Sustainable Architecture
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Lecture – 03
Sustainability and Sustainable Development

Good morning. Welcome to the third lecture on the online course on Sustainable Architecture. And I am your course instructor Dr. Avlokita Agrawal, Assistant Professor at Department of Architecture and Planning IIT, Roorkee. So, continuing from where we left in lecture 2, we started defining what sustainable development or sustainability comprises of. So, we started with a very generic understanding of what sustainability would encompass.

So, it if essentially has this triple bottom line which is the most commonly understood definition of sustainability or sustainable development. I am using sustainability and sustainable development as inter changing terminologies; however, they are not. We will come to that a little later. For now, understanding the definition of what comprises or what comprises of sustainability is here.

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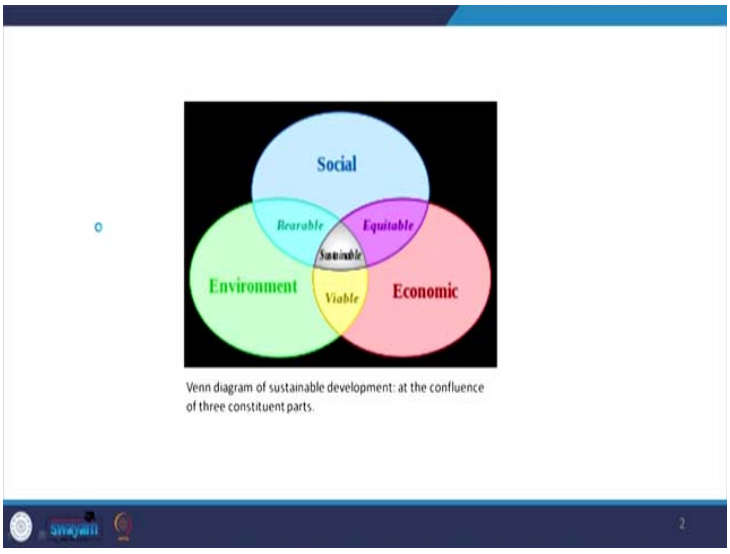

So, these are these three spheres, where social, environment and economic form the triple bottom line, and there have been various attempts across the globe to understand

sustainability the process of it the definitions. So, let us see couple of these definitions and then try to come back at sustainability and the concept of it.

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So, here are some of the most accepted widely accepted definitions of sustainability. As per Thomas Jefferson sustainability council sustainability may be described as our responsibility to proceed in a way that will sustain life that will allow our children, grandchildren and great-grandchildren to live comfortably in a friendly, clean, and healthy world.

Now, let us look at the keywords in each of this definition. First is we have to proceed in a way that will sustain life. So, we have to sustain the life in a way that is comfortable, friendly, clean, and healthy which implies that the environment is good for our future generations they are comfortable. So, they have enough resources to sustain themselves flourish, and they have a friendly environment which is socially and culturally thriving. So, this is what we are meaning when we are looking at this definition.

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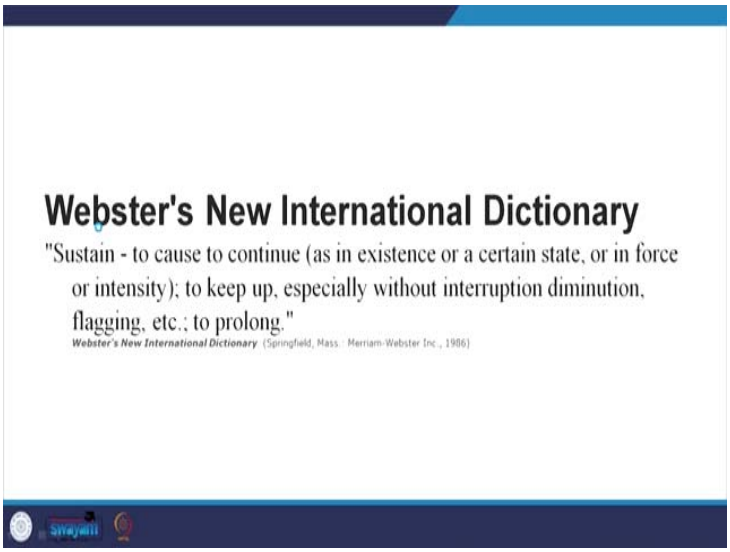

Let us look at another definition. So, if you look at the Webster's International Dictionary, the word sustain literally means to cause or to continue as an existence or a certain state, or in force or intensity, to keep up especially without interruption diminution, flagging etcetera or it is to prolong. So, in whatever state we are today where in any point of time, sustain implies do continue in the same state.

Now, if we look at some time back say,

two centuries back at the beginning of industrial revolution was the environment the overall environment which is which includes the socio-cultural context as well. Was it the same at that time as it is now? No, of course it has changed it has evolved emerged, but will we be able to provide the same environment as we have today to our children to our future generations probably not or maybe yes. So, sustain is essentially to continue in the same state.

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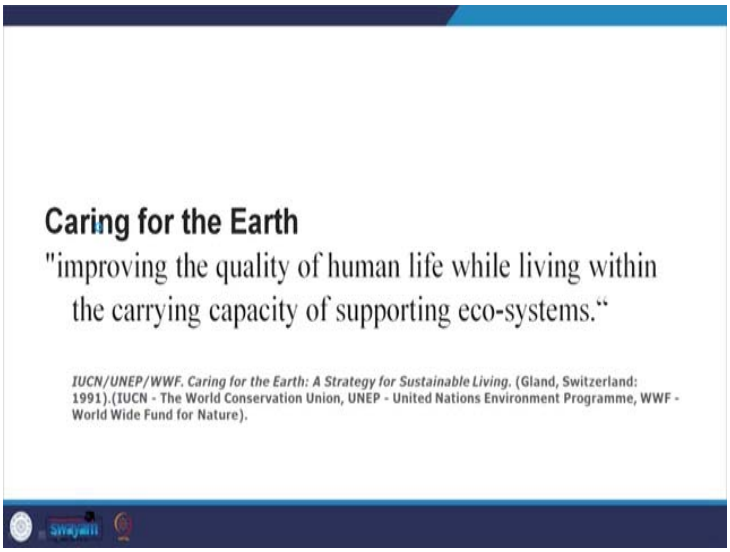

Another definition says improving the quality of human life while living within the carrying capacity of supporting eco-systems. It is in essence the way of achieving sustainability. So, if we continue to live within the carrying capacity of supporting eco-systems, we will be able to sustain ourselves. So, it is the process we have to consume only what is available to us say per capita basis from the surrounding eco-system. One of the most commonly accepted definition of sustainable development came from the report our common future and it says sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

So, it says we are not compromising our own needs of present, but we are also not compromising on the ability of future generations to meet their own needs. So, as we saw yesterday in the previous lecture, the needs can be controlled we have to frame our needs in such a manner that we are able to fulfill them today and tomorrow as well for our future generations.

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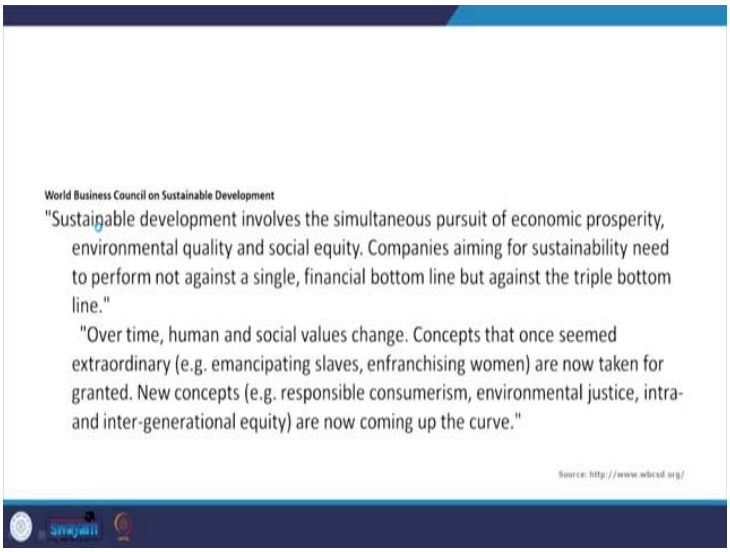

If we look at the world business council on sustainable development and how it defines development, we see that gradually the focus on economic prosperity, social equity, social justice, finds a little more emphasis mentioned as compared to the environmental definition, and that is what gets reflected through the definition if you read. Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. And it says that companies should aim to perform not against a single, financial bottom line which majority of the profit-making companies are focused with, but against the triple bottom line which is of environment, social and economy.

So, some of the concept's extraordinary concepts in those times for example, emancipating slavery, or enfranchising women are now in today's times they are taken for granted; at one point of time they were like big issues. So, similarly the new concept of responsible consumerism, environmental justice, intra and inter-generational equity, they are now being discussed as big issues; however, in the time to come they will change

Now, once we have looked at couple of these definitions, we see that some of the points, issues they keep coming repeatedly in all of these definitions while the focus may vary a little bit. So, there are different definitions or understandings of sustainability depending upon the point of view, the perspective of who is defining the definition of sustainability. So, there is a need to develop scientific models of how to understand sustainability. They

could be different types of models, they could be different ways of understanding sustainability, but the essential characteristics of any scientific model has to be seen while defining or coming up with a new model of sustainability. We will see couple of these scientific models of defining sustainability in the slides ahead.

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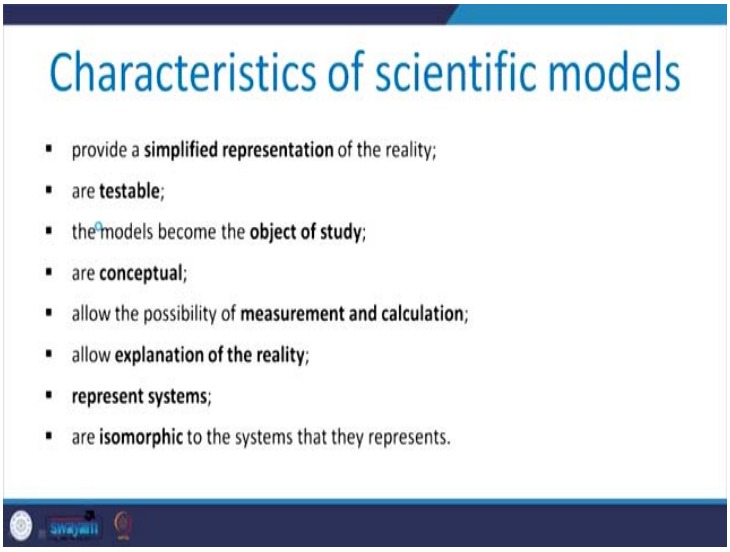

But the essential characteristics of scientific models must stay. The first and foremost is it has to be a simplified representation of the reality; it has to be very simply conveyed. We cannot make a model which is very complex difficult to understand; it should be testable we should be able to test the model on different situations, different conditions. It has to itself become the object of study which we will see how it gradually becomes. It is usually a conceptual model which we apply to a given circumstance given context and test it. And it allows the possibility of measurement and circulation.

So, it has to be tangible we have to be able to measure it on various parameters. It allows the explanation of the reality. So, we have to be able to relate associate the reality and express it through this model. If it is not doing that, then it is a failed model. And it has to represent the systems and is isomorphic to the system that they represent. So, it has to be a direct representation of the reality.

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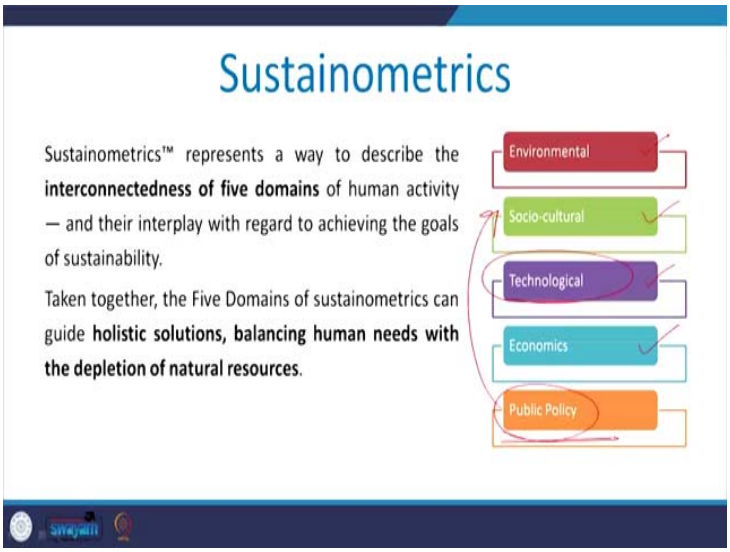

Now, let us look at some of the models of sustainability. Now, all these different models which are defined to asses to measure, quantify, define, understand sustainability can be clubbed under a broad study which can be which is termed as sustainometrics. Now, sustainometrics is actually a way to describe the interconnectedness of five domains. So far, we have been talking about three domains environment, society, the social domain and economy. However, if you see here we are talking about these five domains where environmental says socio-cultural dimension is there, an economic dimension is there.

So, the triple bottom line is anyways there, but with given penetration of technology in our life almost all spheres of life, technology also becomes an added domain, and policy which includes politics as well. So, often this public policy and politics was clubbed within the domain of socio culture, and gradually it has come out as an independent domain which defines the sustainability, different models of sustainability.

Depending upon who is defining sustainability what is the definition of it, the focus on each of these five domains may vary slightly, but they are most likely to be present whenever we are defining sustainability. So, what is the criteria for modeling sustainability? Now, sustainability is a very, very vast subject simply, because it encompasses almost everything, we are talking about environment here, we are talking about social-cultural domain here, we are talking about economics here, we are also

talking about technology and politics and policies. So, it is a very vast domain; it is an interdisciplinary study at any given point of time.

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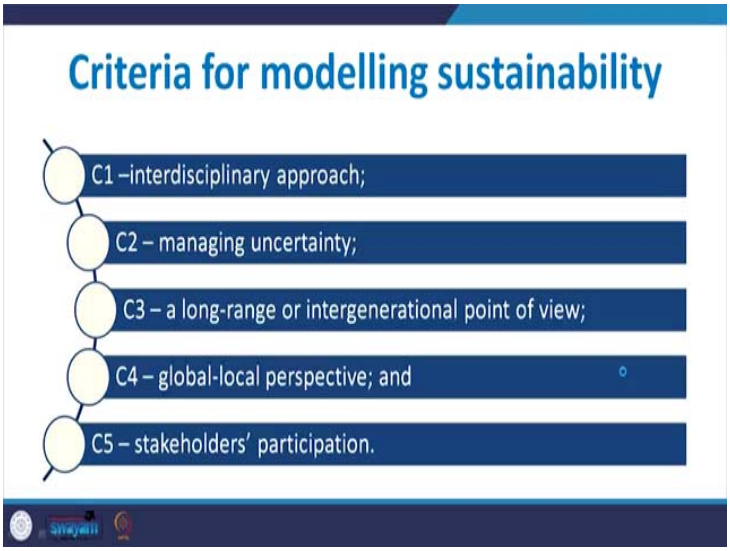

So, if we are talking about any system from just one perspective, one point of view, it is not understanding sustainability. So, the first essential criteria for modeling sustainability is that it has to be interdisciplinary in its approach, it has to talk about all the disciplines all the domains. Second is, it has to manage the uncertainty. Now, uncertainty comes in because it is so vast there are so many domains to be touched upon discussed about that there are greater chances of uncertainty creeping in. Now, any model of sustainability which we are developing, defining has to manage that uncertainty in very clear terms.

Third is it has to be a long range or intergenerational point of view. It has to bring into the picture an intergenerational point of view. Now, anything the moment we talk about sustainability we are talking about a system to sustain for long to continue as we have just seen in the definition. So, we are not talking in a given point of time, but we are talking about a long duration of time and that is why a long range or inter-generational point of view is essential to define or modern sustainability.

Fourth is global local perspective when we were discussing in lecture-2 that gradually how we are looking at buildings and how we are constructing them is becoming more and more global while losing the total focus on our local conditions that is where the unsustainability creeps in or it becomes the other way around where we are only

focusing about the local perspective, then also it becomes unsustainable. So, it has to have a balanced approach where both global and local perspectives are brought together into understanding.

And the last is stakeholder's participation. We cannot define sustainability or we cannot develop a model of sustainability from third person's perspective, it has to incorporate the perspective and participation of the stakeholders who own that system which is being tested for its sustainability, so, with these defining of criteria for modeling sustainability.

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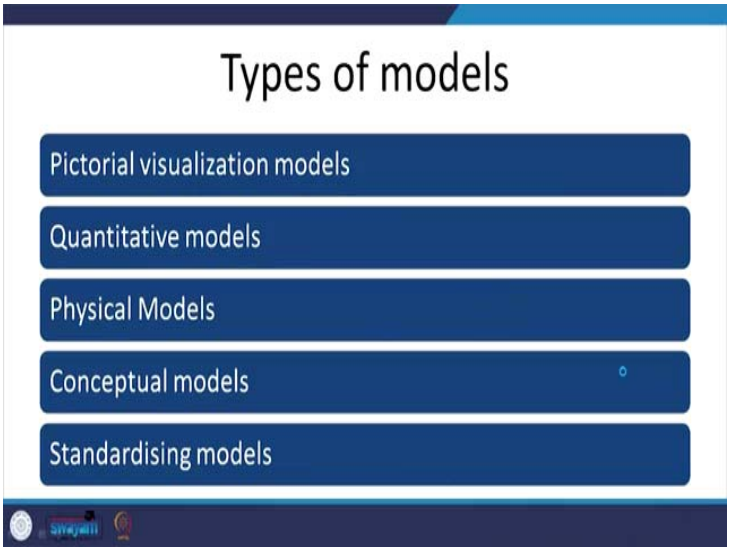

Let us look at the different types of models of sustainability which are available as on date. So, people have tried to define sustainability through different types of models one is pictorial visualization model. Next is quantitative model which talks about numbers and quantifying measuring the different parameters. Physical models, which are physically available which are tangible which can be seen, constructed. Conceptual models which are available only as a concept, and standardizing model where we develop standards and talk about sustainability. Let us look at each of this model and briefly discuss about what we understand by sustainability through these different types of models.

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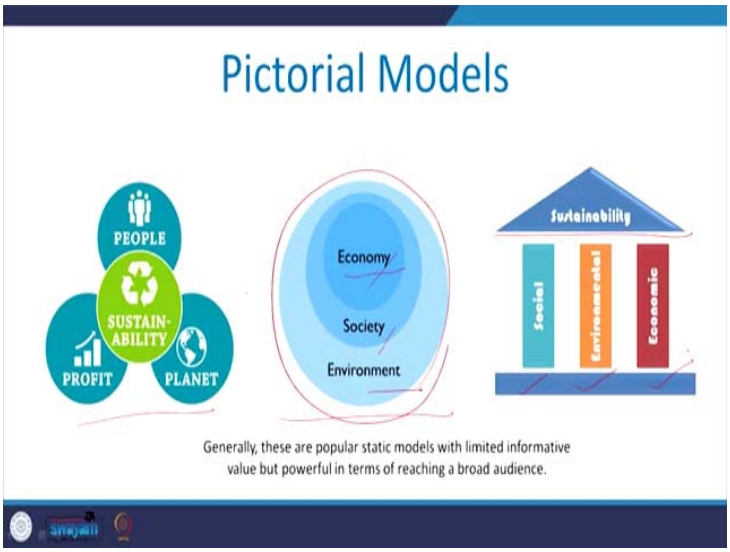

Now, these models this pictorial model here, this we have seen which was the first to the presentation of sustainability through the Venn diagram. Now, gradually people started arguing that what is the use of economy if the environment is not there. So, there was one very noted ecologist environmentalist Herman Dally, and he discussed what is the use of a saw mill if the forest is gone.

So, what is the use of a sawmill which is used for generating economy if the environment is not there if the forest is not there and that is true for all the cases. So, the definition of sustainability through the pictorial means was redefined where environment would become the main focus and the larger point of discussion while society and economy are within the environmental domain. So, the definition of sustainability it says changed evolved where a larger emphasis was to be placed on environment.

Another definition where sustainability was supported by these three pillars which we have seen so far all these three domains was also developed. Now, all these pictorial models essentially discuss about a very broad understanding of sustainability. Now, from these models we cannot really quantify or understand a given context very clearly, but we can make a form a general understanding.

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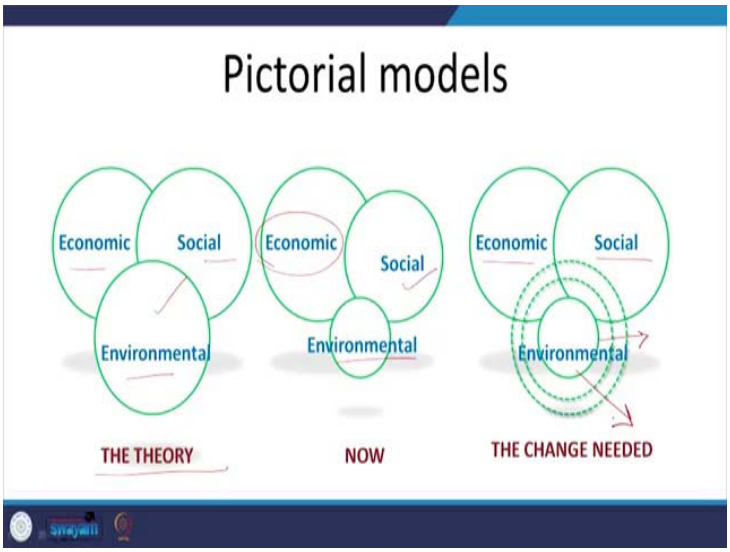

Now, these models have also been changing. For example, initially we were talking about this theoretical model where we considered all these three spheres to be equal in size, currently there is a larger focus on economy. So, the environment, to the focus on environment has been decreasing it has been greatly reduced, and the social sphere is where it was. However, the kind of change that is required to sustain the world at large is that the environmental sphere grows bigger, and the other two spheres if not diminish they remain the same focus. So, this is the kind of understanding we get through pictorial models. Now, how will this be done, how will the sphere we enlarge, what do we mean by a large in the environmental sphere, all those things may not be understood to a pictorial model.

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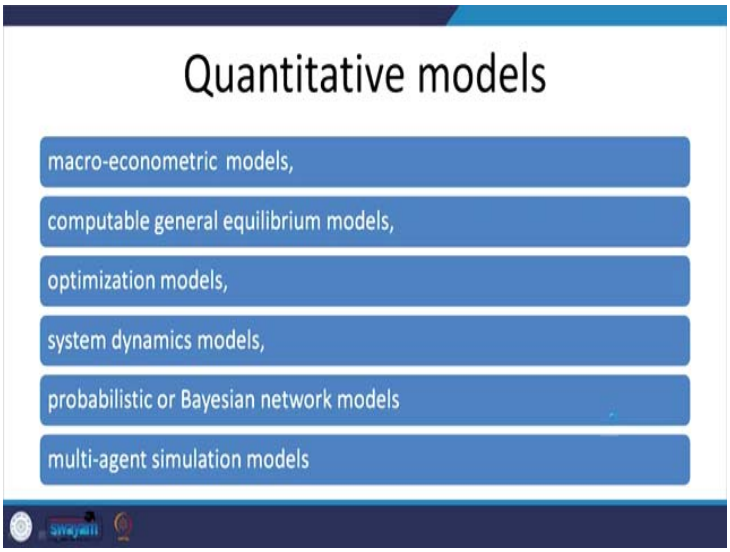

Next we can come to quantitative models. Now, quantitative model is a type of model which quantifies the different parameters which lead or which impact sustainability. There are different types of models within quantitative, macro econometric model, computable general equilibrium model, optimization model, system dynamics model, probabilistic models and multi-agent simulation models.

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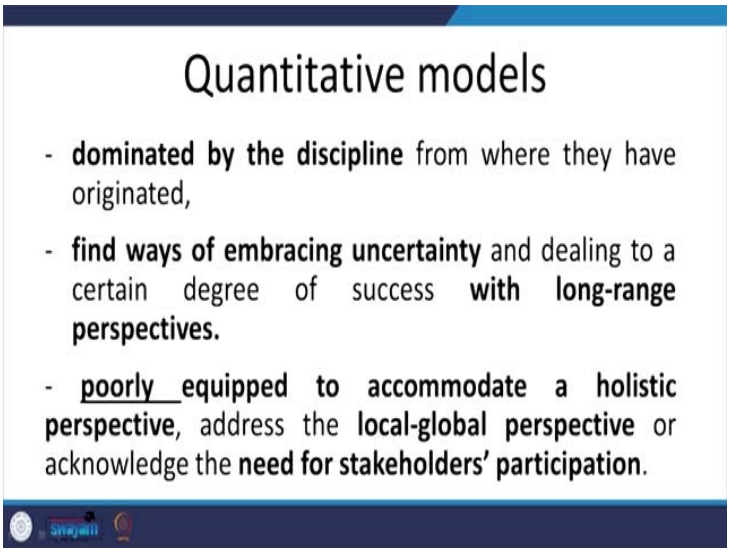

We can quickly look at these, but the basic qualities of quantitative models remain the same. First is, they are often dominated by the discipline from where they have

originated. So, if they have originated from the economic discipline, we would always find larger focus of the economic discipline and like that. Second is, they find ways of embracing uncertainty quite well, and to a certain degree they also deal with the-long range perspective because they put the numbers into it with the help of these different parameters.

However, the drawback is that they are poorly equipped to accommodate a holistic perspective, because it is not possible to take into account all the parameters which affect sustainability of a~~our~~ system of a modern. And there poorly equipped to address the local global perspective often and they do not often acknowledge the need for stakeholders participation because these parameters are so quantitatively dealt that we are only looking at the numbers, but we are not looking at how stakeholders are responding to it.

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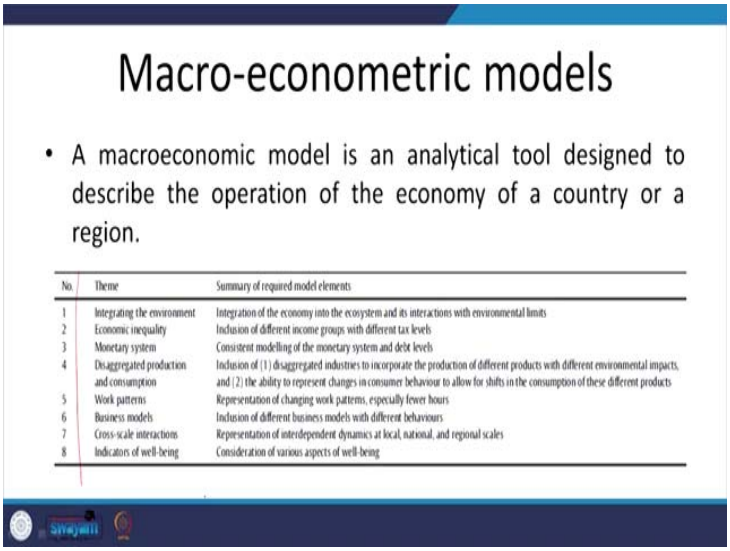

Some of the examples are say one of the macro econometric model actually talks about the operation of the economy of a country or a region by taking into account these different parameters, these different themes incorporating them. However, the focus on these themes may vary little bit.

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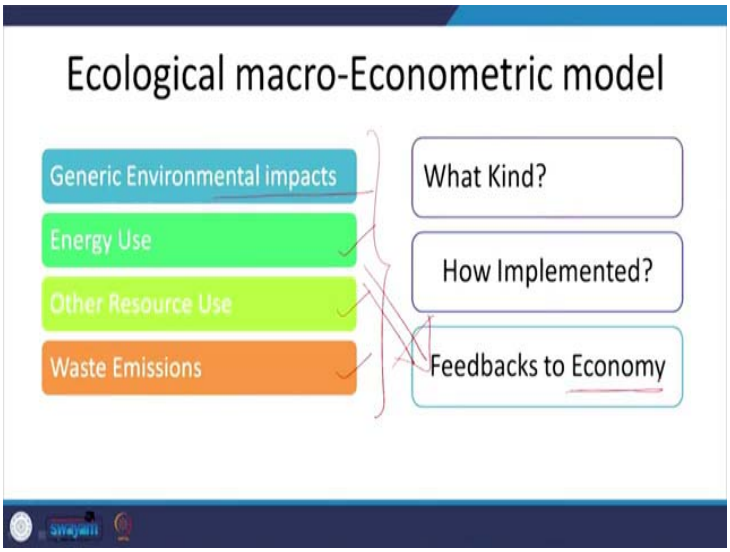

The next is ecology macro-econometric model. It is the subset of macro-econometric model where our larger focus is on economy of a country, or a region, or a place, but we are talking about the genetic environmental impacts. We are talking about the energy use, resource use, water emissions and all of these in terms of economy. So, we are talking about their impacts through a feedback on economy. So, if place if a country implements say a particular policy or a particular program or system is being run, how is it affecting the economy will be tested and that is what this ecological macro econometric model does.

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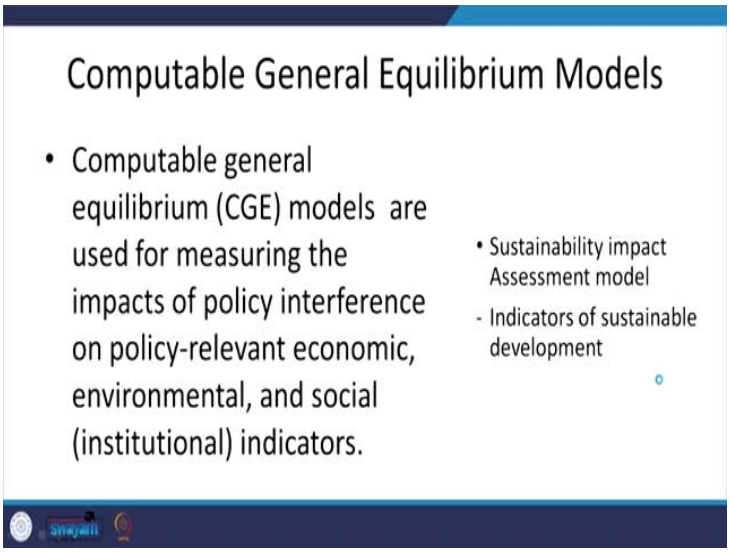

Next is computable general equilibrium model, which are used to assess the impact of policy interference of policy relevant economics, environmental and social indicators into one model.

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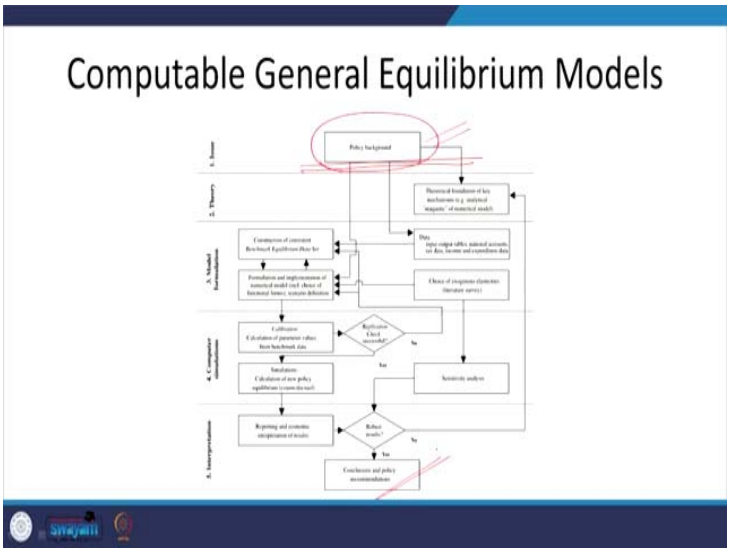

For example, we have a policy say Government of India comes up with a policy that every village gets connectivity of pucca~~[FL]~~ roads, permanent roads. Now, this is one policy. Now, what is going to be the impact of that policy will be understood through this computable general equilibrium model. Now, here we may we will be talking about the environmental impact of it how much material will be required; there will be a social impact of it that how when people are connected through roads how will they be benefited, they will have better access to medical facilities, they will have better access to education facilities and like that, so that is a social impact of the same policy.

And there will also be an economic impact, so the farmers in the villages will be able to sell their produce for a better price when they will take their produce to the cities. So, a policy will be taken up and its impact will be calculated through these different parameters, and finally the conclusions of and recommendations for the policy will be made.

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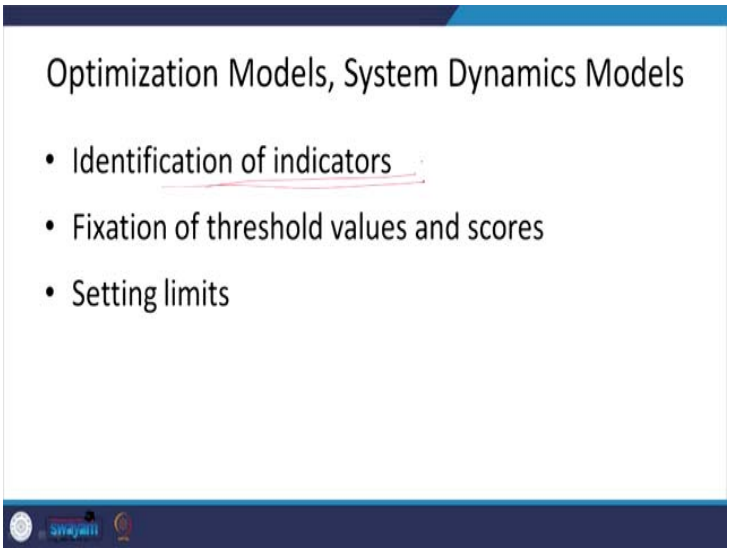

The next is optimization model or system dynamics model. Now, here it largely relies on identification of indicators. Now, suppose if the indicators have not been properly identified, the system dynamics model may fail, because it is not even considering a particular indicator.

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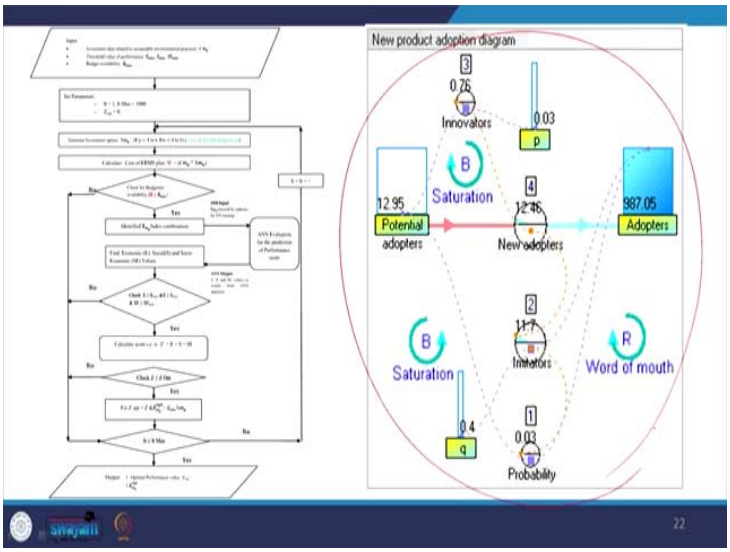

However, if the indicator has been aptly identified/ clearly identified , ~~Next we can come to quantitative models now quantitative model is a type of model which quantifies the~~

different parameters which lead or which impact sustainability. then based upon the data analysis data acquisition and data analysis, a or robust model can be developed which will explain the interdependencies all a lot of different parameters and it will explain it can explain sustainability to a large extent. These were all different types of quantitative models.

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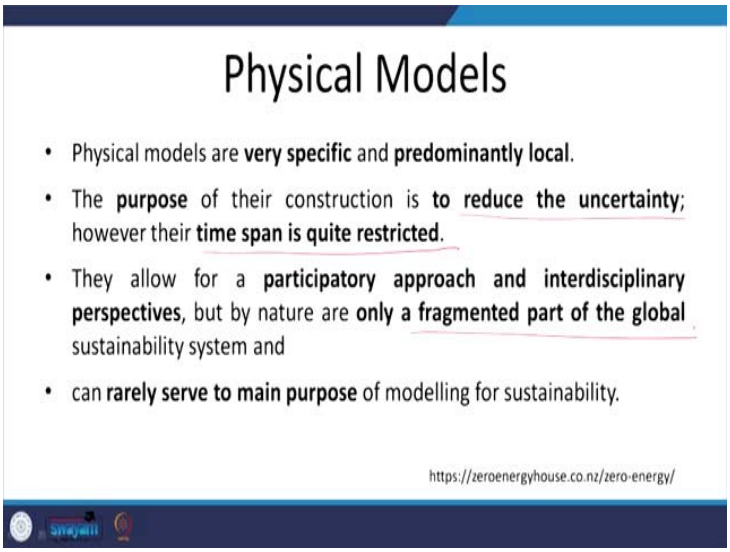

The next type of model is a physical model. Now, physical model as I said is a tangible model a real model which we can see. For example, modern of a net zero building. Now, there we will be constructing a net zero building, a model of it a physical model of it and then carrying out tests, gathering data based upon that physical model. It is very specific and it is largely local. So, there are certain drawbacks, because it is yes reduces the uncertainty to a large extent, a large extent; however, the time span is quite restricted, because we are talking in a moment of time. The model was constructed today and the test who are carried out today. So, the results are also valid for this given span of time. They may not be long ranging.

Another, they yes, allow for participatory approach and interdisciplinary perspectives, but that only a fragmented part of the global sustainability system simply because they are so predominantly local and confined within the time and space. They are very rarely used to serve the main purpose of modeling for sustainability, they largely cater to the

requirement of ruling out the uncertainties for a very specific issue, specific problem, say for example, I said net zero buildings.

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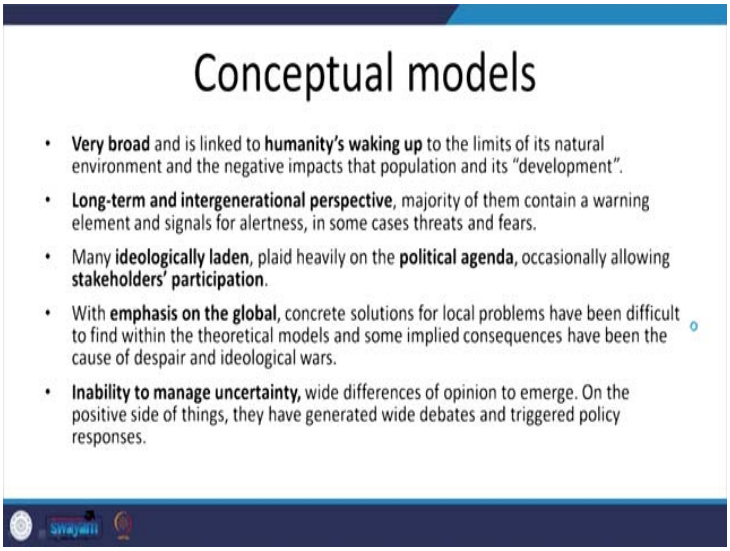

The next type of model is a conceptual model. Now, conceptual model is a very broad model, and it is largely linked to very grave serious issues with which concerned the entire world, globe, humanity at large, and they talk about the long-term and inter-generational perspective they are not locally focused, we are talking about global issues global perspectives. They are usually ideologically laden, they are heavy on ideology people talk about ideologies through these conceptual models, and it largely is driven by heavy political agenda. So, politics is driven through these conceptual models.

Let us look at one of the examples. For example, the entire conceptual model of ozone depletion. So, at that point of time when the depletion of ozone was brought to the forefront by scientists, at that time enough scientific evidence was not available to back the fact or to back the point of discussion which was that ozone depletion is happening at a very fast phase. Scientists did not you would not know for sure with conformity that what is causing the ozone depletion, there were flaws in the kind of research which has which had happened, because the research was anyways going on the scientists who weare not sure.

However, the conceptual model of what is causing the ozone depletion was publicized and advertised through politics through political agenda so heavily. Now, it actually led

to one of the most successful global treaties which was Montreal Protocol. In the later years yes of course, the scientific evidence also pointed to the same fact that yes certain compounds certain elements were causing the ozone depletion to a larger extent, but at the time when it was proposed as a conceptual model, there was no very strong scientific backing.

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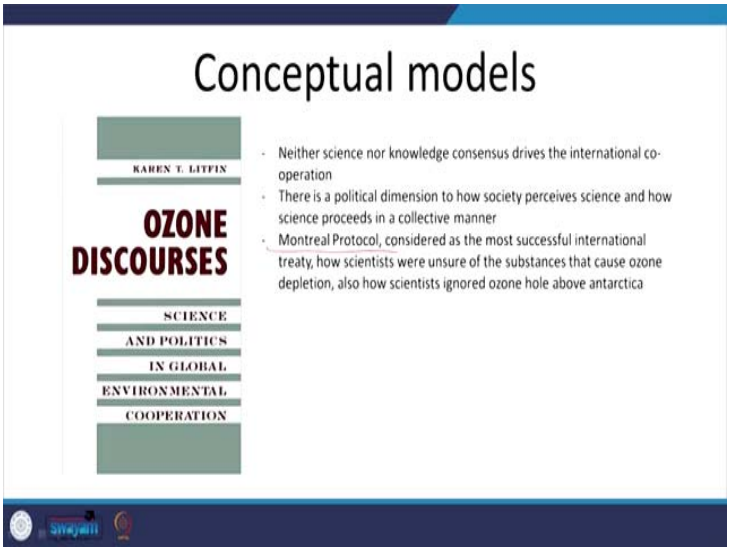

So, it actually led to a very successful 3D Montreal Protocol which is what usually happens with the conceptual models because they are so heavy on political agenda. It has been good for the world at large.

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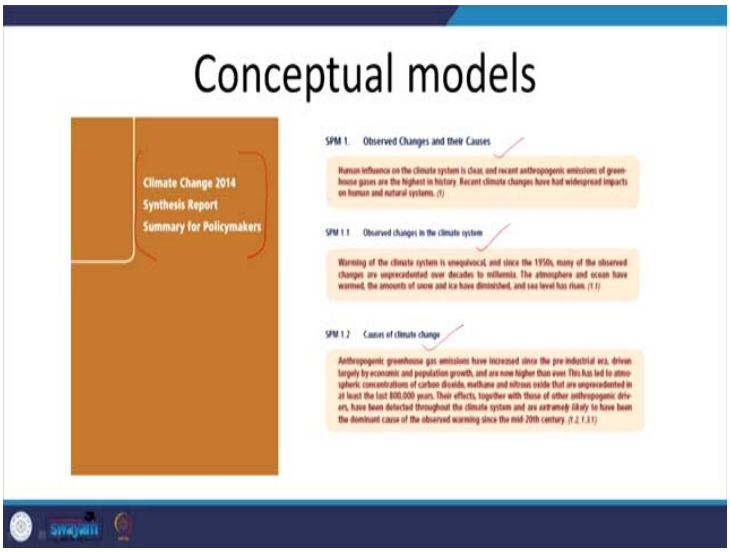

Another conceptual model that we would see was this for example, this climate change report 2014. Now, it talked about the observed changes and the causes, it observed the changes in the climate system and the causes of the climate change. So, if you remember there was a lot of uproar on the rate of how glaciers are melting, how it was projected, because there is no scientific backing to it at, what pace will the glaciers melt, at what rate and in how much time will all the glaciers be melted and how it would lead to the sea level rise yet, it brought to the fore the conceptual model that climate change is happening.

These are the changes which are happening though the pace, the rate at which these changes are occurring is not scientifically proven yet. It is good enough to sensitize people to create an overall large awareness and drive a political agenda where majority of the world comes together to discuss about climate change and to take to act upon it. So, that is what ~~laminate~~ conceptual models do.

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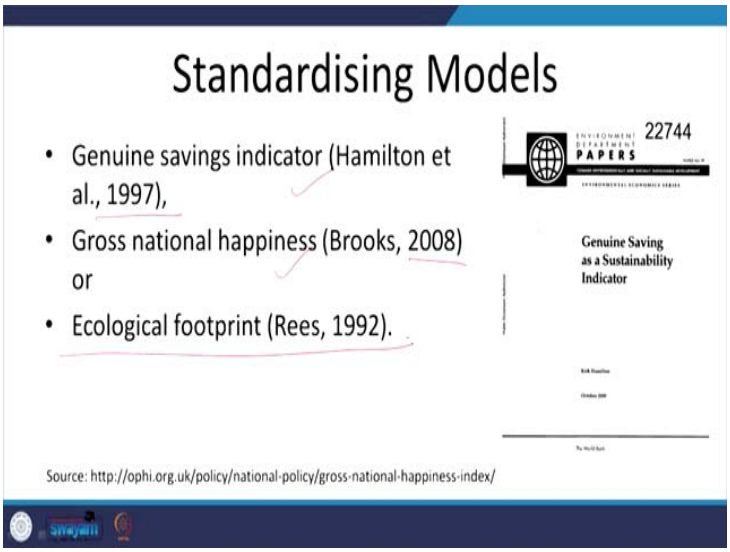

The last is standardizing models. Now, these standardizing models develop a new benchmark, a standard which in reality does not exist. It is a combination of various different parameters put together to lead to a quantity, a standard which is proposed and it is counted as a benchmark. For example, genuine savings indicator which was proposed in 1997, or Gross national happiness which would was which was proposed in 2008. Now, these are not really tangible though the parameters which lead to these quantities are standards are tangible. Another one which we often see here is ecological footprint. Ecological footprint is a very popularly commonly understood standard though it in reality does not exist.

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Let us look at what ecological footprint is. So, ecological footprint actually measures the amount of resources which we consume, it could be per capita basis, it could be per state or nation, or for the entire world. How much of these resources are consumed per capita is what our ecological footprint is, and how much off ecosystem land, water, trees, plants, agricultural area from land is required to sustain the kind of lifestyle which is being discussed for rich ecological footprint is calculated.

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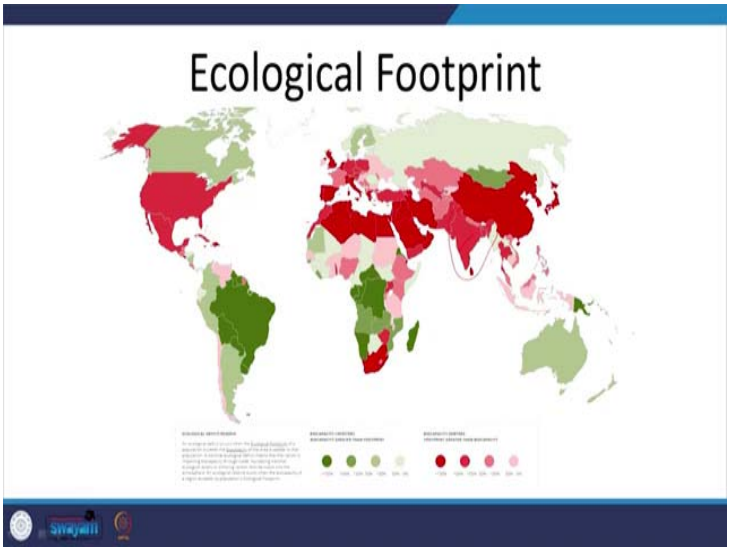

So, there our websites which are available, you would see a link of these websites and you can actually go and visit these websites, where the ecological footprint of the entire world different nations has been calculated. Now, the ones that we actually see in reds have a larger ecological footprint than the amount of resources which are contained within the boundaries of these countries. A darker of red implies that the resource consumption, the rate of resource consumption is much higher than the amount of resources which are available within their boundaries. So, we can see that India our country is quite intensely using the resources we will see whether it is per capita consumption of resources or it is the consumption of resources for a nation at large.

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So, this is looking at the ecological footprint off on the basis of countries population. The darker of the red implies there is a higher concentration of population and that is why the ecological footprint is greater. Countries which are sparse where population is less, even though their per capita ecological footprint maybe higher, overall for the country they will still have a smaller ecological footprint.

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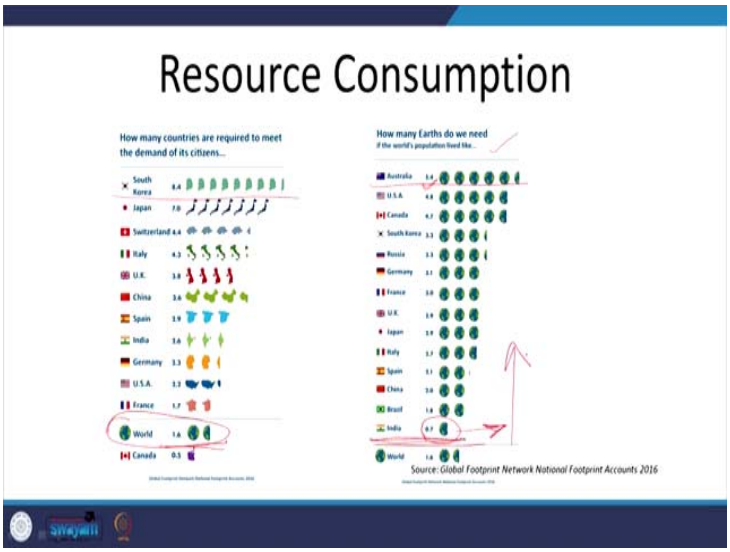

Let us look at this resource consumption chart. Now, here we see that given the kind of lifestyle people in our country follow, and the way they consume resources, how many countries of the same size are required to meet the demand of its citizen. So, this is resource consumption. If you look at the world here the rate at which the global population, the world is consuming resources, we would need 1.6 times the earth to fulfill our demands fulfill our needs for the resources.

We can also look at this very interesting piece of information where if the world's population lived like the population in these countries, the way people are living in these countries, how many earth would we need like that. So, it is a direct representation of how sustainably people in different countries are living, the lifestyle which we say. So, if people live like the way Australians do, we would probably require 5.4 earths to fulfill our needs.

However if the world lived like the way Indians live, even today, we would need only point seven of the earth that is if the entire world starts living like the Indians do. However, there are a lot of associated facts and issues which need to be discussed. We must very clearly know when I am saying that if the way Indian population lives, we are also talking about crores of people who are living below the poverty line, where they do not have access to the basic amenities of life that is why probably per capita resource consumption is quite low for a country like us.

And as we go on with improving the quality of life this resource consumption is bound to increase. We will not be able to sustain ourselves and also given that countries like India and China have very large concentration of population, a per capita increase in resource consumption multiplies with the population and suddenly makes a bigger number. So, this is a very interesting fact to see. And while I was saying that if we continue to live the way we are living the world at large, we need 1.6 to fulfill our demands.

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So, looking at that, there is a concept of earth overshoot day where the resources which are available to us for an year have been already consumed by a particular date.

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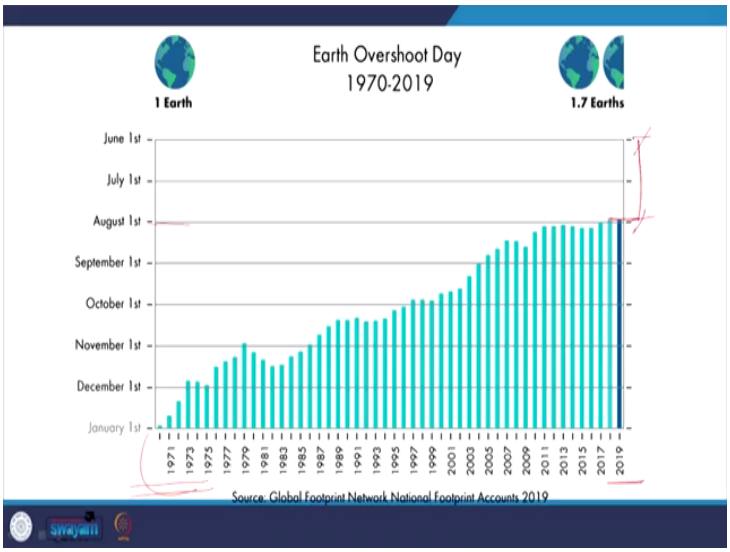

So, this has been coming down. If you look at the historical data we would see that at around 1970s, we were almost consuming the amount of resources which was available for an year in an year only. However, when we are coming to 2019, we are exhausting the resources by July 29th. So, we are short off this much period. Now, if you total it up, so every year we are reducing it by say 5 months, we are reducing it by 5 months in 1 year and like that, we have very little time left on earth to survive. This is the reason why all of us must act now, and especially we are talking about country like ours India which is a developing nation.

We yet need to provide the basic facilities to our people of~~f~~ drinking water or shelter. If we do not move ahead in a sustainable manner, it will be very difficult for us to sustain the growth, sustain the population in a healthy manner, and provide the same immunities provide the same quality of life to our future generations.

So, with this I will close this lecture 3, where we have discussed what are the different concepts, different definitions through which we can understand sustainability. As we move on we will discuss how sustainability has come to the point the way we are discussing today, has it always been discussed in the same manner like we are discussing today, or what are their different issues which people talked about when they were talking about sustainability previously say couple of decades back or almost a century back or more than that.

So, see you in the next lecture. Goodbye.