Coastal states have rights and obligations within their marine jurisdiction.

So, let us begin to understand the complexity. As explained in the report we see that the ocean currents can carry chemicals, wastes, emerging organic pollutants, and pathogens beyond areas under national maritime boundaries. So, your area can be influenced by the activities of the others over whom you have no control. And marine organisms and seabirds that you see may not remain under the jurisdiction of a state or the boundaries defined by you.

These interlinkages between ocean conditions and marine life and the especially dynamic ocean processes mean that the activities of any single industrial sector may have far-reaching impacts. So, anything that is done in one industry can impact somewhere else, people located in some other place. So, you see the complexity of the problem and its impact on different places. And such factors destroy the livelihoods of people who receive no benefits from the industry that has caused the impact. So, they just become the victims of the functioning of others.

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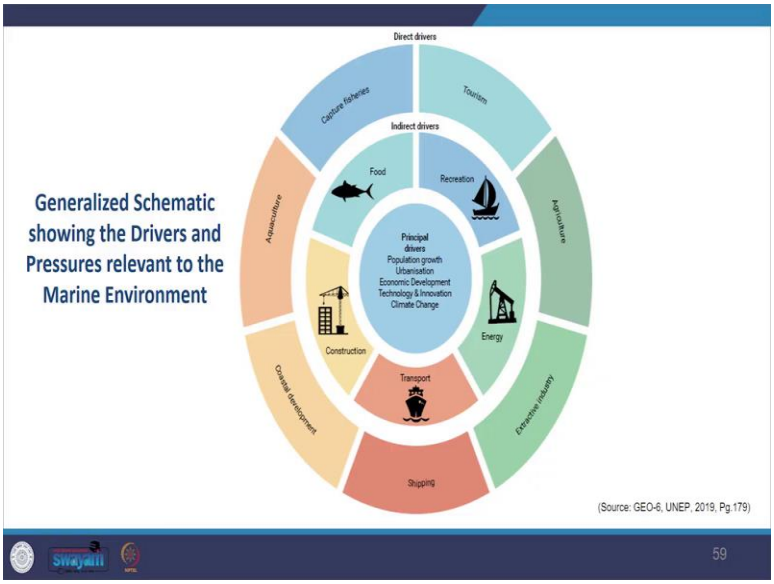


We also see that there are multiple and often conflicting uses. As we can see in the image here the central circle represents major high-level drivers of change in human demands on the ocean such as, and as discussed before also, we have discussed this before also, population growth, urbanization, economic development, technology and innovation, and climate change these drivers create societal needs indicated in the inner ring such as the need for food, construction, transportation, energy, recreation.

In the outer ring, we see the industry sector which addresses the societal needs. These industries address our needs and often, we will see through all EIA and this course, we need to regulate them to protect the ecosystem through policies. So, we can see how we have multiple and conflicting uses.

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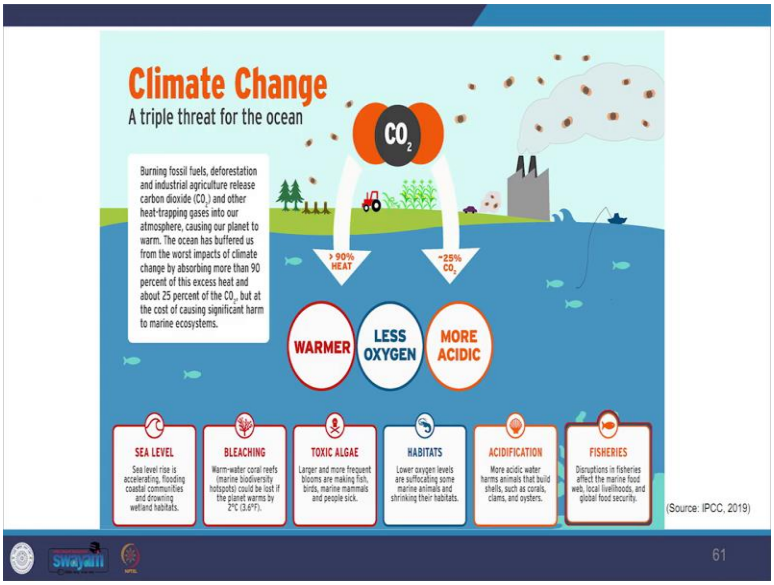


Then we also have global problems like climate change and ocean acidification which need to be addressed. Climate change impacts ocean temperature, sea ice extent and thickness, salinity, sea level rise, and extreme weather events. Ocean has many uses and there are too many linkages among marine ecosystems and between the land and adjacent seas.

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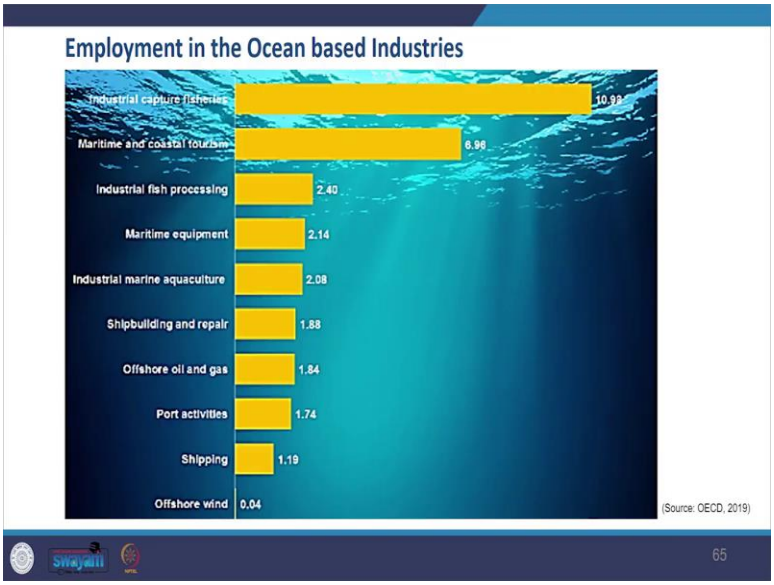


We may also reflect that there are numerous industries dependent on oceanic and coastal resources with very high economic value and generating increased employment with major environmental impacts. We see sectors such as fishing, shipping, port, offshore hydrocarbon industries, other marine-based industries marine-based mining, and marine-based tourism. So, all these you can see.

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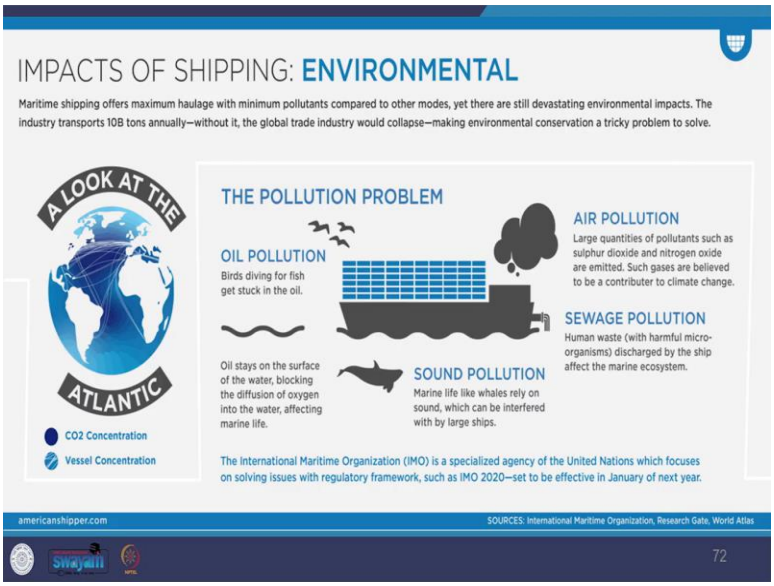


Then the impact ranges from changes in the food web structure and functioning. we also see that bycatches happen of the non-targeted species during the fishing, gear impacts on the seabed habitats, and benthos, benthos which means the flora and fauna found on the bottom or in the bottom sediments of the sea or a lake which are especially structurally fragile habitat. So, even they get impacted by this. Shipping is, accidents also happen. We also see chronic and episodic release of fuel and other hydrocarbons.

We see the discharge of sewage, waste, and greywater. We also see the transmission of invasive species. So, there are very invasive species that get transmitted to other locations because of this. We also see noise from ships. Maritime transport responsible, we see that maritime transport is responsible for about 3 percent of global greenhouse gas emissions. Furthermore, we see a concentration of shipping and its potential environmental impacts. There are frequent needs for dredging and access to deep water passages. We also see impacts on the sea bed and coast from the construction of infrastructure. So, you saw a range of impacts that happen.

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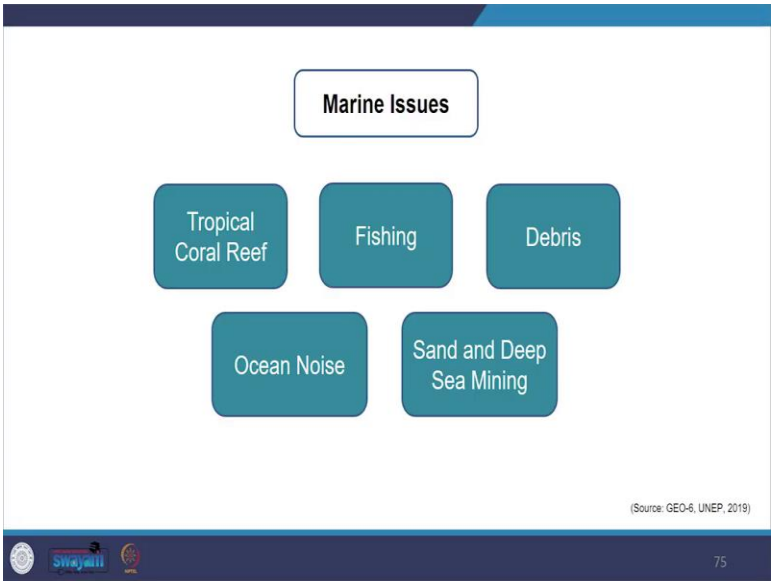


Now, we will look at some of the upcoming issues. So, what are the issues? We will only focus on the limited ones. So, we will look at tropical coral reefs and the fishing issue. We will also look at the debris entering the marine environment which is marine litter. We will also look at a few emerging topics such as mercury, sand mining, deep sea mining, and ocean noise.

The UNEP report states the well-established fact that the tropical coral reefs have passed the Tipping Point whereby chronic bleaching, chronic bleaching has killed many reefs that are unlikely to recover even over a century-long time scale. Let us try to understand what Tipping Point means. The Tipping Point means from where we cannot resume. We lose the balance and we cannot get back to normal. Things are out of control.

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The coral bleaching observed is due to the warming of the oceans which is because of anthropogenic emissions of greenhouse gases which we have already seen before. These emissions have been happening since the Industrial Revolution. Here looking at the significance of the tropical coral reefs they are an important biodiverse ecosystem on Earth. As per the study, we see that tropical coral reefs display approximately 30 percent of all marine diversity.

As per the report on the Coral Triangle region, we are looking at the Coral Triangle region which includes Indonesia, Malaysia, Philippines, Timor Leste, Papua New Guinea, and the Solomon Islands as the area of greatest biodiversity. The Coral Triangle which we are looking at hosts more than 550 species of hard corals. Due to multiple human pressures in this particular area including pollution, fishing, and coral bleaching the current state of reef health is very poor at many sites here.

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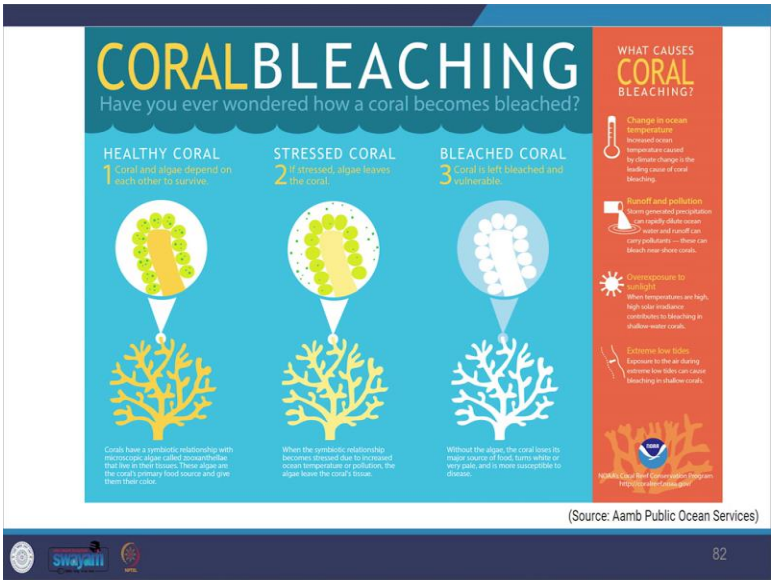


Let us try to understand coral bleaching. What is that? Coral bleaching occurs when corals are stressed by changes in conditions such as temperature, light, and nutrients. These changes cause them to expel symbiotic algae which rest over it, living in their tissues. Once the symbiotic algae is expelled the coral looks like white skeletons. That is called coral bleaching as you can see in the image here.

It is important to note that why we are saying it has reached the Tipping Point. Although the study is incomplete and ongoing, as per the study the frequency of large-scale coral reef bleaching events which happens because of the change in ocean surface temperature has increased over the last two decades.

The recurrence interval between coral bleaching events is now about 6 years whereas the reef recovery rates are known to exceed 10 years, which means that as the cycle of bleaching is shorter, we are looking at the 6 years than the recovery which is 10 years, the difference in the cycles will not allow sufficient time for reefs to recover between the bleaching events. Therefore it is expected that in times to come there will be a steadily downward spiral in the reef health. The scientific evidence however inconclusive right now indicates that the reef death will lead to loss in fisheries, tourism, livelihoods, and habitats. Depletion of the coral reef ecosystem will cause the loss of industries and employment dependent on them.

According to the reports 2015 Northern Hemisphere and 2015, 2016 Southern Hemisphere summers were the hottest ever recorded. This caused the worst coral bleaching on record. The United States National Oceanic and Atmospheric Administration declared 2015 as the beginning of the third global coral bleaching event following similar events in 1998 and 2010. The report indicates that the third event is still ongoing. So, we are still experiencing the loss. The third event is the longest and most damaging recorded so far. This event to date has affected 70 percent of the world's reefs and some areas are experiencing annual bleaching.

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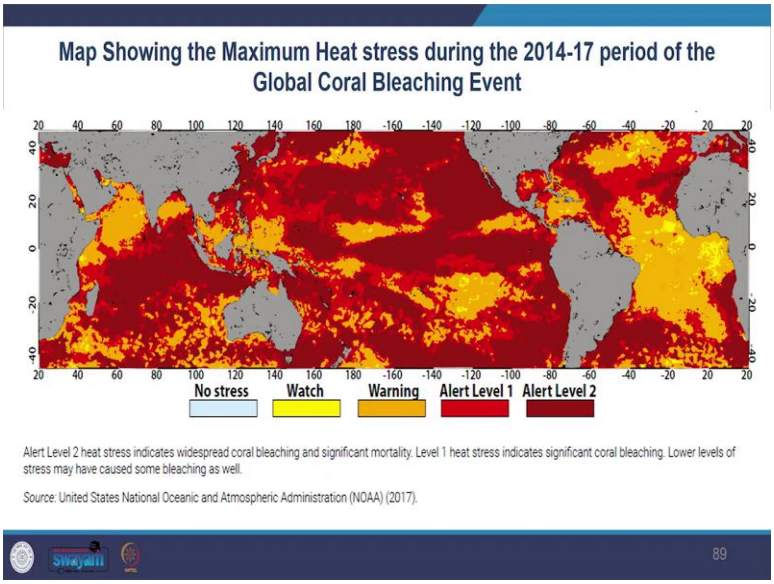


In the map, you can see the maximum heat stress during 2014 and 17. It will continue in 2021. the dark brown zone that you can see in the map is the alert level 2 which indicates widespread coral breaching due to heat stress and significant mortality levels. Level 1 heat stress shown in red indicates significant coral bleaching. You may see other warning areas marked in mustard and yellow color here. You may try to identify India and the coastal regions and their associated alert levels.

The report quotes from the initial study from Vernon in 2009 which predicts that coral reef breaching Tipping Point would occur once global atmospheric carbon dioxide reaches 350 ppm. This value was reached in about 1988. So, we have to reach that value, then but as indicated by studies, because ocean warming lags behind global atmospheric CO2 levels it has taken almost 30 years for the impact of this level of CO2 to show up.

The given explanation for the lag effect is that global ocean circulation is slower compared to the rapid rate of rising CO2 levels. So, the ocean gets normal later. Because of this ocean is currently responding to CO2 levels of decades ago and subsequent accumulation which gathers later. The evidence indicates that Tipping Point for coral bleaching has now been passed. We are already late. The report states that global atmospheric CO2 levels are now more than 400 ppm. Therefore there are serious implications for the very survival of coral reefs.

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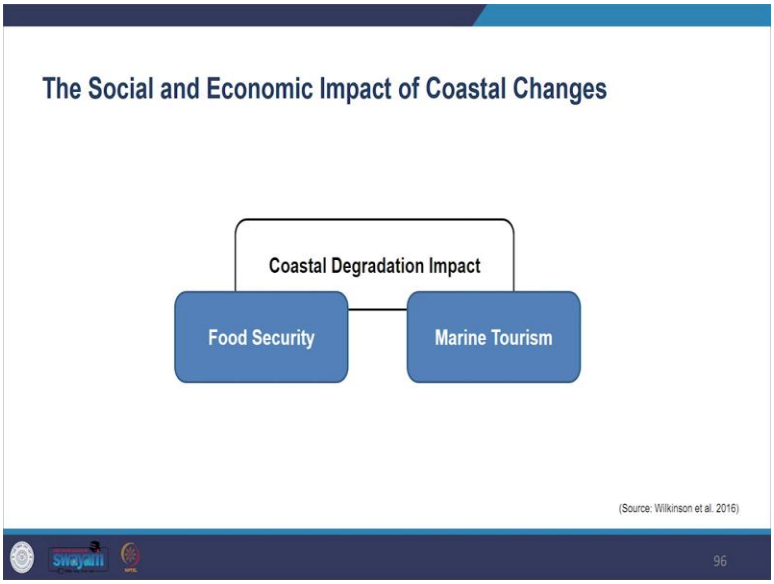


Now, let us look at the social and economic impacts of these changes. According to a study conducted in 2016, 275 million people in 79 countries depended on reef-associated fisheries as their major source of animal protein. So, today there is an issue of food security. The degradation of coral reefs has eroded their values which has adversely affected the dependent communities. With the death of coral, there will be a gradual loss of reefs.

The danger of the death of reefs is that the shorelines will become vulnerable to storms and rising sea levels because the reefs will be submerged because of this gradation which is happening. So, dead corals will have reduced tourism value because of the loss of beauty and will also contain less biodiverse species of fish all this cumulatively threatens the livelihood of communities. Living coral reefs are also said to be important religious symbols for some. So, we see how this loss is going to impact us socially and economically.

Moving on now let us look at the fisheries. The ocean is an increasingly important source of food. As per the report, fish provides more than 20 percent of dietary protein to about 3.1 billion people, particularly in the coastal areas. Food security concerns are increasing nutritional value of fish is challenging to replace in areas where the availability of fish is declining. To meet future challenges of food security and a healthy population, expansion of fisheries and aquaculture is inevitable. So, because we have to meet the food needs of so many people we have to expand fisheries and also look into aquaculture.

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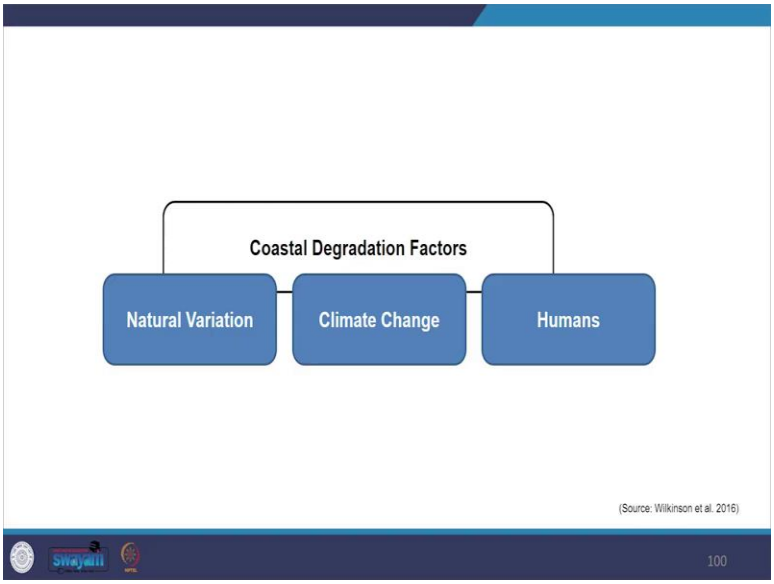


The changes which happen to the ocean are due to the following reasons. Number 1 we see that it is because of the natural variation. Number 2 the climate change. Number 3 and most important by us. We remove the resources from the ocean mostly by harvesting fish and other marine organisms for our consumption and industrial uses.

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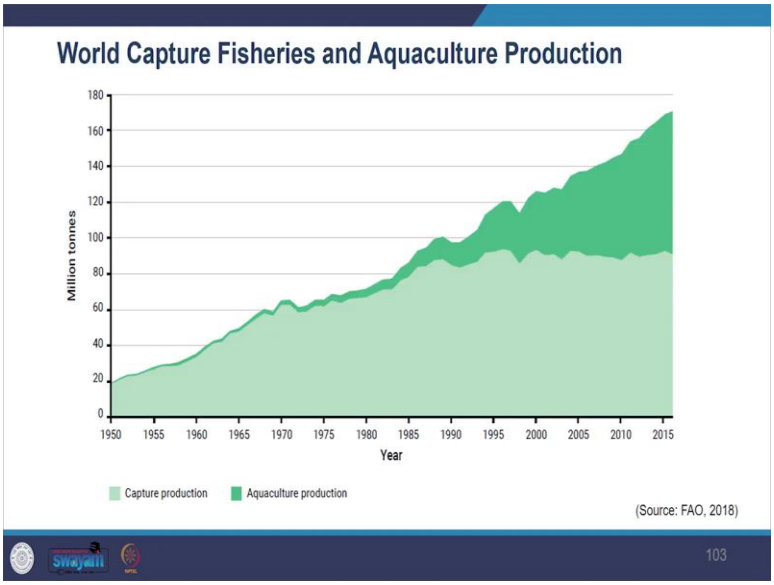


We also see the capture production fisheries, the fishing we do, which is natural fishing has been stable at around 90 million tonnes for over 50 years. However, we see an increase in the production from aquaculture facilities as seen in the graph here. Although the capture fisheries plateaued, it has become stable for quite some time in the early 2000s, mariculture continues to expand and if current trends, and it is said that if current trends continue, will soon surplus. Large-scale mariculture of market-oriented high-value fish and shellfish that as tuna, salmons, and so on, now contributes significantly to the economies of most coastal developed countries. We also see small-scale mariculture expanding to less-developed countries and economies that are in transition.

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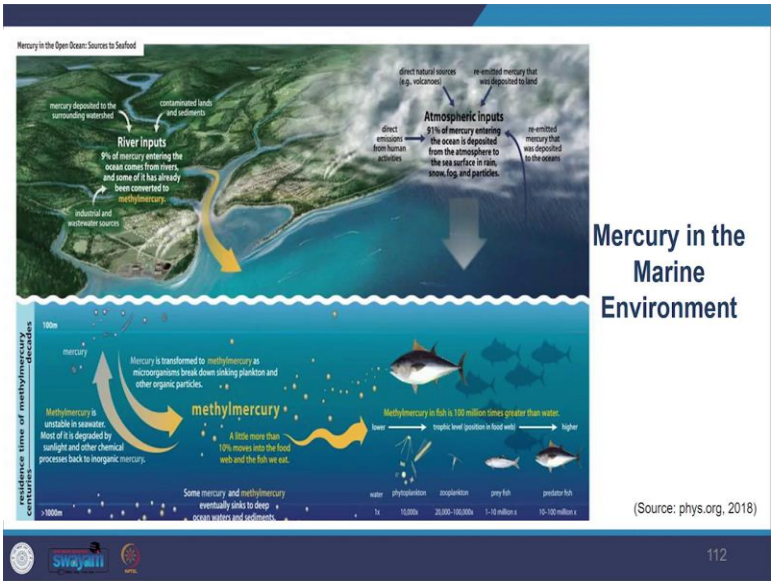


Moving on, we also find mercury in the marine environment. Mercury is top 10 chemicals of major public health as per the World Health Organization. Mercury especially in the form of methylmercury is a powerful neurotoxin that even at a low concentration can affect fetal and childhood development and cause neurological damage. Despite the associated health benefits of eating fish, due to high methylmercury levels in some seafood and risk, and uncertainty, I think there are lots of advisories that have been given especially for pregnant women in many countries.

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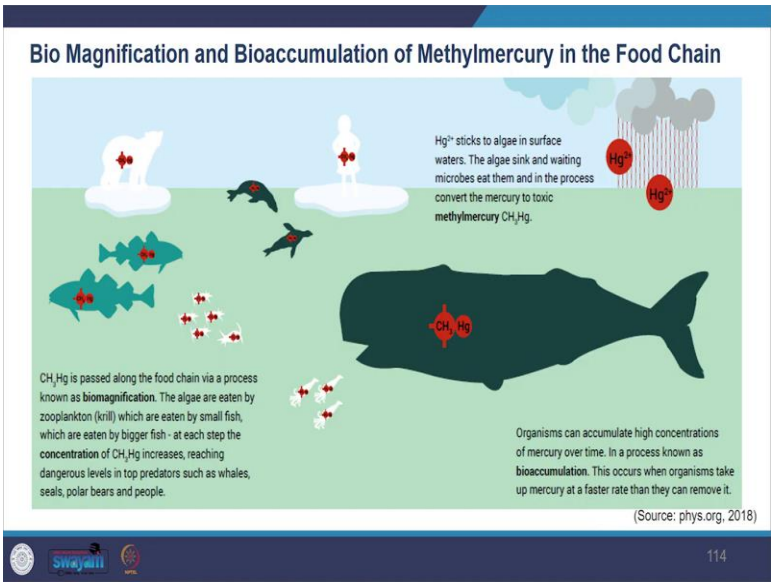


You can see the process through which mercury enters the food chain. Mercury sticks to the algae in the surface water which eventually sinks and is eaten by microbes. In the process, it becomes toxic methylmercury. Methyl mercury is passed along the food chain through the process known as biomagnifications. In the process, the toxin passes from small fish to large fish, and its concentration increases. Organisms can accumulate high

concentrations of mercury over time. The process is known as bioaccumulation. Bioaccumulation happens when organisms consume mercury at a higher rate than the removal rate.

As per the report, the population depends on marine organisms for nutrition and may be vulnerable to high exposure to methylmercury and persistent organic pollutants. And especially pay attention that these risks are highest in areas of considerable food insecurity. Moreover, climate change may also aggregate emissions of mercury from long-term storage in the frozen peatlands of the northern hemisphere. This has the potential to increase the input of mercury into oceans.

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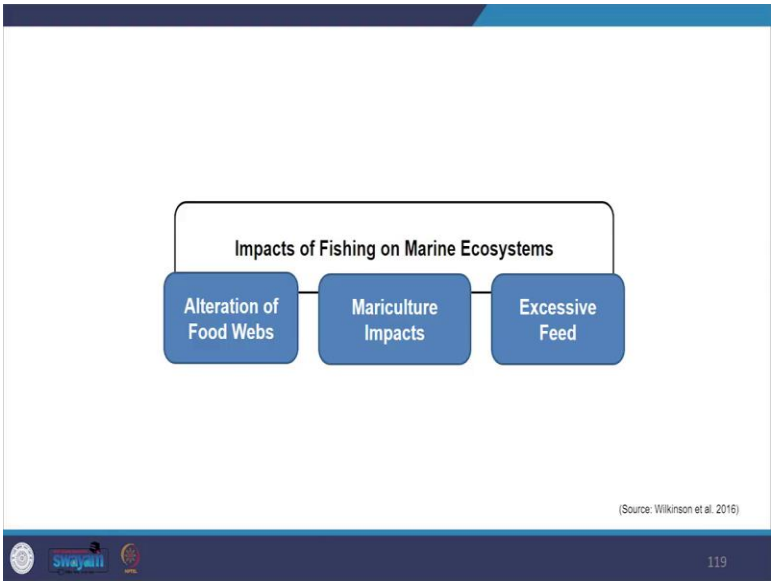


Now, let us look at the impact of fishing on marine ecosystems. Major impacts include number 1 we see alteration of food webs. Number 2 we see mariculture impacts. Mariculture is the cultivation of fish or other marine life for food has also substantial impact on the marine ecosystem. The study shows that the impact of these effects is growing. Conversion of mangroves for mariculture has resulted in widespread habitat loss. These losses have far-reaching implications for dependent species.

Loss of species happens because of the dense culture facilities and, the use of antibiotics and other medications to prevent disease in these kinds of facilities. Also, the excessive feed that sinks through accumulates on the sea floor and decomposes and reduces oxygen levels in the water. So, all this is causing an impact.

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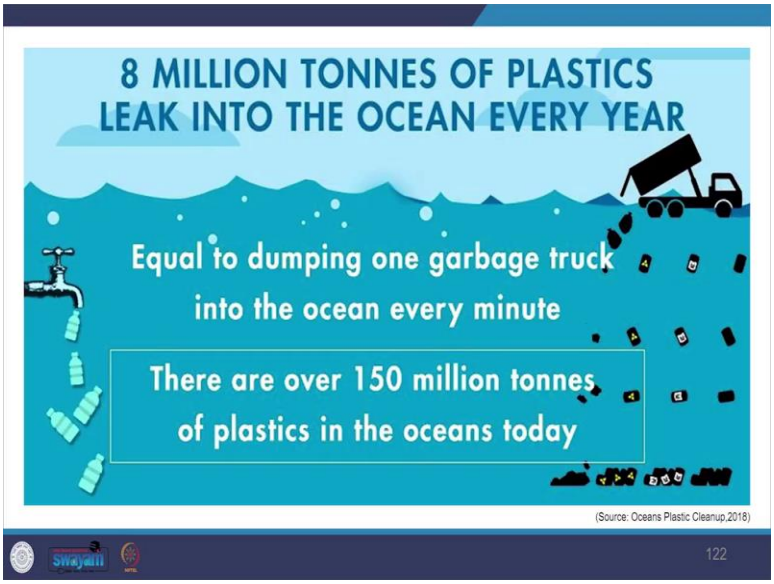


Now, moving on let us look at marine litter. We see that the amount of marine litter which is the waste, continues to increase. It is estimated that 8 million tons of plastic enter the ocean each year mainly because of the mismanagement of domestic waste in the coastal areas. As per the established ongoing studies marine litter has been found at all ocean depths. The report suggests that without intervention the quantity of plastic in the ocean is expected to increase and the number is going to increase from 100 to 250 million tonnes by 2025.

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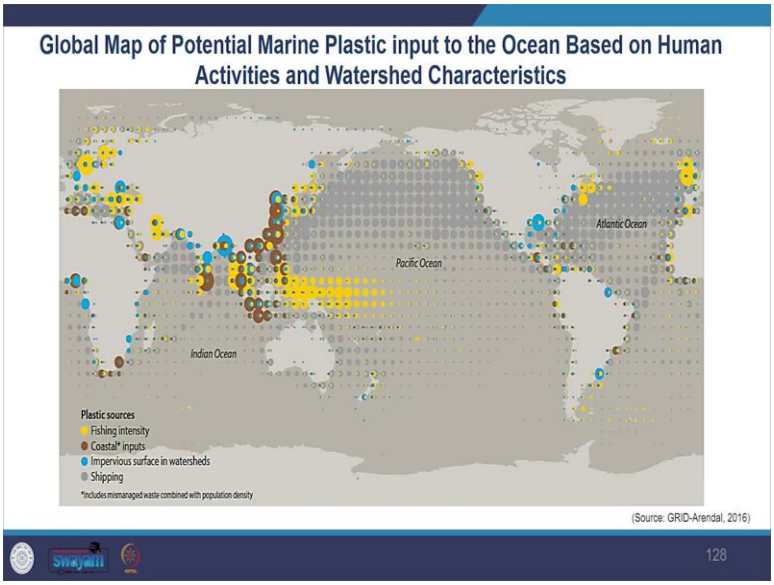


In the image, you can see that the global plastic input in the ocean is based on human activities and watershed characteristics you can see various plastic sources. The circles shown in yellow are from the fishing intensity. The brown circle is from the coastal input, the blue circle is the impervious surface in the watershed and the gray circle is due to shipping.

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The studies indicate that marine litter is related to the efficiency of solid waste management, and how well we manage our solid waste and wastewater treatment. It is generally accepted that a large proportion of plastic enters the ocean and originates on land. So, that is important for us to note. It makes its way into the marine environment via stormwater runoff, or river or is directly discharged into the coastal waters.

Uncollected waste is thought to be the major source and we also see that poorly operated dump sites also contribute to this particular problem. We also see that the greatest accumulation of marine litter is in the coastal

environments. Plastics are distributed worldwide in oceans with increased accumulation in the convergence zones of each of the five subtropical gyres. Plastic pollution has been recognized for decades as a threat to marine biodiversity.

One of the most visible impacts is the death or injury of marine life from entanglement with old fishing gear plastic packaging and so on. Recent reviews have found that a growing number of turtles, marine mammals, and seabirds are endangered or killed by floating litter.

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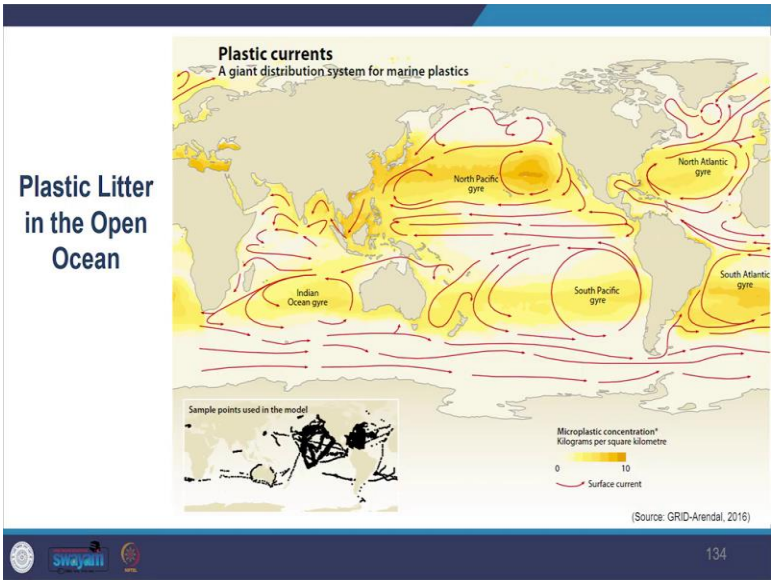


In the image, you can see the plastic current. The study also highlights the concerns of chemicals found in oceans, and the economic and social cost of marine litter including indirect effects such as interfering with small-scale fishing opportunities, tourism, and vacation. Some direct economic costs include the cost of beach cleanup and accidents related to navigation hazards.

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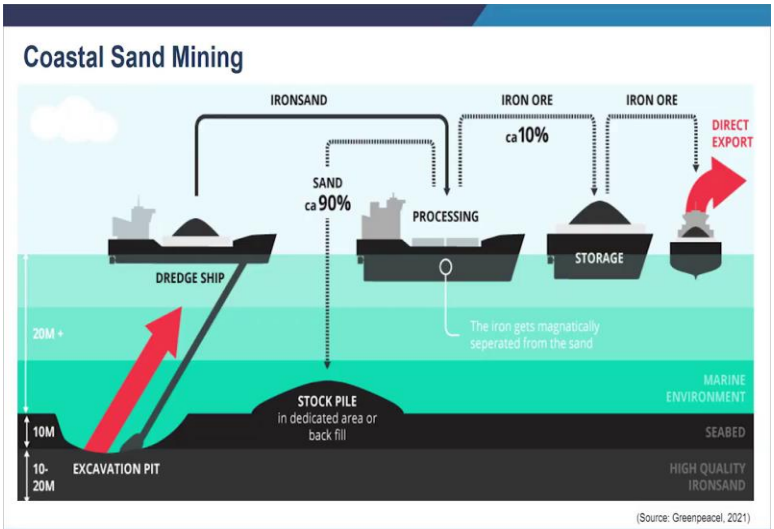


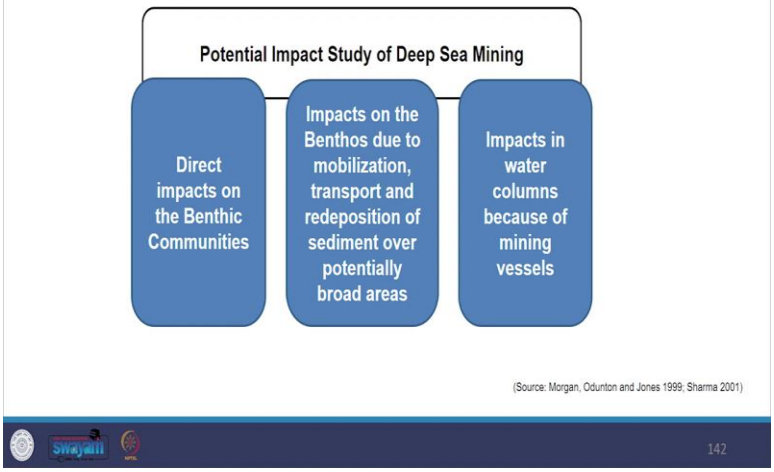


Now, let us look at a few other emerging issues for oceans. We look at coastal sand mining. Around the globe, coastal and nearshore areas are being mined for construction sand and gravel. These are nonrenewable resources and these are one of the second most used natural resources in our planet after water. So, we see that this mining is constantly being done and if it is illegal and poorly regulated sand mining on beaches it is causing major damage to the ecosystems and landscape.

We see that deep-sea mining exploration has been initiated to search for more oceanic resources. We also see it is however not well-established but we see that even this has an impact. It impacts benthic communities, the bottommost sea bed. Impact on the benthos due to mobilization, transport, and redeposition of sediments impacted the water columns because of mining vessels. These all impacts are happening.

We see that the seabed disturbance experiment which is done in the Peru basin found very little recovery of benthic fauna 26 years after mimicking mining operations. You see how long it takes for recovery. We see that

lack of knowledge and understanding. However, it is time for us to be very cautious about how we start in this particular industry.

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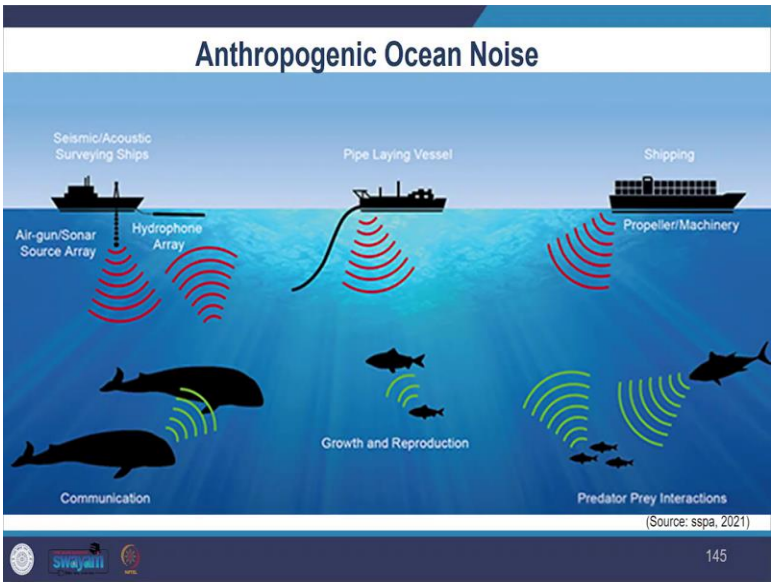


We also see cases of anthropogenic ocean noise. This is another concern raised in the report. The potential impact of anthropogenic acoustic noise on marine life is the noise generated by a range of activities including shipping, seismic surveys, military operations, wind farms, channel dredging, and aggregate extraction. So, we see that there is increasing concern about the long-term and cumulative effects of noise on marine biodiversity. Therefore the oceans are impacted by numerous human activities and the most serious impact is related to climate change, land-based pollution, and fishing.

The impacts of climate change as assessed by UNEP indicate several issues such as ocean acidification, sea level rise, changes to the bottom water, the disturbance of marine fish and invertebrate species, and ocean circulation. The most dramatic and immediate impact of climate change in the ocean in recent years is bleaching which we have already discussed and explained in detail. And we also looked at the pollution from plastic in particular. And we also looked at the fisheries sector. There are concerns about overfishing, climate change's impact on species distribution patterns, and the rise of aquaculture.

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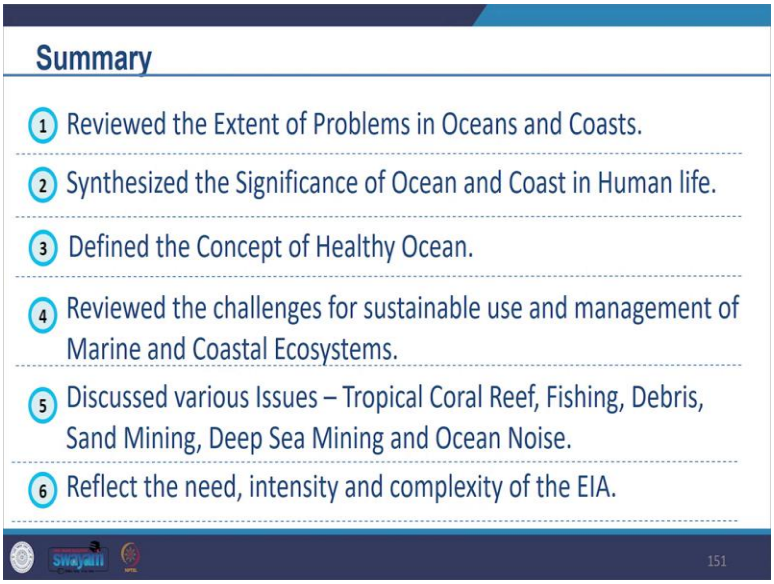


So, to summarize today's session we reviewed the extent of problems in oceans and coasts and saw the significance of oceans and coasts in human life. We defined the concept of a healthy ocean. We reviewed the challenges to sustainable use and management of marine and coastal ecosystems. We discussed various problems related to tropical coral reefs, fishing, debris, sand mining, deep sea mining, and ocean noise. We all must reflect upon the need, intensity, and complexity of the EIA which we are going to explore.

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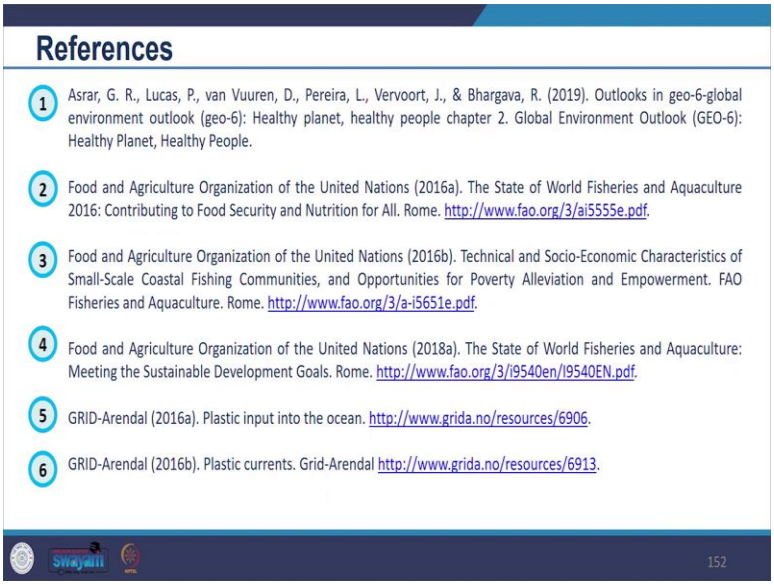


These were the references used for this particular session. Our coverage has been limited as per the scope of the subject.

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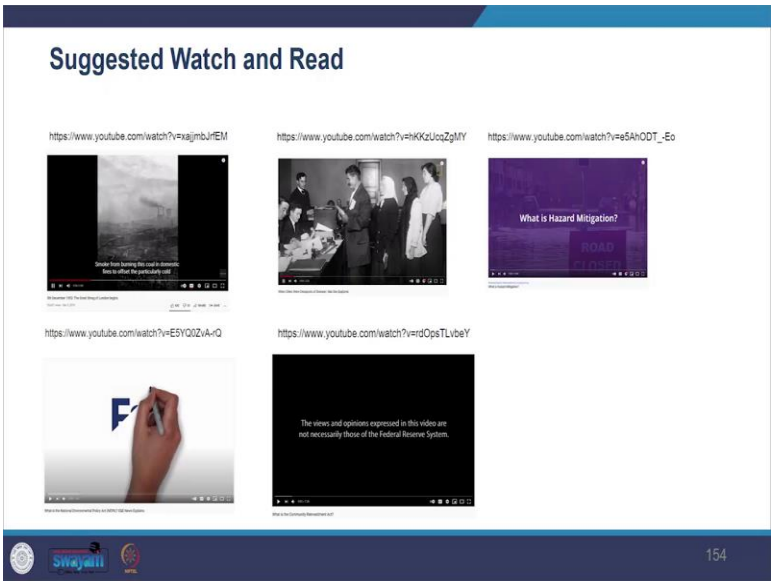


Additional resources to read and watch are provided to you.

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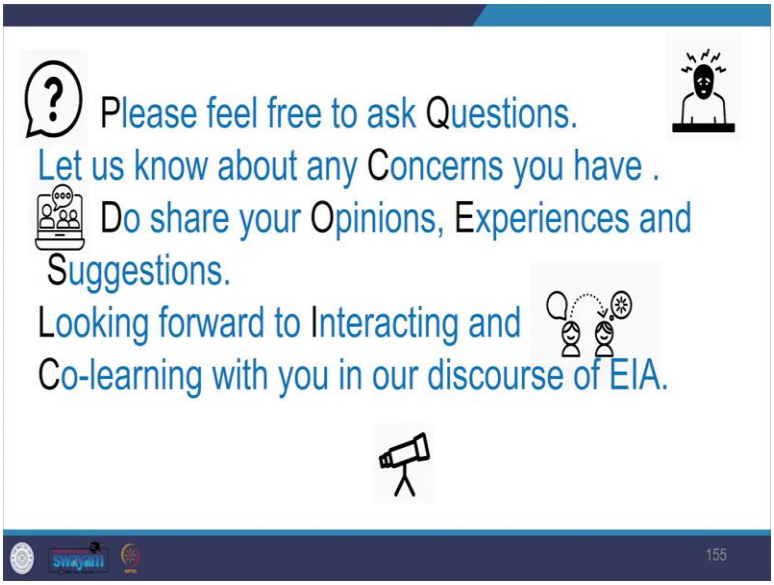


Please feel free to ask questions. Let us know about any concerns you have. Do share your opinions, experiences, and suggestions. Looking forward to interacting and co-learning with you in this course of EIA. Thank you.