Chemical Process Intensification
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Lec_07
Problems Leading to Sustainable Development

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Welcome to massive open online course on chemical process intensification. In this module 3 role of process intensification in sustainable development, we will discuss something about the sustainable development and its problems and some aspects in 3 successive lectures, in this lectures problem leading to sustainable development will be discussed.

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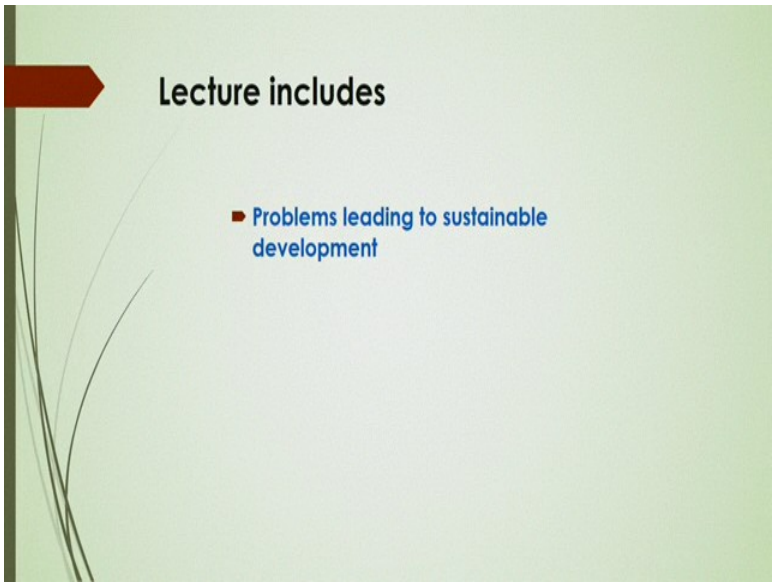

So, this lecture includes the problems those are actually leading to sustainable development, a different aspect of that problems in different, you know aspects like in environmental, even in socioeconomic and also technological problems for the sustainable developments. Now you know that various, you know precautions are taken. That is, you know for the control of large-scale use of environment and also socioeconomic resources for our human being for their daily social life.

Now, in different aspects we are actually use that environmental resources and also some other socioeconomic resources for our daily, you know development of life, but for that, since the resources are not, you know, being used in wisely, so there are various precautions are actually arising for the use of this large-scale environment and socioeconomic resources. Now there are different problems for which the several technological solutions have been implemented for the beneficiation of the growth of the social as well as, you know that economic development of the nations.

However, this, you know that technological solutions did not solve the problems in sustainable way, the problems still, you know the pertain for in different aspects of economic as an environmental and also, you know that social life, there, so for the sustainable development, sustainable growth there should be a, you know increase or you can say that the policy should be made in such a way that the technological solution whichever coming that should be, you know selected and also should be wisely used, so that there should be sustainable growth and also that should be, you know that acceptable in range for, you know that good impact of environmental life.

And also, sometimes the problems technological whatever that, you know that sustainable development, for the sustainable development problems those are coming, though technological solutions are coming, some technological solutions are not giving, you know sustainable way to growth our society and sometimes those technological solutions when it will be used that may sometimes again create a problem and if a bigger problem that also being created. So, in that case, the technological solutions are to be, you know that selective way and it should be, you know that intensified or the process whatever it is coming for the, you know that sustainable growth that should be, you know that devices properly.

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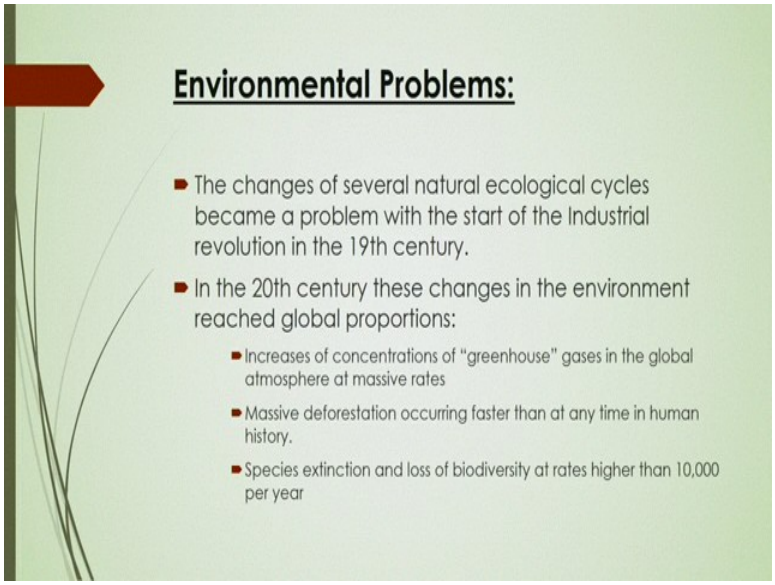

Now you will see what are the different problems in different sectors? Like you know that in environmental problems, even socioeconomic problems and in technological problems, where those problems are coming let us consider her the environment problems here. The change of, you know that several natural and ecological cycles that become a problem with the start of Industrial revolution in the 19th-century.

You know from that on what there will be a, you know that huge progress of industry development and you know that industry installation and at that time actually there was no actually precautions was taken, whether that emissions from that industry or whatever product-by-products are coming whether it should be environmentally impact bad way or not, that was not actually considered.

Now, it is seen that after a long use of those, you know that technologies in industrial in stock, installation there, so you know, those, you know impact of environment actually

destroy our, you know socioeconomic lives, so those you know the change of several natural ecological cycles actually started from then onwards and in the 20th century, this changes in that environment, you know that reached global proportions, you know that there are several now bad impact is coming by that industrialisation in 20th century.

And actually, it was growing continuously that is why at this stage we are realising that there is a huge change of that, you know that environmental bad impact on socioeconomic life and also in that case if you increase that industry, so there may be though increase of concentrations of greenhouse and gases in the global atmosphere at massive rates, that is why nowadays the concerned about the climate change, even you know that greenhouses gases, those are coming due to that industrialization, that is carbon dioxide gases are coming out or emitted from the industry and it is seen that it is now coming as a massive rates.

So there should be a measurement to be taken, so that, that how to control those massive output of this greenhouse gases and also another aspect that due to that industrialization, there is a massive deforestation occurring faster than at any time in human history, so you know that just destroying the jungle and you making the industry and emitted carbon dioxide, of course, it will be continuous, you know that happening of those, you know occurrence then of course our human life or socioeconomic life.

Even you know environment due to this bad impact of this emission or you know that deforestation, indirectly that deforestation will give you that increase of that, you know greenhouse gases also, because you know if you have that forest, then whatever carbon dioxide is coming out or emitted by the industry that may absorb by the, you know that plant in forest and so that is why if you make the deforestation for your industrial growth, of course, will give you that impact on human life as per that environmental based.

Now, species extension and loss of biodiversity at rates higher than 10,000 per year, that is also one important aspects where that environmental problems here sustain, because you know that those who are species in, you know that in forest that you can say, if you destroy those forest, of course, there will be a, you know loss of this biodiversity, you know, so that should be controlled, so this biodiversity is occurring at a higher rates even more than 10,000 per year.

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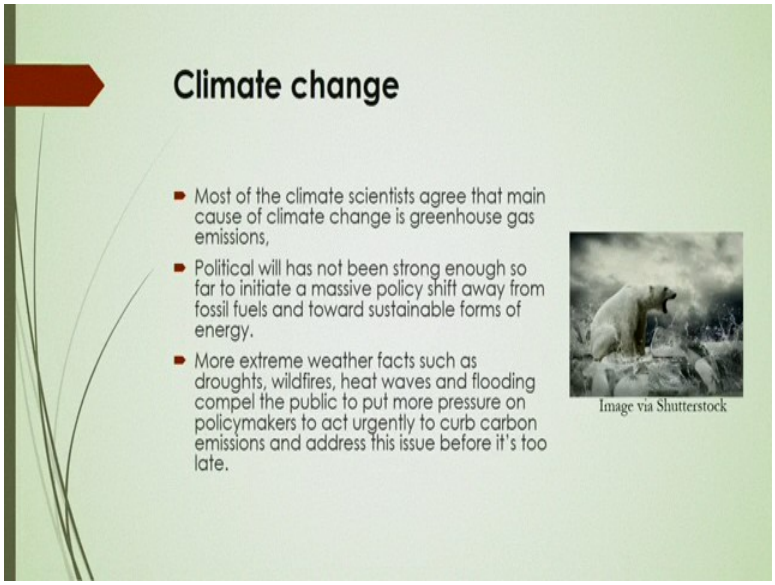

Now, one of the most important, you know aspects of an environmental impact in the that climate change that most of the climate scientist they agree that the main cause of climate change is greenhouse gas emissions, of course, this, you know that nowadays, you know everywhere we are seeing that there will be a change, you know that we are not getting that proper, you know that seasonal change that, you know sequence of seasonal change sometime, so because of that, that carbon dioxide gas emission or greenhouse gas emissions.

Now, political also will has not been strong enough to so far to initiate a massive policy shift away from fossil fuels and towards sustainable forms of energy, so you know, of course, government should take initiative that in this case, to reduce that greenhouse gas by industrialization and also some policy should be made, so that for the emissions of that greenhouse gas to be controlled.

And also, more extreme, you know that weather facts such as droughts and also a wildfire, heat waves and flooding that compel to public to put more, you know that pressure on policymakers to act urgently to curb that carbon dioxide gas emissions or carbon emissions and address this issue before it is too late.

So, government should take initiative as early as possible, where that due to this weather facts like droughts, wildfires, heat waves and flooding, though public are being compel to actually put it more pressure on policymakers, not to do all these things, but you know government should take good measurements, so that our socioeconomic life based on this environmental bad impact will not be hampered.

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Now pollution is, of course, everywhere now we are facing that, due to that industrialization, due to the increase of human population, even other different, you know activities of the human beings, even some other animals also, there will be a continuous, you know that pollution of air, water or you know that land also there. So air pollution and climate change are closely here related, as the same greenhouse gas emissions that are warming the planet are also that creating, you know that smoggy conditions in major cities and also you can say that in various locations as per that, you know that activities of the human being, that activities maybe different way, maybe industrialization, maybe some activities by the human being, so that actually is very endangered for the public health.

So that is why you can say that the air pollution, mostly because anyway, we are surviving, you know that by taking that air, so if that air is being polluted then of course the health problem, of course, will come. So in this case, air pollution, so pollution be made in such a way that to reduce that gas emissions, some other you know that different, you know geographical locations that their weather impact on that and because of which that some particles, some dust, even you know that some unwanted hazardous materials also would be, you know, flowing in the air, so you have to reduce all those things by making a policy and/or you can reduce those this making a certain sustainable process by intensifying the conventional process.

Water and soil pollution might not get the media attention that air pollution does, in that case you will see not only that air pollution is happen, of course, that water pollution also will be happen, we are very much concerned about that, you know that air pollution because that,

whatever it is that media is, they are you know more focusing on that air pollution, but similarly in the same way and same measure that water and soil also are being polluted and in that case that media are not giving that much attention on that water and soil pollution.

So, but there is still important public health concern because we are anyway taking water, even when we are actually living if those land should be actually checked but whether it will be feasible for the living of human being on there are not, so that also should be there because there are several organic, inorganic compounds will be mixed in this oil and water also that, of course, directly, indirectly will impact on our health.

According to the Natural Resources Defence Council, you know that dirty water is the worlds biggest health risk there, so anyway, very few course proportional of the, you know that human being are taking very clean water in the world, but maximum portion of our, you know that creatures they are taking the water that is very dirty, so that is, you know that impure waters, so there is a biggest health risk are there.

And also soil contamination is a major issue across the world, you know that in China nearly 20 percent of arable land has been contaminated by toxic heavy metals, not only China in our country also, in Indi also, you know that around you know more than 25 percent of the arable land has been contaminated by toxic, you know heavy metals.

So soil pollution threatens food security and poses a health risk to the local population and also, you know that the use of pesticides and you know that agricultural, you know that waste and fertilisers, industrial wastewater, industrial waste those are also the major factors, you know soil pollution, anyway they are going through the, you know that certain medium of that, or you know if it is living to the water that also settle down in a land, so that also you know directly, indirectly it will be polluted, so the pollution is also one important measurement of that for the sustainable growth that to be taken care.

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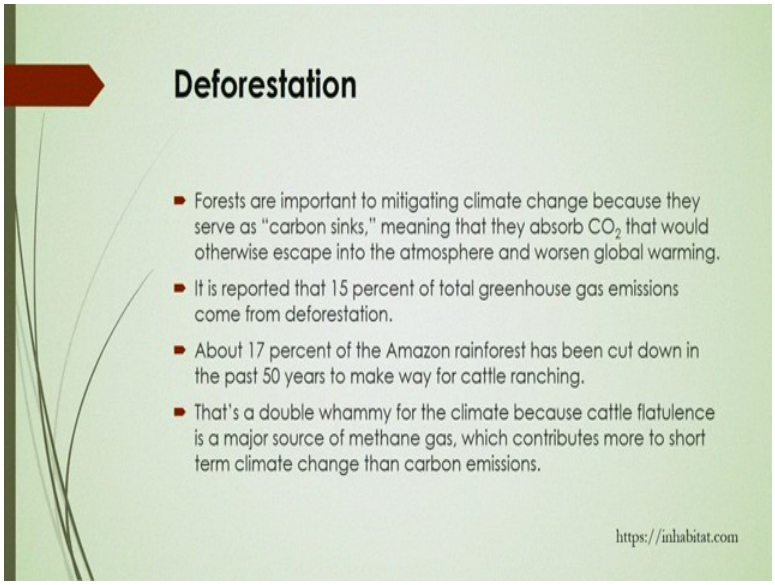

Deforestation forests are important to, you can say that mitigating climate change because they serve as you know that carbon sinks, meaning that they absorb carbon dioxide that would otherwise escape into atmosphere and worsen global warming, so you know that indirectly can say that if you are destroying the forest, absorption of the carbon oxide would be, you know less, so ultimately in the air, in the atmosphere, you can see increase in carbon dioxide and that will, you know, resulting global warming.

So, it is reported that 15 percent of the total greenhouse gas emissions that come from deforestation, about 17 percent of the, you know that Amazon rainforest has, you know been cut down in the past 50 years to make way for the cattle ranching, so that is, you know that while a double whammy for the climate because, you know that flatulence is a major source of methane gas, which contributes more to short-term climate change than carbon emissions.

So that is why it, you can say that the change of climate not only by this carbon dioxide gas emission, there may be a you know that huge impact, bad impact of that flatulence and you know that major source of that flatulence is the methane gas, which contributes more to climate change, then carbon dioxide emission. So, deforestation is one of the important factors or you can say that the important environmental pillar, where we can say that we have to, you know reduce that carbon dioxide emission, just making a policy where that deforestation should be reduced.

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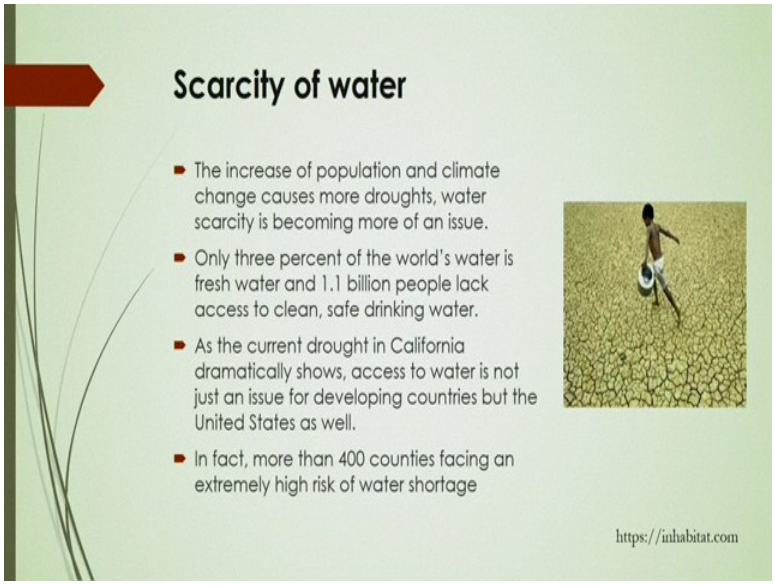

Another is a scarcity of water. The increase of population and climate change that causes more, you know droughts, water scarcity and which becomes more of an issue in the environmental society or in environment, only 3 percent of the worlds water is fresh water and 1.1 billion people lack access to clean, safe and drinking water, you know this, you know only 3 percent of the worlds water we can say it is a fresh and maximum people of that they are unable to access to get this clean and safe drinking water.

And this is coming, sometimes in different countries, sometimes due to this, you know drop-ness of that may, you know give the impact that is scarcity of the water and you know that access to water is not just an issue for the developing countries, but in that case the, you know that some other reasons where that the scarcity of the water can cause further development of the growth.

So you know that you have to, you know, suppose in a society, if you that human being that are growing because of that, you know water, without water cannot be surviving, nobody can survive in that case, so anyway ultimate growth for that, you know, sustainable development, they should not be the scarcity of water, in fact, more than 400 countries facing an extremely high risk of water shortage and because of which they are, that places are remained undeveloped there.

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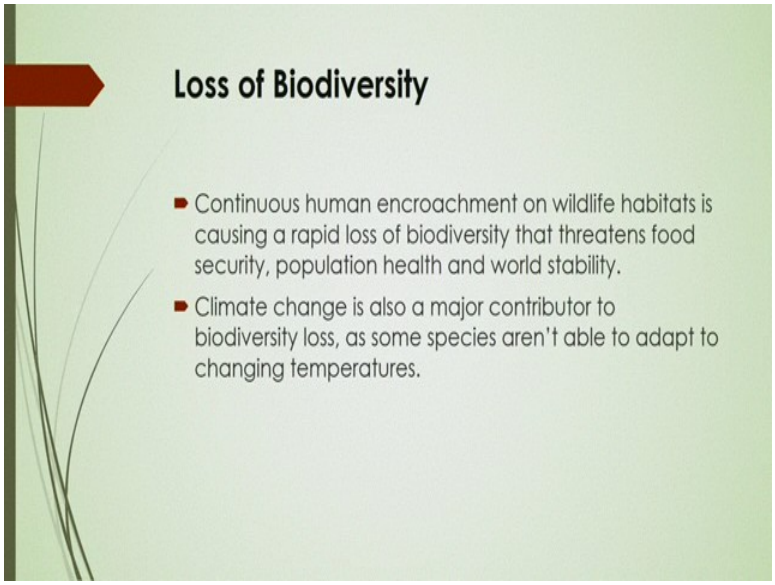

Loss of biodiversity also important aspects of this environmental pollution and indirectly to the contributes, to the sustainable development and continues human, you know in encroachment on wildlife habitats is causing a rapid loss of biodiversity that threatens food security, population health and world stability there. So wildlife that, you know that you have to make a policy in such a way that you have, that is our wildlife should be, you know that be alive and also, you know that should not be destroyed and rapid loss of biodiversity should not be happen and also in should not be such that, there should be the food insecurity and also there should be, you know that population health and world stability should be, you know maintain their.

So, there should be some certain degree of you know style of life or lifestyle you can say and that, you know that should be maintained just by, you know that making the food security and population health and world stability. So, if you are there and the human, you know that encroachment on wildlife that will actually cause a rapid loss of biodiversity and ultimately hampering the sustainable development in the society.

Climate change is also a major contributed to biodiversity loss and some species are not, you know that able to add up to change in this temperature also, due to this global warming, you know that there are several species creatures that are, those are not actually surviving because of that, you know that change of temperature, some creatures are, you know not able to survive at a very low temperature.

You know that some creatures are not actually able to live in very high temperature, in global warming scenario, you will see there will be huge temperature rise in summer and also, you know, in winter may be huge, you know temperature, you know drop there, so because of the temperature gradient or temperature, you know difference, you know there will a loss of biodiversity and loss of some species there because of this climate change.

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Soil erosion and degradation by unsustainable industrial agriculture, you know that practices also lead to less arable land, clogged and polluted waterways that will increase the flooding and you know decertification and, in that case, according to the world wildlife fund, half of the earths topsoil has been lost in the last 150 years there. So, soil erosion and degradation also sometimes one factor that will directly and indirectly influence the sustainable development.

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And in this case, the achievement of the sustainable development in environment necessitates, you know a holistic effort in all areas of society to meet the, you know appropriate criteria and current debates about that urban sustainability not only tend to focus on the carbon emission, energy consumption and the waste management, but also the role of facility managers in, your know that dealing the environmental problems towards sustainability development and environmental, you know that growth and there is a need to specify the permissible, you know building specific environmental that must be actually compatible with the overall sustainable targets there.

So these are the actually basis where you can debate that and which way actually you can, you know that grow your, you know sustainability of the human well, you know wishers and also you know that to develop the society in sustainable way and also to, you know grow the our environment in sustainable way, you have to devise, you have to develop a process that may be chemical, that maybe other way.

But it should not be that, whatever earlier is they have used that process to be used, so that is why the process intensification term has come where by which you can apply that process intensification principle to actually develop a certain process to, you know to change your, you know environment in a better way, to give you the better growth of your, you know, socioeconomic system.

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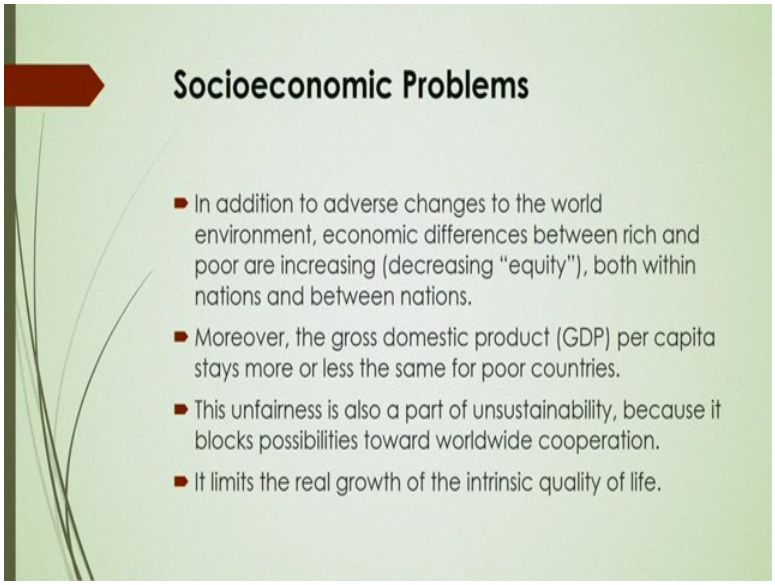

So socioeconomic problems are also there in that case, in addition to the adverse changes to the world environment, economic differences between rich and poor are increasing, in that case, the equity decreases, so both within the nations and between the nations are happening. So, in that case, the gross domestic product is per capita stays more or less the same for poor countries, there will be no change in that case of you know, capita, per capita or GDP, that is gross domestic product for the poor countries.

Otherwise, you know that the developing country or developed country, they are going up, but the poor countries should be also equally you have to develop for that environmental aspects and also that economically growth should be there, this unfairness is also a part of the unsustainability and because it, you know blocks possibilities towards worldwide corporation, it limits the real growth of intrinsic quality of the life, so that is why there should be, you know that equally development of the human being for the rich country and also poor countries, so that you can say that the sustainable growth of the society will be there.

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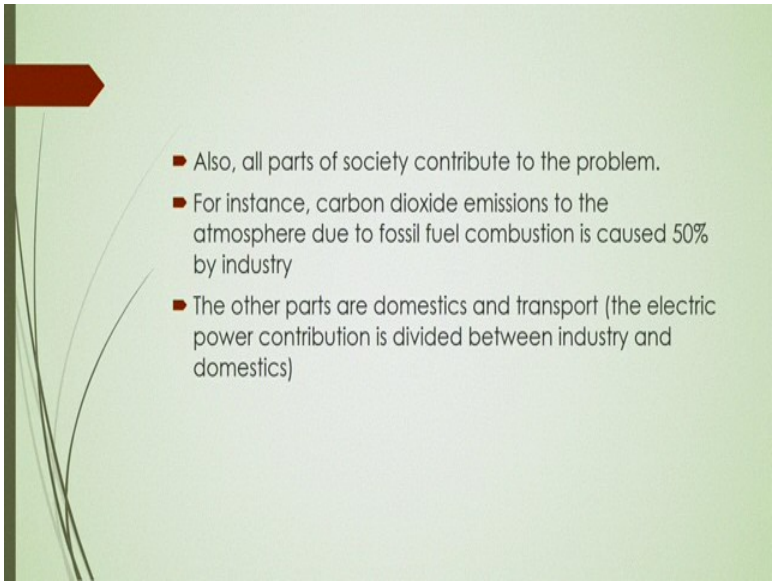

Also, all parts of the society are responsible to develop that economic or sustainable growth of human being, so in that case, whatever problem that is contributed by the different people, that peoples should have that much of concern to reduce those use of that resources in bad way and optimize the use of the resources in, you know that sustainable way or at a particular process, so they should actually follow the some process principles, everybody should follow the process principles by which you can get that sustainable development.

For instance, the carbon dioxide emissions to the atmosphere due to the fossil fuel combustion is caused 50 percent by industry you know that industry are the major cause for this, you know that emission of the carbon dioxides, so industry should make a policy, so that the reduction of the carbon dioxide to be there. So, any process, they should develop a particular process where the carbon dioxide is being coming out, so to reduce that process, they have to intensify the process, they have to develop the process unless the less carbon dioxide emission will be there.

The other parts are domestics and transport also, there are different factors that also we have that, for which that environment, you know that are being polluted, so other parts are, you know the domestic and transported, since the human populations are being increased, so in that case, the domestic uses and the transport uses that contribute to, you know that the emissions of different unwanted materials, you know that wastage of the unwanted materials.

For sometimes you know that hazardous, some maybe (())(30:13), so in that case, it may cause the health risk for cancer and other things, so in that case, you know that the

contribution is coming not only that industry as well as domestic also, so domestic people also they should understand that how to use those, you know worst material, so that should not be effect, that should not effect on or bad effect on the society.

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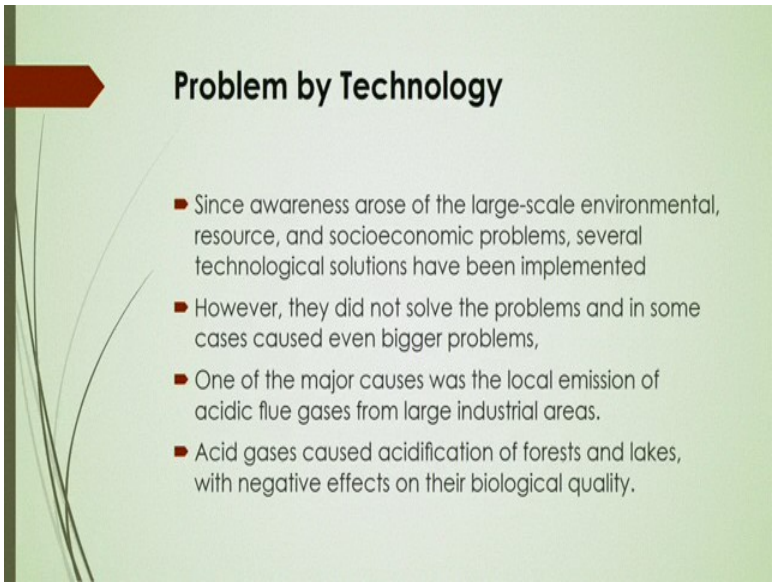

Now, there are several, you know that technological problems also coming that also directly effect on that sustainable growth. Since awareness arose of the large-scale environment, resorts and you know socio-economic problems, several technological solutions have been implemented. However, they did not solve the problems and in some cases, you know caused an even bigger problems by that conventional process of the technological solution.

One of the major causes was the local emission of acidic flue gases from large industrial areas. Acid gases that caused acidification of forests and lakes and also other, you know parts of that forest which negative effects on their biological, you know quality.

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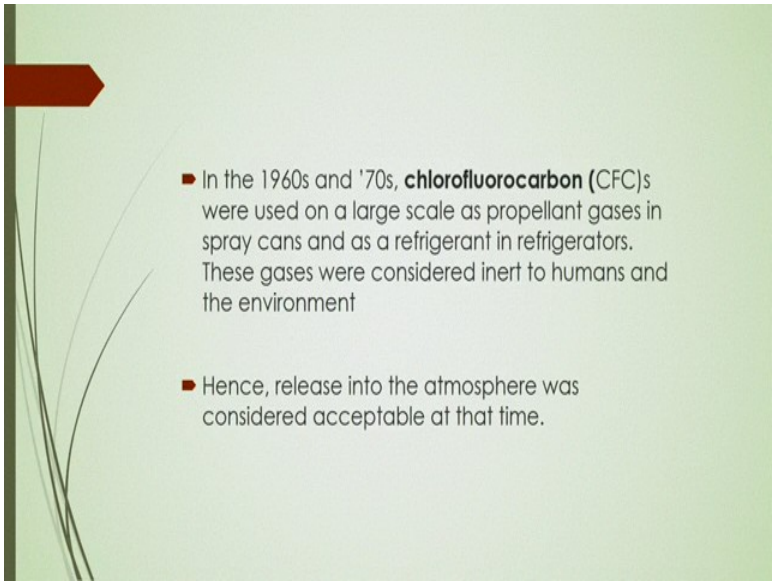

In 1960s and 70s, you know that chlorofluorocarbon were used on a large-scale as, you know propellant gases in spray cans and as a refrigerant in refrigerators, they have used this chlorofluorocarbon and this gases were considered inured to humans and the environmental at that stages. Hence at that time actually these were actually released into the atmosphere and it was considered that acceptable policy for the emission of this chlorofluorocarbon to the atmosphere.

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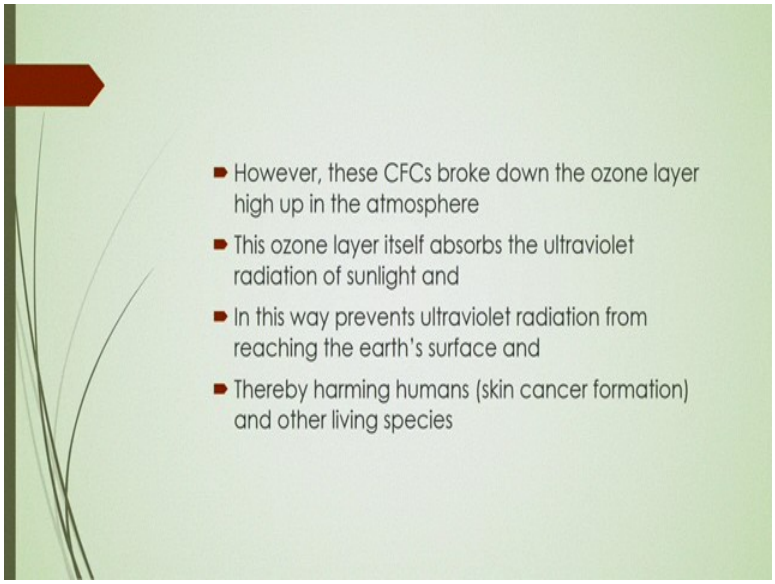

However, these chlorofluorocarbons you can say CFCs broke down that ozone layer high up in the atmosphere and this ozone layer itself absorb the ultraviolet radiation of the sunlight and in this way that prevents ultraviolet radiation from reaching the earths surface and

thereby harming, you know humans skin cancer and also other, you know diseases happens and also not only human beings, others, you know, living species also suffered by that.

So earlier stages, you can say that the CFC are acceptable to, you know that release to the atmosphere, but it is later on understood by research that no, this CFC actually broke down the ozone layer high up in the atmosphere and this ozone layer absorbs the ultraviolet radiation of the sunlight, so in this way prevents ultraviolet radiation from reaching the earth surface and thereby harming humans so and other living species.

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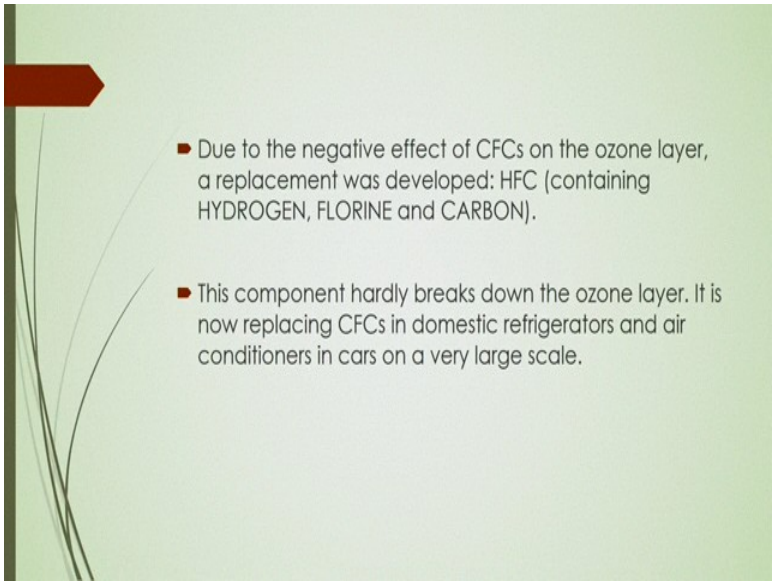

So, due to the negative effect of the CFCs on the ozone layer, a replacement was developed, so in that case, HFC containing hydrogen, fluorine and carbon that is called hydrofluorocarbons, so in that case, this component does not break down that ozone layer and that is why it is now replacing CFCs in domestic refrigerators and air conditioners in cars on a, you know very large-scale.

So, this is called one of the important aspects of technological development for the sustainable, you know growth. So here, you know, CFC earlier how it was being used and what was the problem that human skin and other things, nowadays instead of this CFC due to that technological development this HFC are being used, so that is why this HFC replace this CFC in domestic refrigerators and reducing that, you know health bad impact.

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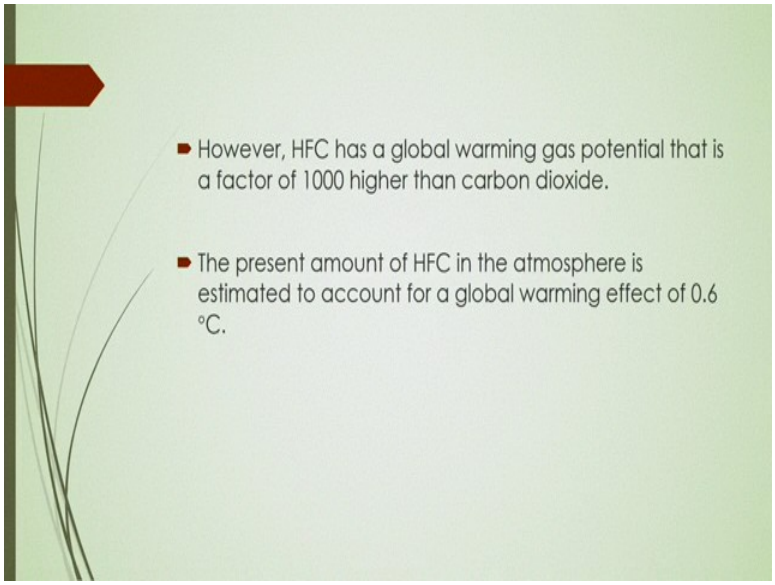

However, this HFC has a global warming gas potential that is a factor of 1000 higher than carbon dioxide, so anyway, this technological development is coming for replacing it CFC to HFC but later on again that, you know by research, it is found that these HFC has a huge bad impact of, you know that for the global warming aspects. In that case this gas, you know has an impact that is called bad impact, that is compared to the carbon dioxide emission, this is actually 1000 times higher than the that carbon dioxide.

So, the present amount of HFC in the atmosphere is estimated to account for a global warming effect of 0.6 degree centigrade. You will see that huge amount of these HFC now changing this, you know that temperature, you know, so that is why technological development is growing, but parallelly research should also be, you know taken whether in other way, this whatever development is there technology development, it is, you know that way that it should be giving the bad impact to the atmosphere or not.

So, parallelly the policy in that case should be made at no, research also to be continued. Whatever, you know that products will be coming out after, you know technology development, whether this technology will be sustainable or not, of course, nowadays that is why greener technologies coming for the more sustainable development because in that case, some solvent or catalyst or some other compound, organic compounds to be synthesised in such a way that it will not have the bad impact on the, you know environment and like human health condition other way.

So that is why, you know technological development, there is a problem also, so parallelly that you have to think about that is there any problem whenever the technology is developed that giving you impact on the environmental or not, so these are the problem in that.

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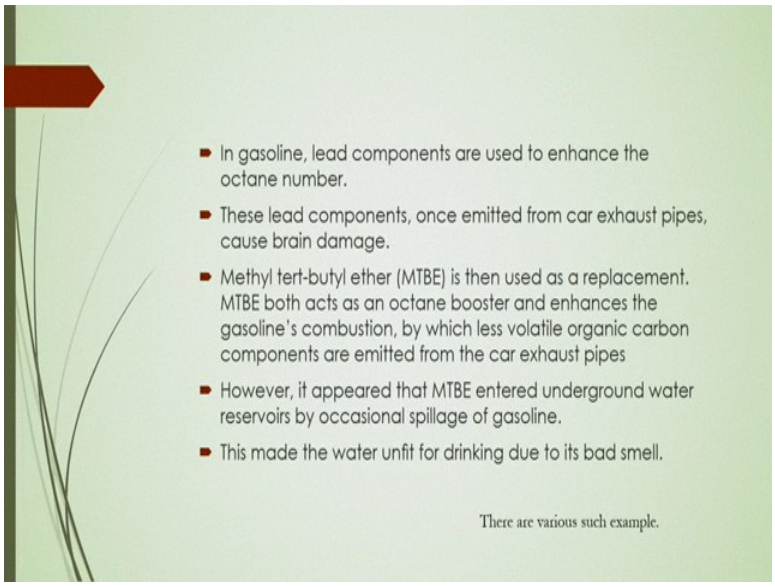

In gasoline components are used to enhance the octane number. These lead components, once emitted from car exhaust pipes, cause brain damage. Methyl tertiary butyl ether is then used as a replacement. Methyl you know that tertiary butyl ether both act as an octane, you know booster and enhances the gasolines combustion. So that is why you know that less volatile organic carbon compounds are emitted from the car exhaust pipes.

However, it appeared that MTBE that is methyl tertiary butyl ether entered the underground water reservoirs by, you know that occasional spillage of gasoline. So, this made the water unfit for drinking due to its bad smell, so this is also you know that technological development is that but parallelly there is a some desirement of that technology to the environment in other way.

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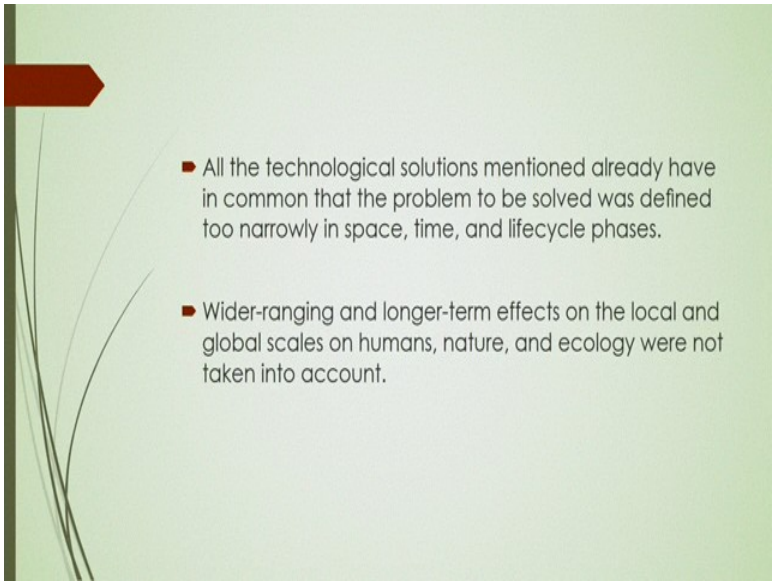

So, all the technological solutions that mentioned already have in common that the problems to be solved was, you know defined too narrowly in space, time and life-cycle phases, wider ranging and longer-term effects on the local and global scales on humans, nature and ecology were not taken into account.

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So, the complex societal challenge of the sustainable development is, of course, should be reduced to the purely technological problem of improving industrial eco-efficiency or producing more with less emissions of that organic compounds or other hazardous materials.

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Transition to sustainable society poses a number of serious technological challenges. First, considering that the very foundations of you know western industrial societies are based on the exploitation of non-renewable minerals and fuels. And it will be extremely difficult to switch to an industrial and economic system-based society or based solely on renewable resources. The continuing use of non-renewable is inherently, you know, unsustainable because of finite material supplies and the fact that 100 percent recycling is there impossible.

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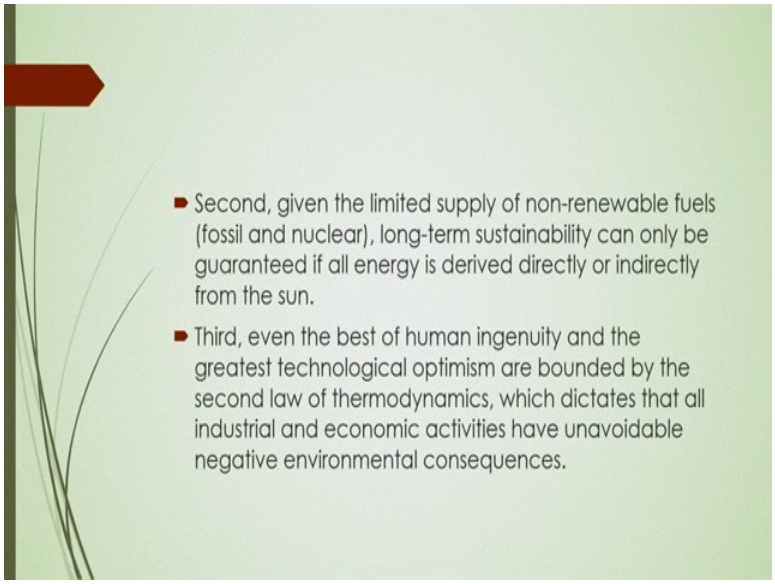

Secondly, you can say given the limited supply of non-renewable fuels fossil or nuclear, long-term sustainability can only be, you know guaranteed if all energy is derived directly or indirectly from the sun. And even the best of human ingenuity and the greatest technological

optimization, you can say that the technological optimism are bounded by the second law of thermodynamics, which dictates that all industrial and economic activities have unavoidable negative environmental, you know consequences.

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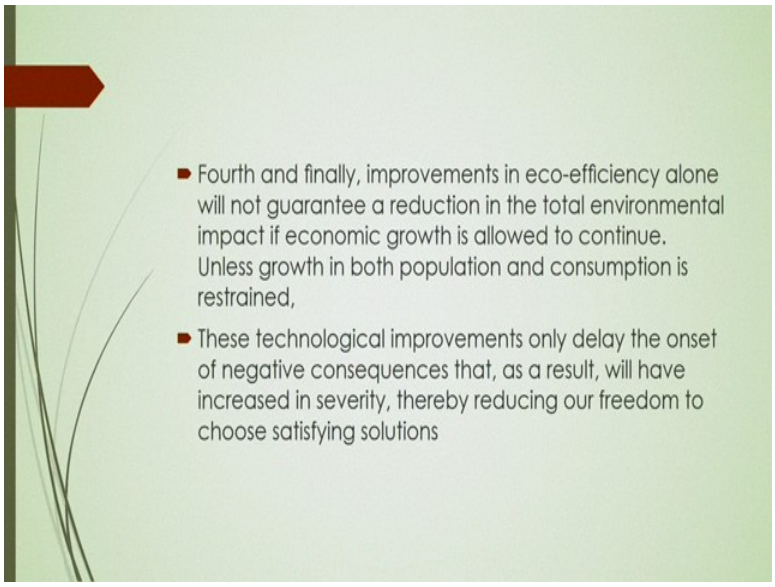

An improvement in eco-efficiency alone will not actually guarantee a reduction in the total environmental impact if economic growth is allowed to continue, unless growth in both population and consumption is considered that. These technological improvements only delay the onset of negative consequences as a result will have increase in severity, thereby reducing our freedom to choose, a you know satisfying solutions by improving the development of technology.

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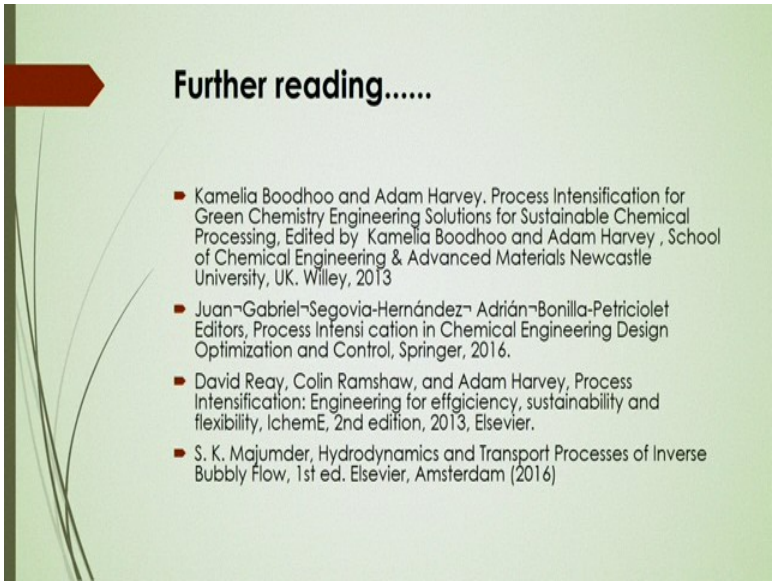

So, thank you for this lecture, I would suggest for this sustainable development for the reading as you know that these books, I think it will be helpful for better understanding, so thank you.