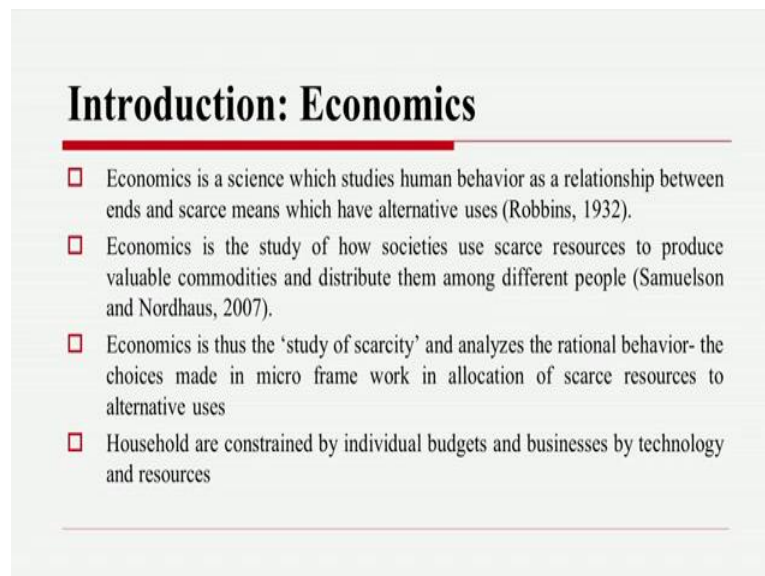


Infrastructure Economics
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Module - 01
Lecture - 01
Introduction to Infrastructure Economics

Welcome to this course Infrastructure Economics. I am Nalin Bharti teaching Economics at IIT, Patna. And let me begin this course with introduction to infrastructure economics. First of all, I would like to have the discussion on two different words economics and infrastructure.

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Introduction: Economics

- ❑ Economics is a science which studies human behavior as a relationship between ends and scarce means which have alternative uses (Robbins, 1932).
- ❑ Economics is the study of how societies use scarce resources to produce valuable commodities and distribute them among different people (Samuelson and Nordhaus, 2007).
- ❑ Economics is thus the 'study of scarcity' and analyzes the rational behavior- the choices made in micro frame work in allocation of scarce resources to alternative uses
- ❑ Household are constrained by individual budgets and businesses by technology and resources

So, what is basically economics? The general meaning of economics studies of human behavior as a relationship between ends and scarce means. Because, there is scarcity of resources in the world, both we are developing economically and socially, we need more resources to utilize. But, at the same time world is not having all the resources ready, there are developed countries with lots of resources, but at the same time they have to also depend on other developing countries for different resources.

Developing countries are also not equipped with all technological knowhow and development, which they required for further development. Least developed countries are more scarce in terms of resources and at the same time they also require development, they also require economic growth. So, we find here that no country in the

world today is fully equipped with all the resources. Somewhere, we find scarcity of labour, somewhere we find scarcity of capital, somewhere we find scarcity of technology and we are finding here that world is inter dependent in terms of development, in terms of economic growth.

So, economics is the study of how society uses those scarce resources to produce valuable commodities and distribute them among different people. So, economics is thus the study of scarcity and analyzes the relationship, rational behavior of the choice at the micro level and it is very difficult for an economy, for an individual, for a society, for a state to find out what development model they have to adopt when they are using or when they are practicing development and achieving certain goals in terms of economic growth.

So, the general meaning of economics is to have the maximum utilization of resources, which is available in the economy or if it is not available in the economy, how to manage those resources from the neighboring countries or from some other part of the country or from outside the country. So, through this activity we do economize the productivity, we do economize the cost of production and these are the achievements of this particular science named as economics.

So, let me begin with a new word infrastructure. In this module we are going to discuss the meaning of infrastructure and then, we will discuss what is basically infrastructure economics and how this infrastructure economics is different from other economics, at the same time we will also discuss about what are the main features of infrastructure, what are the types of infrastructure.

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Brief Outline

- Introduction: Economics
- Meaning of Infrastructure
- Infrastructure Economics
- Infrastructure: Features
- Types of Infrastructure
- Indicators of Infrastructure Development

And how we will find out whether the infrastructure is in the developed stage or infrastructure is in under developed stage, what are basically the indicators of infrastructure development.

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Meaning of Infrastructure

- **Infrastructure** is the system of public works in a country, state or region, including roads, utility lines and public buildings (United Nations, 2000).
- Infrastructure refers to the substructure or underlying foundation or network used for providing goods and services; especially the basic installations and facilities on which the continuance and growth of a community, state, etc depend (U.S. EPA, 2009).
- Infrastructure is the basic facilities and services that are necessary for carrying out the economic activities and which help in the economic development of the country. These basic facilities do not produce goods and services but facilitate the production and distribution processes.

So, let me begin with the first concept meaning of infrastructure, generally infrastructure is a system of public works in a country, in a state or a region that includes road, utility such as telecommunications, bridges, different other public utilities such as airports, roads, buildings and parks and so many other things which is generally buildup not in a very short period of time, but in a very long period of time.

Infrastructure development is completely different from other development. Because, if we have to produce some agricultural production, agricultural production does not require 20 years time or 10 years time to have that productivity. But, when we have to build up certain infrastructure, infrastructure development needs planning, because infrastructure refers to the structure or underlined foundation or network, which is used for providing goods and services.

So, it is the life line which a country is developing, it is a long run process in which we are involved to satisfy the future needs and the future generation's requirement, at the same time we do care for the current requirement of the population, current requirement of the economic growth process.

We are building infrastructure in a way that can lead us for the long run achievements and the sustainable achievements, which is more required today, because taking lessons from infrastructure from different part of the world, we can today realize that infrastructure development should consider the environmental aspect. Because, lots of infrastructure projects in India and outside India is now realizing that it should not be in the cost of environmental degradation or environmental loss. So, when we say infrastructure, it is not only a very short run process, which one can build up, a country can build up within a month or within a year, but, it is a continuing process. There are certain agencies, which do develop the infrastructure and sometime it is developed by the government, sometimes it is developed by the partnership between government and the private parties. So, it is the basic facilities and services that are necessary for carrying out the economic activities and which help in economic development of the country. These basic facilities do not produce goods and services. But, it do help to produce, it do help to facilitate the production and distribution process in a country that is the advantage of infrastructure.

So, infrastructure is basically backbone of the economic development, today we cannot say that a country can really have a fast economic growth and a very fast economic development without having the infrastructure in the background. So, if you can see today the entire development of most industrialized countries and developed countries, we are not finding that these countries are developed just because of the lack of infrastructure, but these countries had tremendous developments, for example Japan or United States or Germany or France. These countries are really developed in last 200 years just because of their constant involvement in infrastructure development and

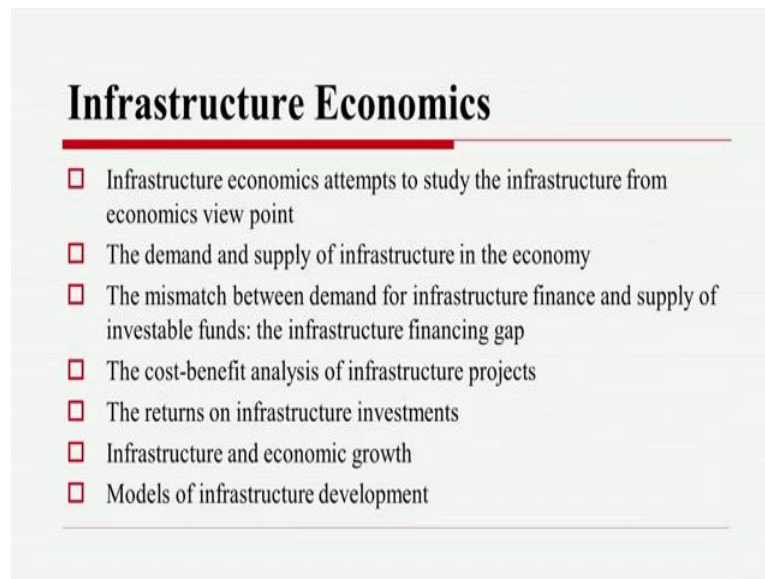
infrastructure maintenance. So, there are certain examples which we are also going to discuss in this course from newly industrialized countries, which have also proved that nothing can be achieved without infrastructure. So, it is basically the basic facility which facilitate for the further development and production and distribution in a country.

So, we cannot really work or we cannot really dream, we cannot really achieve any growth and development in any part of the world without a proper infrastructure support. And so that this particular course infrastructure economics is important in terms of understanding the linkage between the infrastructure and economic growth, at the same time to understand how infrastructure is being developed, what are basically the partners in infrastructure development, what should be taken care during the infrastructure development, what are the missing points in infrastructure development, what lessons we can take from the developed country, what lesson we can take from the successful examples of infrastructure development, what lessons we can take from the failure of the infrastructure development projects within in the country and outside the country. How infrastructure development projects are different in developing countries and how infrastructure development is different in least developed countries and so that this particular course will give you a broad range of understanding about the infrastructure development and the meaning of infrastructure in terms of economic well-being as well as social well-being.

Because, infrastructure when we say infrastructure the first thing which comes in our mind is the building or the road or the towers or something. But, the fact is that infrastructure is not only the thing which we are seeing in front of us, but there are certain hidden infrastructures. For example, the social infrastructure which is different from the physical infrastructure, we are going to discuss this particular aspect of infrastructure also.

But, I thought that it is better to first introduce the meaning of infrastructure and then after discussing this it will be more appropriate, appropriate to distinct between the different aspects of infrastructure, different types of infrastructure.

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Infrastructure Economics

- ❑ Infrastructure economics attempts to study the infrastructure from economics view point
- ❑ The demand and supply of infrastructure in the economy
- ❑ The mismatch between demand for infrastructure finance and supply of investable funds: the infrastructure financing gap
- ❑ The cost-benefit analysis of infrastructure projects
- ❑ The returns on infrastructure investments
- ❑ Infrastructure and economic growth
- ❑ Models of infrastructure development

So, when we say what infrastructure economics is basically doing and what basically infrastructure economics is helping us, infrastructure economics basically attempts to study the infrastructure from the economic point of view. Because, lots of a majority of the production activities, it cannot be successful, it cannot be profitable as long as the production is not reaching to the consumer or to the last consumer of the economy.

So, how to bring those produced material to the consumer that is one of the major tasks for the producers today. For example, one can say today that yes if the production is over through the advertisement we can reach to the consumer, answer is right, answer is not wrong. But at the same time the point is how you will deliver to the consumer, advertisement cannot deliver the product to the consumer, advertisement can only give certain idea to the consumer that what this product is and what merits this product is having.

But, at the same time what you need is the connectivity between the consumer and the producer through the roads, through the flyovers and through other communication services and through other transportation activities. Then only you can really carry the product from one part of the country to other part of the country, one part of the country to other part the world and within the economy also you can really supply the product on time.

At the same time when we say production and consumption, the production cannot be possible without having the inputs available with the producer. Infrastructure do helps to

cut down the cost of the inputs. If you have the express highways, if you have the proper rail linkage, if you have the proper air connectivity, if you have the proper connectivity through the sea, then the product which you are producing and the raw material which you are using, it is very easy and very cost effective to achieve those inputs, those raw materials from different part of the economy and also from different part of the world.

If you do not have connectivity in terms of road, in terms of rail, in terms of airways, if you do not have that connectivity, certain raw materials may be available in the neighboring country. But, you cannot have such possibility to get those raw materials, in such a situation you are having the capability to produce something, but you are not able to produce anything, because you are not able to have the inputs with you.

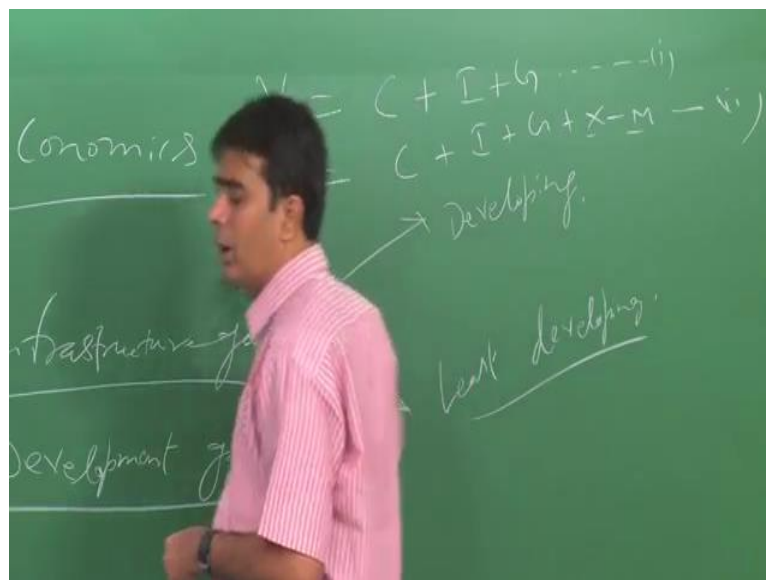
Because, the cost of inputs are so high, because it is stuck somewhere on the way and ultimately you are not in the position to get it on time, you are not in the position to get it on low cost and since you are not getting it on time and not getting it on low cost. So, your cost of production is rising up and as we see today, because in some of the module we are also going to discuss how open the world economy is today and in this open economic model, how infrastructure is going to help you to achieve certain targets and to be a competitive partner in the world economy.

The moment your cost of production is very high, you are not the part of the competition, because in terms of production competition is nothing except maintaining the cost of production at a very low level, so, that you can beat, you can compete and you can become the leader in the production in the world today. Many newly industrialized countries we are going to discuss today certain examples from different part of the world where we will find out that there are many economies of the world, such as Taiwan, Korea, Singapore, Japan already developed previously. But, Hong Kong, Singapore are some of the examples which has proved that very quickly within 20 years, within 30 years time within two decade or, three decade they had proved that they can do wonder in the world and they became certain leader of the product, certain leader of producing some of the items and many developed countries are also in the position to compete with them and still they are challenging certain developed countries to compete. This magic happened not because they have never thought for infrastructure, but, this magic happened, because they always thought for infrastructure development and they always realized that how infrastructure is really one of the important point and important target to achieve, which is always going to help the economy for the long run development.

So, infrastructure economics which we say that it basically attempts to study the infrastructure from the economic point of view is very important, because it is the only one point which makes the difference between the developed, developing and least developed stage of the economy.

All the production activities, all the economic activities of demand and supply is linked with the infrastructure today. India needs more food production in coming years, India needs more electricity today, India needs more transportation facility today. So, this is the demand of the economy. But, in terms of supply of the infrastructure, different agencies, different private parties are ready to produce some certain infrastructure, but it also requires the partnership from the government side, it also requires certain freedom from the investor side, certain freedom from the government side to catch those investment.

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So, this particular demand and supply gap in terms of infrastructure, which is also named as the infrastructure gap is seen in many developing countries and this gap is very wide in basically the least developed countries. Developing countries are trying to narrow down this infrastructure gap and the least developed countries will take years to narrow down or to reduce this gap in terms of infrastructure.

So, this infrastructure gap leads to have a further gap which is called the development gap. Because, if you have point one missing, you have point two also missing, because both are interconnected, one and two is interconnected. So, the mismatch between demand for infrastructure, finance because infrastructure needs a huge finance, because it

is always difficult to build up the infrastructure it is all capital intensive and technology intensive development, infrastructure is not only the labor intensive projects, it is always depend on the huge finance and financial support from though from the partners.

And that same time when we have these mismatch between the demand for infrastructure and the supply of inevitable funds, the infrastructure gap, do emerge in the economy and that leads for many years and there are certain examples in the world which has tried to reduce this gap. But, there are certain examples in the world which has still trying hard to reduce this gap but they are unable to do it because of many political and social factors. So, there are costs involved in the infrastructure and there are benefits involved in the infrastructure projects. So, many developing agencies of infrastructure are basically managing the cost-benefit analysis of the infrastructure and whether how much they can put and how much they will get in as the return on the infrastructure development and through this activity the mismatch between the infrastructure demand and infrastructure supplied can be easily understood. Because, the society which really needs more vibrant infrastructure development that also needs more vibrant investment in terms of FDI or in terms of FII (Foreign Institutional Investment), which we are going to discuss in detail very soon.

And investor needs return on infrastructure, because without having a proper return, why anybody will invest in a country and why anybody will develop the infrastructure and when there are certain return on infrastructure investments. There are certain good sign in terms of economic growth, because the good message is running across the world that a country like India or a country like Singapore or a country like Taiwan is building this infrastructure and it is good to have infrastructure development in those economies and at the same time other FDI investors also look for those destinations, where the rules for FDI is very normal and where the gains are better, where the entry is easy, where the exit is easy at the same time, where the other economic growth process is also smooth.

So, we will also discuss in this particular course about the models of infrastructure development, there are different models of infrastructure development through the previous examples of the development in the world. We are finding that it is very difficult and challenging for the government today to only have the investment from the public side. Public investment is declining everywhere and a public investment in infrastructure needs certain support from the private investors. And there are PPP model, Public Private Partnership model adopted in the world today.

And these models are important, because we are not really today we are not only living in a closed economic model, closed economic model or those model where economics are basically looking for their own resources. And the production is subject to the domestic consumer, local consumption and the economy is not really looking for outside the boundary of the after consumption or the productivity.

So, for an example if we have to define closed economic model and where the Y is the total output of the economy, so, $Y=C+I+G$. So, this may be treated as equation 1. But when we basically make the economy open as most of the economy today is open, we are not really having closed economy at the mass scale, most of the economy are exporting, importing lots of things and in this situation, the models of infrastructure development cannot be only based on the government expenditure.

When we say open economic model, the equation will be completely different and the equation will be $Y=C+I+G+X-M$. So, when we say open economic model, when we say export and import will be applicable in terms of the total output of the economy or the GDP of the economy. In that case we are allowing other investors of the world and we are also allowed to invest outside. So, the economy is not really restricting anything in terms of production. At the same time economy is not really restricting anybody to come in and not restricting anybody to go out in terms of investment.

So, when we have to understand economic system today, our economic system for example, India one of the largest economy of the world or even China another largest economy of the world is not only looking only for the public investment or the infrastructure development through the government support only. Because, neither we can afford that and nor we should do that, since our economic model is open, economic system is open. So, we are looking for partners in production, we are looking partners for infrastructure development, electricity production, communication, telecommunication is one of the example where we can find out that how there is a U turn in India or in many part of the world from a system, where we were having a completely non digital telecommunication system. Now, we are having a completely digital telecommunication system and the telecom use to become a telecom was one of the luxury in a country like India.

For instance, I have waited; my house has waited for around 3 years to get a BSNL telephone connection long time back before 20 years. And today every member of the

family is having a mobile connection. How this happened? How this magic happened? India became one of the major partner in the world today major subscriber in terms of telecommunication today and we do have the cheapest call rate today in the world. How this magic happened? This magic happened, because we have allowed investors to private investors to join our hand.

It was impossible for BSNL or MTNL to have that level of tele density to achieve that level of tele density and the 90 crore subscribers having mobile sets or telephone connectivity. It was not possible even it was not the dream of India in 1991. So, but soon after economic reform processes started in 1991 in India. We are finding that today it is not the luxury, but it is the necessity in fact many people are having two different sim cards and two different mobile phones and that shows that how investment in telecommunication is really played a very positive role in terms of communication, telecommunication development. And this is one of the successful examples for anybody to understand as a part of infrastructure economics and there is an impact of such activities, such development on other sectors also.

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Types of Infrastructure: Broad Category

<p>(a) Economic Infrastructure</p>  <p>Economic infrastructure is the basic facilities which directly benefit the process of production and distribution in an economy. Roads, railways, telecommunication systems, waterways, airways, financial institutions, electricity, water supply etc are the examples of economic infrastructure.</p>	<p>(b) Social Infrastructure</p>  <p>These are the basic amenities that do not directly influence the economic activities, but indirectly have an impact on the economy through achieving certain social objectives. For example, education does not directly influence economic activities like production and distribution but indirectly helps in the economic development of the country by spill-over effects. So education, health services and sanitation etc. are the examples of social infrastructure.</p>
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So, in this particular module 1 we must focus the difference between the economic infrastructure and social infrastructure. Because, the economic infrastructure is the basic facilities which directly benefit the process of production and distribution in an economy such as road, railways, telecommunication, waterways, airways, financial institution, electricity, water supply and etc. But, at the same time this is not only the infrastructure we should consider as the infrastructure in too.

But, there are certain infrastructure which is named as the social infrastructure and these social infrastructures are the facilities that do not directly influence the economic activity. But, indirectly have an impact on the economy through achieving certain social objectives for example, education, it is not directly influencing the economical activities, but it is indirectly influencing the skill development of the citizen, well being of the citizen, better level of understanding in the society and it has the indirect impact on the production and distribution.

And such not only education, but also health services, sanitation these are also some of the social infrastructure which is equally important when a country has to really achieve a fast economic growth and development targets. Because, economic infrastructure can help us in production of goods and services, but the social infrastructure helps us for many years in terms of designing the economic development and growth. Because, more you have the educated and healthy citizen more you have the good production system, because only they are basically the real customer as well as the input in terms of labour.

So, it is not only when we say infrastructure it is not only the physical infrastructure which do see on the roads as the part of construction and other activities and telecommunication and waterways or airports, but it is also the hidden infrastructure, social infrastructure is hidden infrastructure and Sen and other economist has proved that how this social infrastructure especially education health do wonder, Singapore many Asian countries. Srilanka is one of the successful examples of the world today which has proved that this type of hidden infrastructure has a very positive role in the economy and they are really the major contributor in terms of well being of the economy.

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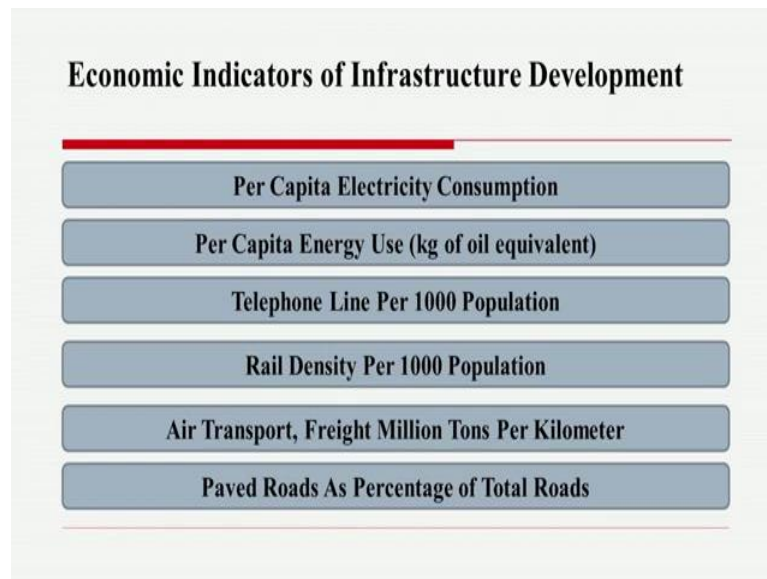
Types of Infrastructure: Detailed Category

Category	Name	Examples
Category 1	Rural Infrastructure	Irrigation, rural connectivity (roads, power, IT), cold chains and mandis
Category 2	Urban Infrastructure	Water, sanitation, sewerage, Telecomm, Internet
Category 3	Core Infrastructure	Roads, railways, airports, sea ports, inland waterways, energy
Category 4	Social Infrastructure	Healthcare, education, housing, hospitality
Category 5	Land- Intensive	SEZs, industrial parks, townships, IT parks

So, there are we can have the types of infrastructure; rural infrastructure, urban infrastructure, irrigation and the rural connectivity, rural roads, power these cold storage facilities, this may be considered as the part of rural infrastructure. We can have urban infrastructure, such as water supply, sanitation, telecommunication, internet. There may be in core infrastructure, such as road, railways, airports, sea, seaports, waterways, energy these are the core infrastructure and that is really needed in the rural area urban area.

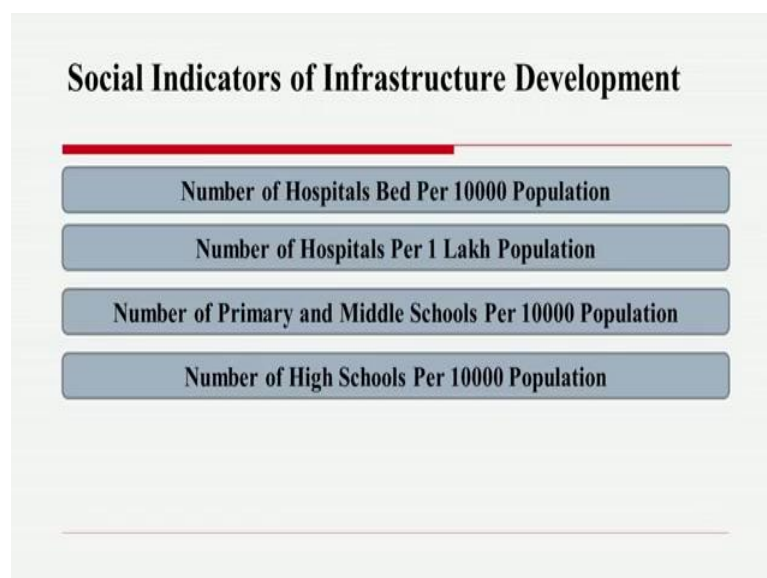
At the same time, social infrastructure which we have already discussed as the health, education, housing, hospitality and there are land intensive infrastructure such as special economic zones, industrial parks, townships, IT parks, these are basically the land intensive infrastructure which require major area of land.

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And how we see that whether the infrastructure is in the developed stage or under developed stage, so per capita electricity consumption may be one of the indicator for infrastructure development, per capita energy use kilogram of oil equivalent that may be another example. Telephone line per 1000 population, rail density per 1000 population, air transport and freight million tons per kilometer and roads as percentage of total roads how much we are developing per year.

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And the same time there are certain social infrastructure which can be also taken care as the number of hospitals per one lakh population, number of primary and middle school and at the same time number of high schools these are some basic indicators which

shows that whether we are really having very good social infrastructure or not. So, to conclude this particular introduction gives you a basic idea about what is basically infrastructure, what is basically infrastructure economics, what is basically the gap in infrastructure development, how this gap leads the developmental gap, at the same time what are basically the types of infrastructure and how and why we need to differentiate between the physical infrastructure and social infrastructure. So, we will discuss in detail about what are basically the features of infrastructure in the next lecture.

Thank you.