Product Engineering and Design Thinking
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Module - 05
Embodiment Design and Echo-design
Lecture - 23
Introduction to Sustainability

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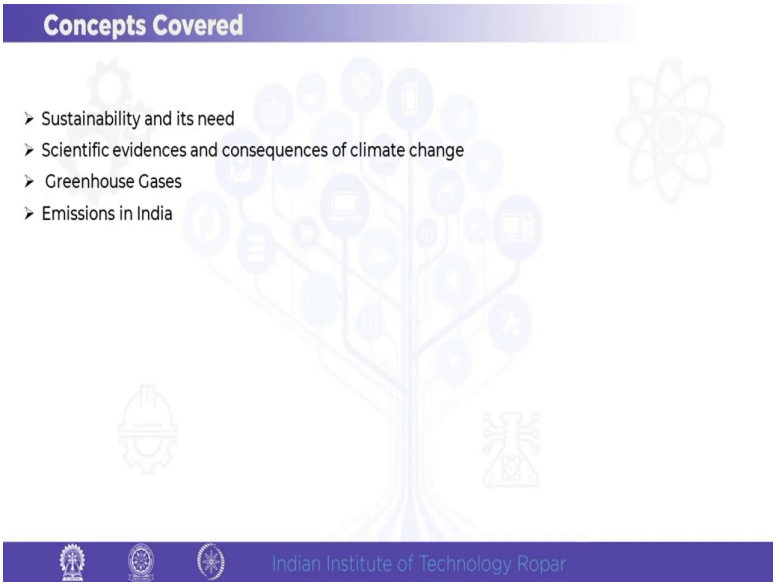

Hello everyone, today we will be discussing about Sustainability and Eco-design.

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So, the first and most important question we need to ask ourselves are we sustainable or not? So, this you need to think little bit more are we sustainable or not? So, what do you think? Do you think we are sustainable? Do you think we are doing the right thing which we should do or not?

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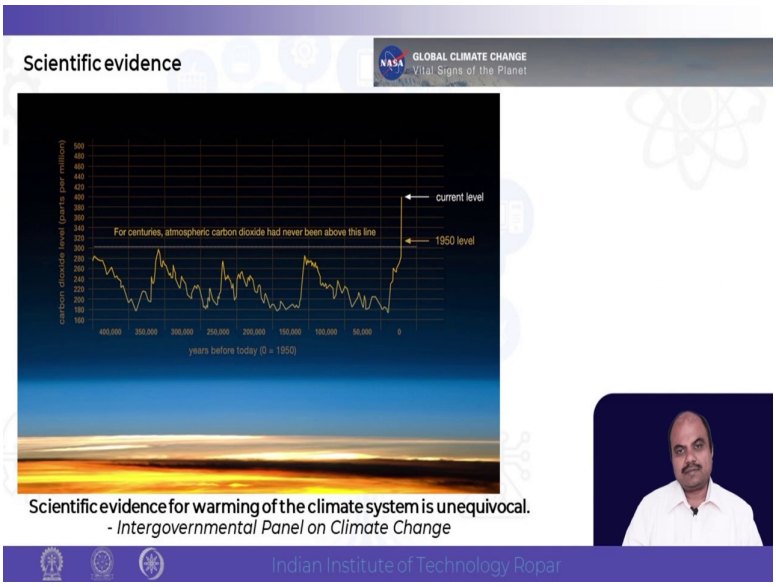

So, while we are thinking on that, let us see what is exactly is happening to the world's atmosphere. According to the climate dot nasa dot gov data from the NASA, it shows that the temperature of earth goes in a cycle. So, it increases over a period of time multiple years and then thousands of years and slowly it will go to decrease, then slowly it is going to increase, slowly it is going to decrease, slowly it is going to increase, slowly it is going to decrease.

So, now we are seeing that the global atmospheric temperature is rising. So, question is that in any case the global temperature supposed to rise now and it will not increase according to the according to the finding. So, do we need to really worry about this or not? The reason is that even though we the global temperature is rising and falling still there is the issue.

Issue is that, in after 1950 level, it does not found that the cycle is broken; temperature is going beyond what is the maximum temperature achieved in the previous cycle or the

previous cycle. It is much much higher now. So, there is evidence that climate change is something which is happening, it is artificially done, especially for greenhouse gases.

And there is now no question of issues or any doubt and the inter-government panel on climate change told, something which is very important that global temperature has rose beyond what it should have been now.

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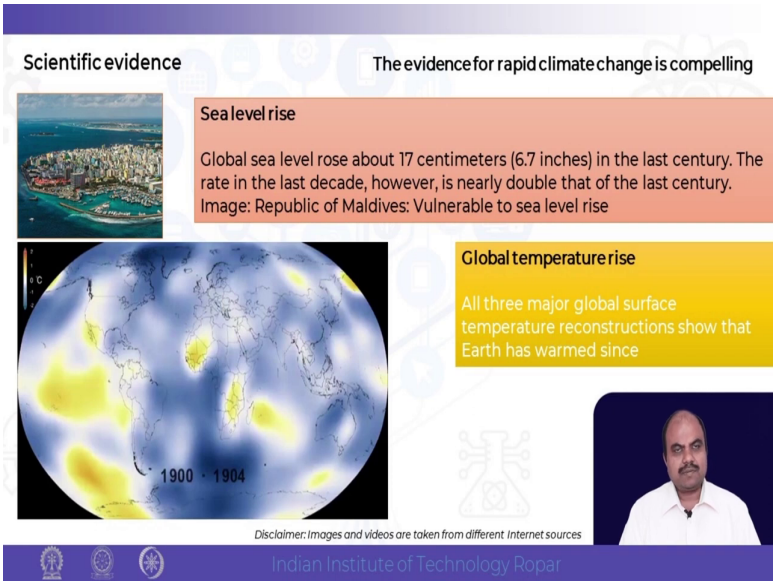

So, apart from that there is some lot of scientific evidence also, sea level rise. Global sea level rise by about 17 centimeters 6.7 inches in the last century. And this is a very important issue. Maldives have all available to sea change, India also. Some of the coastal areas in India, part of Orissa, part of Mumbai, part of Kolkata, some part of Sundarban and possibly some part of South India.

One of the biggest challenge of sea water lies which is going to be there for USA is the New York. So, do not expect that this is going to be suddenly rise, no, slowly it is going to rise. Slowly you are going to be intervened. We are going to get a effect of the sea water rise.

It is going to change the useful area which is there for mankind in each of these areas where what I mentioned. This something which is already happening is going to happen. Global temperature rise. Global temperature is rising enormously in last few years.

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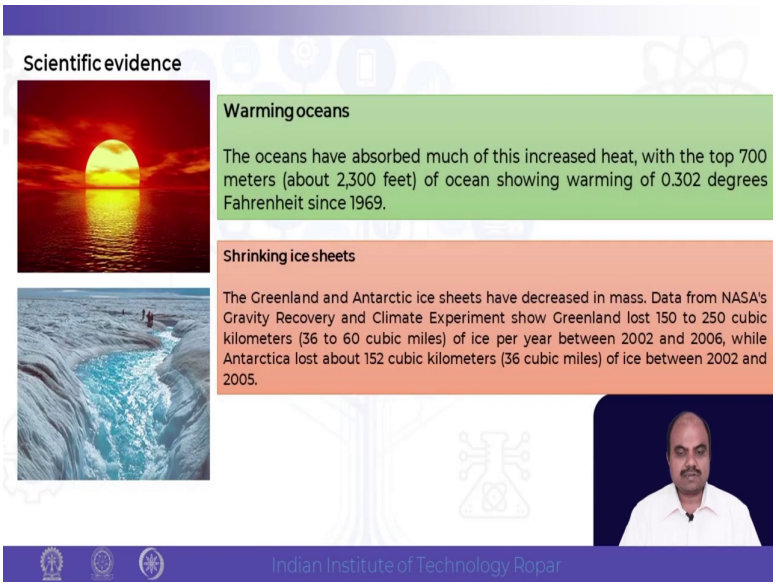

Warming oceans, the oceans as much of the increased heat last many years. And due to heat, the especially top 700 centimeters, the heat is being absorbed. The temperature of the global oceans arise in, is something which is something to really worry. Shrinking ice caps, the Greenland and Arctic sea ice sheets has decreased in mass.

Data from the NASA's gravity recovery and climate experiment shows Greenland lost about 150 to 250 cubic kilometers. That is really a big amount, 36 to 60 cubic miles of ice per year from 2002 to 2006. Antractic lost about 150 cubic kilometers of ice. India, there are lot of reduction in the ice level in Himalayas.

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Declining Arctic sea what sea ice, glacial retreat, it is happening in India. You see the northern side in Himalayas, glacial retreat. Extreme events, ocean acidification, and that is going to have big impact on the flora and fauna of the ocean. Decreased snow cover, this is something like all these things are scientific evidence that this is happening.

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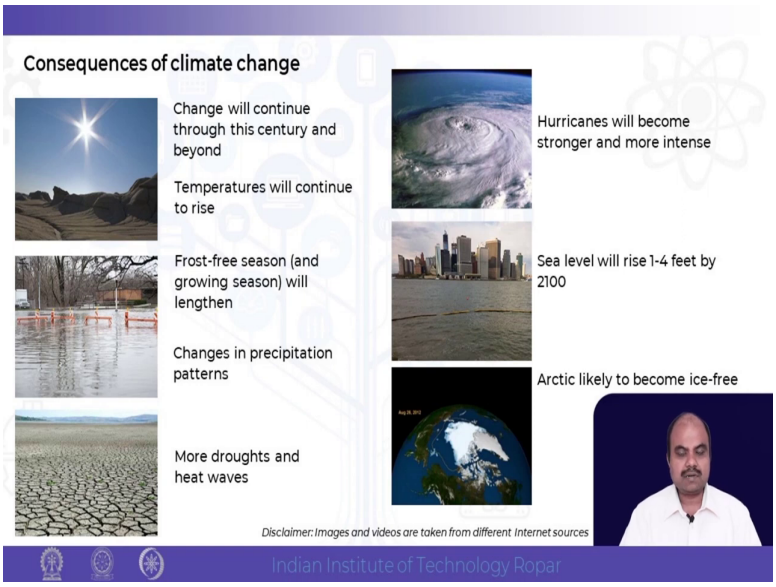

Changes will continue through the center which has century and beyond temperature will continue to rise. Researcher found out even if you stop all the emissions today, the effect of this emission, it will effect of previous emissions it is still in the containing. Because we have use, we have added, we are adding emissions every day and night in the atmosphere.

So, even if you have stop, somehow, we stop all the emissions, emission, new emissions today. The effect is still there, it will still increase the temperature of the earth. So, this is something which is important to understand. Frost free (Refer Time: 08:19) season, sometime season are changing. So, whenever we have cold, in particular month, after few years, it is changing now. Precipitation pattern, our livelihood especially in India and many other Asian countries, even part of the US and other countries also.

Livelihood of human beings is very much dependent on agriculture and agriculture is affected predominately by the rainfall. So, rainfall pattern changes the agriculture will have an effect. More droughts and heat waves. Hurricanes will be stronger and intense. Sea level will rise to one, 1 to 4 feet and then Arctic will become ice-free. Sea level is rising. We are losing land.

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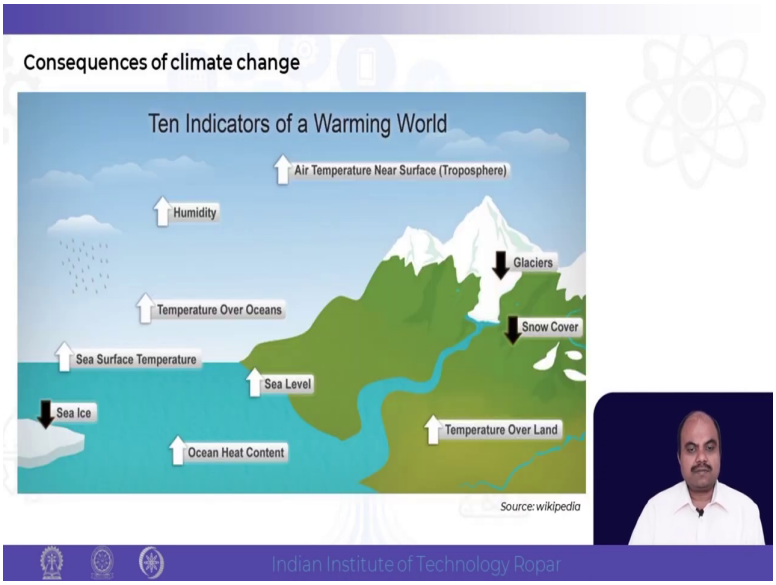

So, effect of these climate change, are there, humid it is changing 10 indicators, air, air temperature is changing, then temperature over oceans is increasing, sea level is, sea surface temperature is increasing. There are so many things which are not desirable or happening due to this climate change.

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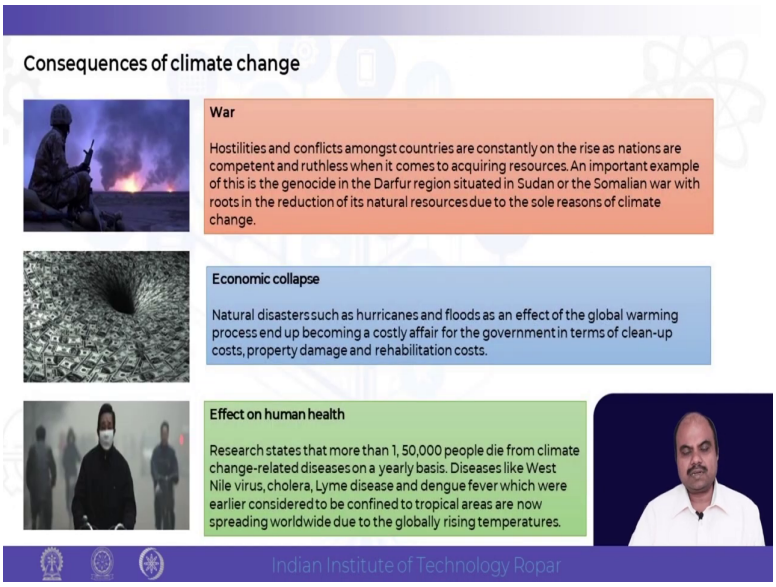

There are other effects. We think the climate change is above over temperature increase and all that, not the thing. Climate change and resource reduction is going to have predominantly lot of other effects, which is this it is bigger effect also. Especially, in the take for example, a war. Because of the resources also so limited nowadays, what we are doing? We are creating lot of waste.

You see a bottle of water, you go travel previously during when we are, we use to be child. Our parents use to carry that water bottles made up either metals or other ways, recyclable. So, we should fill the water, use it, again bring it back, use it multiple times. So, those are water bottles which are bigger size for the family and then we use to carry that.

Nowadays, you go, you will go and buy mineral water bottle, 10 rupees, 20 rupees. Drink it and then throw the bottle out. And we imagine, we assume that somebody is going to pick up

this water bottle, recycle it, or you are clean it or recycle it and make a new water bottle and give it to us. That is not going to happen that easily. We will not do it. We need to pay for it, nobody.

So, ultimately what is going to happen is that these material is going to go landfill. Now, what is happening landfill? Let us go to an understanding little bit in depth. Landfill is what is landfill. All these waste plastic, some are sometimes metals, then sometime bio waste, sometime hazardous waste, sometime other waste, all this going in the landfill.

So, what is this landfill? Landfill is the place where this all this waste has been dumped. But is it that only thing is happening? Everydays, everyday, not 1 kg or 1000 kg, thousands of kgs of waste is being generated by bigger cities. Why is this space to keep all this landfill? There is no space much in the city. Designation spaces are getting filled. Recycling is happening. We are not disagreeing.

But the amount of recycling is very less. What should have been? Plastic can be recycled to 98 percent almost. But actually, it is not found in research in many places. Although there is a maximum 60 percent, generally get recycled. So, what is happening to so many things is basically waste.

Nowadays, people are dumping waste in the sea because the no space is there. Once we dump material in the sea, that amount of resources which is supposed to be recycled. Chance of recycling is completely gone permanently. So, what we see here? Somalian war is one of the examples where the natural resources are reduced and then war has war was created one of the reason.

So, climate change has lot many adverse effect on us which we sometime do not even know or understand. Economic collapse is another one. Natural disasters such as hurricanes and floods as an effect of global warming process and ends up becoming a costly effect to the government in terms of cleanup cost rehabilitation.

So, when you talking about natural calamities like hurricanes, this is not at all something new which is happening for many years 50 years, 100 years, 200 years back also, hurricane is to be there, flood is to be there. So, why need to worry about now? It is the intensity and the how many times it is happening? How often it is happening? Now, it is increased.

You can see some of the like recent, this recent, this hurricane which is there in Bay of Bengal in other areas near Bombay near Kolkata. These are not something which is which was which was there previously. The intensity is much higher. Human health, research states more than 1,50,000 people die of climate change related diseases yearly. And all these viruses, cholera virus, lyme virus, these are all basically affecting also.

There is a saying even though it is not officially done, but it is saying then two semesters of the saying is true, right. The lot of things are being happening in this in this place and when people are creating these products, emissions being created.

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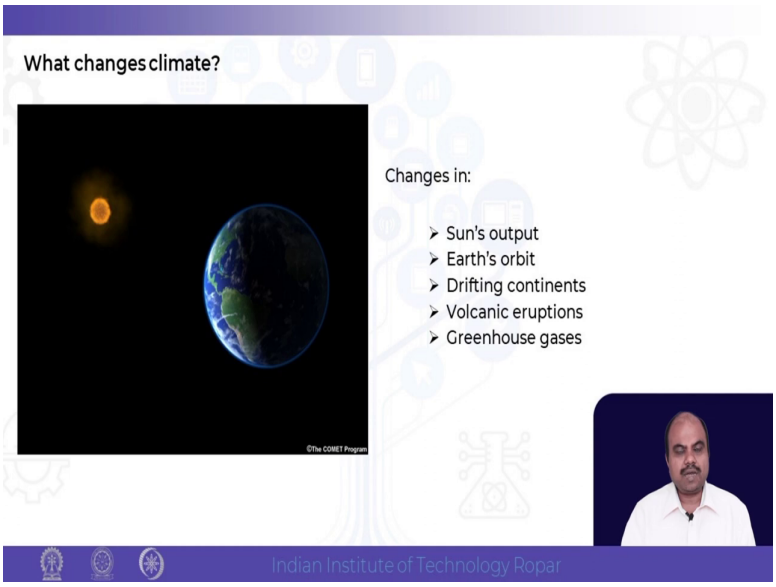

So, whenever we have these emissions, the human health is going to get affected. And so, that when the emissions are not just local, it is also global. Now, when we are talking about these emissions, the first thing is coming in mind that climate change is happening for different reasons. Yes, there are reasons. What are the reasons?

The suns orbit, earth orbit rotating around the sun, drifting continents, volcanic eruptions, greenhouse gases, all these things are responsible for climate change. But you think, little bit think, what is happening to all these before 50 years, 100 years, all these things are there. There also volcanic eruption was there if you see the past history.

So, what is the mega thing which is happening is there is something which is really worrying is the greenhouse gases. The amount of greenhouse gases which you are going to use are emit is much much higher now.

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So, many of you I think many of you know about greenhouse effect. Green house effect is basically caused by greenhouse gases. So, green house effect is where you would have seen green house especially, people who are in especially in cultivation on horticulture. They have a house and the it is made of some kind of cover, green cover or plastic cover and it and inside there are some plants will be there.

So, the design of this greenhouse is such a way that when sunlight enters, it enters with heat also, ok. But the heat gets trapped in the greenhouse. Similarly, in the earth atmosphere also, ideally what is should happen is that the solar light is going to come, it is going to some other

portion is going to reflect back, some other is going to get absorbed, some other is going to some portion is going to leave.

So, then a balance is maintained during the day and night time, more heat is getting dissipated and similarly there is a balance between day and night between day and night and the temperature is going to get balanced with respect to the weather of that place. Now, when this greenhouse gases are there, basically this greenhouse gas is going to trap this heat, it is not going to allow the heat to come out of this earth atmosphere that is easily, it take time.

So, the earth atmosphere is constantly getting heated up due to this not allowed not availability of the way to get out of the heat and that is what the causing is greenhouse. So, question is, what causes this greenhouse?

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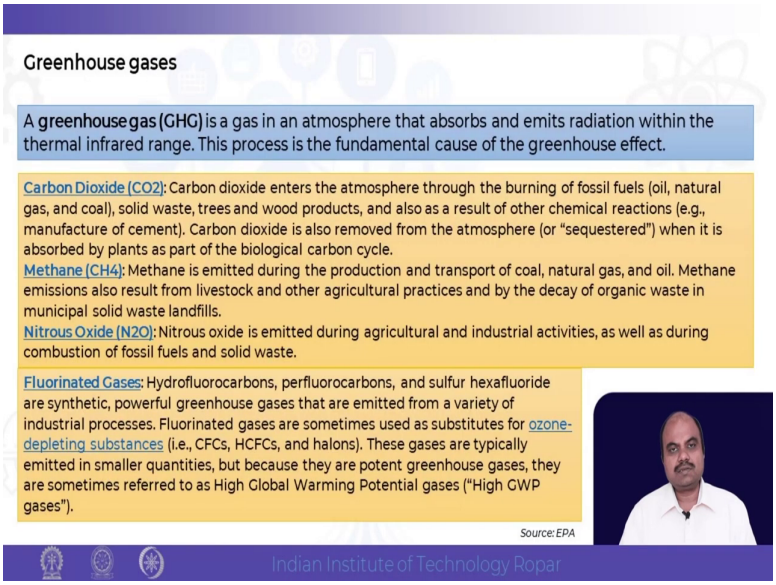

So, greenhouse is being caused by greenhouse gas. It is a gas in which the atmosphere that absorbs and emit radiation within the thermal infrared range. The process is the fundamental cause of greenhouse effect. So, there are multiple gases which are responsible for greenhouse effect. The first and most important of them and most commonly the carbon dioxide.

So, carbon dioxide enters the atmosphere through the burning of fossil fuel, oil, natural gas, coal, soil waste, solid waste, sorry solid waste, trees, wood products and also as a result of other chemical reactions, manufacturing of cement. Carbon dioxide is also removed from atmosphere sequestration which is absorbed in the plants as a part of the biochemical carbon cycle.

Now, you can ask question that by default carbon dioxide is a part of the gas which is there in the atmosphere. So, what is the problem? Problem is the amount which is going to be there. The amount of CO 2 which is naturally occurring that is fine, but when you add more CO 2 in the atmosphere then it is going to hamper the balance in the heat absorption ability of the atmosphere.

So, that is a limit and now we are going for going added more beyond the limit. So, what we can do? Carbon sequestration, it is done both naturally and artificially. Naturally if you want to use planting of trees, these trees are life savers. These trees are required for us. It is going to give us multiple things, fruits, food, but apart from that it is also going to give a way to sequester the carbon.

Sequester means to absorb the carbon, convert the carbon dioxide into oxygen. Of course, this happening most of the time is day time, but that is fine. But research has found that even if we plant the trees, carbon dioxide, sequestration is important and we have to do it very very fast. So, there is some process which has been done to make the carbon in the liquid format, come put it in the cylinders and put it under the ground.

It is an arrangement to reduce the effect very fast, but not a suitable arrangement because anything can happen to the to cylinder later on after multiple years. So, there are certain

companies which are doing it and they are doing it not just, they are sometimes it is required to be, to request is very fast so they are doing it. Methane is another one which is emitted during the production of the coal of coal natural gas methane emission.

So, methane is having more potent as a, it is a more potent greenhouse gas. It is the effect is much more dangerous, completely four times as compared to CO 2. Nitrous oxide, nitrous oxide is emitted during the agriculture and industrial activities. Fluorinated gases, hydrofluorcarbons, perfluorocarbons, sulfur, hexafluorides.

Ozone depletingsubstances, OFCs, CFCs, halons. These are many times; these are potent greenhouse gases. This is high GWP, Greenhouse Warming Potential Gases many times, the free refrigerators, previous old refrigerators, these gases are being found. So, little bit of emission of these gases will have much higher emission effect compared to even normal CO 2. These gases are really dangerous for the atmosphere.

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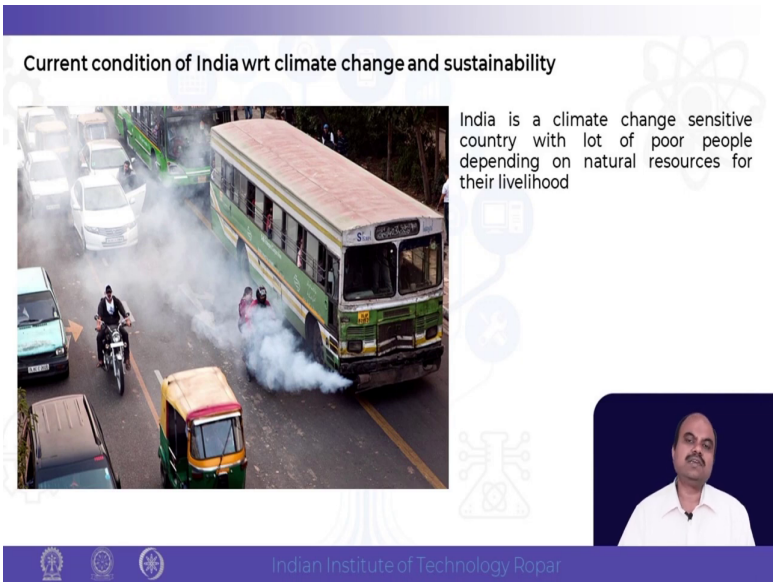

So, if you see the Indian scenario, climate change which is going to affect natural livelihood of people. If India, in India, there are many, many people who are poor. They are very much dependent on the resources of natural resources and climate change is affecting India a lot because of this.

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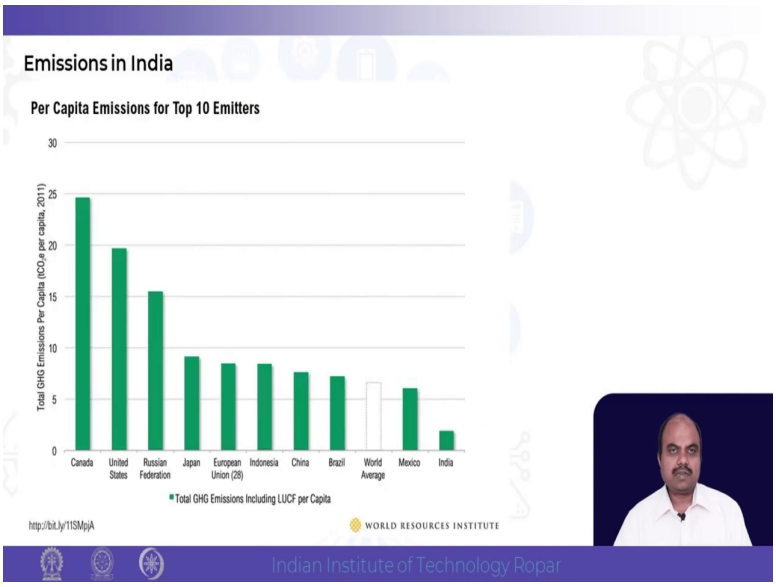

So, now, let us understand the climate change on the especially the emissions especially in little bit more way in especially India. Per capita income in this slide, you see the per capita in the sorry, per capita emission per capita emission of multiple countries. Per capita emission means per capita emission means each every person how much emission is doing on an average.

For Canada is high, United States are also high, Russian Federation is high. Whereas, if you see India, it is much much less than even world's average. So, then we should be happy or it should be something to worry. Yeah, we should be happy, right? First thing is going to be yeah, our per capita emission is very less so why need to worry? People are in other countries; they are doing more emissions than us.

We shall we are fine. Is it true? Just think. Is it true or not? So, what is the problem? Problem is that total emission.

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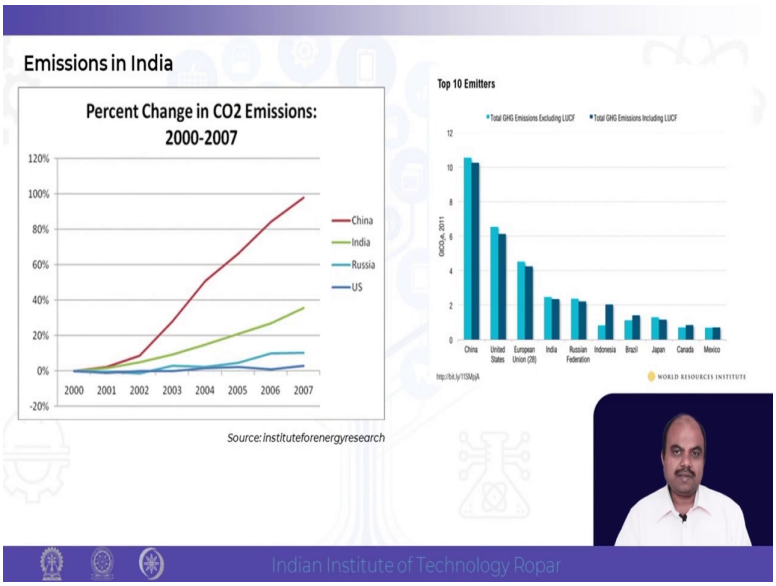

India is having lot many people compared to other countries. Now, I think it is like 1.5 billion, 1.3, 1.5 billion people. It is going to cross, it is just crossed or just going to cross the population of China. Now, you see, you multiply per capita emission with the total number of people who are living in India, total population.

So, total emission, if you see, it is pretty high. However, we need to also see that that the emission, total emission, China is contributing to the world is really high and it is increasing as a drastic stage, but India is also increasing, Russia is also increasing, US is kind of stabilized.

So, if you see, now India is on the fourth level from the, from average now it is China, United States, European union and then India. So, amount of emission, total emission is really, really high for India. Something we need to be careful. We need to understand, it is our responsibility for government, for companies, for individuals to reduce the emission of India.

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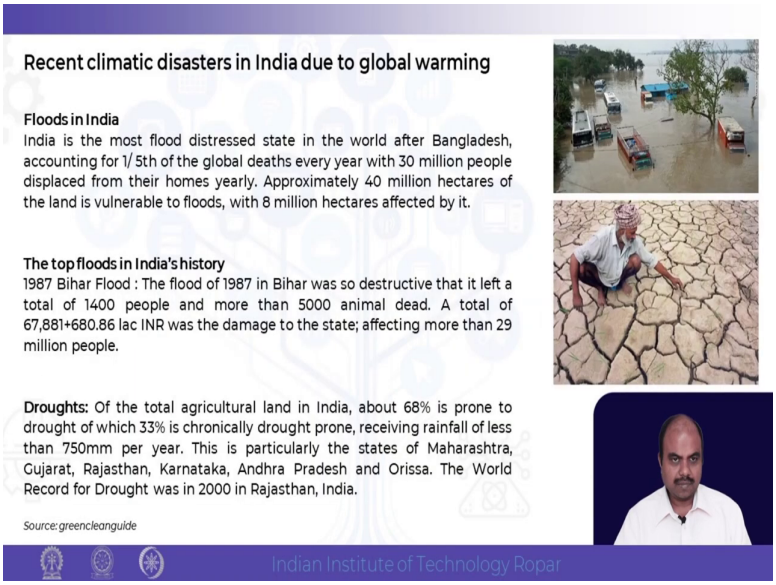

Now, we are just talking about the emission, but is it really affecting India? How much is it affecting? We should know first. So, floods, floods in India, India is the most floods distressed state in the world after Bangladesh. Accounting for one fifth of the global depth, death every year, 30 million people displaced from every, every time you see, you know that de estimergement group has moved a lakhs and lakhs of people from one place to another place.

You cannot free, they do not do any free job. It is being paid by the government or the local government or the people. Imagine, imagine that you are leaving your home for 20 days by force and then you have to stay from some other place in where there is, you know, home is also not there. How much difficult life is? And this is happening for flood, this is happening for hurricanes when they are coming.

So, this is something which is expensive. This is something we need to worry about. We are paying taxpayer money to do all these things. 40 million hectares of the land is vulnerable to floods and 8 million hectares affected by it. When flood comes, everything is gone. The first thing in our mind, it comes oh our important things are there in the home that is going to get affected.

But what we do not understand that a flood is there for 6 days, the entire cultivation of that area is completely wiped out, right. How the plant is going to survive? Cultivation is gone, sewage system is gone, power is gone, system is gone, economic collapse, food is not there, good water is not there, people are going to move from one place to another place. Where this kind of thing is happening after before 50 years, 100 years, I think.

Top floods in India, 1987 we have, Bihar flood, the flood of 1987 in Bihar was so destructive that it left a total of 100, 1000, 400 people and more than 5000 people, animal dead. Another thing, animals. When we are talking about animals, the first thing come in our mind, ok. These animals speak people are having, but they are all animals which are there in the forest and other we are not taking care of those effects. And after flood also (Refer Time: 30:02) big effect there.

So, once I was travelling to Sundarban area and then recently after that big flood which is recently few years back it has come, people are telling that so after the flood it is so terrible condition that places, it takes many years to actually make some improvement on it. 20 and million people are affected.

Droughts another thing, another big issue in India. Total agriculture land is of 68 percent to prone to drought, 33 percent chronically drought to prone. And see this is more specifically affecting Maharashtra, Gujarat, Rajasthan, Karnataka, Andhra Pradesh and Orissa. And also, is having a lot of drought to prone. From where the water is going to come, most of the water either comes from the underground pumping system or river or streams.

The precipitation system get changed then all these things are going to happen. But now the question is, all these affecting what are the things are affecting? It is affect in only India or some other countries also?

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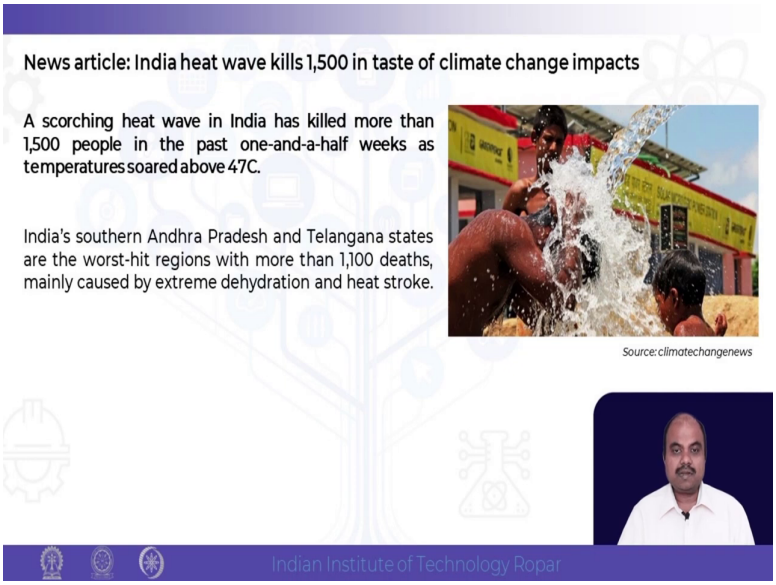

Many countries are getting affected. So, Indian in India, the heat wave which is there the 1000, 1500, this so many people are getting killed. Scorching heat, nowadays so many places the so many people are getting affected so many people are dying. Thousands of people got

affected in Telangana. And these are not that we are making, we are news is coming, news is there. If you see the news old newspapers a few years back. So, all these things are there, right.

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So, what I am studying is, it is affecting in even in even in Pakistan also. In (Refer Time: 32:15) Pakistan, you see the people are getting affected due to heat waves.

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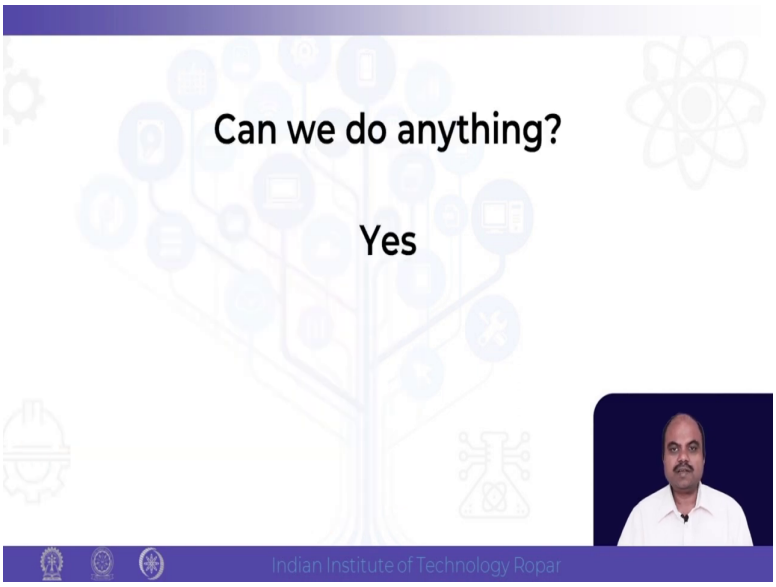

The question is, can we do something on this? The answer is yes, we can do something. We can we can change the way right now the current condition is, we can make our self more sustainable.

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So, before we do this, we have to understand what is sustainability and how we can measure it and how we can develop products which are sustainable.

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