

Sustainable Architecture
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Lecture – 06
Environmental Impacts of Development: Impacts on water

Good morning. Welcome to the second week of the course on Sustainable Architecture and I am your instructor Doctor Avlokita Agarwal; Assistant Professor at Department of Architecture and Planning, IIT Roorkee. In the week one, we have seen the historical development of sustainability as an idea, as a philosophy. We have seen the historical events which have led to the understanding of sustainability as it is today. We have talked about the different visionaries of their times who in some way or the other have worked towards enhancing or strengthening the idea of sustainability or sustainable development through the course of their works.

We have also seen different definitions of sustainability and sustainable development as they are being discussed in today's times and how they have evolved. In this week, we will be talking about the different problems of development, urban development or human made development and how it is impacting the natural environment. From this lecture onwards we will see the impacts of development on natural environment through different elements.

Natural environment is primarily consisted of five basic elements; water, air, earth, space and fire or energy. Water being one of the most important element of natural environment is also available in limited portions, limited proportion on our planet earth. It is one of the very basic life lines and earth is habitable only because it has water on it. It has water which we can drink and life can flourish.

However, the development which humans have made have impacted the water bodies, the water sources on earth in a severely negative manner. Let us look at some of the impacts on water.

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One of the major impacts on water as an element is the shrinking of water bodies across the world.

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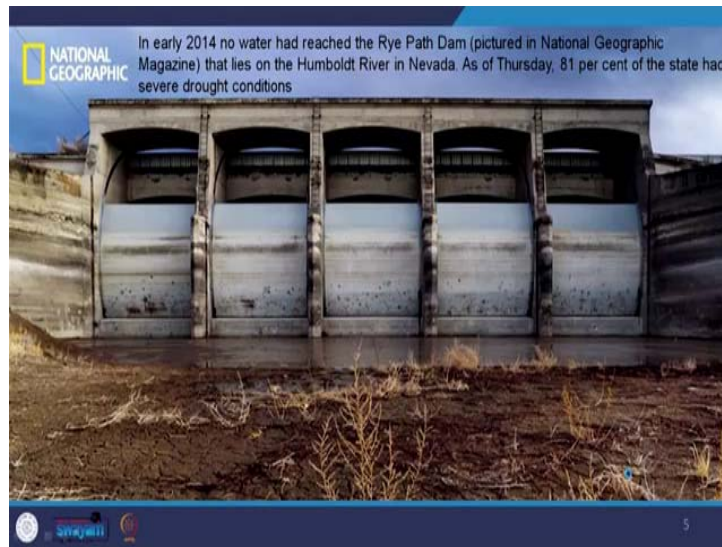
There are several areas like this one in California which have been converted to barren lands or deserts; every subsequent year because of lack of rain, lack of precipitation.

Now, this lack of precipitation itself is because of many reasons. It is because of the lack of forest cover, plants which help in bringing rains, which help in creating the humidity required for the rains precipitation to happen. Or it may also be because of the way

development has taken around these areas which has blocked the streams, the channels of water which are reaching a certain area certain land.

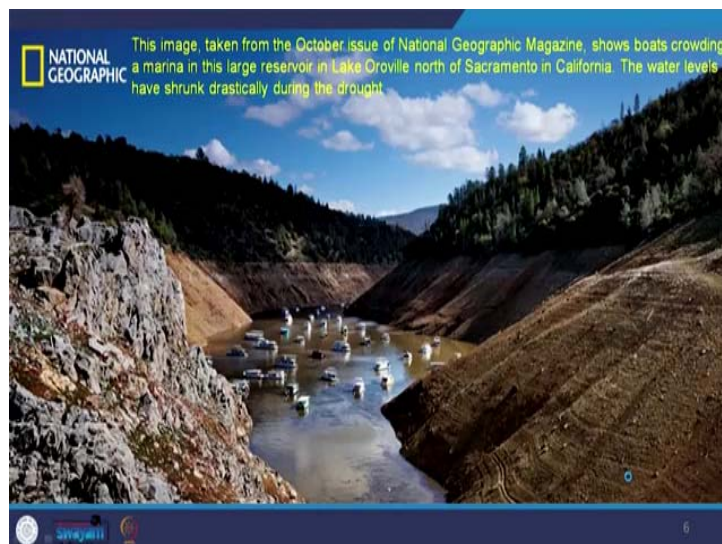
But such sites are very common across the world where huge areas of land are gradually converted into barren land or gradually becoming desertified deserts.

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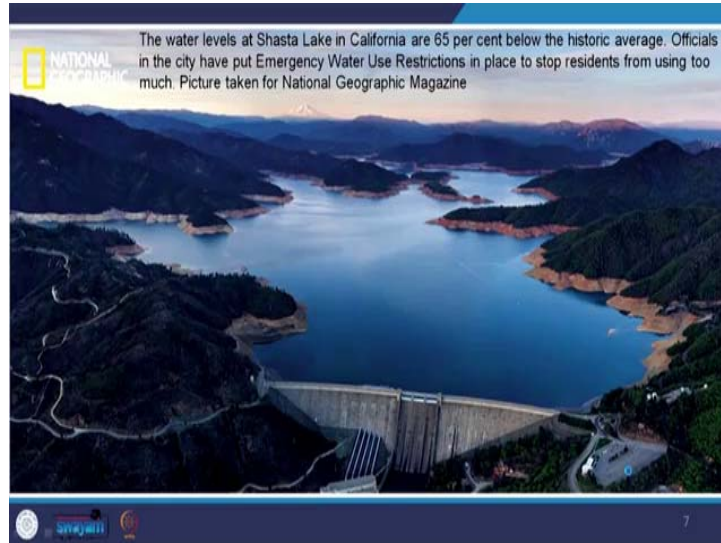
This is another picture of Rye Path Dam in the year 2014 where there was no water in the dam reservoir for the dam to operate for supplying downstream. And such was the case in many many other water bodies in other parts of the world.

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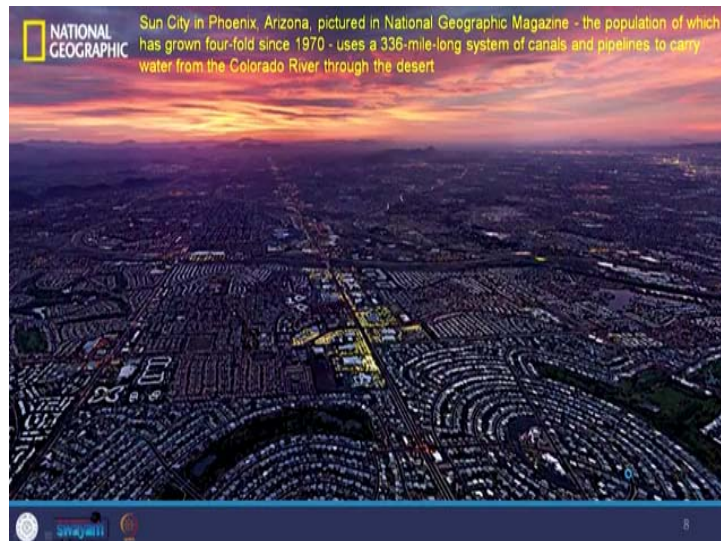
This particular image was taken from the October issue of National Geographic Magazine in 2014 which shows boats crowding a marina in a large reservoir lake Oroville north of Sacramento in California. That particular year was a severely draught year in US; especially in California and water bodies had reduced greatly shrunk in size.

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This is a view of Shasta lake in California when it was full yet; not full, but it was 65 percent below the historic average.

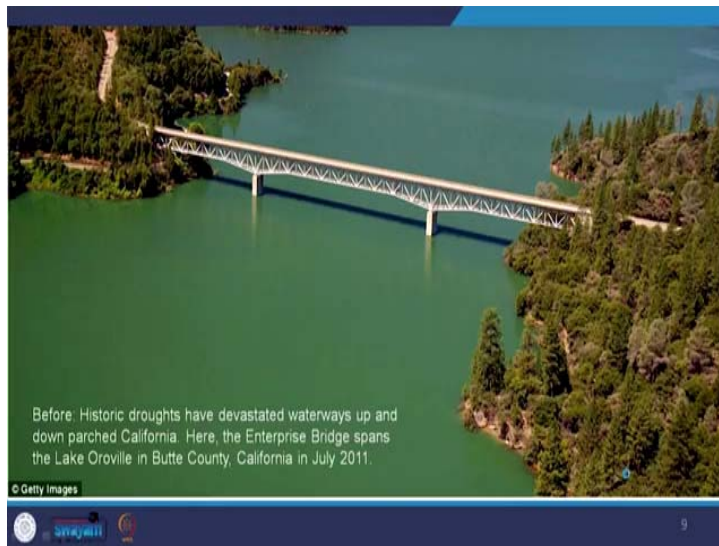
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Again, the picture has been taken from National Geographic Magazine; this is an image of Sun City in Phoenix, Arizona where it uses a ~~336-mile long~~336-mile-long system of canals and pipelines to carry water from the Colorado River through the desert.

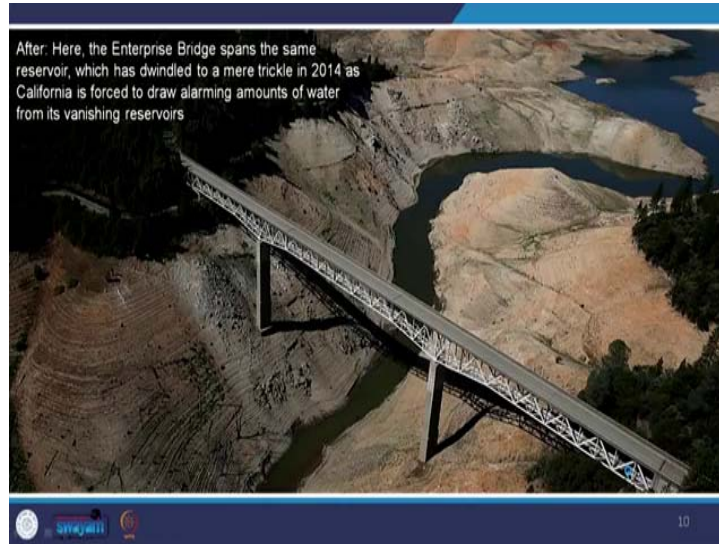
To only feed this city, the City of Phoenix; Sun City in Phoenix which houses huge population, large population which further consumes a lot of water which is being brought to the city from a large distance.

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This particular picture is of Enterprise Bridge which spans the Lake Oroville in Butte County California and this picture was in July 2011.

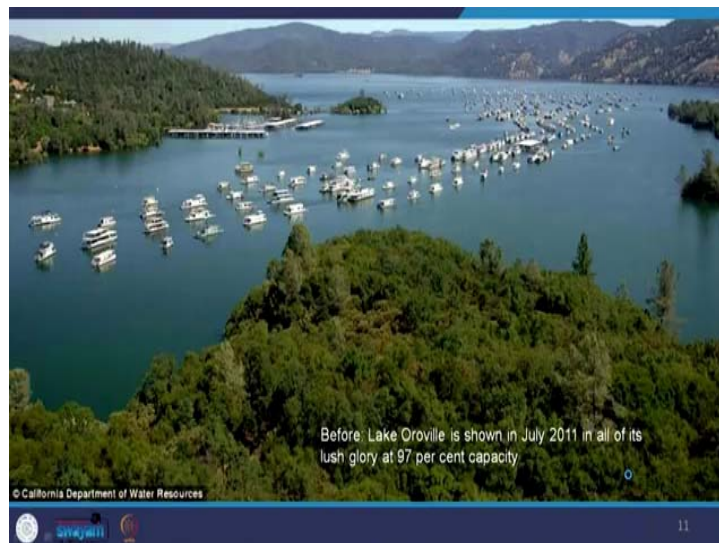
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And, this one is the same place in 2014. Look at the devastation to the water body which has been caused. This is not the current state though it has gradually increased, the water level has increased and 2014 was particularly a very bad year for the rains.

But the condition is gradually deteriorating. This was a sudden change that is why it was evident, it was visible; but such changes are happening worldwide across the world.

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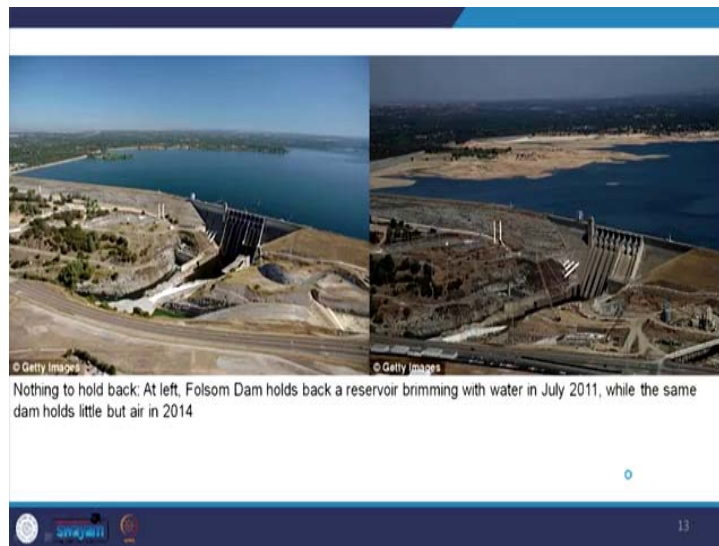
This is again Lake Oroville as in July 2011 where it is full to its brim, people are enjoying. So, it is not just that water is essential for our survival as a basic need; for

drinking and bathing and all other basic uses. But it is also an important means of recreation for us rejuvenating ourselves. This is the view of the same place in 2014 where there is hardly any water left in Lake Oroville.

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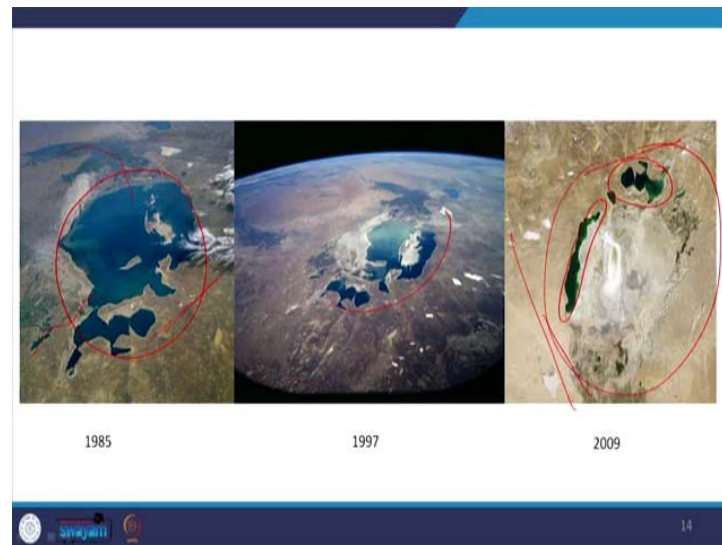


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This is the image of Folsom Dam in 2011 and in 2014. We can see huge areas being inundated initially in 2011.

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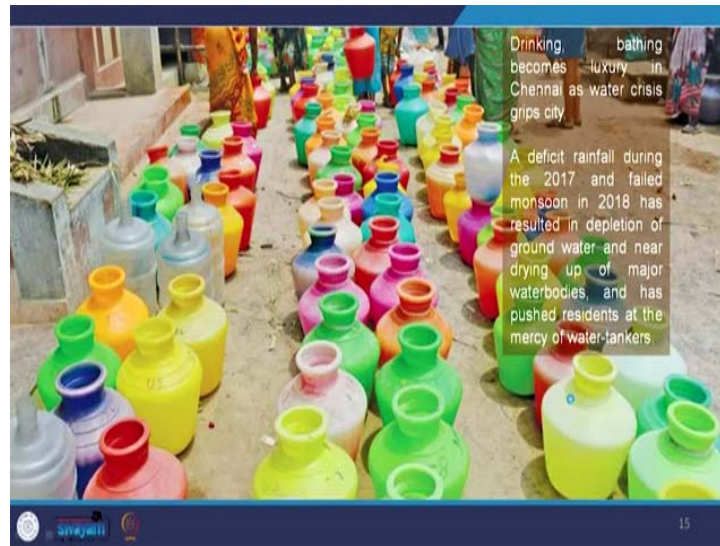


And they are gradually revealed towards the 2014 when the water levels have shrunk, declined. This particular image is of Aral Sea which is an inland sea. In from 1985 to 2009, the sea a water body as large as a sea; it is called an Aral Sea was totally parched dried up and it is now available in very small parts as lakes, small lakes.

So, an area which is as large as this has been reduced to these small patches of water bodies. All courtesy the human development which has taken place around it, the blockages to the water channels which were initially feeding this Aral Sea which were coming from all these different sides, different channels. And, they have gradually been blocked up. They have been blocked up. So, the water is actually not reaching Aral Sea and besides the drying up of this water body, it has subsequent impacts. People who were thriving because of the fishing industry, because of fishing in this sea Aral Sea; they have all lost occupation. People who were cultivating, who were using the water of the sea and the farmland which was around this sea is no more there. People are not farming there anymore because there is no water.

The quality of land has totally changed from Greenland to a totally dried up desert like situation is there.

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This is how water bodies are shrinking. This is just one of the examples. There are several such examples, if you go to Bangalore; the famous Vrindavan gardens and the dam on Krishna River. An entire temple and an entire community was submerged because of making up of this dam which again revealed itself, because there were no rains and there was no water in the reservoir.

So, much so that an ancient temple got revealed again, which has been taken out and rebuilt on the banks of the reservoir, such examples are ample. They are available in plenty and what is that leading us to. It is leading us to a crisis of portable water; water which is fit for drinking and human use. There is less and less of rainfall across the world and hence our water bodies are shrinking. Cities which were once built on the banks of rivers, no more can draw water from these rivers and that is something which is a cause of worry for governments across the world.

And as water bodies shrink, it is not just the quality of life which deteriorates. It also creates socio political problems. Wars will be fought on water in the coming times because that becomes a commodity. There will be countries, nations fighting over a resource as precious as water. Because rivers are uncontrolled, and people will fight to gain the control of these water bodies if this shrinking of water body continues at the same pace. Patrick Geddes; when he advocated for a regional plan, it implied taking care of all the elements together in a plan in planning.


However, till today we have not been able to do that as he advocated. That is why such a devastating state, devastated state of water bodies, the availability of water across the world. The second impact on water has been through pollution of water bodies. These water bodies are of two types; one underground aquifer and surface aquifer, surface water bodies and pollution has reached both of them underground as well as surface aquifer. Now the pollution to these water bodies could be ~~ofa-further~~ two types. It could be a point source pollution which is originating from one point or it could be a non point source pollution which is almost everywhere, either ways the water body is contaminated. And it is not only unfit for portable use or human use, but it also stops supporting the ecosystem. The other life forms; aquatic life, marine life and all other life forms which thrive through the water body because humans still consume a smaller part of, smaller portion of this water.

There are several causes to this water pollution, how these aquifers are getting polluted, contaminated. One of the major causes of this is sewage. Almost everywhere across the world traditionally we have dumped our sewage into water bodies, into flowing rivers eventually converting them to drains, large drains. Huge rivers as large as Yamuna which is originating from Glacier which is a perennial river which will not dry up, has been converted to look like a drain and that is one of the biggest rivers I am talking about. Smaller rivers have totally disappeared. We do not know whether there was a river at one point of time.

You go to any city; Gwalior for example, has a huge nala, huge drain which is passing through the city which was at one point of time; a river named as ~~Swab~~ Barnarekha. People do not even know if a river ever existed. The city was actually on the bank of a river and such is the case with almost all water bodies because they have been totally contaminated. And the reason is; our growing population, we are more in number as Ramchandra Guha puts it and we are creating more and more of waste. Instead of disposing it properly, instead of treating it, we have taken to a very simple mechanism of just throwing our sewage waste into rivers.

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Causes – Industrial waste (chemicals, heavy metals)



In 1938, a Japanese factory discharged a significant amount of **mercury metal** into Minamata Bay, **contaminating the fish stocks** there.

It took a **decade** for the problem to come to light.

By that time, many local people had **eaten the fish** and around **2000 were poisoned**.

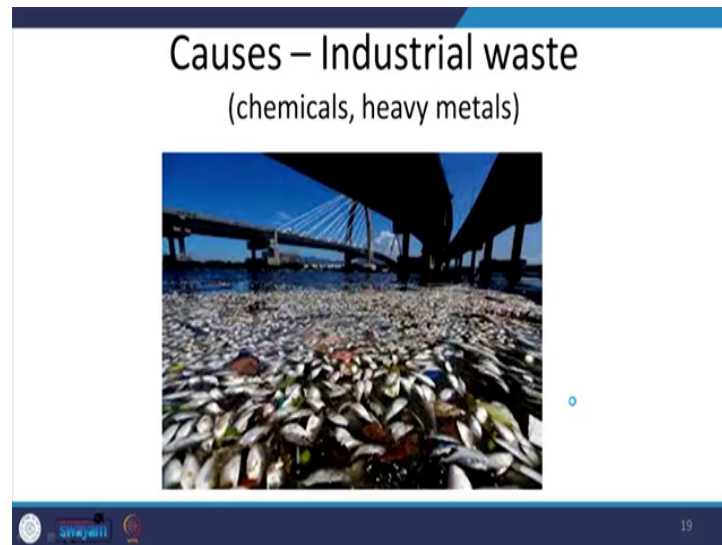
Hundreds of people were left dead or disabled.

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Another cause a very serious of nature is dumping of industrial waste into water bodies. This industrial waste contains chemicals and heavy metals and these chemicals and heavy metals totally poison or disrupt the aquatic life. They poison ~~they the~~; they poison the aquatic life. They enter they taken up by fish, the fish further enters our food chain. It is part of the food chain and humans are poisoned by the; these chemicals and heavy metals which have already entered the system through pollution of water. There are several such examples and events instances of this pollution entering into the human food chain and affecting human life from across the world; for example, this event of 1938 where a Japanese factory discharged a significant amount of mercury into Minamata Bay.

And which contaminated the fish stock there. And it does not get highlighted, it does not come to the limelight immediately because the impact the effects are so subtle that it takes decades, years to come to the forefront and get recognized. So, ~~it is~~ it got recognized much later and by that time it had already done the damage to the human life form.

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This is one of a very distressing pictures where all the fish suddenly died, and an entire water body was rendered dead. Because all the life form suddenly died because of the contamination which was dumped into it through the industrial waste and such have been cases plenty of them.

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The slide features a title "Causes – Alien invaders/ Invasive species". On the left is a photograph of a person in a red life vest in a body of water that is almost entirely covered in bright green, thick algae. On the right is a bulleted list of examples. The slide footer includes a logo and the number "20".

- Animals or plants from one region introduced into a different ecosystem
- no natural predators, so rapidly run wild,
- crowding out the usual animals or plants

Common examples of alien species

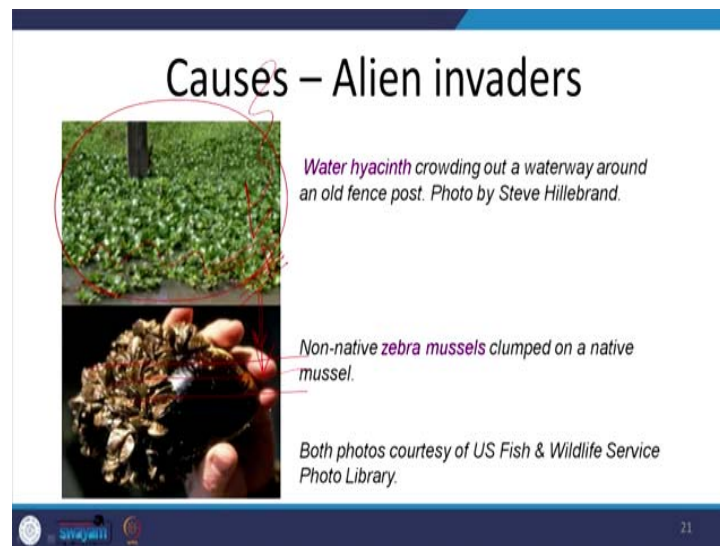
- Mediterranean Sea - alien algae called *Caulerpa taxifolia*.
- In the Black Sea, an alien jellyfish called *Mnemiopsis leidyi* reduced fish stocks by 90 percent after arriving in ballast water.
- In San Francisco Bay, Asian clams called *Potamocorbula amurensis*, also introduced by ballast water, have dramatically altered the ecosystem.

Another cause is alien invaders. Now alien invaders in itself is not a cause, it is the result of an activity like dumping of chemicals or excessive use of chemicals which have then got washed off and entered into a water body. And then an alien invader enters into that

aquatic system. Now what is alien invader; alien invader is actually an animal or a plant from one region which has introduced itself into another region.

Now in this new region which is for example, a polluted water body which is getting a lot of excessive fertilizer being washed into ~~it~~ it; because excessive fertilizer is being used in the farmlands today. Now there is a lot of nutrition which is available for this new animal or plant species. Now this plant species or animal species will start to grow stronger because it can thrive on the nutrition additional nutrition which is being supplied. And in that process, the population of this one specie grows beyond the limit while it did not even belong to that ecosystem. And thereby eating up on all other parties to that ecosystem, all other life forms; plants or animals and thereby creating an imbalance in the system.

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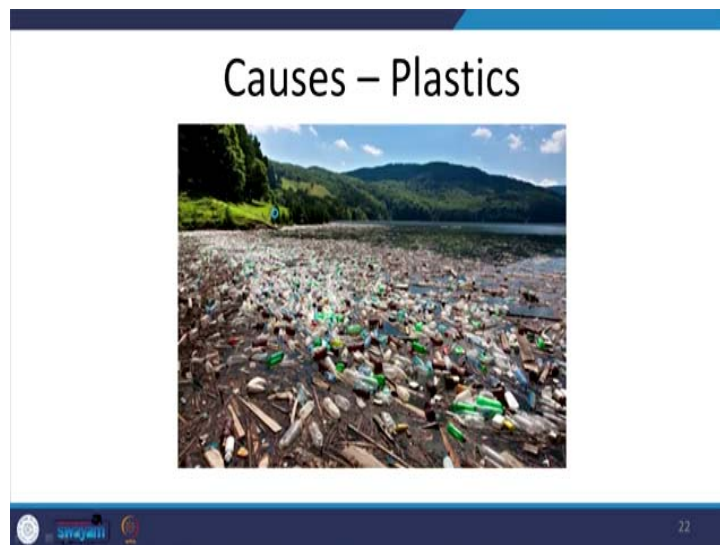
And so, gradually none of the other life forms would survive, but only this life form which also may in the end totally eradicate get extinct from that water body; for example, this water hyacinth. You must have seen this kind of image in several of the water bodies. Now water hyacinth is an alien invader. It is not native. Why is it there in this water body? Because there is a lot of nutrition available, because the sewer is being dumped.

Now, sewer is rich sewage is rich in nutrients and water hyacinth takes up all that nutrition. It grows many fold, it multiplies very fast and it covers the surface of this

entire water body. Because of covering of this entire water body, because of water hyacinth the growth of water hyacinth. The water beneath, the water body is devoid of sunlight and it also takes up all the oxygen. It is getting a lot of oxygen from the environment and it takes up all the BOD and there is no sunlight which is penetrated in. So, all the life form which is beneath in this water body will stop getting the nutrition, the sunlight, the oxygen which initially it was getting. And the water body eventually turns is turned dead; there is no life in it.

Gradually the water hyacinth when the nutrition which it requires is not there, it will also become dead and the entire water body is then dead.

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Another major cause is dumping of plastic.

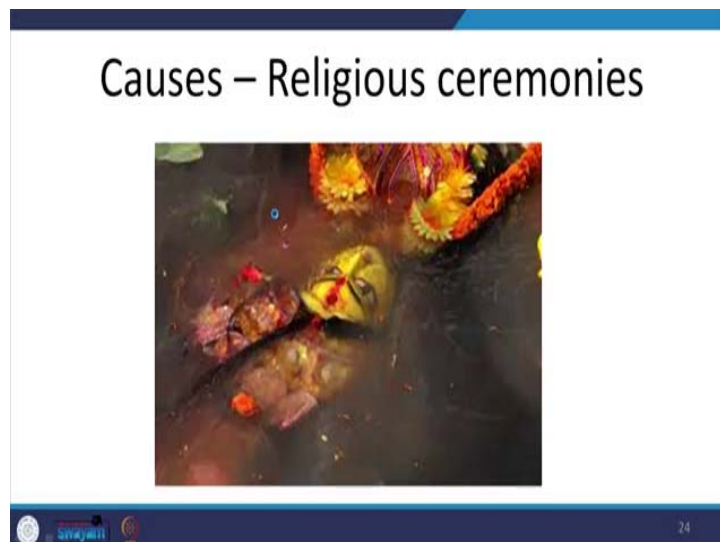
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We are seeing distressing images like this. Lot of aquatic life like this turtle are dying because of the plastic which is flooding our oceans and other water bodies. They are dying, they are getting paralyzed, they are their bodies are getting mutilated simply because we are dumping plastic. And some way or the other this plastic when disintegrates enter into the bodies of ~~this~~ these aquatic life forms comes back into the human food chain.

And we are also getting affected because of it.

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Another major cause, ~~special~~especially in India is religious ceremonies. We have this faith in immersing our idols into the water. Earlier, originally the way these idols were created; they were created out of unburnt clay and only organic colors which would ~~derived~~derive from nature were used on these idols. Now gradually as the times changed, more and more idols were required for celebrating these religious ceremonies, because we are more number of people. Now families or artists who were creating these idols, took a lot of time in creating these idols; because unburnt clay takes a lot of time to dry up and also the natural color takes a lot of time in its processing, making.

So, to replace that ~~labor-intensive~~labor-intensive process, people started using materials, alternative materials. So, instead of unburnt raw clay, they started using plaster of Paris. They started mixing gypsum, cement with the clay or sometimes making an entire idol out of plaster of Paris. And instead of making natural colors, they started using synthetic paints, which are chemical based on to these idols. And it was very fast, because POP would set within half an hour, and it would with the help of a cast.

One family which was earlier able to produce only 5 to 10 idols in a season was able to make 100 or 200 idols in a season; thereby increasing ~~its~~ his profit, the profit of the family, earning of the family, but in turn totally contaminating or polluting the water body. So, it is a change in culture which has led to the pollution contamination of the water body.

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Another major cause across the world is oil spills. Because of our lifestyle changing lifestyle, we need more and more of fuel oil for our day to day running of life. These oils are procured out of some or the other oil field which leak and there are spills somewhere or the other in the world.

It is not only affects the other life forms, but is it also affects people in those areas. There are cases where communities are fighting for their rights because their fields have been inundated by oils, the spilled oil. Their cultivation, their primary occupation has been ruined. People are struggling for their own life because there are a lot of new diseases which they have been exposed to and in turn the economy has gone down. So, initially communities who were getting benefited economically out of setting up of an oil field in their communities, gradually have their economy totally devastated; not able to survive because of a nexus, because of this whole chain of events.

So, oil spill has been another major cause of water pollution.

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Causes – Radioactive waste

The biggest sources of **radioactive pollution** in Europe are two **factories that reprocess waste fuel from nuclear power plants**:

- Sellafield on the north-west coast of Britain and
- Cap La Hague on the north coast of France.

Countries such as Norway, which lie **downstream** from Britain, **receive significant doses** of radioactive pollution from Sellafield.

Both the Irish and Norwegian **governments** continue to press for the **plant's closure**.




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Another cause though relatively smaller in proportion, but its impact is often much larger and at times goes unnoticed for years and decades before its impact comes to surface is dumping of radioactive waste. There have been cases where industries have dumped their radioactive waste in water bodies and which has then created significant amount of negative impact on human life and all the aquatic life downstream.


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Causes – Nutrients


- Suitably treated and used in moderate quantities, sewage and fertilizers can be a rich source of nutrient.
- Excess sewage and fertilizers **harmful algal bloom** (also known as an HAB or red tide, because it can turn the water red) or **Hypoxia**
- It removes oxygen from the water leading to **dead zone**.




Lake Erie has a significant bloom of cyanobacteria, a toxic blue-green algae in 2011



China's Lake Dianchi is a dead zone



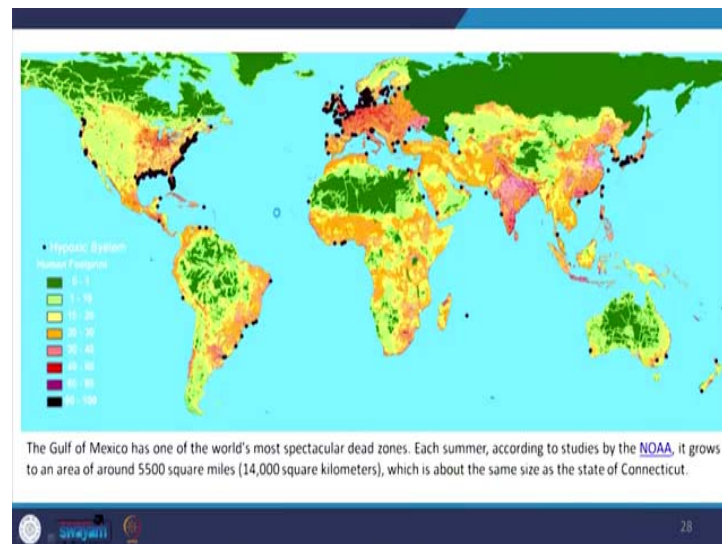
Bloom of Algae Microcystis in Lake Ontario



Algal Bloom hits the coast of Gulf of Mexico

Another cause is washing away of nutrients, excessive nutrients which are being used in our farmlands these days. This excessive washing away of nutrients causes alien invaders to enter into the system and then eat up all the oxygen of the water body and turn it into a hypoxic system. These are some of the images where algae as an alien invader, not an alien invader it belonged to the system, but it increased it swelled in such proportions that ~~that~~ it renders the entire water body hypoxic. And the water body eventually becomes a dead zone.

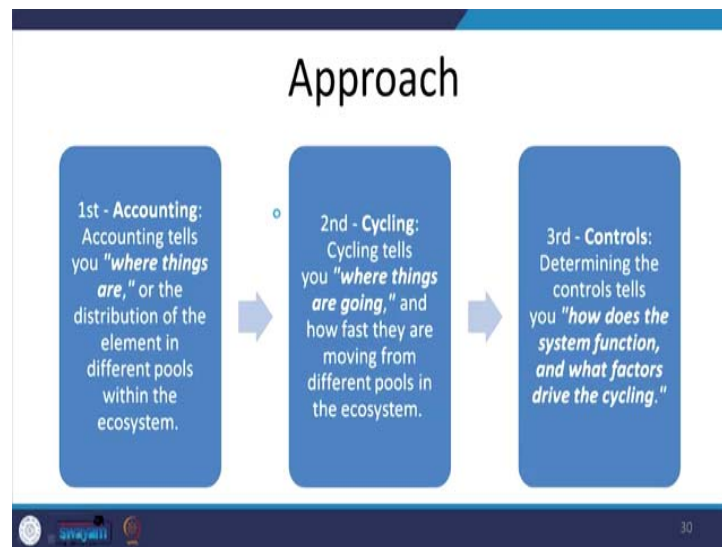
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If we look at the world, there are many--many dead zones across the world right now. And if these causes or solution to solutions to these causes are not found out, there will be greater damage to the water bodies, water systems of the world. And it would be very difficult for the human kind mankind to survive. The third impact is of altering water cycle. Besides shrinking water bodies and polluted water bodies, there is an impact on the water cycle itself. All these three are connected to each other. In fact, everything that is the fundamental of sustainability that everything in the world is connected to each other.

If we do something here, it has an impact on rest of the world though it may not be evident immediately. So, the water cycle is altered. When water cycle is altered because of one of the human activities, it has an impact on the size of the water bodies and water bodies shrink. Once they shrink, they have a lesser capacity to carry the pollution, the contamination, the waste and they become easily become polluted. So, all these three are interrelated. Let us see how the water cycle is being altered.

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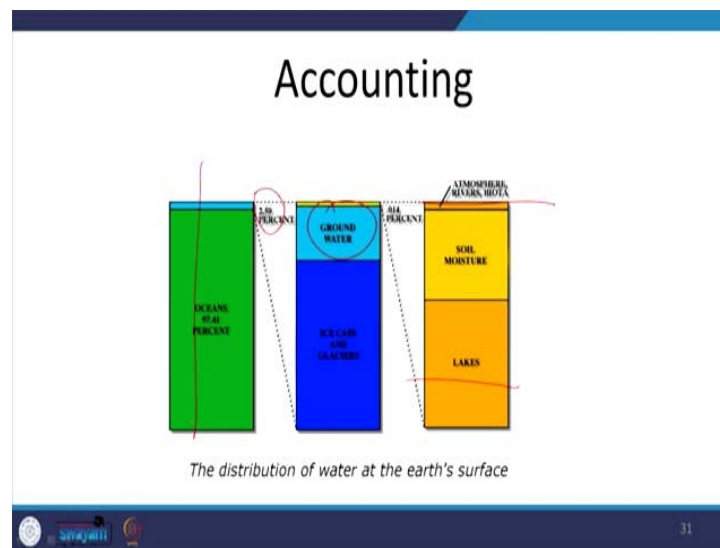
But before we understand how water cycle, or any other cycle is being altered we have to follow a systematic approach.

The first of it is accounting; we have to first know where things are, how much of that particular component is stored in the ecosystem in which place. Once we have known that, as on date it is in current state of time current moment then we go on to see cycling.

How things are moving from one state to the other state and how this entire cycle is going on. And simultaneously; we also talk about, we also understand the controls which determine how the system is functioning and what are the factors that are driving that cycling.

So, now let us look at how all these three steps would be taken care of or understood in terms of water cycle and then we will see how water cycle is altering here.

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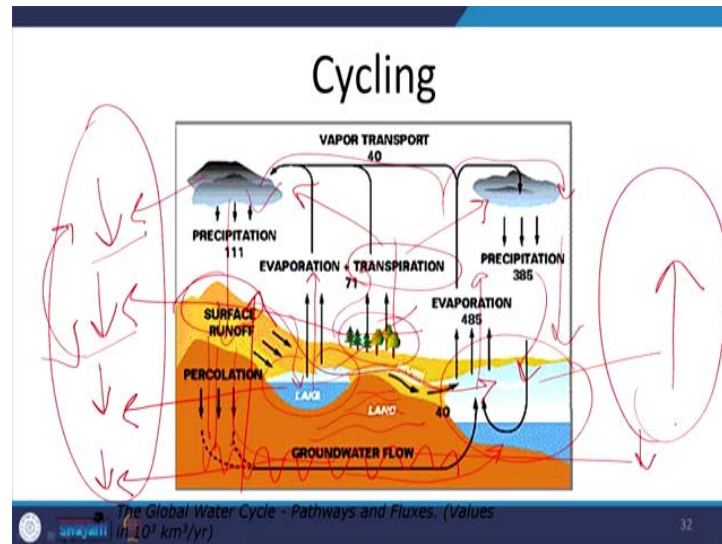
So, first of all it is accounting. If you look at 100 percent of the total water which is available on earth, only 2.5 percent of the water is available in surface aquifers and underground waters. Rest of it 97.5 percent is in oceans which cannot be used by humans for consumption. Out of that 2.5 percent, a large portion is logged in ice caps and ice glaciers.

They gradually melt and become available to us in the form of water bodies. A large part of that 2.5 percent is also available as groundwater underground and only 0.014 percent is available in terms of surface water bodies, lakes, rivers and also the soil moisture of the topsoil. Now if we look if effectively, we just have around 20 percent of 2.5 percent of water which is portable available to us for consumption. Now this is accounting; we know we are talking when we are talking of contamination, we are talking of this just minute minuscule portion of this entire water body water which is present. We are

contaminating groundwater as well as ~~we are contaminating groundwater as well as~~ the lakes and the rivers, the other water bodies.

And it is hardly 1 percent of this total water which is available.

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Now, how is the cycling happening? All of us have seen this water cycle right from our school classes. So, we know how water which is stored in surface aquifers say oceans and lakes and rivers gets evaporated. This evaporation is then transferred and then it precipitates to come back to the land as well as water body as portable water. Part of it this water actually percolates down the earth ground, part of it is also taken up by plants which further add to the evaporation through transpiration. This ground water is available in terms of soil moisture; part of it takes form of rivers and surface water bodies and as part of this groundwater goes back to the oceans. This is how largely cycling is happening.

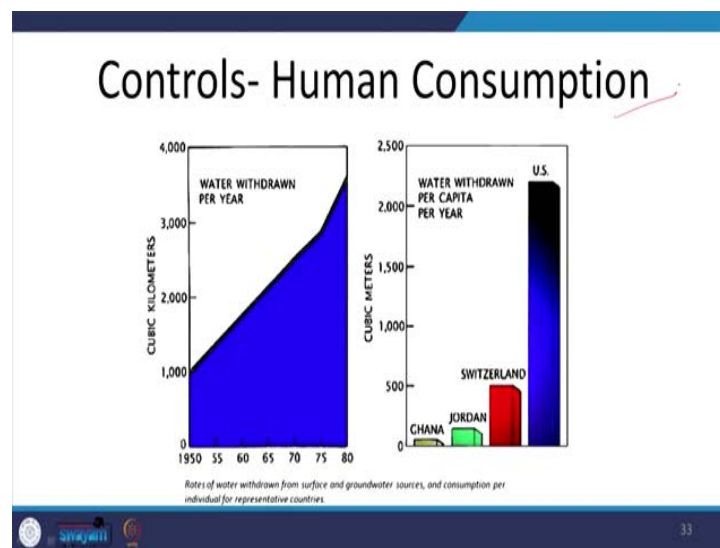
Now, once we have understood how a cycle what a cycle is taking place if it is not altered, this is what it is. However, if we look at it in current scenario; when we cut down these ~~tree~~ trees, we have less of transpiration here. Less of transpiration implies let us less of precipitation ~~here~~ here; that is one. Second, the water which is available as groundwater because we require more of it is then brought out to the surface. Now this is reducing. So, this groundwater is actually going down. We are consuming more and

more of it and that is now the waste water is now being dumped into surface water bodies even oceans.

So, the quality of water though the overall quantity may remain the same, following the basic scientific principle of the mass of anything remaining constant at any given point of time. Though the quality of this water is going down, it is reducing. So, we have less of portable water available in surface aquifers, we have less of groundwater available in surf underground water, we have less of precipitation which is further leading to several other problems which is interconnected. We have less of vegetation, less of precipitation supports lesser vegetation and vice versa.

So, we have totally altered this water cycle and there is the final impact is that we have less and less of portable water available. While at the same time, the water which gets capped as glaciers here and which reaches rivers and then oceans, this overall quantity is going up. Now this is non portable water. So, we have potable water quantity getting reduced and we have non portable water quantity which is increasing further causing leading to a lot of problems. Now how will it be driven. So, we have to look at the controls. So, we have to see how the cycle is getting altered through the controls; first and foremost, of which is human consumption.

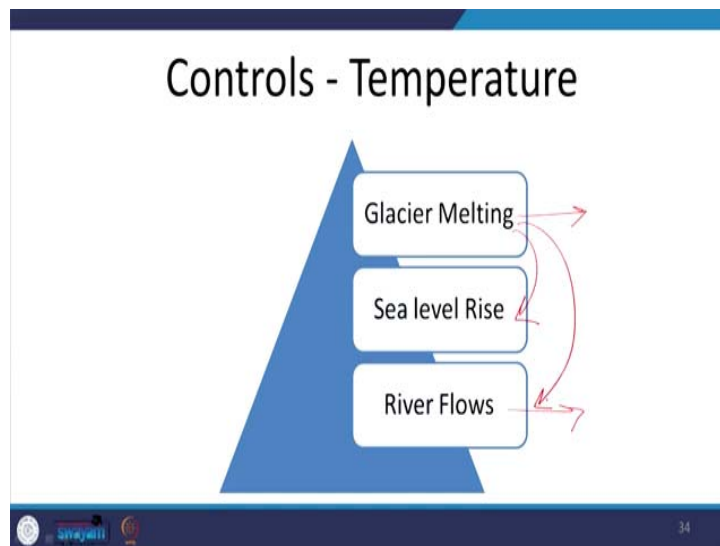
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The human consumption if we look at historic data from 1950s to 1980s has increased at almost four times across the world and specially in developed countries like US.

Our traditional values especially in India where water was abundantly available; we have many—many rivers and surface aquifers which were available for us, and our practices of conservation of water have gradually given the way to a more wasteful practice of consuming water. And that is why more and more of portable water is being consumed, used up and also the groundwater which is portable water and hence the groundwater table is going down. In several places it has gone down to double the depth of what it initially used to be. So, the areas are becoming parched, they are becoming deserts.

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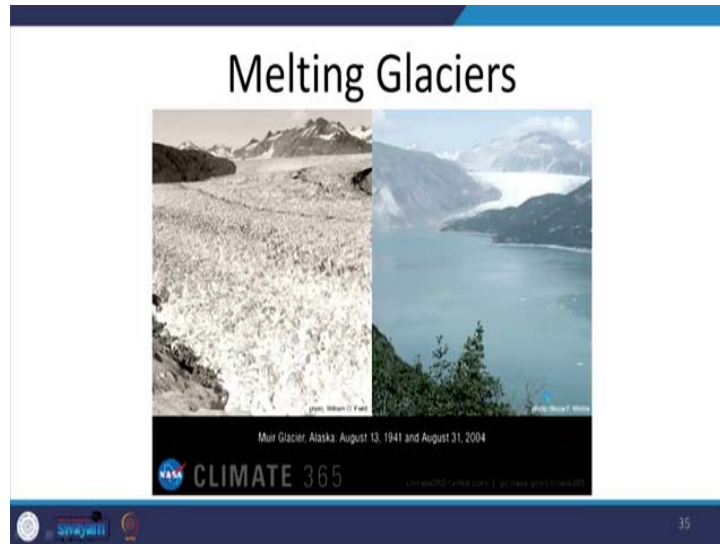


The second control is temperature. Because of human activity, the global temperature is increasing. We have more and more of greenhouse gases being emitted into the atmosphere because we are consuming the fuels, we are burning the fuels. Our lifestyle is more dependent on energy, different forms of energy. Conventional fuels like coal and diesel, petrol, kerosene and also electricity even when it is coming from a lot of renewable energy sources, but our lives are becoming more and more dependent on them. Now all this together and also a wasteful ~~lifestyle~~ lifestyle, all this is leading to global warming, rise in temperatures. Now this rise in temperature is melting the glaciers.

Now, water; portable water which is stored in the form of ice caps and glaciers is melting and it is reaching the sea. So, this melting of glaciers is causing sea level rise. It is also causing the rivers to flow at an increased pace at some point of the time in the year and at

other times the flow is greatly reduced. So, there is no prediction or there is no continuity of the flow. So, certain areas are suddenly flooded because of this overflowing river and sometimes the areas which are otherwise fed by these rivers are forced to face draughts they are pushed.

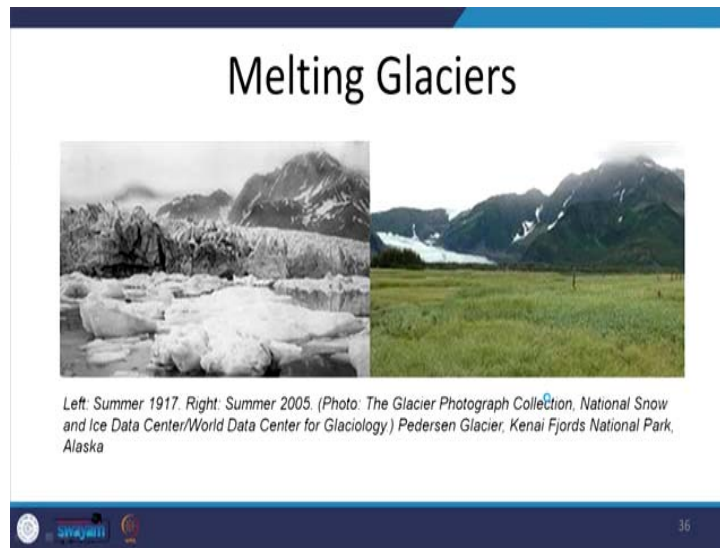
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Because of this increasing temperature, this is the state currently; the glaciers are melting. As the climate change report has also pointed out.

Kilometers and kilometers of glaciers have become water bodies, or they have become the flat lands.

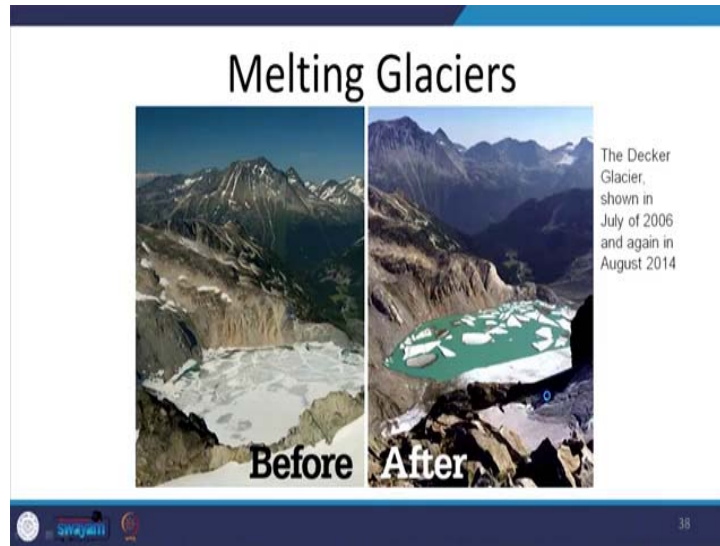
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And it is not just one, but almost all the glaciers. Very recently, I think last year my students from sustainable architecture went on for a trek trip to one of the glaciers in Uttarakhand. And the glacier had shifted, drifted back 14 kilometers from what it initially was almost three decades back. So, in three decades the glacier had drifted back 14 kilometers. Now 14 kilometers and it is like thousand square kilometer of area which was initially a glacier has totally disappeared.

Now, it is not feeding the rivers anymore, it is not available for people as portable water. That is the state almost everywhere.

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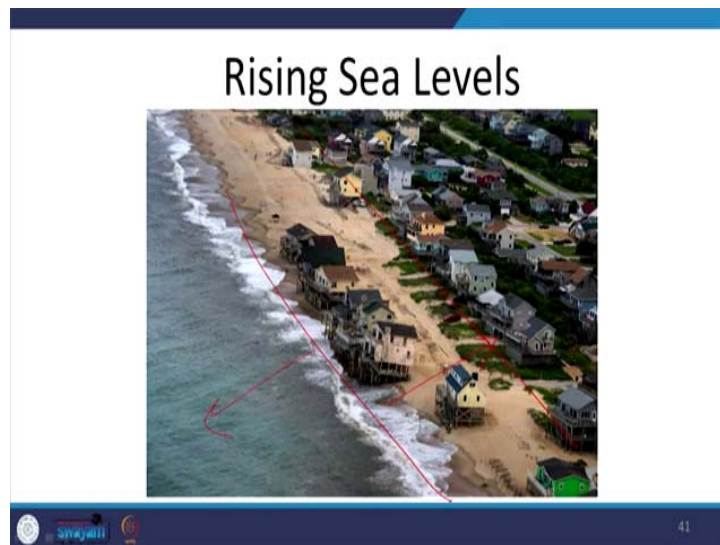
We can talk about any glacier and scientists are now recording how and at what pace the glaciers are receding, they are going back.

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Now, all these melting glaciers are resulting in the rising sea levels. The water because it is constant the overall quantities constant, is now shifting from the ice caps and glaciers to these sea levels. And several nations are under the threat of getting submerged because the water is increasing like an entire nation of Mauritius.

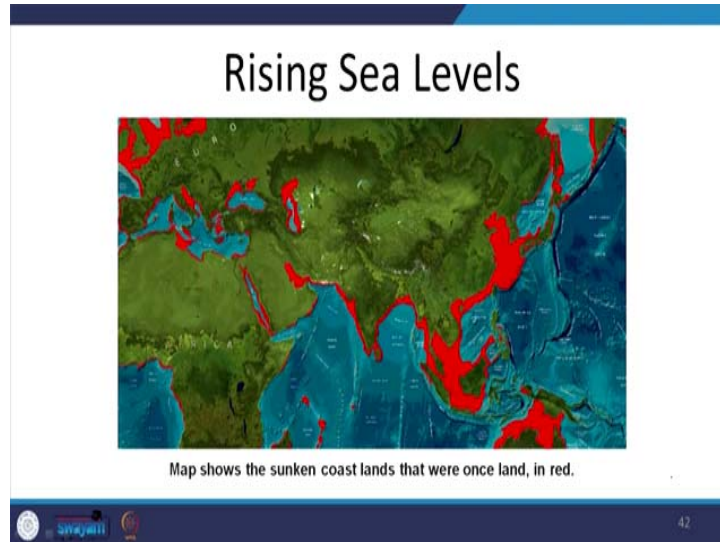
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This is the state and if another ~~one-meter~~one-meter sea level increases, several coastal areas across the world will totally be submerged. We can very clearly see how the lines are shifting. Houses which were right on the bank, right on the shore of the sea because

the shore was anyway probably here, they have all shifted back and this shifting is will continue it will continue.

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This particular map very clearly shows that these areas were once land.

And this is further continuing. If the sea levels continue to rise, more and more of the land will become submerged and will not be available for human habitation. We anyways have less for the given population as we have today.

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These rising sea levels will also have an impact on the oceanic conveyor belts which are the regulatory mechanism of the oceans. And they regulate the entire water body of on earth because the seas which are cold in one part of the world and warm in the other part of the world are regulated. And they support they help the sea life, aquatic life to thrive because of this conveying of temperature and water from one place on earth to the other place.

Now, this would have an impact on the amount of food which will be available for us humans. So, as I said in my very first lecture, we are not worried about anybody or anything else on earth. We are only worried about our own survival. This is what all of this is leading to. The third control, when we are talking about the altering water cycle is land use changes.

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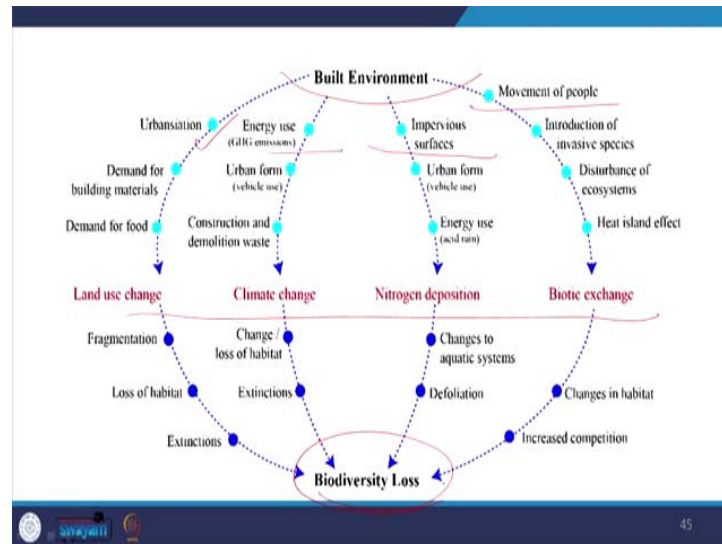


Now, this land use change is further reflected in the form of the temperature; global temperature. But these are the changes; deforestation, increased runoff because we have more and more of built up areas which are there. Places which used to have forests or if not forests just barren land which helped to absorb water which helped water to percolate down to the ground, now are being paved and they are leading to the increased runoff.

Now, this runoff water is going to rivers, channels, stream which are eventually going and meeting the sea somewhere. So, we have less and less of portable water getting into the ground. That is for the causing the land to become infertile and barren desertified and

this increased runoff is also leading to excessive nutrients in the water bodies. Now all these we have seen leading to some or the other problems of water bodies.

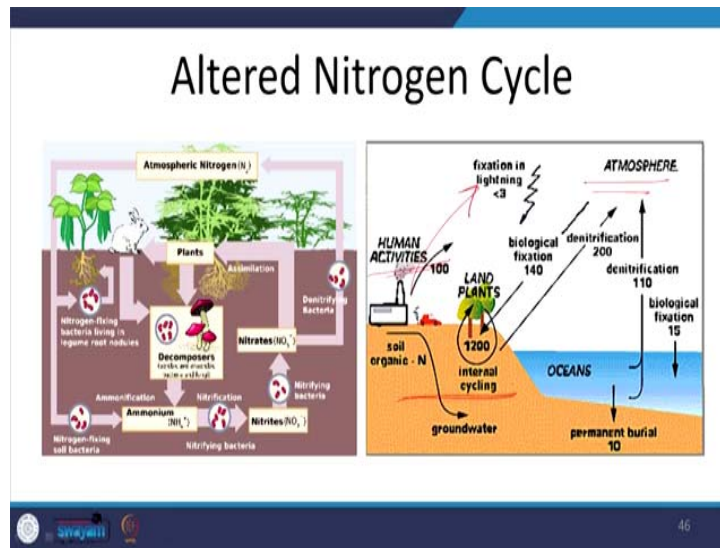
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If you look at this particular chart, all the changes which are happening in built environment whether we are talking about of urbanization, we talking of impervious surfaces, we are talking of movement of people or energy use, all of it through some way or the other is leading to a biodiversity loss.

And this biodiversity loss is eventually a loss of human beings, human life. We may not see those changes that impact coming directly, but it is actually leading to a loss of human life in the time to come. Once we have understood ~~the these~~ these three components, we will have understood how the water bodies are getting impacted. It is not just water body, we have almost all other natural cycles getting impacted.

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Whether it is nitrogen cycle; we are cutting down more and more of trees which were able to fix the atmospheric nitrogen and fix it in the form of nitrites and nitrates and decompose, used for decomposition and hence further help our crops, our agriculture and farming to be better.

Because of loss of this vegetation, the entire nitrogen cycle is altered; also because of the emissions, the human activities. For example, cement industries. Huge industries which directly emit and there is a lot of nitrogen which is released because it gets fixed. So, we have more nitrogen in the atmosphere than which is fixed underground which is taken up by plants and utilized. The nitrogen cycle is totally altered and there are severe impacts of this altered nitrogen cycle.

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Impacts of altered nitrogen cycle

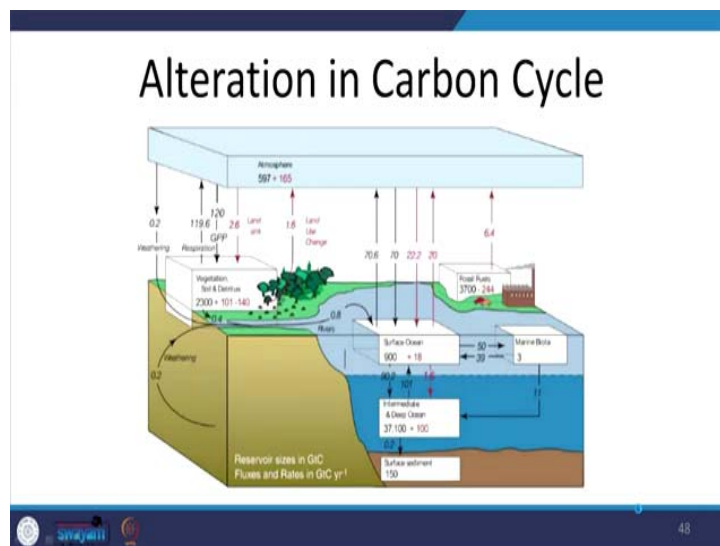
- Acidification of soils and water bodies
- Altered forest and grasslands
- Decreased Atmospheric visibility
- Elevated Ozone concentrations
- Health problems
- Global Warming
- Smog and Acid rain
- Decreased Agricultural productivity
- Nutrient imbalances
- Contamination of drinking water
- Toxic Algal Bloom



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And this nitrogen cycle alteration is again affecting the human built environment; environment for us. It is acidifying the soils and water bodies, it is altering the forests and grasslands, it is decreasing the atmospheric visibility. There are elevated ozone concentrations leading to further health problems and global warming, acid rain, decreased agricultural productivity and many more.

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Same as with carbon cycle, there are alterations in carbon cycle which are there. There are more and more of fossil fuels are being taken out for our consumption. There are less

of trees, the trees are being burnt which are the stores of carbon. Now all this is has already led to an alteration of carbon cycle where more and more of carbon dioxide, carbon monoxide, carbon in general is available in the atmosphere. While earlier, it used to stay fixed underground. That is what all this alteration in carbon cycle is doing. So, these are the impacts which are on natural cycles because of human activities and some way or the other some or the other human activity is responsible for it.

In the next lecture, we will talk about the impact of human development, urban development on land as natural part of the natural environment. That is all for today in this lecture. See you tomorrow with the next lecture.

Thank you.