Strategies for Sustainable Design
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Lecture 1 & 2
Welcome Lecture

Hello everyone. We are starting this course, strategies for sustainable design. So, I welcome you all.

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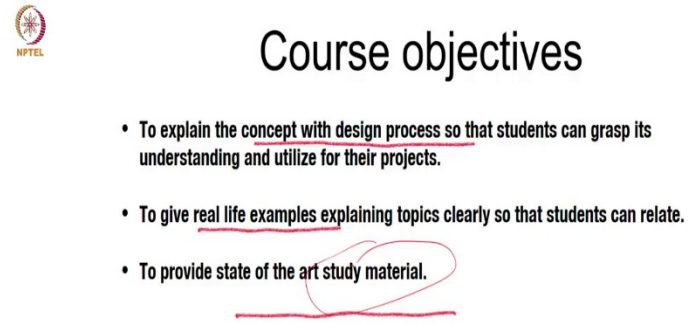

So, the objective for this course are, to explain the concepts, with the design process, so that you can understand, and you can grasp it, and you can utilize it in your projects and studies. Second objective is to give you real life examples, so that you can relate, you can relate with the real life, and things which are happening by the efforts of several researcher agencies, all around us. And the third one is to give you the state of the art, like a literature and study material which is very very crucial in today's time to understand and move ahead.

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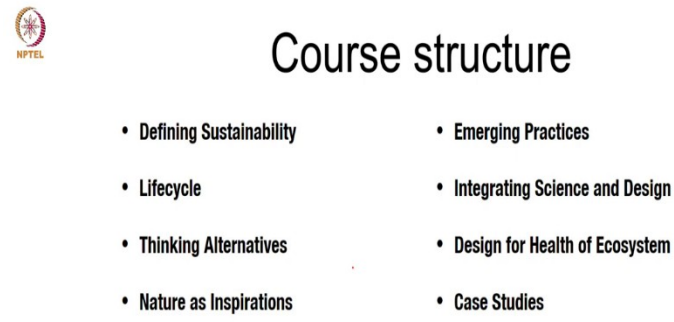

So, the course structure is a divided into a several sections, so defining sustainability, what is life cycle analysis, thinking alternatives, taking nature as inspiration, emerging practices, integrating science and design, design for health of the ecosystem with several case studies. So, case studies varies from industrial design to architecture to the city planning. So, there are several actually types of case studies depending upon the uses of the material and several techniques depending upon the those the strategies which have been discussed in this course. So, we have taken, actually, and we have selected some case studies.

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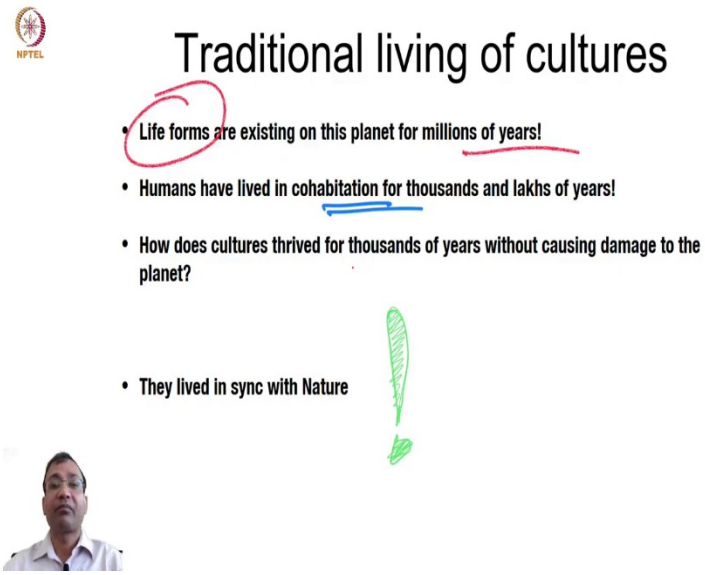

So before beginning the course, I would to put up one point. Well, there have been innumerable number of life forms which have been existing on this planet for like millions of years. While humans have also been a part of that, actually (())(1:58), which has been living in this co-habitation when along with other species, whether they are animals, birds, reptiles, plants, vegetation trees and all of those, even aquatic life.

For like thousands and lakhs of years at least. Whatever our scientific studies they are like actually give some ideas, so well some form of other species of the humans, our ancestors of humans they have been existing on this planet for a very long time. So, the question arises how these cultures of like a humanity, they have actually survived for 1000s and 1000s of years without causing much damage or almost any damage to the ecosystem to the environment to this planet.

Well, this is like a undisputed fact, they have been living in the sink with nature. So, in our this course, we will try to see how much off-track we are living right now, as a civilized society, away from the nature.

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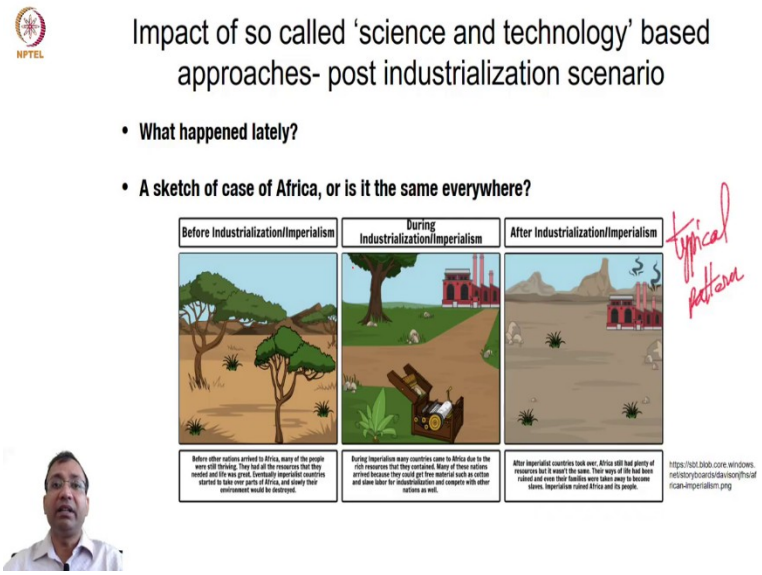

So if we see like a impact of science and technology on any place, any one place, any given ecosystem so it is tremendous, so it is illustrated over there with this, a sketch, what is the impact before industrialization, what happened during that industrialization period or imperialism and what happened afterwards.

So, it is very very clear and I think evident, what has gone wrong. So majorly, the period of industrialization which happened mostly in the European countries at that time, has actually given the spur of this kind of development which we are part of right now, almost every country is emulating the same format of growth and development and well planet, you see the apathy of the planet and it is not just the Africa as illustrated in this a sketch, I believe it is every continent almost every country on this planet is facing the same thing, whether this way or the other, but actually cause and effects are almost the same everywhere.

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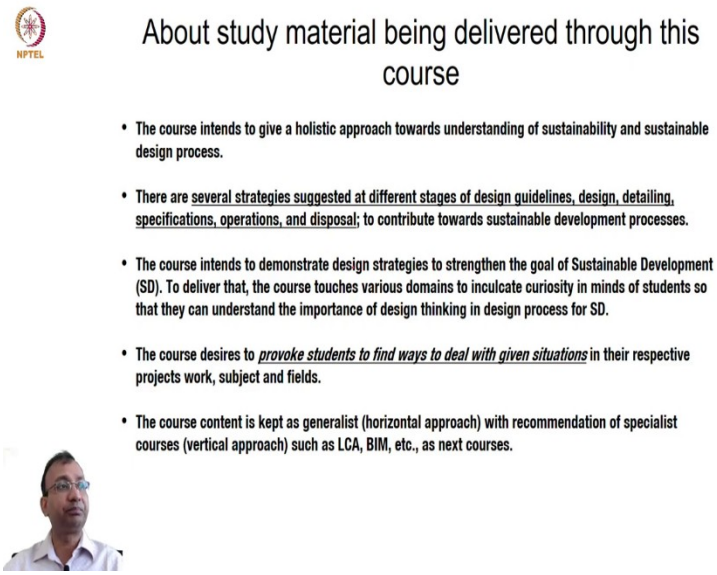

So, about study material being delivered over here, the course intends to give to explain various strategies needed for a different stages of design for example design framing a concept, framing design guidelines, designing itself and detailing specifications, operations and disposal of that, whatever the artefact is.

So, yeah, and actually the idea and the intent behind this course is to provoke you to find and deal with a given situations in your daily life, in your daily academic and research life, in your professional life, always. So, the course intends to give you that introspection and several ways through which you can devise to deal with it.

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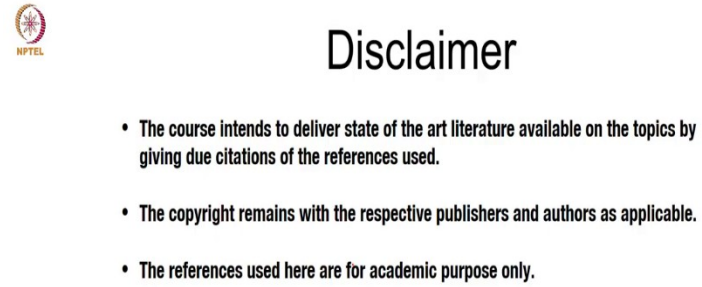

Well, this course I have to prepared with the help of several literature material available from books, research materials, articles and reports published from a respected agencies like United Nations, IPCC and several other. So, this content, and or research material, given over here, they belong to the respective copyright owners and the copyright remains with them only. I am using this study material here only for the academic purpose.

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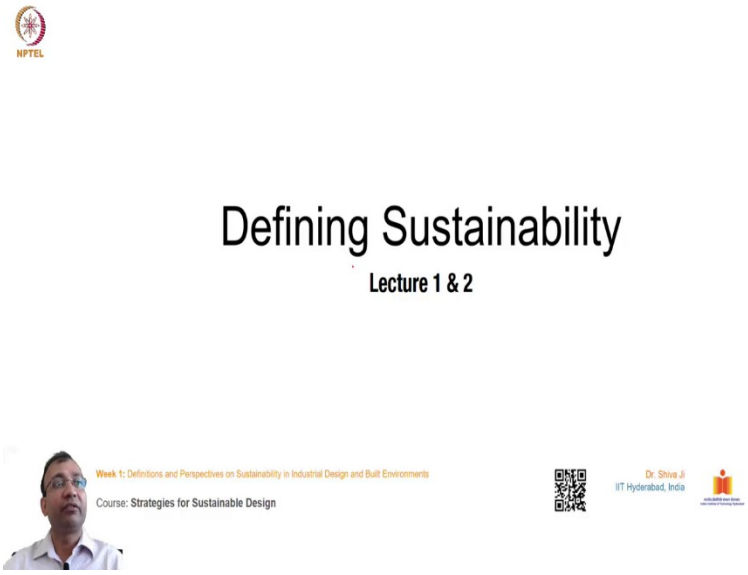

So, let us begin with our first actually and the second lecture which talks about defining sustainability.

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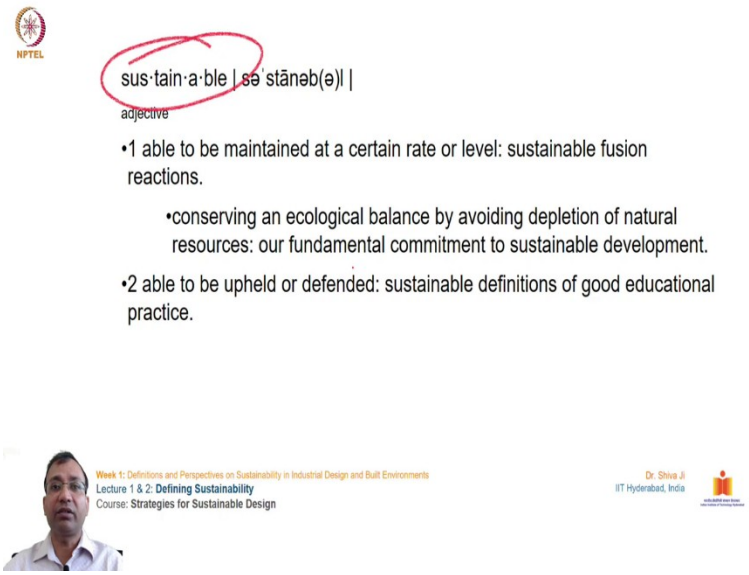

So, if we simply see the dictionary definition of what is sustainability? So, sustainability word is an adjective which defines a kind of assert maintaining a certain rate, maintaining a certain pace, so what has gone wrong in the recent time, return decades and maybe one or two centuries, that the pace at which the human societies growth and development has depended upon has actually taken a very odd turn.

So, there has been a very strong a joke which we have, which we are experiencing in the terms of climate change. So, sustainability actually comes right there where there have been a, like an imbalance, in the pace in the growth and development are actually observed in this a planet.

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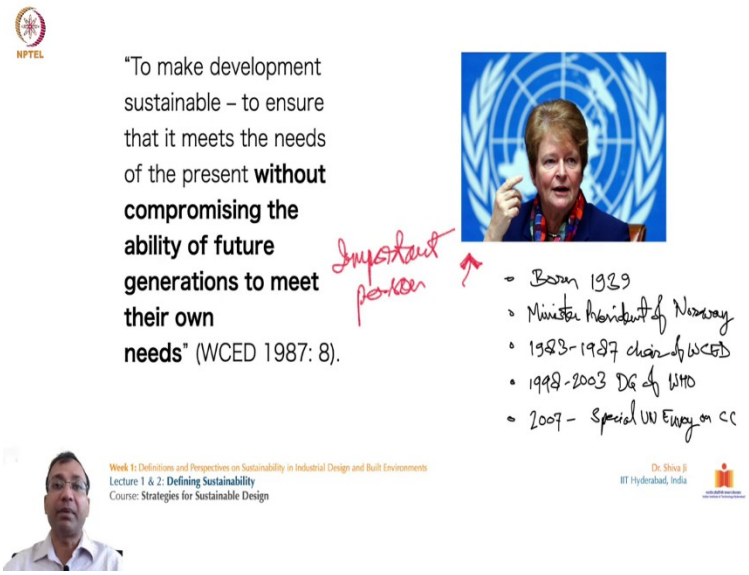

So, well you are seeing a very famous person, belonging to this, the whole scientific studies around sustainability. Well she is Gro Harlem Brundtland, so she has actually presented her thoughts long back in 1987, it was published as a report. So, there she mentioned to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of the future generations to meet their own needs.

That means we have to preserve the resources we have to preserve the finite resources of this planet, because this planet is like one-unit planet. It is made up of certain amount of some certain substances. The ratio of the the oxygen, the ratio of the other materials, ratio of the everything and everything, has like a, has been maintained for a very long time and I think that is very critical to support the present life form on this planet. So, if there is an imbalance being observed in that balance, obviously it is going to have its impact on the (())(7:32) sphere, the ability to sustain life on this planet.

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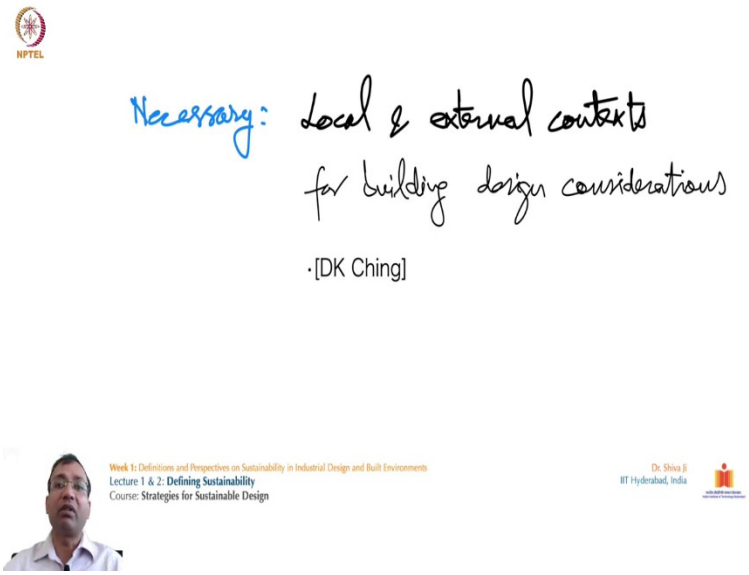

So, there is another actually a perspective given by DK Ching, he says local and external contacts are necessary to consider for building design process and without which one cannot proceed. So as we can see, it is not just the internal, it is the external is the surrounding, it is the all of the contexts whether they are at present on the site or they are even external, they all matter, because we are all part of one big ecosystem. So, everything matters.

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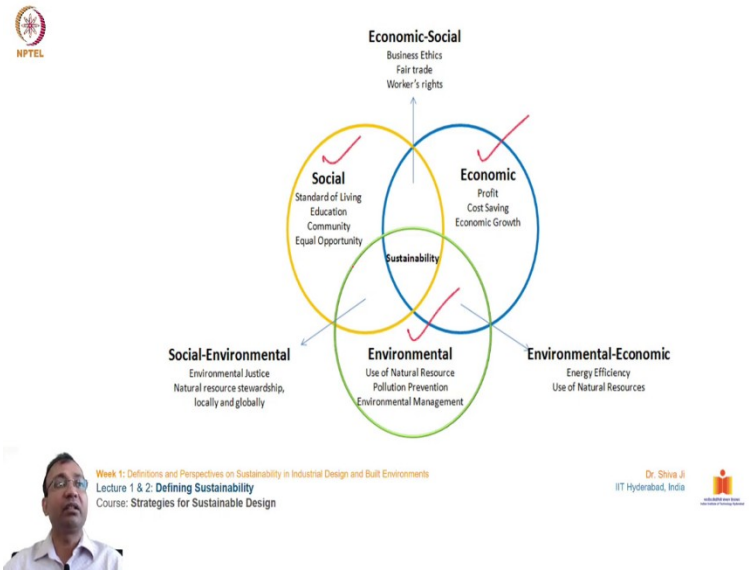

So here, I think this is a very familiar actually diagram to define sustainability there are very important and prominent three different aspects which are a environmental, social and economic around these three, the whole concept of sustainability is actually evolving at present time. Thus, sustainability is a dynamic concept.

So, it may be possible that the whole definition of sustainability itself may gets revised tomorrow in the times to come and it may include actually several other aspects also, which we have been observing for a long time, like how the scope of this like sustainability has evolved in the recent decades.

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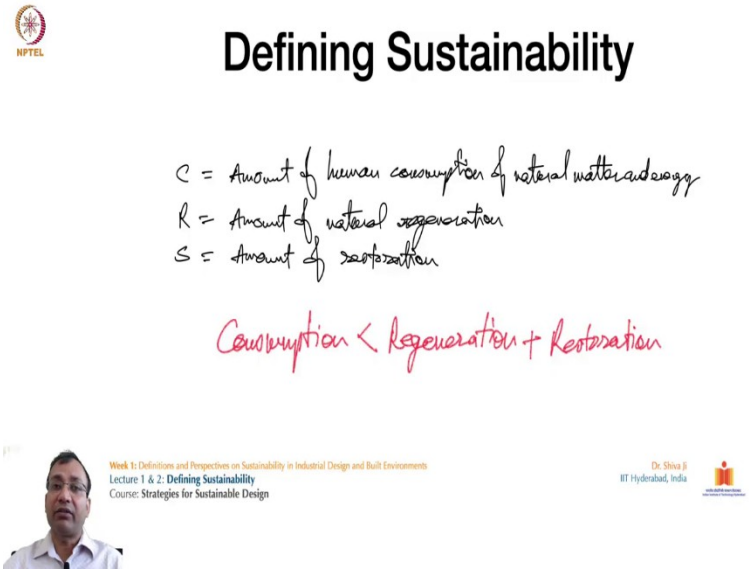

So, here if you see in a very, very a, in terms of the formula. So, here the consumption should be lesser than the capacity of this planet to regenerate and restore resources. Obviously it is a simple formula of a demand and supply, where demand is used and supply is little, so obviously we are going to run out of the resources and there is no factory, there is no other facility available to regenerate the resources artificially it is not possible.

So, if we are falling short of the resources of this planet, obviously tomorrow we are going to face a very critical situation. So, that is being given over here, the consumption must always be within the limits of this planet to restore and regenerate combined.

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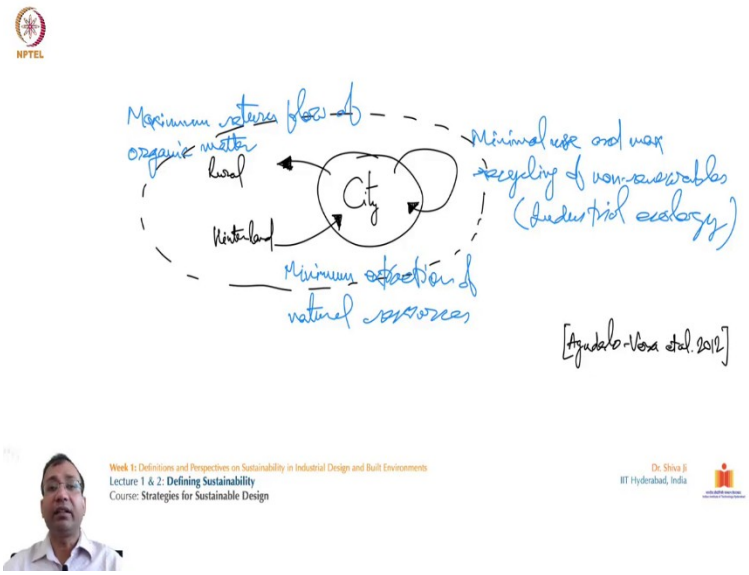

For any given setting of rural and urban industrial ecology, you can see in this illustration, it talks about, there are resources which come from an outside the limits of that settlement, you can see in this figure over here and there is something which goes back also, what is happening as the imbalance today, what goes as a byproduct has become a non-fitting or unfitting actually resource that we generally know as pollution.

So, cities and any urban settlements any settlements, they are consuming lot of resources and in turn, they are generating a lot of polluting material, polluting substances, in all the I see or something this ecological system, whether it is for air, whether it is for soil, water, in terms of noise, even in terms of a light. So, all of these forms are actually the bad effects of this whole development. So, minimum use and maximum recycling of nonrenewable resources is the very primary and foremost recommended actually thing to be a taken care of, other ways obviously as it as it was stated, we are going to run out of the resources.

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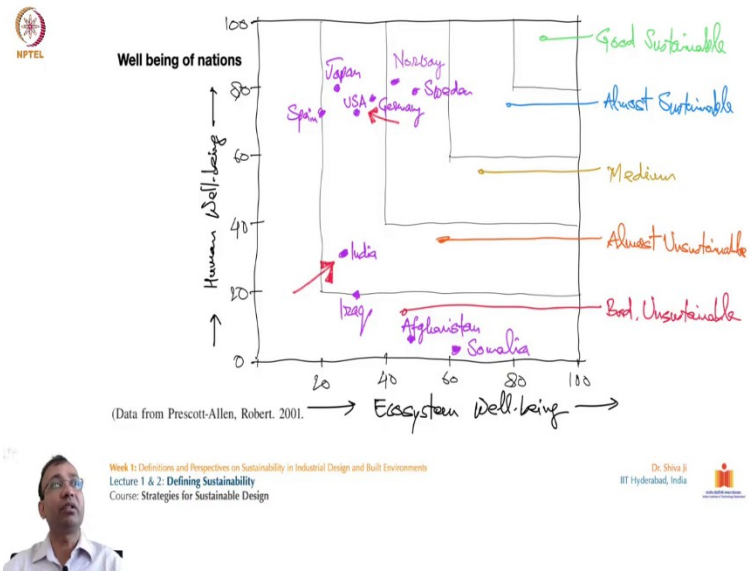

So, let us have a quick look on the two parameters two important parameters of today's society. The first and foremost look at human wellbeing and the second, the wellbeing of this ecosystem. So, how different countries are actually fairing today, I think it is very important to note and observe, because this actually decides what kind of a policies and guidelines and the procedures these countries are going to adapt to make a balanced to establish a balance between these two very important actually aspects.

So, as you can see over here, the lower part on the y dimension, it talks about the human wellbeing, so it starts from 0 goes up to 100 and the same for a ecosystem wellbeing also starts from 0 goes up to 100. So, on this scale if we see on the y dimension, some countries, they have not even crossed a level of 20 on the human wellbeing, which is this 20 percent of the whole, so those countries very evident over here like Somalia and Afghanistan.

So, these countries have been doing relatively very bad as compared to the other countries. So, on the other hand, if you see on the x dimension, so this country is Somalia, which is doing very bad on the human wellbeing is doing relatively much better on the economic wellbeing. If you see the countries like India, they are doing fairly poor, but on the sustainability also they are not so good.

Countries if you see Norway and Sweden, they are doing much better on human wellbeing. Well, they are almost topping the list of a human wellbeing countries like Japan, Norway, Sweden,

Germany, USA and Spain, they are actually qualifying in a group for having a better life, life situations better conditions for a survival in their own countries.

On the other hand, if you see on the economic wellbeing factor Sweden is doing well, better in that group. But, Japan and Spain, they are not doing so good. So, that means, there is a correlation we can see if there is a advanced country who is handling a human wellbeing in a much better manner, they are somehow unable to maintain the balance on the ecosystem. So, it is a kind of a correlation which we are seeing which is inversely going. So, we will see in the coming lectures, how this is being done, what is this procedure, what is this phenomena, how is it happening.

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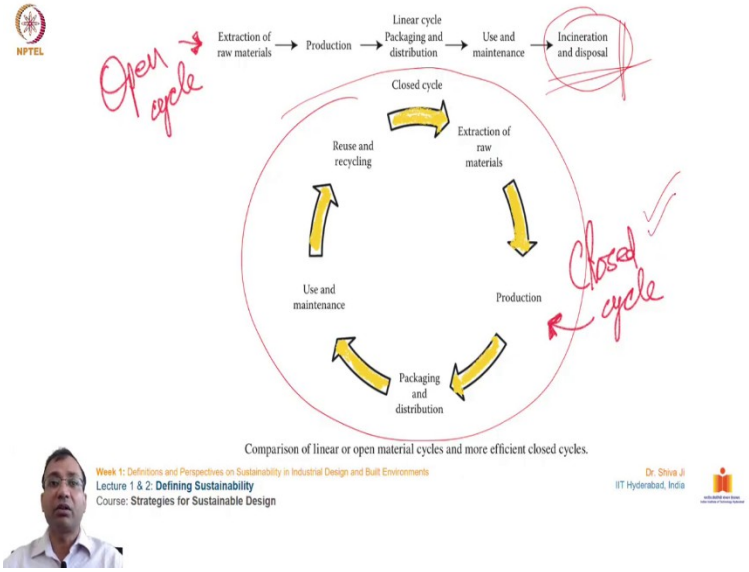

So, let me before going on to those details, let me give you some insights about how to go about designing, how to go about a manufacturing, how to go about availing any resource and making use of it for our consumption. So, there are two types of a cycles, for any product, for any service for whatever we are actually sourcing from this entire nature.

So, there is one way which is very, very a normal is the extraction of raw material production linear cycle packaging distribution use of maintenance and incineration and disposal. So, it is a linear way of actually progression on the other one you can see, right here it is a cyclic way of progression in which there is a closed loop.

So, from where we are starting, we are coming back, right there and we are starting again. So, this is called as a closed cycle loop. So, this is very essential actually for maintaining the replenishment for maintaining the balance, because in the first one, as you can see over here, there will be a lot of resources which will be coming for a as a byproduct as a permanent waste.

So, that is very hazardous for the ecosystem and the certainly it is causing actually of an exhaustion in the already limited resources which are available on this planet. So, currently in today's sustainable studies. Obviously, this closed loop cycle is the preferred one were we must close the cycle; we will discuss more in detail in the coming slides.

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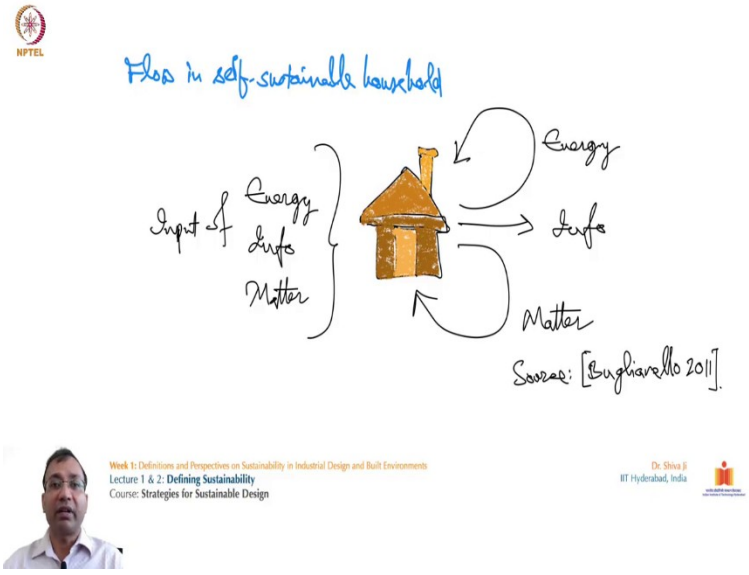

So, going back to simple example of a house. So, a house, actually consumes energy, it kind takes information, as well as it utilizes matter. So, energy again consumed and it comes back to it matter, again, goes and comes back to it, but information is one thing, which flows outside. We take actually cues from, we take the knowledge from it and utilize it elsewhere.

So, we must actually close this cycle except the information part from where, for example, any research or any studies are happening over here, those in today's time are able to utilize elsewhere also. So, let us see how these the game of resources and this consumption has actually outpaced the supply part. So, on this x axis you can see there is a, this is a global million square kilometers, so it talks about a how much we as a human species have exhausted that actually the capacity of this earth.

So, in terms of like a capacity of the resources, that is we measure in the term of biocapacity. So, area into bio productivity. Bio productivity is a capacity, which a particular place or a particular region actually produces in a given time. So, if we directly multiply by the area, we will get the overall biocapacity of that place. So biocapacity is a capacity, which is able to, with the help of which we are able to get the resources.

Resources like minerals, resources like water, resources like soil, earth, vegetation, vegetation based actually plant based actually supplies, animal base supplies. There is all sorts of supplies, so combined to them all, we know it as biocapacity and on the top part if you see over here, so it says, what is the ecological footprint of our planet right now. So, that is the, there is actually a formulae given to understand that, population multiplied by consumption per person multiplied by resource use intensity, multiplied by resource use inefficiency, so it equals to the ecological footprint of any given place.

So, currently with the study of this from year 2008, it has already overshot the biocapacity by 79 million square kilometers. So, that means our one earth today in terms of this rate of consumption has already fallen short by these many square kilometers, which is very, very absurd. That means the consumption has already exhausted, the pace at which these resources can be supplied by this planet earth.

That means with this rate one earth, in today's time is not able to meet our requirement of different resources. That means, do we need more number of earths? Are we going to populate earths? Where are those new earths or extra earths, we do not have. So how this balance is going to take place is the actual equation and that is why we are here to discuss how we can bring back our rate of this consumption to the normal were it equally matches or even, it should ideal in the ideal conditions, it should be lesser always for the biocapacity of this planet.

So, if we bifurcate actually that diagram into different elements, different unique things. So, carbon is the one thing, which has already exhausted this threshold and it is going quite high. So you can see it has already crossed across this the limit in I think in before year of 1971 and currently it is almost nearing the double, because this data will is till the year of 2012 only, so I am sure it has reached almost the twice of the the one unit of the equilibrium.

Well, some other resources fresh crops, beta plant forest products, well they are in the limit, but there is a significant rise which is being observed, even in those. So, eventually, if the requirement of resource actually continued with the same pace, I am sure we are going to cross even those.

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So, what are the main environmental issues over here. So, if you see in generic terms, there is a issue of global warming, there is issue of pollution, the issues of various other natural elements which are the part of this whole planet earth and they have been the very important actually factors to sustain life in different forms as it as we can see it in today's time.

So that is ozone, ozone depletion is the one phenomena which has caused severe distrust on the species of this planet how they are going to survive in the future and of course, the water, different other resources deforestation, soil degradation, waste, extinction of flora and fauna and of course the tremendous growth, being observed in the population.

Population is one very important factor over here, because population is the one important thing, which is increasing the demand of every resources, more number of mouths, more number of food is required, more number of bodies, more number of clothing is required, more number humans, the number of shelter and housing is required.

So obviously, if we multiply with the number of growth of the people, so the number of resources is also applying like a tremendously and in the recent times it is being observed that the consumerism has also increased, the per person the usage of any resource, what it used to be early 50 years ago has multiplied manyfold in today's time.

So, the number of increase in the person, as well as the number of usage of resources, so it has, as a resultant, it has grown actually very fast rather exponential growth has happened actually over the time. So, these are the actually major environmental issues being observed in today's time, slowly and steadily, we will discuss more in detail in the coming lectures.

So global warming, global warming is a phenomena which is happening right now in the recent decades. As the average temperature of the Earth itself is rising by few points. So, there is always a may, there have been always maintain level has been maintained for several centuries and 1000s of years. Well, there have been a cycle of temperatures going up and coming down that happens at the scale of million years.

So, well that has been the part of this earth cycle before also, but in the recent times the span, the rate of the increase of the overall temperature the global temperature has rising tremendously and that is being deciphered as the, which is happening for the first time in this all of these years. So, whatever the records which are available from the ancient times, this phenomenon is happening for the first time in a very short span of time, the average global temperature is going to rise.

Well, there are very catastrophic repercussions to this effect in terms of it is going to melt the ice caps and snow caps of the Antarctica and other Arctic and other mountain ranges and all that. So as a resultant, the sea level is going to rise and the moment sea level rises, they will be a catastrophic actually situation arising in the countries which are low lying, which are right situated next to the sea shore level. So, resulting into the loss of the lives and loss of the lack of place for the humanity, so it will create a crisis, plus it with the increasing temperature, there may be imbalance in the atmospheric composition of the oxygen and several other gases.

So those gases are behaving like a greenhouse effect and the overall temperature of the Earth is rising. Well, it is creating an imbalance in the, like a cycle of the water and cycle of the air. So, some places which have been living like a normal life, they have been receiving at the certain rate at the precipitation. They are experiencing some fluctuation in the either there are droughts,

or either there are floods. So, this kind of imbalances are actually occurring because of this situation.

The next one pollution. So, the pollution of air, water, land, light. There are several types of pollution, so the all of these mostly these industrial effluents and discharges. They are actually degrading; they are creating an imbalance in the places. As a resultant, several aquatic lives, several ariel lives, several land based lives, those are being lost today, because they are losing their habitation the toxic effluents from the manufacturing units and from a different, other facilities, they are coming out in the ecosystem and they are creating havoc on the species.

On the ozone depletion, well this is somehow being has come under controlling with a lot of effort from different countries, different companies across the world, because they have actually regulated CFC emissions from the electronic and electrical gadgets, home based gadgets and even industrial gadgets and appliances.

So, well, this has come under some control. So, we can obviously say this, with the consistent actually effort and intent, we can obviously have the corrective measures, coming to some results in on our planet earth. So, this actually emphasizes how important these efforts are, because these with these with the help of these efforts, we can obviously overcome the challenges which this earth is facing it is with the entire group of species, which our cohabitating species are also facing.

And water, when one third of actually globe is covered with more than one third of the this globe is covered with water and water is an important, very important actually ingredient to sustain life, whether it is even land based life, so our bodies are also made up of major component of water, so water is very important for everyday life, water is important for our metabolic activity, water is very important and critical for the climate and weather patterns how for example, India how India depends on the monsoon and the rains which comes in the month of June, July, August, September.

So India actually receives it is water supplies through the monsoon in these months and entire almost 90 percent of our agriculture, today's agriculture in the rural areas, depends upon actually the monsoon, because obviously we do not have the capacity to dug up the actually lakes and bring the groundwater on the (())(27:11), and even though that the level of the groundwater has

actually decreased significantly in several places in the several states are facing a huge crunch for water supply for our everyday needs.

Well, in the recent years the last one or two years it was observed, you may have of course read this in the news, the city of Chennai faced a severe problem and there was a mini migration observed in the society, so there was no water supply at all. So, people were actually forced to move out of their houses and take shelter elsewhere.

So, this is a very catastrophic situation which has already started giving us some actually bad effects in our society. Other resources like nonrenewable resources such as a hydrocarbon such as gases, such as petroleum products, such as other mineral based products as such as several like queries. So, these are present in a very limited amount. They are not unlimited supplies we can be, which we can keep digging and keep actually sourcing, they are going to exhaust, one day.

So, we must take care of the supply of these resources, so that we can keep taking them, even for tomorrow, because if it is going to exhaust in coming few years, there will not be any new mineral available or there will not be any new hydrocarbon available for consumption. So, how the human society is going to sustain in those times, is a big question.

Deforestation well obviously everybody knows even a child knows trees are really important for the oxygen supply to maintain a balance of oxygen in our atmosphere on this planet, so with this current rate of deforestation, the cutting of trees, this oxygen supply is directly going to be affected and where are we going to get that oxygen from, there is no facility to produce oxygen at this global level.

Well, we can produce oxygen for one cylinder two cylinder, but we cannot produce oxygen at this level. We cannot actually oxygen, the supply of oxygen artificially for this entire planet. Well that is not feasible, that is not possible, that is not practical. So, we must actually take care of these trees, because these trees are very important to maintain actually life, not just for humans for every living being.

Soil degradation, soil is very important. We are standing all our works, all our things, all our buildings, all our structures, all our transportation everything is happening on the actually top of

this soil. So, this soil is very important ingredient first of all to give us food, because on, in this soil only we grew our crops and other vegetables and their fruits and everything.

So, we are very much dependent on this soil and we must not degrade it, because this is not going to give the desired yield in terms of agricultural produce and waste, well there are huge amount of waste being generated these days, cities, you may have seen artificial mounts, which are coming up, artificial hills which are coming up in the cities, on the outskirts of the cities and there are low lying areas which are just being filled with the huge amount of trash, they are as good as, as high as a small hillock or maybe a hill.

So, this is the condition if you go to New Delhi there are three major actually landfill slides, which have come up in the recent decades. On the outskirts of city of Delhi and New Delhi, which is a very, very bad because if you cross, from that area, so they actually have created a very bad atmosphere for a good comfortable living over there.

They create a lot of they actually create poisonous gases, poisonous like substances, the concentration of actually different elements and compounds which are hazardous in nature, which cannot be actually decomposed which cannot be actually degraded in a short span of time, they have all been gathered at one place for, in a very high actually concentration, so which is really bad.

So, we must actually take care of waste. So, the first and foremost actually way is to minimize the amount of waste first and then the second could be recycling and reusing it, so we will go through these strategies in the coming lecture, how we can take care of the waste generation.

The second last one is the extinction of flora and fauna. So, all of this postindustrial industrialized actually era effects, there have been quite a much impact on the different living species on this planet like birds, animals, reptiles, aquatic animals and as a resultant of toxic chemicals and imbalance in the temperature, imbalance in the climate and overall weather pattern. They are actually facing a very difficult situation for their survival.

So, their new beings their eggs their newborn actually babies they are unable to survive in such an in-hospital actually situation as a resultant, they are losing their they are losing their

significantly their population and several of this species in front of our this human society in the last 150 years, they have actually kind of vanished from this planet for forever.

Which is very very unfortunate, how does one species, like us humans, homosapiens are causing such an catastrophic situation to create imbalance on their planet, and as at all several other species, who are equally deserving for this to live on this planet, they are losing their lives, they are losing their entire species to this kind of effect.

Well, of course, as I emphasized earlier population is one thing, which is creating such kind of demand, so population is the first and foremost culprit thing which comes the under sustainable studies, how population can be controlled and as a resultant, every every consumption, every need of the resources every requirement of resources can be controlled.

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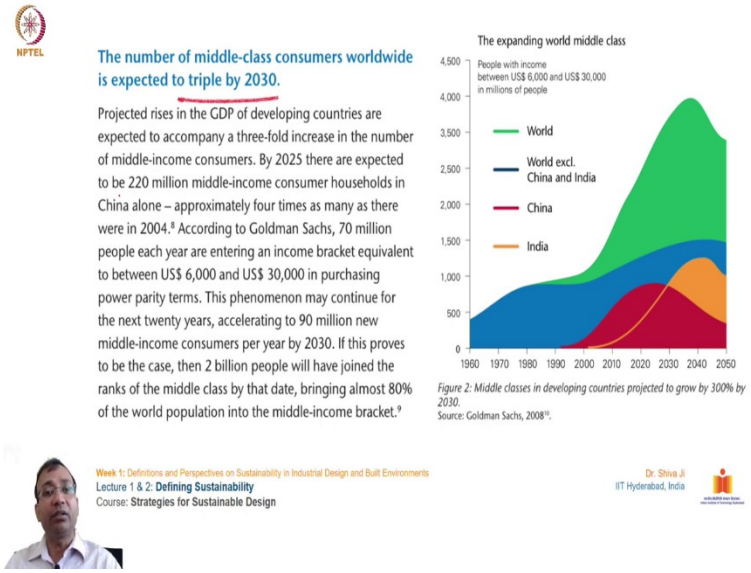

So, let me give you some figures like the number of middle-class consumers. So, it is being expected. It is going to triple by year, 2030. So, as you can see on this graph on the right-hand side, the overall world's the number of other people, with income range between the US dollars 6000 to US dollar 30,000 is around 3,500.

And is this is in the millions of the people and if you see like, there are two big countries, while of course ours own country India and China, which are the major actually contributors for the percentage of population at the global level. So, we India stands somewhere close to 1500,

China's somewhere stands around 2000 and the rest of the world minus India and China stands somewhere around 2500 and the entire world as a like a one unit standing somewhere around 3500.

So, there is a projection, if you see the coming years, this percentage is going to will decrease with a lot of effort being made from government and governmental agencies, our health sector to control the population to bring the population at a check. Where the number of population, which is the number of people who are being born, every year, should come to the closer of the number of people who are dying like every year.

So, static rate of growth can be maintained in terms of population. So, this is very important because as the number of consumers as a number of mouths are rising, well, the number of the amount of food required will also has to rise. But the question is, with the limited number of resources, whether it is possible?

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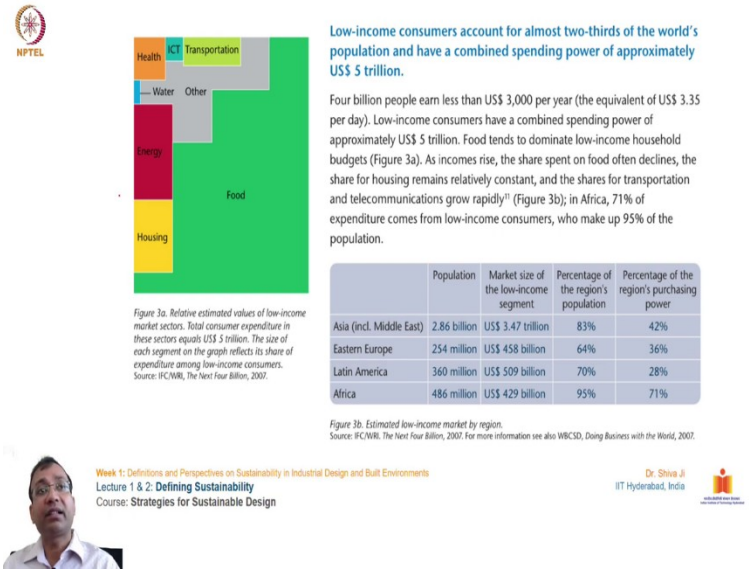

So, let us see, this actually chart shows the relative estimated value of a low-income market sectors, the total consumer expenditure in these sectors equals US dollar 5 trillion. The size of each segment on the graph reflect its share of expenditure among low income consumers. So, in this one if you see, food is the first and the foremost item, which is like a taking huge space, I think more than 50 percent is taken only by food.

Well of course the number of people are rising and the basic requirement is to feed them. So, and after that, there is housing, the need of energy. So now, per person consumption of energy has also risen significantly in the recent decades. So, almost every electrical, electronic gadget and every kind of appliance even with this computer on which we are actually making this video and we are reading and learning this, is also consuming a lot of power.

So, the reliance of the human society in today's time has significantly risen for the need of energy. So, each and every exploration whatever we are doing today, requires energy, whether it is electrical energy. So mostly it is electrical energy, which we derive from a coal, which we derive from oil, which we derive from wind power, solar power, nuclear plants, hydro plants.

So, there are several ways we are actually harvesting this energy and we are trying to meet our demand, but still world is not able to fulfil the entire, the electricity demand of it. So, the this energy sector has actually rising tremendously in the recent decades, it is very important to address actually the requirement of the energy which is needed for our survival.

The next has like a transportation. So the as the globalization has happened over the time over the like a, India started globalizing its economy since 1991 and since then until today and I think the future is going and in the then the future which is going to come, the moment the global movement of people, goods, everything has rised like tremendously, earlier the generally like whatever was produced in an country was consumed also within the limits of that country, there was very little actually exchanged from the outside world.

But in today's time, this world is reduced in a global village and now there is a lot of transportation, so this transportation also exerts a lot of problem directly and indirectly on this ecosystem. So, now instead of going for any such time for smaller requirement for a, for a touring or a day out for like two three days or a week or something. Instead of going nearby, we are now on disposal to go anywhere on the (()) (38:20).

So, this is actually increasing lot of transportation. Now we are sourcing actually buying stuff internationally, so as you as you may be aware of China in today’s times have become global factory. So, China is supplying a lot of material, a lot of finished material, for every almost every country on this planet.

So, well, meeting the requirements is one thing on the, on the other hand if you see this exerts a lot of pressure also. So, how this can be maintained you can see on the table on the right side over here, the population of Asia, including the middle east is around 2.86 billion and market size of the low-income segment is around US dollar 3.47 trillion dollars. So and percentage of the region's population in this actually sector is around 83 percent and percent over regions purchasing power overall, is only 40-42 percent.

So, in actually these charts actually give us this picture how this low-income consumers, they are actually accounting for the consumption of the resources. In the continents in the subcontinent and at the global level.

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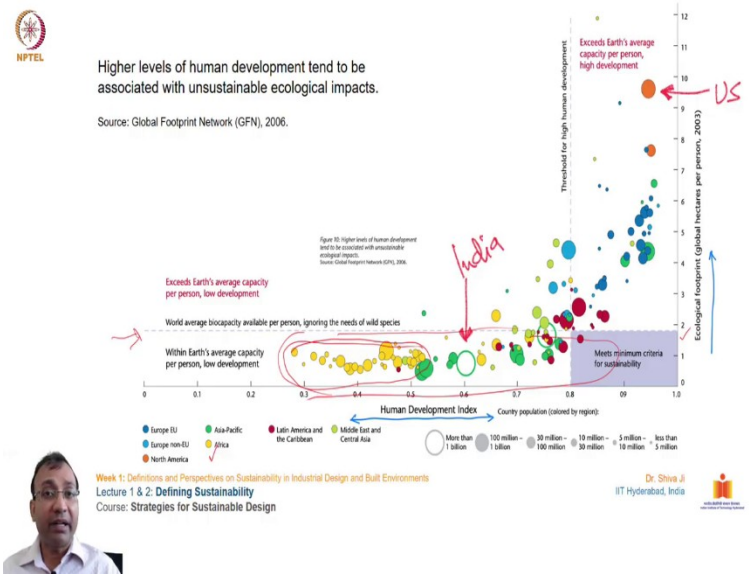

So, in this slide, I would to talk about the effects of the development, which we discussed in one of the previous slides, the human Development Index, human wellbeing and those kind of a thing, so there is a unit between 0 to 1 and on the y dimension we have actually the ecological footprint of humanity at the global level.

So, this is given in global hectares per person and this data is from the year 2003. So, I am sure there is a lot, actually has changed in the recent years, because every new decade, we are experiencing tremendous growth from the previous decades, in terms of the sharp incline in the our whether it is like a global footprint or it is a consumption either the consumption of like resources or even increase of the population, several actually factors.

So, here as you can see, there is a dotted line right here, which talks about the, this line actually denotes world's average biocapacity available per person. So, this is, this biocapacity little below of two, this is a average biocapacity which this earth offers without harming the threshold of it, without harming the overall balance of this planet. So, there are a large number of countries in this region from here to here, you can see, which are still within this limit. Mostly, these are the countries in this yellow circles, they are from Africa.

So, the countries, mostly from the African continent, they are well within the reach of ecological footprint as a country, they will, except one or two which have actually gone above this line. So, in this one, so in this actually if you slide if you see, as we discussed in the previous that earlier slide, the pace at which the human wellbeing is being taken care of and the pace at which the ecological footprint or the ecological balance is being taken care of is going inversely proportional and that is evident, even here.

So, mostly these are the countries from Africa, where we generally know because most of these African countries, they are not doing so good on economic terms, they are lagging behind, even though there are some countries who are faring very bad on, even being able to feed the citizens, the people of their country. So, as a group of country if we see as a continent, Africa is far behind in terms of a human development index. So, Africa in a group is doing the bad among all the continents.

The next comes a few green ones over here. Well, this circle. See this unfilled circle, this is India. So, from this population chart if you see these, the unfilled circles are the there are two unfilled circles one right here and one is India. So, this one is China and this one it is India, the population with the more than 1 billion people. So, there are only two countries right now who have actually the population of over 1 billion each.

So, India is almost at the 0.6 of the human development index and on the parameter of ecological footprint, India is still doing much better. We are somewhere close to one unit of the ecological footprint on these, this on this dimension. So, that means even with the doing so bad we are still as a country, we are far below, causing the negative harm to the planet.

So, as a country, we are still doing much better. But there is, there are some different kind of issues, the issues are related with the number of population since we have actually a huge

number of population. So, we have a different kind of challenges. Overall if you see, the per person the purchasing power of the citizen of like India and a per person GDP if you see, so that is one of the lowest ones in the world.

So, even with the doing so fairly, there are a lot of different sets of challenges in front of countries like India, because we have to bring a number of people and a huge number of people at par with the people from other developed countries like Sweden, Norway and the USA which we saw in the previous slide. So, they are doing very much, very good in terms of human wellbeing, somewhere we are lacking in those lines.

Let us see the other reflections from this side, this slide, so there are some countries from the Asia Pacific, these green chilli circles, you can see from here till here, so this is the range, so the most of the countries from Asia Pacific, they are still below this actually threshold.

But, except like few, here, here and here, and these are actually countries like Japan and all they are developed countries from Asian region. So, they are actually doing a much better in human development index, as well as ecological footprint. So, even if they are high on this x axis and they are high in the y axis also.

So, they have already crossed this limit. So, the countries which are above, actually this dotted line. So, all of this group is the group of the big polluters. So, these are the countries actually mostly who work on contributing for the imbalance of this planet, which is topped by you can see the country like United States of America, which is topping the list over here.

Well, there is one small country also here right here, which is light green, which belongs to this group, this group Middle East and Central Asia. Can you guess which countries is this one? This is not very big in the population size, this is in the range of 5 to 10 million, but in the terms of an ecological footprint, this is exerting the highest.

That, I will explain more about it in the coming's coming lectures, but I want to give you the answer to this actually question. This country is Qatar. So, Qatar is actually giving a lot of the biggest ecological footprint on this planet right now, at the pace at which it is growing and developing and at the pace at which it is creating waste and other degenerating actually elements for ecological balance, it is the highest among all countries combined. So, even if it is doing very

good in the human development index, it is somewhere close to 8.5 or 8.4. But in terms of ecological footprint it had reached at the level at like 12.

India at the level of just 1, so see there is a 12 times rise in terms of India to this country in terms of a global ecological footprint. So, this kind of development, which is going to exert such a stress on this planet, could be very catastrophic. So, such development, which is going to bring the humanity whether the its citizens to such a high standard of living, in-turn it is creating such an havoc kind of situations for the other species other citizens, of the other countries also. So, as you contributed to the imbalance, these countries are quite responsible for such a mess.

And then the second one, United States of America, as you may be aware of, in the recent like last four or five or six years, America as a country has actually withdrawn from several International co-operative policies like Paris summit was there and the Kyoto actually summit was there. So, America as a country has never signed the Kyoto Protocol and is pulling out of the Paris agreement also, which is going to have further fueling this ecological footprint, so it means they are going to even top, actually this present status, which is somewhere close to 9.6 or 9.7.

So, they are going to rise even further on this scale. Well, as a country they may be progressing, but as a country which is responsible for such a bad state of ecological footprint. This is really actually not so good. So, other countries and other forums, other actually platforms are trying hard to convince them to control their emissions, control the rate at which they are consuming the resources, because it is very important to maintain that balance and America is one of the actually large size country also which falls in the range of 100 million to 1 billion.

So, as a country they are currently very advanced league and they are actually footprint is also very large in terms of number of population and overall resource consumption. So, they must actually consider the situation which other countries, which are in this actually league over here are experiencing, which are which we which belong, mostly to the third world with what we call them as a third world, mostly African countries mostly some Asian and South Asian countries, countries from Latin America. So, they are not doing so good in a human development index.

So, how the effort from the other developed countries who are far actually ahead of these countries can help to establish this balance, so that we as a species, why we as one unit species on this planet can survive altogether. Because, at present the, even if we are divided with the

political politico administrative unit such as countries, but as a species, this planet or the ecological imbalances they are not going to affect us based on our country or the citizenship.

They are going to affect anybody and everybody. So, how this can be maintained is a big question and countries which are responsible for this, if you see China has also crossed this threshold over here and there are several other countries from this blue group, blue group belongs to this Europe and Non-European, non-EU countries, so mostly European countries and non-EU countries, they have also crossed actually this the limit of threshold. So, as a group if you see mostly these EU, European countries and these are red ones, Latin America and some Caribbean countries and of course the North American countries.

So, these actually group is majorly has actually impact on actually this y dimension actually major and they should actually help to establish with the transfer of technology because in the recent times recent years, several like a clean actually technology has also come into the picture to consume resources, to for simple manufacturing, for service sector also, a service sector has evolved as quite a much in the recent times. So, for example, aviation, so aviation also exerts emits lot of carbon footprint.

So how this can be minimized? So a collective actually pace of this growth and consideration is actually required in today's times to bring this whole thing to a balanced actually life. So, we saw actually with this slide which I have sourced from the global Global Footprint Network. So, this data belongs to year 2006, so it talks about, the ratio between the human development and the ecological footprint. So obviously, it is not directly proportional. So, with this I would to bring to an end to this lecture one and two. Thank you everyone.