Environmental Impact Assessment
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Lecture – 05
State of Global Environment (Fresh Water)

Welcome to the course Environmental Impact Assessment. Today we will look at the state of freshwater which is an essential element for us.

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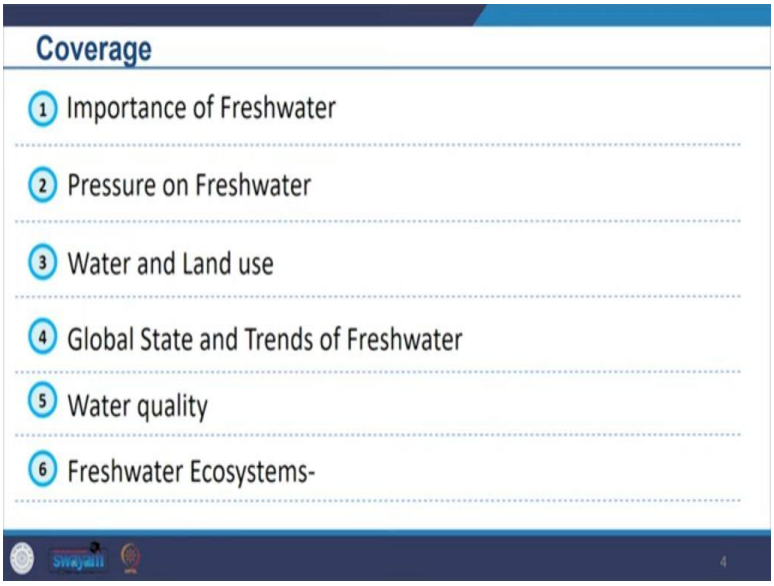

So, accordingly, our coverage will include looking into the importance of freshwater. We will look at different pressures on freshwater, especially due to climate change. Further, we look into water and land use, and then we look into global state and trends, what are their regarding freshwater. Particularly, we look into water quantity, and water withdrawal rates, we look at the glacial retreat water scarcity.

Further, we look into water quality, how we really, and what are the determinants at which we look at. So, we look at the pathogen's issues, nutrient sediments, and so on. Further, we will look into freshwater ecosystems like what is happening with the freshwater ecosystem, the loss of wetlands, biodiversity loss, and an impact on human health and other areas.

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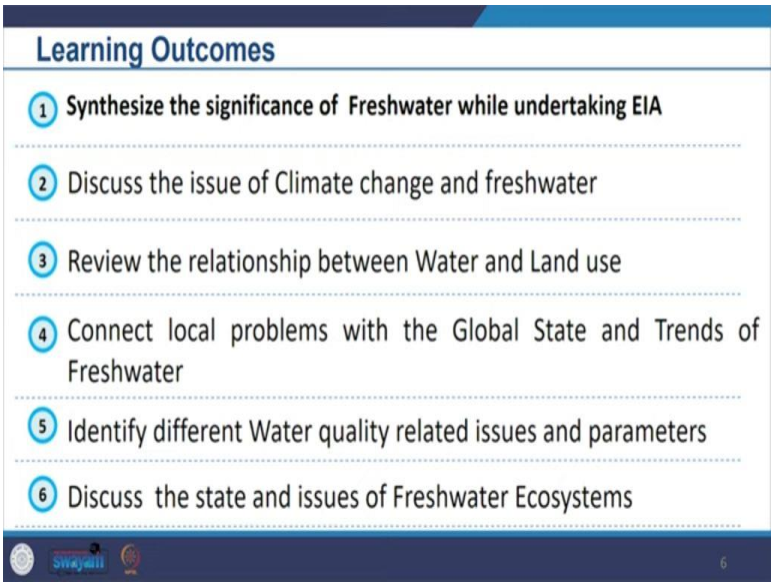

So, the expected learning outcomes which is expected from you after you complete this particular session, that you should be able to synthesize the significance of freshwater while undertaking EIA. So, when you look at EIA, you should have a conceptual understanding of where you are locating yourself in the entire context. You should be able to discuss the issue of climate change and freshwater. Further, you should be able to review the relationship between water and land use. You should be able to connect local problems with the global state and trends of fresh water which you are going to see today.

You should be able to identify different water quality-related issues and parameters and support them with case examples, and facts that we are going to see. Further, you should be able to discuss the state and issues of freshwater ecosystems.

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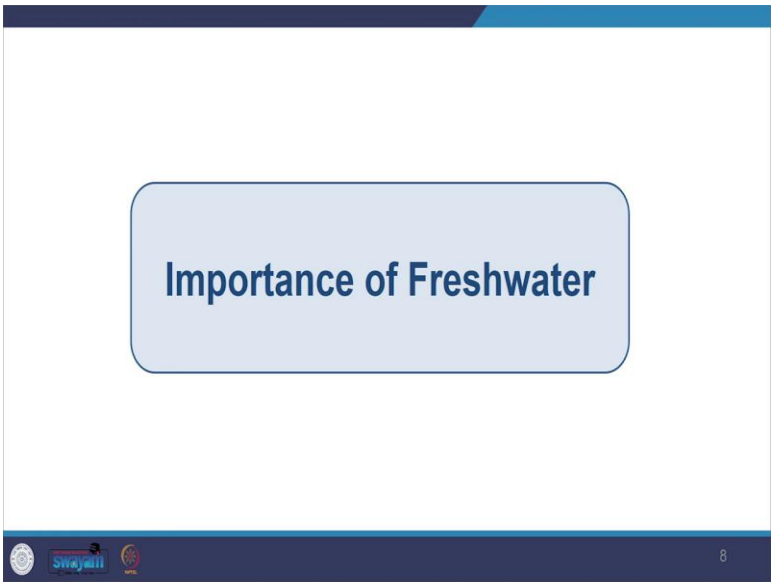

So, let us first think of the importance of freshwater. It is essential for the health, our well-being essential for animals, plants, and both aquatic and terrestrial ecosystems. Its important importance has been recognized in Sustainable Development Goals. Review, and think about how many SDGs are concerned with water.

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And further, many of the SDGs apart from these, which are directly connected to water will not, will not be achievable without the availability of freshwater. So, water is one of the very important, and freshwater is one of the very important parts of the entire SDG. So, we see that SDG2 deals with food security, and SDG3 deals with health and well-being. So, you can see several SDGs that are directly connected to water.

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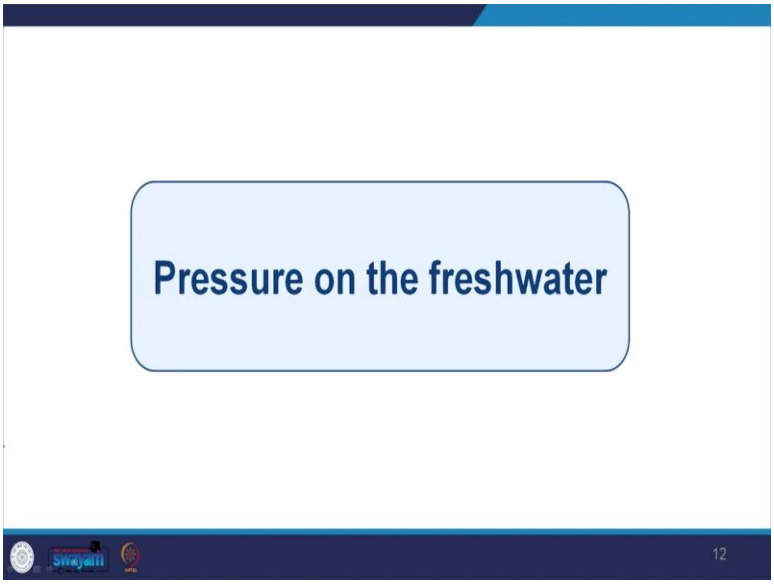

So, now moving on we see what kind of pressure is there on freshwater. There is considerable pressure on freshwater due to climate change. We see that the global water cycle which is the most important component of the weather and climate system is changing.

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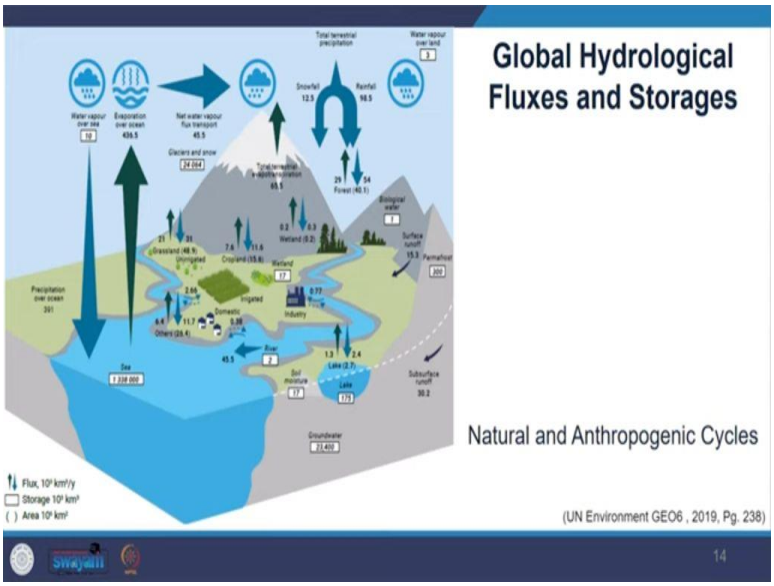

And the image you can see the global hydrological fluxes and storages here it is expressed in a thousand-kilometer cube kilometer cube per year. How much water storage is there in the boxes you can see in the diagram? You can see the natural and anthropogenic cycles used for the domestic irrigation industry and so on. So, you can read this diagram and see how the water flows. And the major concern is that this cycle is becoming faster due to our warming planet. You may also be aware that freshwater available as surface water in rivers, lakes, and wetlands is limited. It is just 0.4 percent.

And you may note that the freshwater is decreasing at a very fast rate. So, we see that the cycle is also increasing as well as there is a decrease in the freshwater. You will also be noticing around you that there are

increased floods and droughts. You have also heard of the loss of glaciers. All these changes cause direct and indirect impacts on our health and the health of the ecosystem. For example, as stated nearly 1.7 million people die annually from a very very preventable disease, Diarrhea. We see in India as per Intensified Diarrhea Control Fortnight IDCF guidelines 2019 by the Ministry of Health and Family Welfare.

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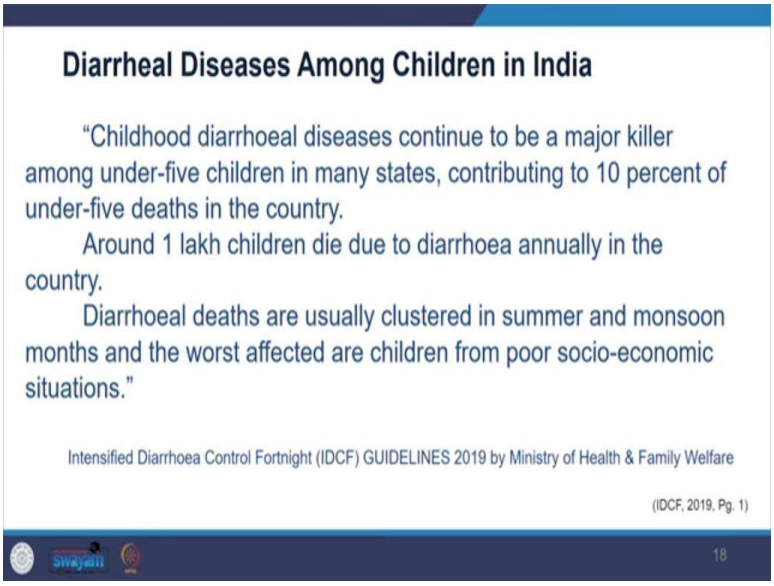

We see that childhood diarrhea diseases continue to be a major killer among under-five children in many states, contributing to 10 percent of under-five deaths in the country. So, that is we are looking at 10 percent is just happening matters. Around one lakh children die due to Diarrhea annually in the country, so that is the death rate we are looking at. Diarrhea deaths are usually clustered in summer and monsoon months, and the worst affected are children from poor socio-economic situations. There are a range of factors that influence freshwater quantity and quality in different regions. The condition worsens, due to uneven distribution of freshwater. So, we see that there is an uneven distribution of freshwater, some areas have lesser water and some have abundance.

People migrating from one place to another, from rural to urban, and over and above, we now have increased even some extreme droughts, floods, and storms. So, these all influence the availability of freshwater quantity as well as quality. We are also witnessing a reduction and the resilience of the ecosystem because of natural and human-made disasters.

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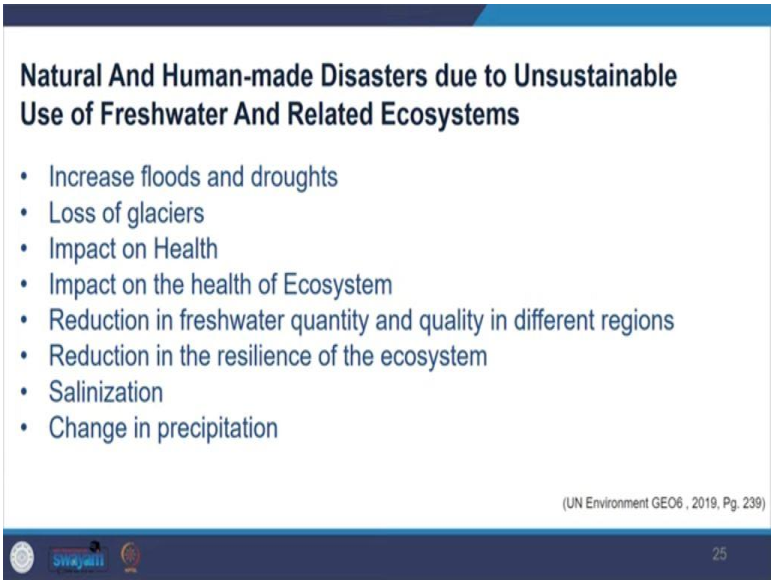

So, in addition to that, we are experiencing disasters along with unsustainable use of freshwater and related ecosystems. So, we are also noticing an increase in salinization. So, there is also apart from this, there is also salinization happening due to global warming, as well as land use changes, melting ice, and snow reserves. And then also pumping of groundwater and then drying of continents and rising sea levels, so, all these are again, influencing the quality of water. We are also noticing a change in precipitation, with many areas now receiving less precipitation or facing drought than in the past.

Whereas, many others experience more rainfall and temperature than before, so we are seeing this variation happening. A major concern is that the fast warming of the polar regions and high mountain regions creates unpredictable situations. Now, we have a situation where we are not able to protect predict. So, we further see that in this situation, there is a contrasting situation, there is evidence of increasing drought severity in Europe, with historical records indicating increased aridity or many areas since the 1950s. So, what happens when there is too much rain? It causes pollution. Whenever too much rain happens, we see an increase in pollution.

We see soil erosion, we see avalanches, and mudslides, and all of these can cause floods, tornadoes, and cyclones. So, leading to another disaster these would further cause physical damage to our infrastructure, cause loss of life and injury. I am looking at what happens when we have limited rainfall. So, when we have little rainfall, it causes draught extreme wildfires, sandstorms, soil degradation, and increased competition over water sources. So, we start this conflict for what water sources we have, and this often leads to accelerated shrinkage and loss of these goods. So, we consume it very fast, and then these sources of what we have started shrinking. So, a very well-known example of this shrinking water body is Lake Chad.

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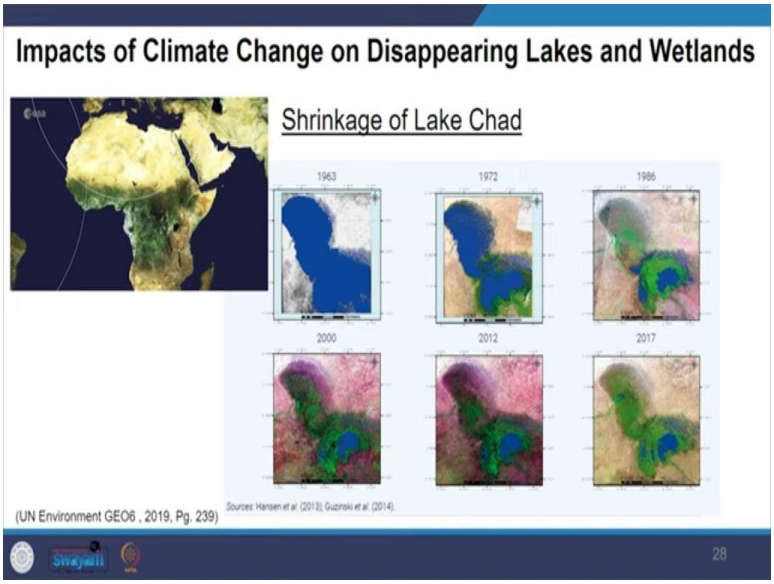

You can see the image here and then we have an example of RLC the disappearing wetlands of the Islamic Republic of Iran, lake (are met), and Iraqi marshes, then you can also think of the Caspian Sea. The videos of these have been given to you in the suggested reading and watch, you can further see their documentaries to understand what is going on. So, global climate change also interacts with weather and local scale climate effects, as well as unsustainable water uses and diversion, leading to dramatic impacts such as shrinking freshwater bodies. So, we see what is going on, so, you can see those cases there as well.

Collectively, these realities and risks have grave very very severe, socio, political, economic, environmental, and ecological implications. So, if such kind of things happen, see all the other dimensions it influences. Making better management and governance of freshwater resources and imperative, so, it becomes very, very essential for us to look into it.

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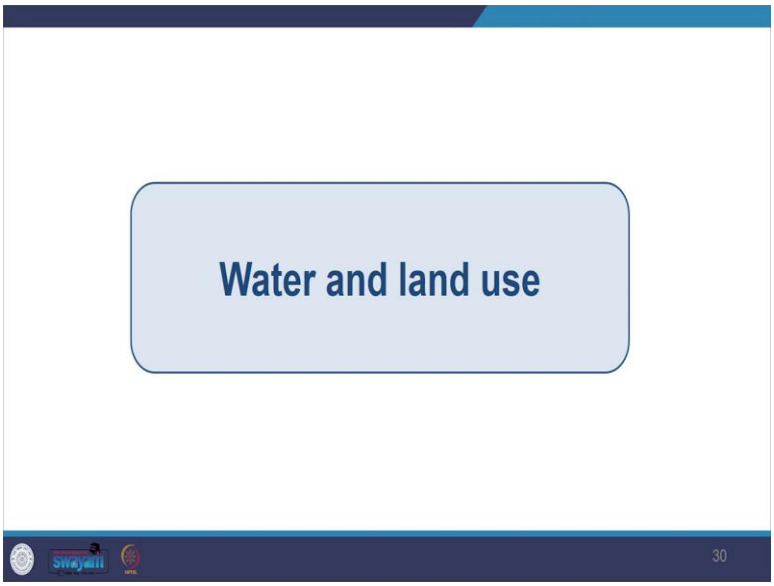

So, now moving on will look into water and land use, and how they are interconnected. So, regarding water and land use, we also see that because of urbanization and agricultural intensification, so, we are witnessing rapid urbanization and then we are also changing land use for agricultural purposes because we need food. There is an issue about food security, we are changing the land use, and eventually, both surface water and aquifers are depleting, and we are reducing that quantity. For this purpose, we are also seeing wetlands being drained.

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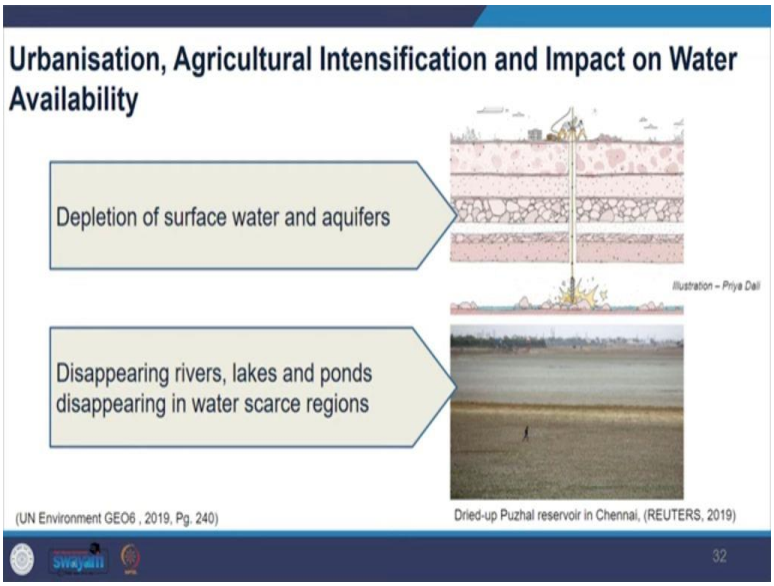

Further, we see that many rivers, lakes, and ponds are disappearing in water-scarce regions. So, we are also seeing the complete disappearance of rivers, lakes, and ponds.

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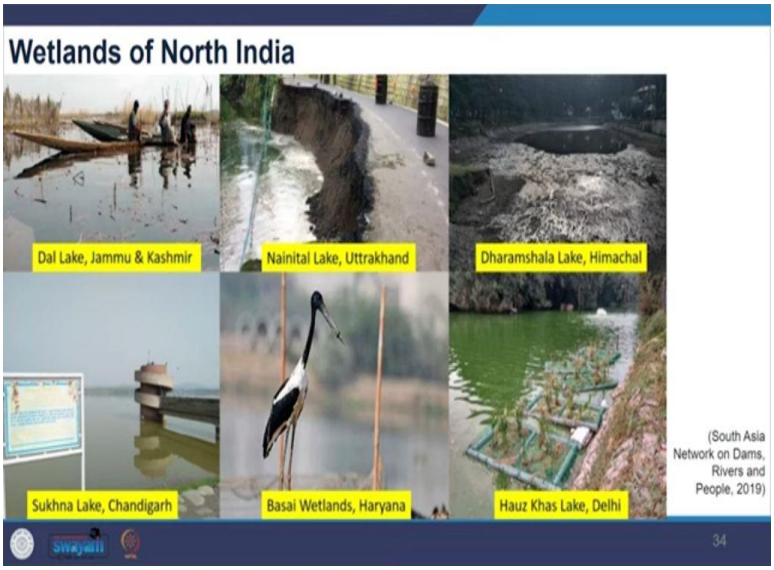

So, despite the environmental significance and associated support services, we see that wetlands have a lot of value. Wetlands have been subjected to degradation for many decades, so we are going on losing them and we are the condition is deteriorating. As we can see in these images, the present situation of wetlands in north India continues to suffer.

So, there are other interconnected problems also which we see because of the land use change. The surface hardening happens in the natural areas, which reduces infiltration and limits the aquifer recharge. So, all the aquifer rehab, limits their recharge as well, at the same time, increases water runoff and pollution. So, when we have increased water runoff, and pollution we again face other kinds of problems.

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So, poor land quality and loss of forests lead to increased runoff carrying eroded sediments through rivers into oceans. So, we also start damaging the ocean and the rivers. So, large-scale deforestation is also increasing the chances of reduced precipitation and an increase in soil erosion. So as a man, we are going on changing the land-land use, we are using cutting more forest. Then we are increasing the charge of the earth, increasing the chances of reduced precipitation, and less rainfall, so that also increases the chances of soil erosion.

We may not as per the report, a major part of the withdrawn water, what we are drawing water is used in agriculture. Though agriculture does not come under the purview of EIA, you might be you need to know that major water goes into agriculture, in the range of 70 percent. There is always a conflict in water usage between the agriculture industry and energy production. So, we see that they all are demanding for water, and water demand for energy. As you will see the water demand for energy is much for non-consumption, such as for cooling of the structure, the mechanism, and so on.

So, a lot of water goes in that. The interconnections between water energy and security and food security have identified tensions. So, because all of these need water, and there is a trade-off between them, it requires very careful consideration and looking into the matter. This nexus becomes especially important when considering drivers such as urbanization, population, economic growth, technology, and innovations. One needs to look very carefully into it. And, when you do EIA, and then how any kind of development is changing, or how it is influencing these conditions.

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Now, let us look at the global state and trends of freshwater, so, we will be looking at the trends now, and the states affect certain facts here. So, first, look at the state of water quantity and the global hydrological map.

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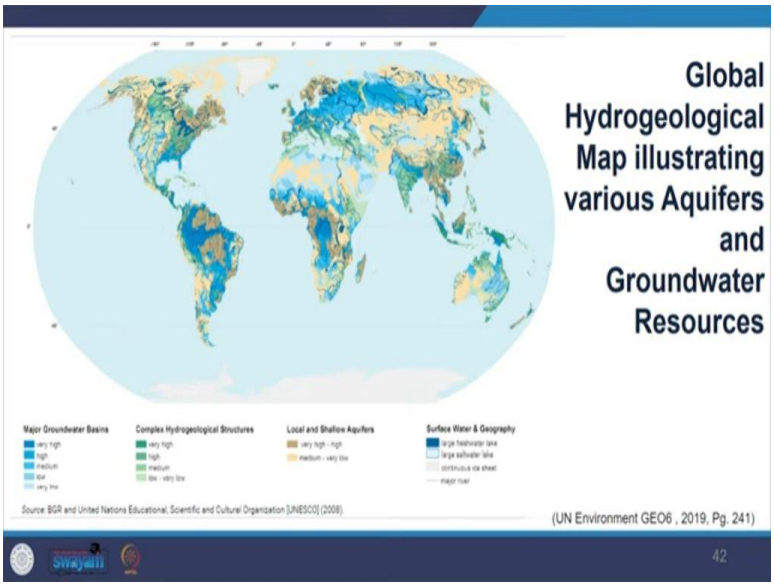

Here you can see how aquifers and groundwater sources are unevenly distributed. As we also talked in talked before we really, water sources are unevenly distributed. Look at the dark blue color indicating a major groundwater basin in India. You can see a dark blue color over the Himalayan regions so that region is rich in water resources. The green color shows the complex hydrological structure. Local, local, and shallow aquifers shown in brown, dark, and light blue polygons with boundaries are the surface water reflection. While you see this reflect how they are distributed and what kind of conflict and challenges it poses.

So, you can look at the diagram here. So, we further see that groundwater is the major drinking water source and its major drinking water source for the majority of people at the global level. Particularly, it is in the arid regions and during the drought, so, one uses groundwater heavily across the globe. So, it is estimated, that the estimated available renewable groundwater resource in Africa is said to be more than a hundred times that of the total annual renewable surface water resource.

However, using that deep aquifer water is constrained by the exploration as well as the cost which is involved. And if you are familiar with the water conditions in Africa, you would know that water is there, but still, it cannot be accessed or it is expensive to access. It is unsustainable to access that water. I have also provided you a link to a video where you can learn more about the issue here in Africa about the water resource, groundwater resources. So, moving on now we will be looking at the water withdrawal rate. So, in the following image, we see global trends in increasing groundwater use.

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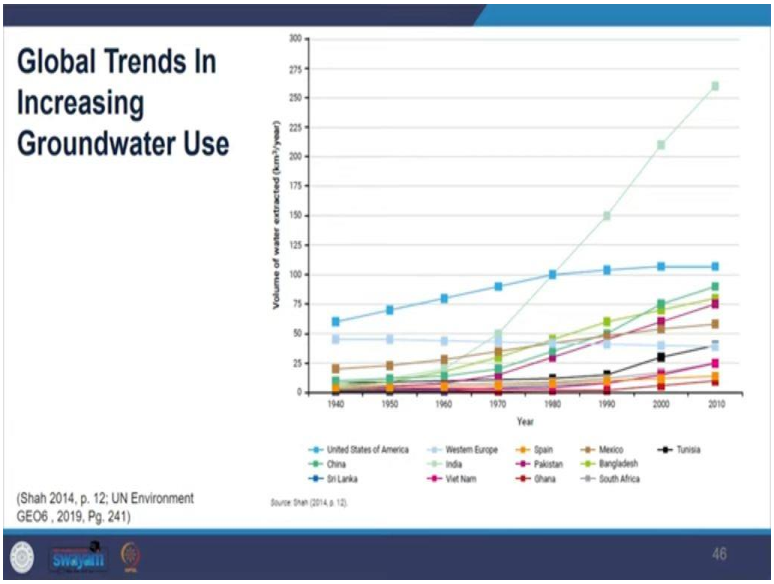

So, shown in a light green box online. Look at the increase in groundwater usage in India and other countries. Water demands vary across geographies and contexts, such as urban or rural areas. So, how we consume water varies culturally as per geography also, per context. Most of the water is used by agriculture as we mentioned before as well and it consumes 70 percent of it, so you can see the global trend of increasing groundwater. So, groundwater use has plateaued, so there is a certain level of stabilization in some regions, but is increasing elsewhere. So, you can see India here, such as in Asia, and the Pacific in West Asia, about two-thirds of the freshwater utilized in West Asia.

About 75 percent of European Union inhabitants rely on groundwater for drinking. Groundwater use compared with surface water has increased substantially at a rate of 1.3 trillion meter cubes per year across North America, so it is been extracted very heavily. So, we further see that UNEP Report 2012 Report suggests that it is because of increased agriculture, and groundwater usage that has caused an increase in depletion rates in major aquifers. So, because of these major aquifers are getting impacted in arid and semi-arid zones. We are mining some of the large aquifers in an unsustainable manner by exceeding their long-term natural recharge rates.

So, all aquifers have their recharging rates, so we have been exceeding those rates. Further, we see that the problem particularly, in fact, if you look at five of the world's seventh largest aquifers are in Asia, and the Pacific and are overstressed, so they have been used extensively. It is also reported that because of excessive groundwater abstraction, there is also a sinking of the land area in coastal cities, such as we can see in Bangkok, Ho Chi Minh City, Jakarta, and Manila we can see.

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So, I have provided you a link for that. So, you can see the image here of Bangkok, how the sinking of the city is taking place and other cities you can see from the suggested watch and readings. Overexploitation of an aquifer can also impact wetland ecosystems. So, once we over-exploit aquifers, it can also impact the wetland ecosystem, hydraulic fracturing for like all the resources like oil and gas extraction, and also impact the groundwater. So, access to groundwater may be further limited to the climate change impact due to the rise in sea level. So, as and when the sea level is also rising due to climate change, it is further increasing the problem of access to water and groundwater.

Most of the islands are experiencing increasing freshwater shortages, so that is also happening. Now, looking at the problem of glacial retreat, so, we are going to look at what is glacial retreat. Climate change, there is an impact on the availability of water in regions around the world. In particular, areas that are dependent on the melted water of the glacier, so a lot of our area is dependent on glacial water.

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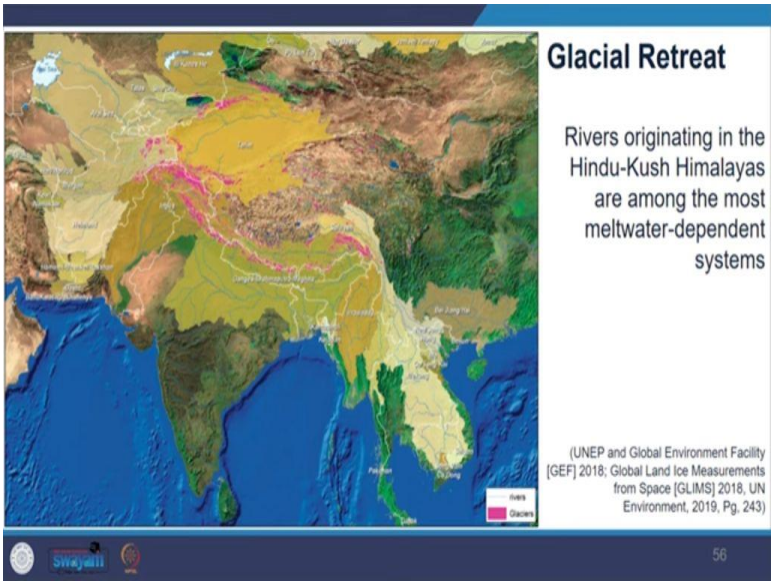

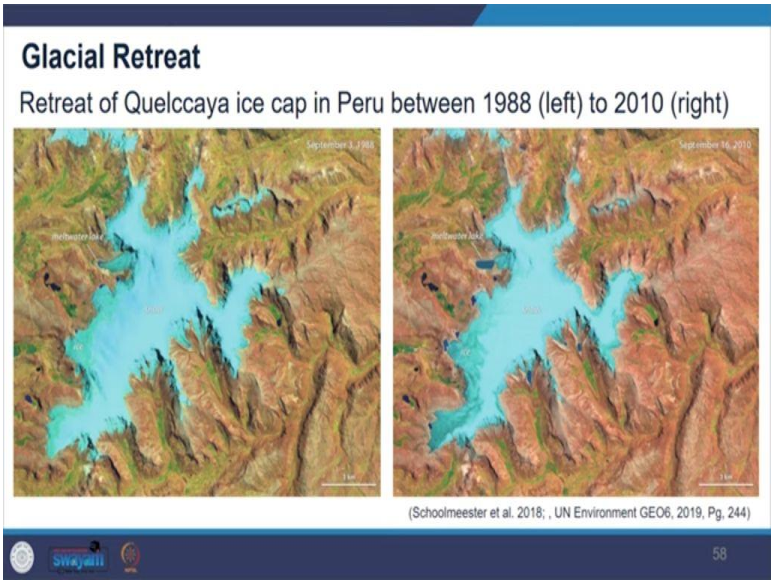

For example, the Hindu-Kush Himalayas you can seen in the image here, this region is largely dependent on the melted water of melting water from ten river systems such as Amu Darya, Brahmaputra, Ganga, Indus, Irrawaddy and so on you can see here as shown in blue lines, and glacier shown in pink polygons. So, you can see how this river system and then the glacier, all that provides water for us. So, Hindu-Kush Himalayas provide water to 20 percent of the world's population, so it's a huge number. What we are looking at huge proportion of what we are looking at here.

In this image, you can see the Retreat of the calcium Cuelccaya ice cap in Peru between 1988. What you can see on the left-hand side to the condition in 2010 in the right-hand side note. How this no area is reducing pay attention to those areas at the edges, see the difference between the two. Studies show a similar loss in tropical glaciers in the Andes, and European Alps and also in Central Asian glaciers, The large population and ecosystem downstream depend on the available freshwater. So, I have given you the link to all these documentaries which you can further if you are interested, you can look at those.

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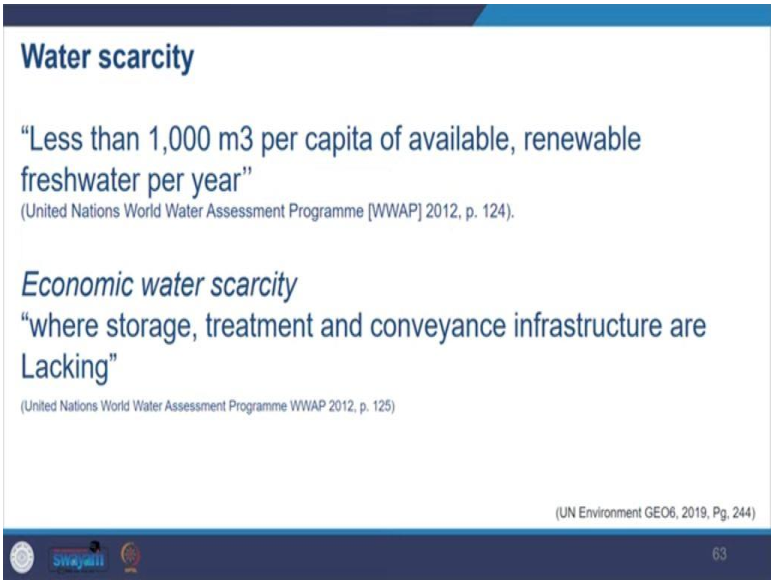

Now, moving on will try to understand what is scarcity. Let us see what we mean by what is scarcity. Scarcity is defined as less than when when is less than a 1000-meter cube per capita of available, renewable freshwater per year, so, that is when we say water scarcity. So, excessive withdrawal is often caused by water scarcity, so whenever we are excessively withdrawing, it is because there is less water.

So, there is also a term, so there is one term which is water scarcity, but then you will also you will familiarize yourself with another term which is economic water scarcity. It is used where storage, treatment, and conveyance, like how to store it, how to treat it, and how to transport it, all those infrastructure are lacking.

So, that then even though water is there, it cannot reach the people, then we say it is economic water scarcity. So, a lack of infrastructure combined with rapid population growth can lead to economic water scarcity. Although there are debates on the actual cause of water scarcity, so like what causes water scarcity is debatable.

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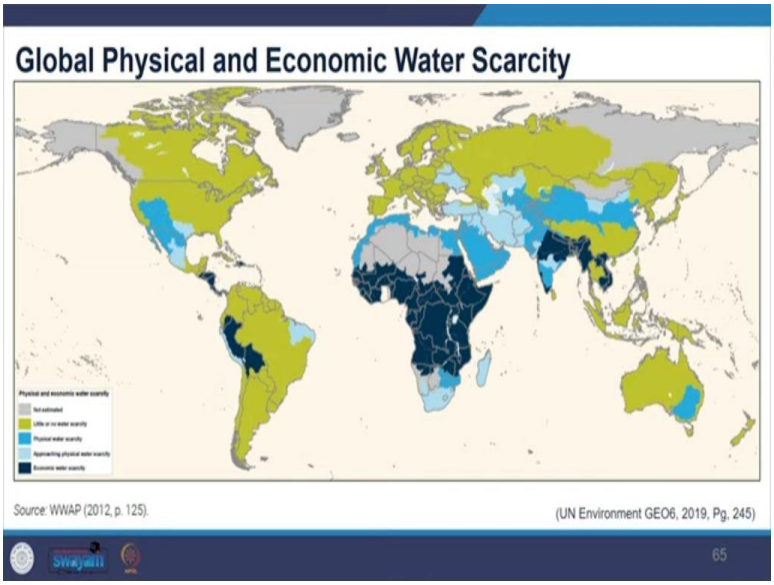

In the image, you can see global physical and economic water scarcity, so you can see the two here. The blue polygon indicates the physical water scarcity when we say as per the definition, what is the water scarcity, and the black polygon shows economic water scarcity. So, you may note the difference here, and you may see in the Indian context also what is how is the variation here. So, water of appropriate volume and quality is not always available at the right time or in the right place for specific use. What is scarcity is common throughout West Asia, Asia, the Pacific region, and in arid parts of Africa as you have seen on the map. Not in America and West to the United States of America and the Middle East, so it is it is like you can see, that it is widespread.

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Factors like what causes water resource stress. We see that it is the large population by pressure of population than the agricultural expansion, as agriculture consumes most of the water and the intensification variation in the rainfall, how the rainfall is changing. And then we also see this very fast development and then increasing urbanization, industrialization as well as climate change, so all of these cause water resource stress. Further, we see another problem which is desertification. Desertification is a pressing problem in Africa's Sub-Saharan region, arising from climate change and internal migration, so that is also happening here.

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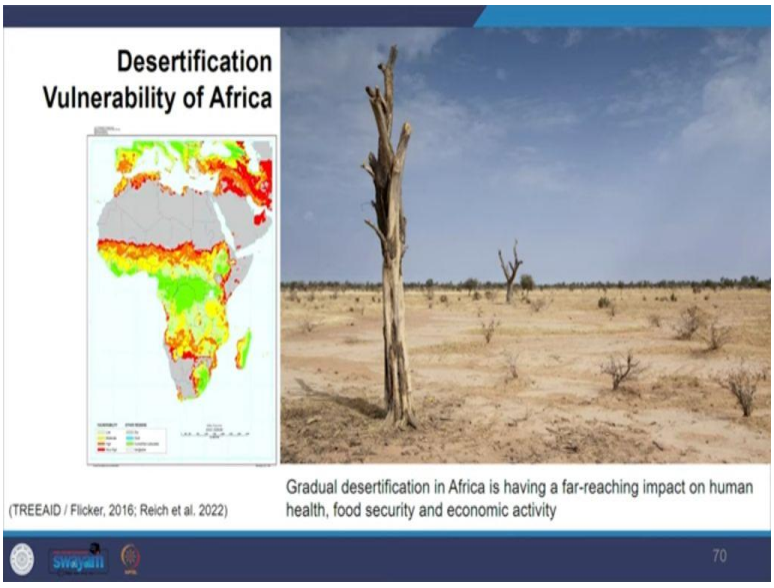

So, you see a lot of desertification happening in the parts of developed worlds. You see the desertification also happening in Europe, North America, and Australia. Scarcity is a challenge that is commonly addressed through large water infrastructure projects such as dams. In parts of the developed world, we see that in particular in Europe, North America, and Australia what is scarcity is a challenge, so it is a problem that is commonly

addressed through large water infrastructure projects. So, there are a lot of water structure, and water infrastructure projects coming up, such as dams, long-distance pipelines, and desalinization plants.

Given expected population growth trends, regions such as Middle-East Africa and Asia need to address water scarcity in innovative, and scale-appropriate ways including water governance, rainwater harvesting and water, and wastewater recycling. They needed to come over leapfrog the conventional solutions of the past, and they needed to have innovative solutions to handle this, so that was about the state and trends of freshwater.

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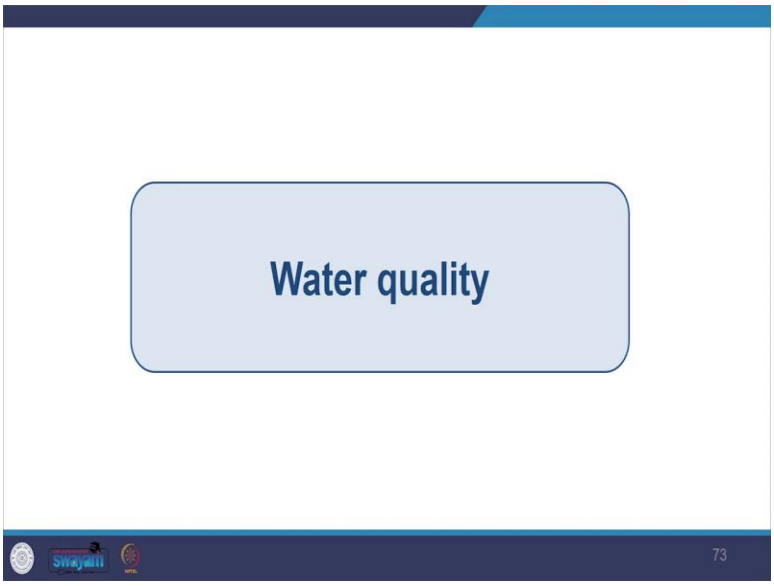

Now, we will look at concerns about the water quality.

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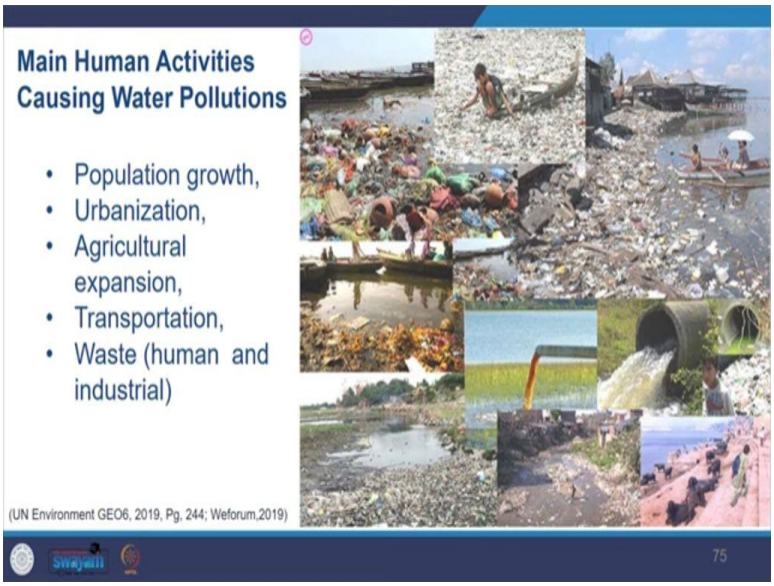

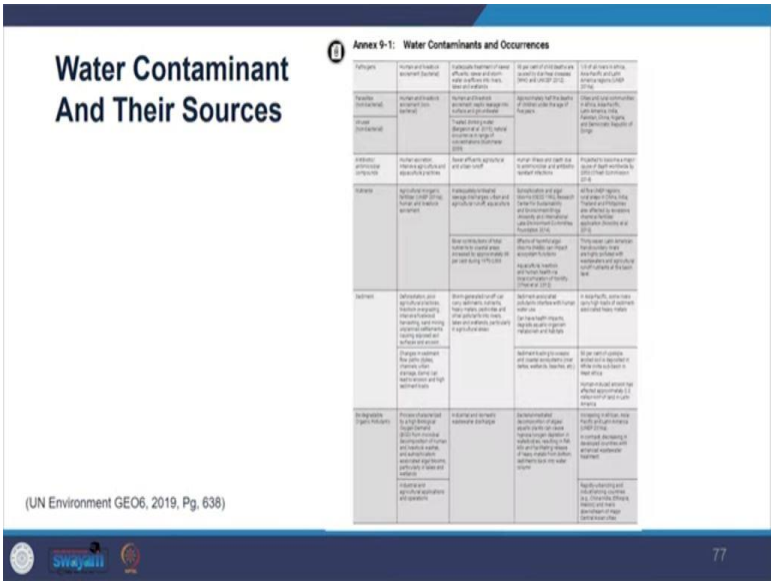

So, looking at the main human activities, water quality is also influenced by natural systems, but we are going to look primarily at the human activities, that causes that influence the water quality, such as you have population growth, urbanization, agriculture expansion, transportation, and human and industrial waste, so you see that it is polluting the water. So, pollution if you look at what pollution includes, it includes pathogens, nutrients, heavy metals, and organic chemicals. You can see in the snip of the table from the global environment outlook, the table shows water contaminants and their sources.

These pollutants come from point sources, point sources such as domestic, industrial, or sewerage pipelines, discharged septic tank leakages, or it can also come from non-point sources. So, like land surface, runoff from extensive diffuse, agricultural use, and urban areas following rainfall and snowmelt events. So, it is reported that the water quality of many lakes and reservoirs is particularly at risk of extinction across the globe, because of long water residence time. So, water is very stable for quite some time, and it tends to accumulate pollutants.

So, that is why we see that the lakes are lakes and reservoirs are at particular risk because it is stagnant water. And it has chances, pollutants have a chance to settle in for a longer time.

So, groundwater pollution sources include non-point, agriculture and urban runoff on-site, on-site wastewater treatment, oil and gas extraction of fracking activities, mining, and industrial sources. So, almost most of this comes under the purview of EIA, so you would be learning about that further, how it is influencing our groundwater pollution, and what kind of how you need to validate that. So further, we see about the pathogens, so pathogens are major concerns causing waterborne diseases.

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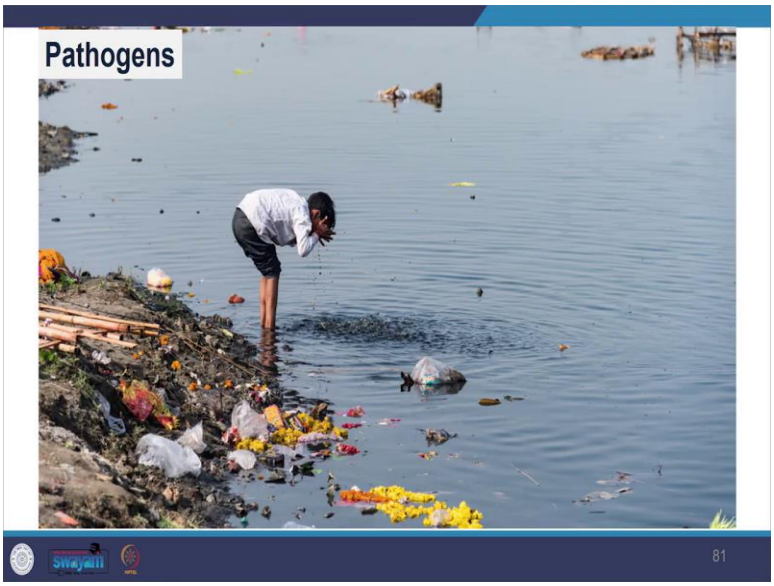

Water-borne disease continue to be a major challenge in many African, Asian, Pacific, and Latin American cities and rural communities, so, you can review the scenario in the same table. You can see you may note that parasites can survive water body conditions for many weeks, and viruses may survive drinking water treatment as well. So, even if the water is treated, the viruses can survive that, so you may consider those things and see these from the facts here. Further, we see nutrients, let us familiarize ourselves with the term eutrophication.

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Eutrophication represents the natural aging process of lakes and wetlands, wherein they become enriched with nutrients. So, it gets more nutrients and sediments and becomes more biologically productive, usually over a long period. So, because of our activities, the nutrient loads can drastically increase, what goes into the water, the nutrients would drastically increase, and this process accelerates speeds. Exploration damages the whole ecosystem because of it getting rapid nutrients. It damages the whole ecosystem, and eventually reduces its usability for our activities also.

It damages the ecosystem at the same time it reduces its usability for our activities and affects our environment. So, algal blooms can turn water bodies opaque and green in color leading to a reduction in water. What is the oxygen content when algae die and undergo decomposition? So, it also causes a loss of oxygen. When there is a loss of oxygen, then it is it kills fish life life also the water. Some blue-green algae species are toxic to fish and livestock and affect our health as well. Studies also indicate a clear relationship between climate change and the eutrophication of lakes.

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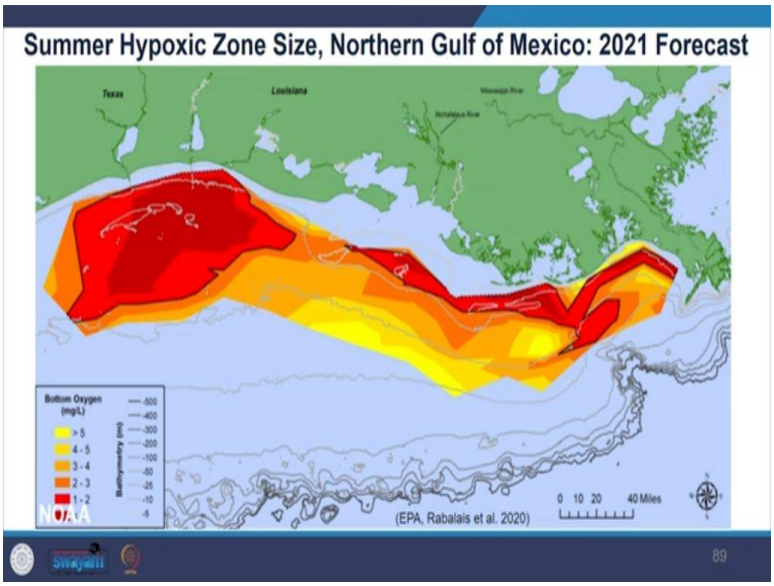

So, in the image, you can see the dead zone also called the hypoxic zone in the Gulf of Mexico, because nitrogen from the Midwestern United States of America is carried down the Mississippi River which eventually decays algae growth, consuming oxygen in the water, and it has suffocated the marine life. So, it is said to be the dead zone. Therefore, there are nearly four times as many dead zones in the ocean now, as they were in the 1950s, so we are finding more and more dead zones in the ocean, including the Mediterranean Sea. So, I have also provided you the link for the additional watch, if you are interested in seeing it.

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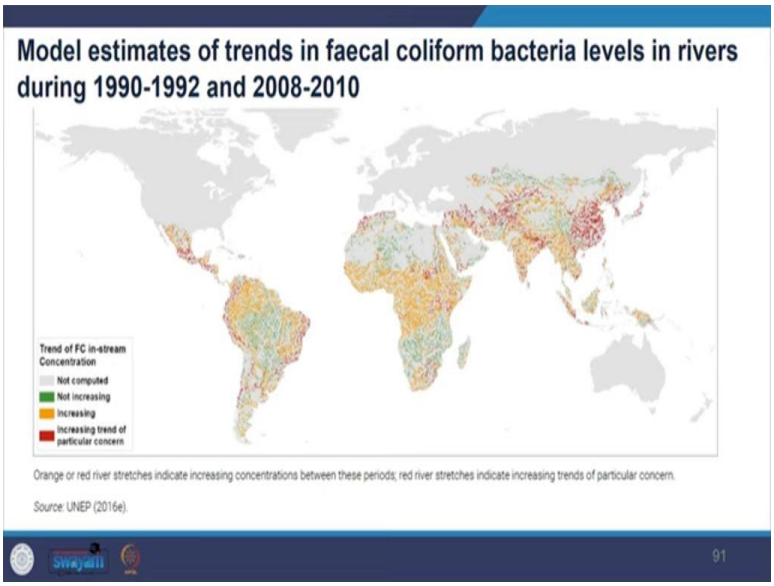

In the image, here you can see the model estimates of trends in the fecal coliform bacteria, which are the group of bacteria that are passed through the fecal excrements of humans livestock, and wildlife levels in rivers. And you can see the difference in 1990-92 to 2008 and 10. Look at the red colors, so you can see how is the spread of this. Now, moving on we will look at the other determinants of the pollutants, here we see sediments. We see

the issue of sedimentation, which happens from erosion of exposed soil surfaces. These eroded soils get deposited in basins throughout the world.

So, it is happening throughout the world, including in Africa, Asia, and Latin America, because of the land use change, causing deforestation, and unplanned settlements are major causes of soil vulnerability to erosion. So, because we are continuously changing land use and causing deforestation, there is an issue about unplanned settlements. So, our soils are getting vulnerable to erosions and storm-generated runoff carries soil into the downstream water bodies, so we are also damaging the water bodies.

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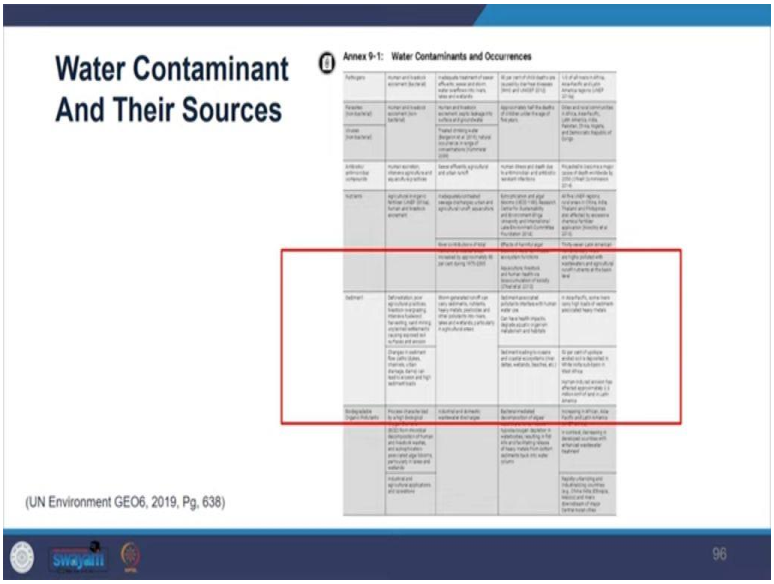

In the image, you can see the tailings sediments from Samarco dam in Brazil, so, you can see here. So, you can further refer table for impact causes and facts you can see here, the contaminants and their sources.

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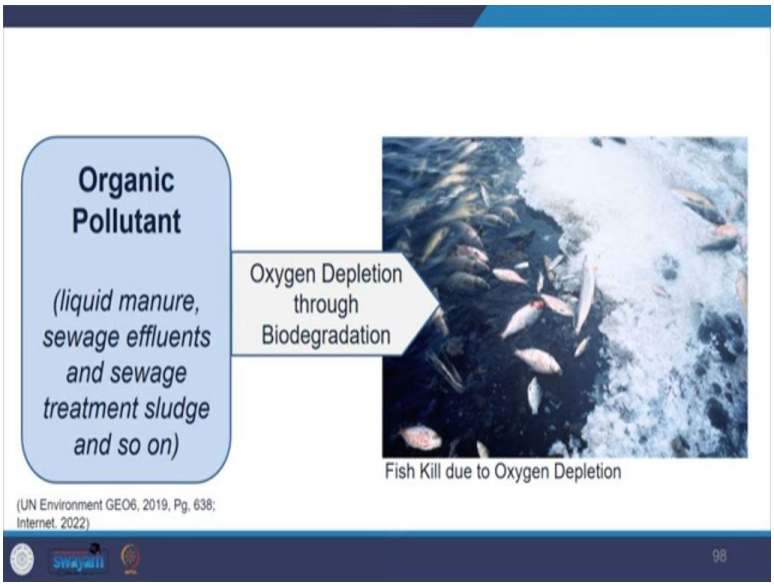

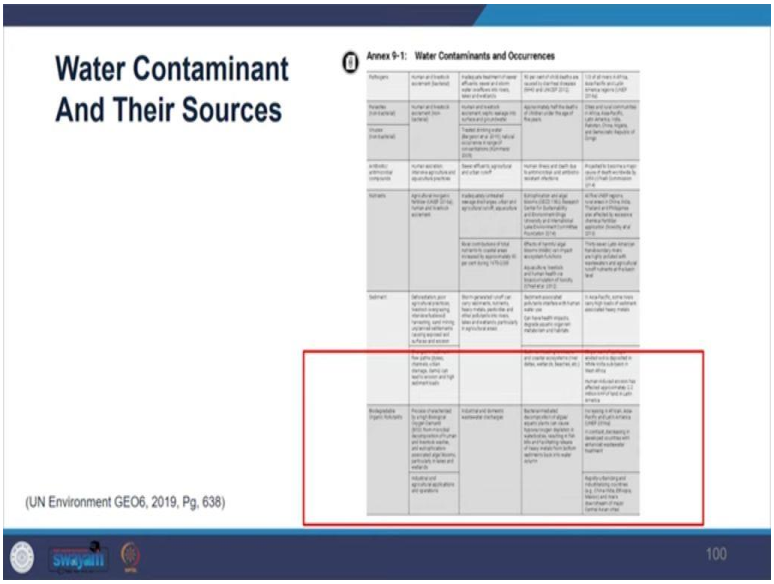

Moving on, now we will look at organic pollutants. Further looking at the organic pollutants, such as liquid manure, sewage effluents sewage treatment sludge, and so on. Biodegradation of these depletes biodegradation when biodegradation happens, these deplete oxygen concentrations.

So, whenever these organic pollutants are bio-degraded, they deplete the oxygen concentration in the water bodies, and oxygen depletion leads to fish kills, and higher Bio-Chemical Oxygen Demand BOD. When there is high BOD from microbial decomposition, these pollutants cause the release of heavy metals from bottom sediments back into the water column.

So, you see the kind of damage that happens. So, studies based on the model analysis indicate BOD concentrations increased in many parts of Africa, Asia, the Pacific, and Latin America from 1990 to 2010, because of the industrial and domestic wastewater discharge, and agriculture in an urban runoff with the highest increase in rapidly urbanizing and industrializing countries, so that is happening more. And now urbanizing and industrializing countries, BOD pollution in most developed countries has significantly reduced with the enhanced wastewater treatment systems.

So, we also see synthetic organic pollutants, which include pesticides, industrial chemicals and solvents, personal care, and pharmaceutical products. Then, we also see persistent organic pollutants POPs are particularly problematic because they do not readily biodegradate biodegrade in the aquatic environment. You may know that these are used by many industries in agriculture applications, they can impact human health and, aquatic ecosystems, persisting in fatty tissues of humans, fish, and other organisms, and accumulating in sediments.

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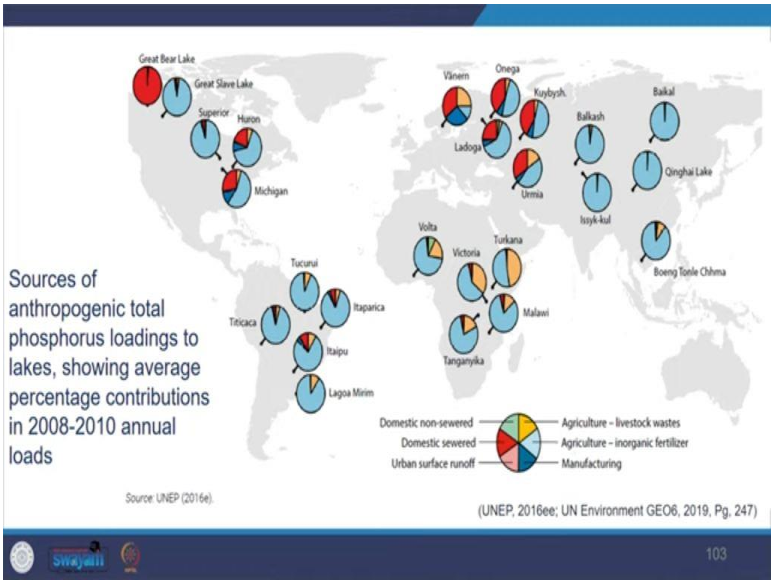

So, in the image, you can see anthropogenic total phosphorus loading to lakes, for the five largest lakes by surface area in each of the five UN Environments regions, showing average percentage contribution in 2008 and 10, annual loads you can see here. You can see how much loading is happening from manufacturing agriculture urban surface runoff and so on, so pay attention to those legends. And look at the colors and how it is distributed here. So, moving on further, we see the pollutant heavy metals, we are also facing the problem of heavy metals, which are used in industrial, and agriculture sectors, water-intensive mining, and so on, which degrade the water.

Concerns are serious in some Asia Pacific and South America, African, and Latin American countries. They also damage plants many like mercury, lead, chromium, and cadmium are toxic to human and aquatic organisms. So, groundwater pollution due to metals also has been reported to have occurred in Canada as well, because of the sand, tars, and industries. So, industries also have a role to play here. We see that the natural arsenic groundwater contamination in South Asia and other countries in Asia and the that s already there naturally. But, that gets further deeply aggravated, with our activities of metal mining and groundwater abstraction.

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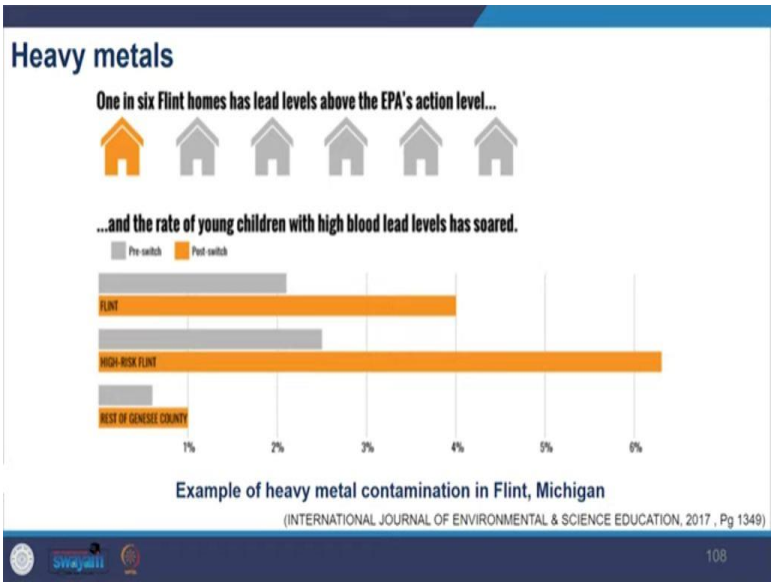

You may refer to the critical example of heavy metal contamination involving the Flint, Michigan case, so, where the source of water had to be changed. So, now will look at another component of water quality that salinity.

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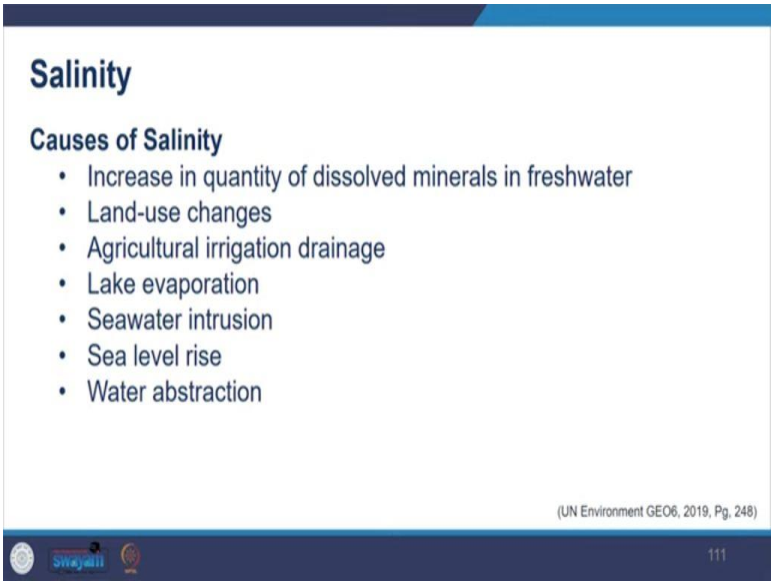

Salinity happens due to an increase in the quantity of dissolved minerals in freshwater from the land-use change. So, it is it happens because of land-use change, agricultural irrigation drainage, lake evaporation, seawater intrusion, sea level rise, water extraction, and so on. If access salinity happens, then it is unsuitable for human consumption, so we cannot consume it. And then many of the plants and organisms have limited tolerance to salinity. So, salinity problems prevail in Africa, Asia, and Pacific, and Latin America and all. And then it has been increasing because of the industrial water uses.

Saline water intrusion into coastal aquifers can result from over-abstraction and mismanagement, as well as sea level rise. So, salinity impacts the quality of the environment and as well as impacts food security. There are now many emerging contaminants, so you have seen certain of (the) few of them.

Now, there are many other emerging contaminants such as human and veterinary pharmaceuticals, personal care products, and insect repellent, so all the stuff we use, you may look at that, and also microplastics and manufactured nanomaterials. So, these all are new contaminants we are seeing. United States Geological Survey detected such contaminants in the majority of sample streams in the US. So, you can see how what is the level of contamination.

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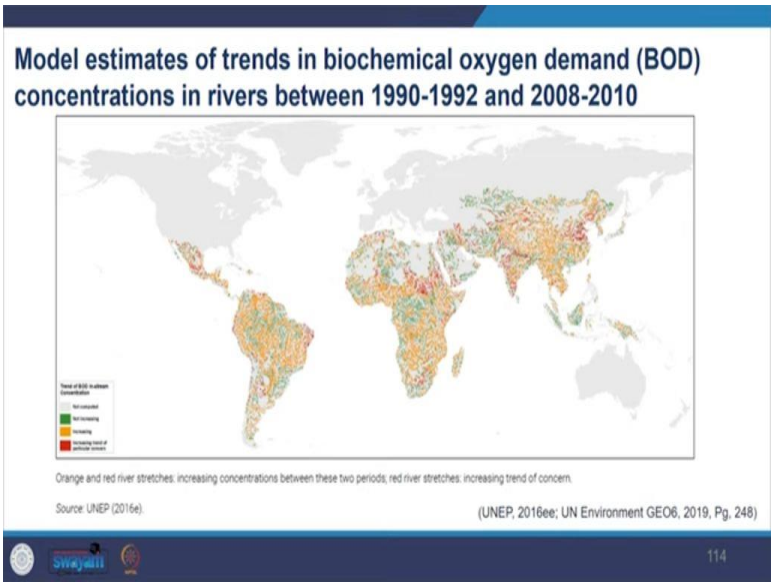

In the image, you can see the model estimates of trends in biochemical oxygen demand, concentrated in rivers between 1990 to 92 to 2008 to10. The red color streams indicate the increasing concerns, scan through where scans through through the image, and see where all you see the red color streams you can see here.

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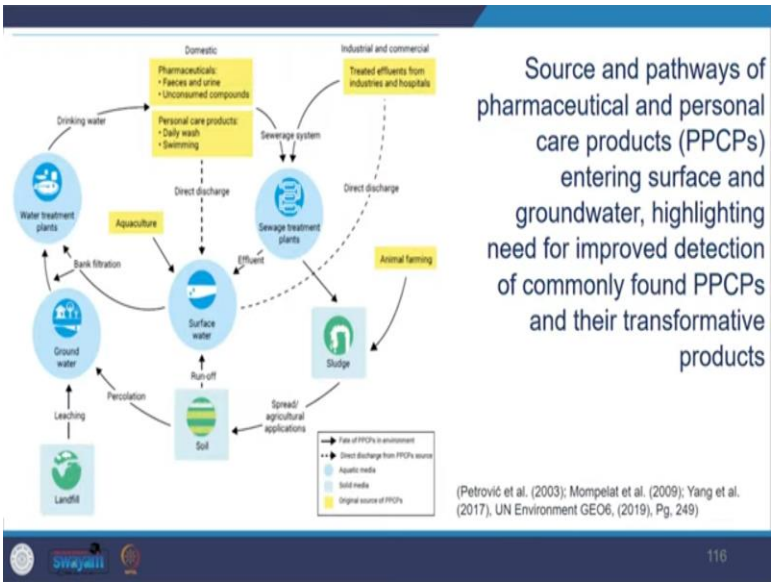

So, in the image, you can see the source and pathways of pharmaceuticals and personal care products entering surface and groundwater. You can see here how it is happening, all the sources, and how they are entering, further we see plastic waste is another major concern. Microplastics are also, can also, can contain and absorb toxic chemicals. Electronic waste is another concern, we see because of its widespread abundance. We have a lot of electronic waste and unknown risks to surface and groundwater quality. So, we still do not, we do not know what kind of impact it has.

So, if you further see, there are other groundwater quality concerns as well, which is important from the EIA perspective. You will see the groundwater pollution from oil and gas fracking activities, which are large quantities of chemicals, and discharged large volumes of produced water, so that all gets into groundwater. Also, the byproducts of all these activities, and their range of products, which also happens during the operations are of concern. We further see lake and acidification, thermal pollution, radionuclides are also problems here we see.

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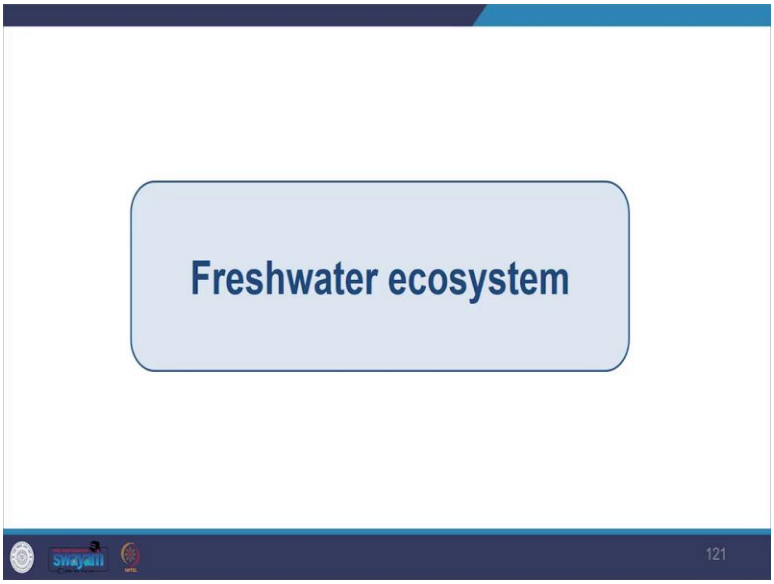

Now, we look at the freshwater ecosystem, so, there is a continuing loss of wetlands. So, we are experiencing the loss of wetlands, examples of freshwater ecosystems or inland, wetlands, include marshes, swamps, peatlands, wetlands, forests, rivers, lakes, ponds, and waters. All these are examples of freshwater ecosystems. And they provide a range of functions. So, there is like it, it does a lot of things, such as providing regulatory and supporting ecosystem services. We will also see all these in the ecosystem services in the methods section where we study them.

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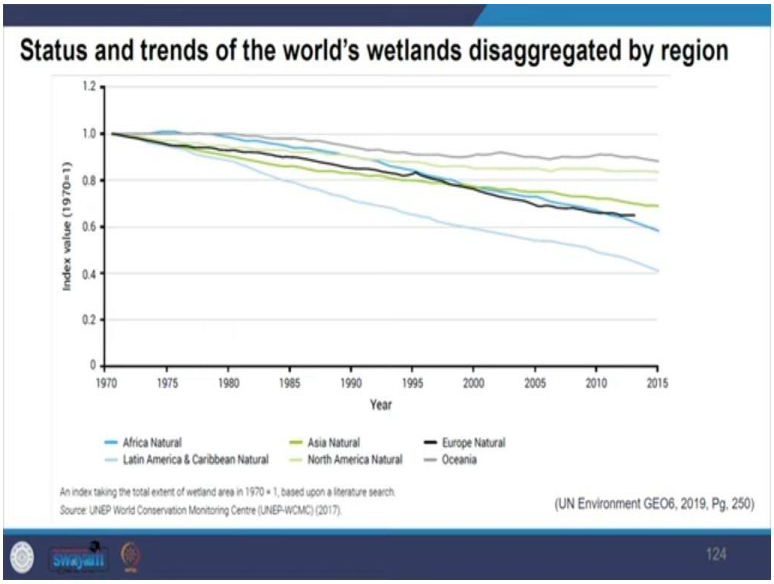

So, in the image, you can see the status and trends of the world's wetlands and wetlands disaggregated by region. And you look at the dark green line indicates the trend in Asia. So, you can see how the wetlands are reducing and pay attention to the dark green line here. So, ecosystem services for all wetland types have been valued. So, it has, I will also look at the valuing system. So, it has been valued financially across, and the value its ranges from US dollar 300 to nearly million USD per 9 nearly 9 million USD per hectare per year. So, you see the value which is there. Peatlands are very important as they have a high carbon sequestration value. As

they have high carbon sequestration value, hence they contain more carbon than all global forest biomass combined.

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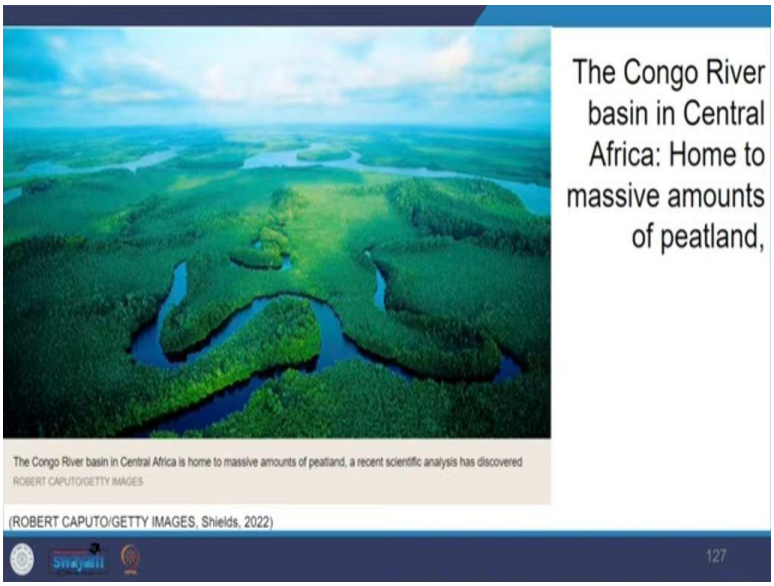

So, you are seeing the image of the world's largest tropical peatland in the Congo River basin containing an estimated 30 gigatons of carbon. So, you can see here, that I have also given you the link to further watch you can see. There have been issues of draining the peatland worldwide in the past decade of changing land use.

We are also witnessing biodiversity loss, studies indicate loss of flora and fauna, because we are losing all these. So, that is also creating that wetlands do have the capacity to filter and improve water quality. However, beyond a certain point like the tipping point, a wetland can no longer regenerate itself.

We are also witnessing the fragmentation of rivers while we are constructing dams, we are creating water diversion, which results in wetlands habitat losses and degradation. So, while we are fragmenting it, these all things are happening, and this has a significant impact. So, dams and reservoirs for water storage and hydroelectric power are seen from different perspectives. So it has been used a lot, but at the same time, the usage is also going down. In recent years dam construction in industrialized countries has slowed considerably. Many older dams are being decommissioned for economic and environmental reasons.

And so dam, in dam remains highest in the industrialized countries. Dam density nevertheless remains highest in the industrialized countries. So, now looking at the impact of problems in freshwater, it has an impact on human health and causes gastrointestinal illness. Predicted changes in the hydrological cycle with climate change may increase environmental health-related disease.

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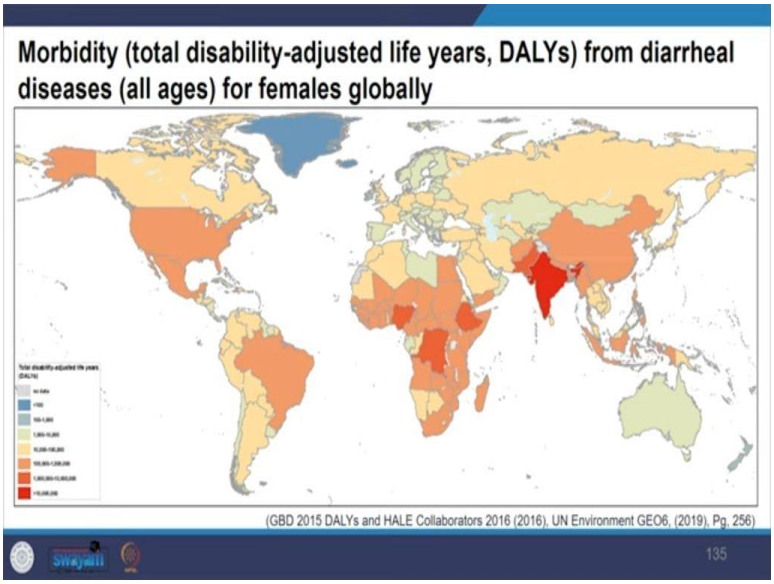

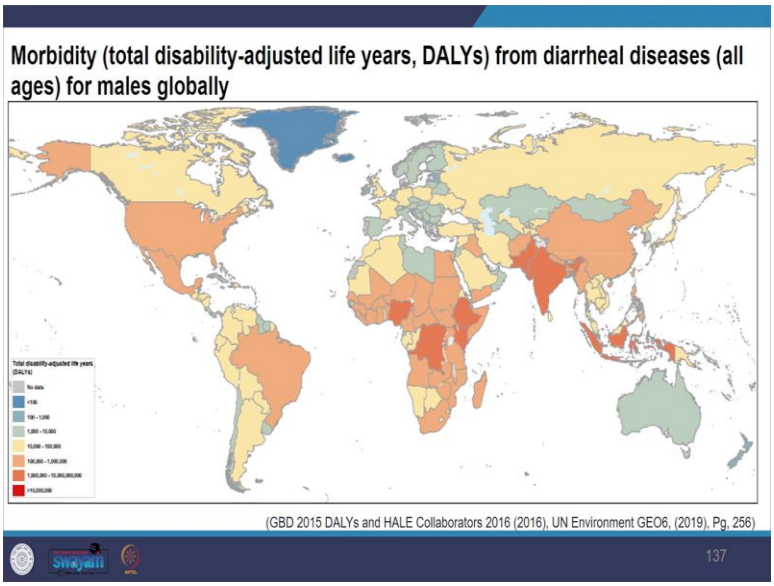

In the image, you can see the morbidity from diarrheal disease of all ages. For females, pay attention to the red color as shown by the study here. You look at the red color, the most severe areas. Then in the image, you can see the morbidity of diarrheal disease for males, so you look at the color difference and how it is different for men and women here.

So, it is it impacts the food security as well, so that also we see. And then furthermore, we see that human safety and security are also a concern, degraded water quality, physical and economic water scarcity, and loss of freshwater ecosystem services have significant impacts on human safety and security. So, whenever floods happen, or droughts happen they affect a large number of vulnerable people with security, and there are also migration implications. So, all that we saw was summarizing what we covered today.

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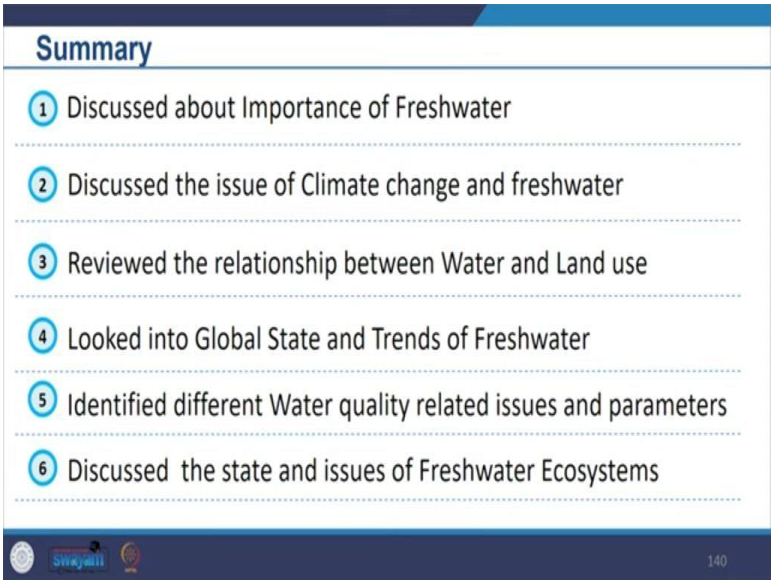

We discussed the importance of freshwater, we looked into climate change and freshwater, and we looked at how the relationship between water and land use. Further, we also looked at the global state and trends of freshwater like what is happening, so that when you do EIA, you have a larger perspective of the environment. Then, we looked at identifying different water quality-related issues and parameters, and then we discussed the state and issues of the freshwater ecosystem. And we also looked at the impact of what happens. So that is all for today.

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And this was our references and our coverage has been limited as per the scope, and this of the subject additional resources to read and watch are provided to you. So, you can look at all these suggested readings and watch them here. Thank you.