Introduction to Environmental Economics
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Lecture - 20
Environment and Economic Growth Linkages – II

Dear students, in the previous lecture, I discussed the relationship between economic growth and environment. You have also studied the four functions of environment and you have also studied how the economic growth lead to environmental degradation or sometimes if the GDP growth rate is coming from the green sources clean sources of energy, it may also help to protect the environment.
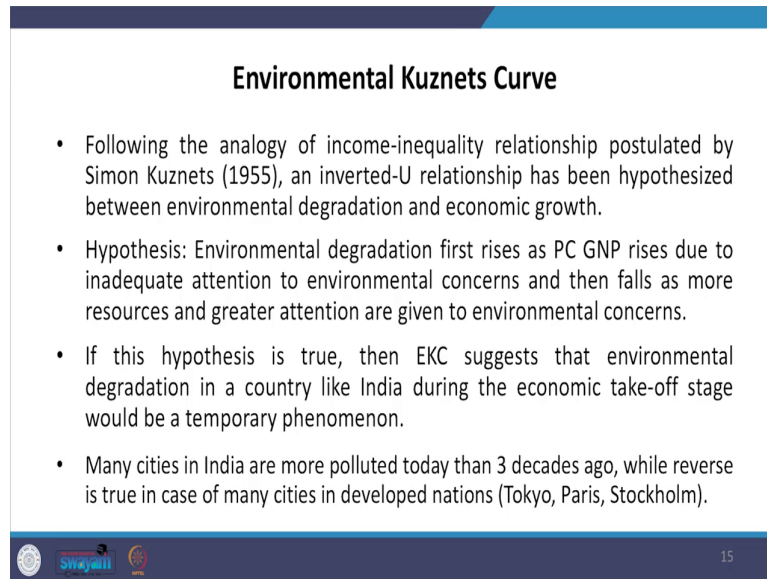
Because when GDP growth rate increases, the government may also get more funds and these funds even if the text GDP ratio remain constant. And if GDP growth rate is increasing, more funds will be available to the government for investing in cleaning the environment. So, high growth rate may lead to better environment conditions in an economy.

So, there is a actually a debate on whether the environmental protection with our environmental condition will improve within GDP or deteriorate. This relationship is discuss in the form of environmental Kuznet curve. This environmental Kuznet curve is actually based on the concept which was developed by Kuznet while studying the relationship between inequality and economic growth.

So, environmental economist use the same concept Kuznet try to establish the relationship between economic growth and inequality. And according to Kuznet in the initial stage of development when economic growth increases, this inequality increases. But when the level of economic development reach at a particular level, after that for the increase in economic growth or economic development would lead to decline in economic inequality.

So, taking this concept, environmental economists try to establish the relationship between economic growth and environmental protection and this relationship is termed as environmental Kuznet curve. So, you will study today this concept.

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As in the very beginning, I told you that environmental Kuznet curve is based on the idea given by Kuznet. He developed his hypothesis taking GDP of different countries over a longer period and inequality. And after analyzing the data he observed or inverted-U shaped relation between inequality and economic development or economic growth. In the initial stage of economic development, inequality increases and after a particular level of economic development, inequality start declining.

Now, it is simply a hypothesis and there are still a lot of debate whether inequality has increased or decrease with the increase in economic development. I am not going to make a

debate on this issue. My only concern is the same idea was taken by environmentalists to explain the relationship between economic growth and environmental protection.

Here the main hypothesis is environmental degradation, first rises as per capita GNP rises due to inadequate attention to environmental concerns and then fall as more resources and greater attentions are given to the environmental concern. So, this is the hypothesis that initially with the increase in per capita income or per capita GNP environmental degradation is started because less attention was given to the environmental concerns.

But later on as the income further increases then environmental protection or environmental conditions improves and probably because people started give more attention to the environmental concerns. If this hypothesis is true, then environmental Kuznet curve suggest that environmental degradation in a country like India during the economic takeoff stage would be a temporary phenomena.

This is obvious because different countries passes through the different stages of economic development. So; obviously, when a country is passing through a particular stage of economic development and in the initial stage if engage in economic development or economic growth is leading to environmental degradation; obviously, after a particular point, environmental condition improves.
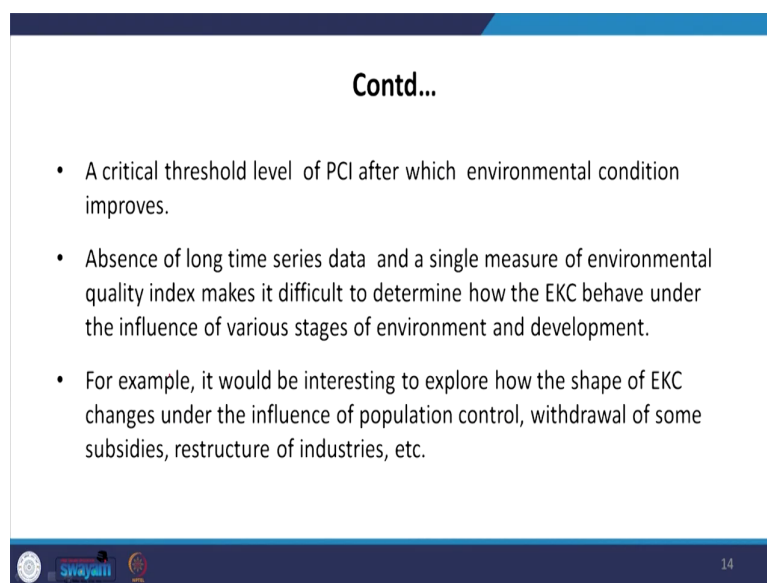
So, now in India, we know that in many our cities pollution level is increasing; but after 30 years or 40 years when further GDP of income GDP or per capita GDP of the country. In case there may be a possibility that our cities become more clean, more environmental friendly as compared to today. So, many cities I can give an example, many cities in India like Delhi are more polluted today than 3 decades ago.

But reverse is true in case of major cities of the world the advanced countries like Tokyo, Paris, Stockholm, London or many other European countries big cities they are now more clean as compared to 3 decade or 4 decades ago. So, important argument here is that since their level of economy has significantly increase and they have more resources to spend or

invest on environmental protection or green sources of energy clean environment, clean water, clean air; obviously, the level of environmental protection will improve.

This is the key argument as far as environmental Kuznet curve is concerned. In environmental Kuznet curve, a critical threshold level of per capita income is determined by many environmental economist.

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And they believe that after a critical threshold level of income, then environmental condition improves in different countries. But here this threshold level of income may vary from country to country and from pollutant to pollutant. In some pollutant, threshold level maybe say dollar 3000, in some cases it may be dollar 4000 or 5000 or 12000 etcetera.
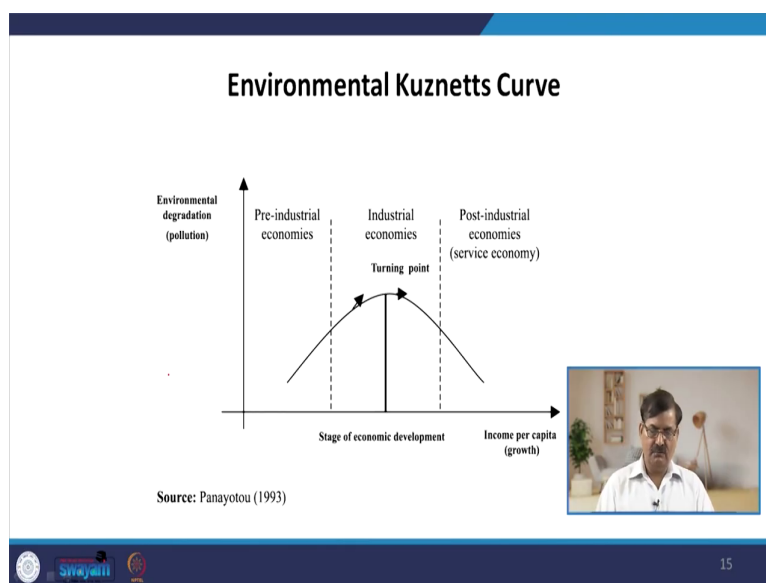
So, the threshold level of per capita income may vary from country to country and from pollutant to pollutant. And another important issue regarding the environmental Kuznet curve is the absence of long term time series data and a single measure of environmental quality index. If you look at the various studies done by the environmentalists, they take either this SO 2 as a indicator of environmental quality or they take degradation of forest.

But a comprehensive environmental quality index quite difficult to take to establish the relationship between environmental protection and economic growth. So, this is a major flow; right now that no comprehension is steady taking the long term time series data and the integrated or a comprehensive index of environmental quality. It is very difficult to take across cross sections of large number of countries.

Moreover, how to determined the environmental Kuznet curve under the influence of various stages of environment and element is also major issues. For example, it would be interesting to explore how the shape of environmental Kuznet curve changes under the influence of say pollution control withdrawal of some types of subsidies or restructure of industries.

So, how the restructure of industries or withdrawal of certain kind of subsidies which are degrading the environment or population control measure adopted by any government are affecting the sake of environmental Kuznet curve?

Now you can look at this graph which shows the inverted-u shaped relationship between environmental Kuznet environment and GDP or income per capita. On vertical axis, we are measuring environmental degradation or pollution and on horizontal axis, we take the different stages of economic development in terms of per capita income growth. And this graph is divided into three stages; first is pre industrial economy.

So, pre industrial economy means an agriculture economy so; obviously, when in any country agriculture is the dominant source of income and agriculture traditional agriculture the level of pollution would be low. But when we gradually move from agriculture to industries like in UK industrialization occurs so, we move from green agricultural jobs to the blue industrial job, then in industrialization will lead to more pollution generation of gaseous waste, solid waste, liquid waste and that will increase the level of environmental degradation in the economy.

But once we reach at the particular level of economic development, then the composition of economy will shift from industry to services and of course, services are more eco friendly as compared to industries. So, services and in fact, the nature of services or prior time also change.

Today in India, IT sector is one of the important sectors around 8 to 10 percent of our GDP is being contributed by the IT sector and IT sector is more cleaner has compared to manufacturing of certain kind of goods like cement or coal burn steel or energy etcetera. So; obviously, when we move from industry to services, then level of pollution should decline that is an argument as far as environmental Kuznet curve is concerned. Now I can give some explanation why these hypotheses in certain conditions may be applicable.

First point is transition of economy from agriculture to industry and then to the services. So, this is one argument made by the analyst that or a period of time with the increasing economic development in different stages, the economy shift from agriculture to industry and then to the services.

So, these are the things which are responsible for application of or empirically validation of environmental Kuznet curve. Now when there is a shifting or change in the composition of the economy, three effects may occur; first is a scale effect, second is composition effect and third is technology effects. So, these are very very important points to explain the environmental Kuznet curve.

A scale effect: a scale effect means when economic grows more production is done in terms of quantity. So, quantitative addition of the production will lead to more generation of pollution. It is a simple principle; if we produce more, we release more waste; if we consume more, we release more waste. So, more consumption, more production means more waste released into the atmosphere. So, a scale effect has a negative impact on environmental degradation.

Second is composition effect when composition of the economy changes, it has some positive influence on the environment offsetting the adverse effects of the scale. Obviously, that occurred after a particular level of economic development like I already given example when we shift from manufacturing to services, then this is a change in the composition or economy. Like in most of the advanced countries, 65 to 70 percent of our GDP is coming from services. In India also around 60 percent of our GDP approximately is coming from services.

So, when more or more income is coming from services sector then; obviously, the level of environmental degradation declines or environmental conditions improves. So; obviously, another third point is technology. So, high growth lead to r and d, r and d lead to new technology and new technology lead to law pollution. So, you can establish the relationship between high growth of the GDP to technology and then pollution.

So, there is a positive relationship between high GDP growth rate lead to better r and d, new technologies and new technologies are more resource conserve conser vatives in nature more conservation occurs and reduce less pollution.. So, environmental Kuznet curve suggests that while scale effect prevails in the initial stage of economic development, the composition and technology affect dominate in the later stage resulting in improved quality of environment.
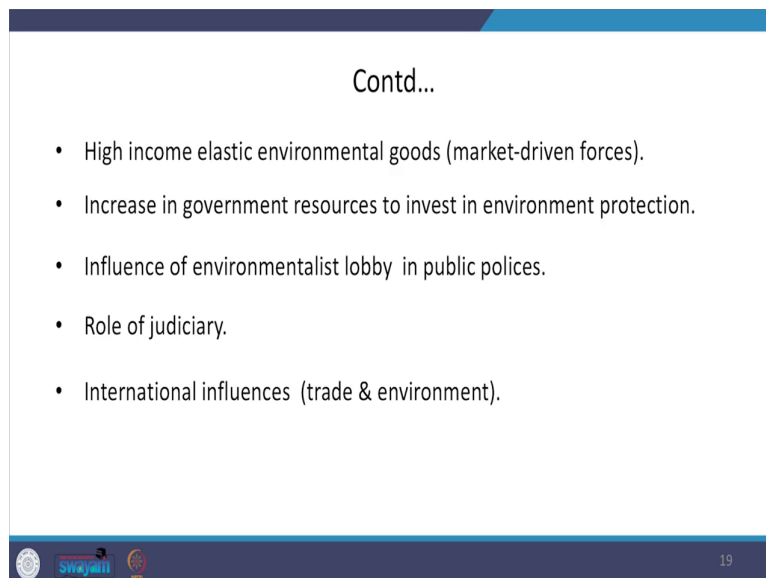
So, these three effects; the scale effect, composition effect and technology effect in the initial stage of development scale effect is more dominant and that is why in the initial stage environmental degradation increases with the increase in economic growth. But in the later stage, composition of economy means shifting income from industry to services and technology they dominate and they help to reduce the level of pollution with the increase in GDP.

So, this is the possible argument in favor of happening of environmental Kuznet curve. I can also give few more points why it happens. First is high income elastic environmental goods. We know as income increases, we demand more environmental goods and services. So, income elasticity of demand for environmental goods is quite high so; obviously, when the

economic growth of any country increases household sectors or you can say the private people they have more income to spend on purchasing the environmental goods.

Although most of the environmental goods are non rival and non excludable, but some part of the environmental goods are also rival and excludable and so, therefore, like household garbage disposal. So, as your income increases you wanted to live in clean environment. So, a disposal company will come emerge in market emerge and people would be willing to pay to these household disposal companies.

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So, clean environment demand increases with the increases income because of high income elasticity demand for environmental goods and services. Second argument is increase in government resources to invest in environmental protection. You know when a economic grows then even if the government is not altering the tax structure; if taxes remain same the
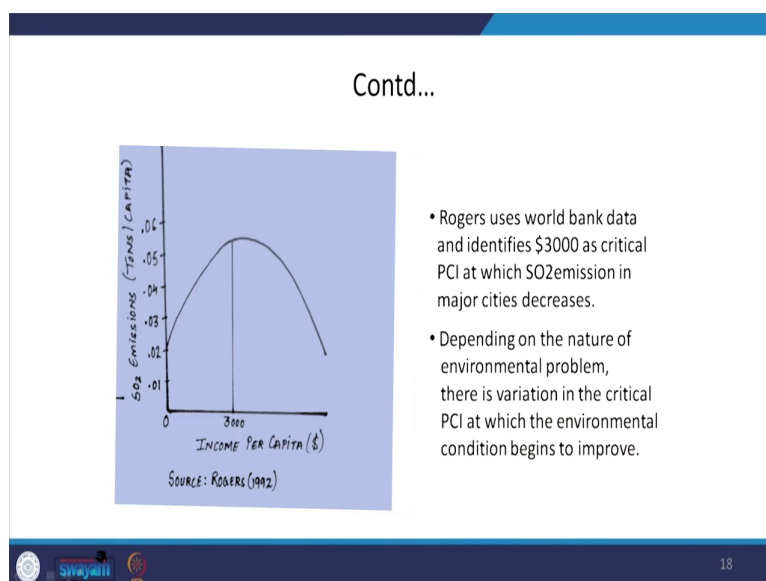
volume of tax received by the government with the increase in growth of the GDP will increase and government have more resources at its disposal to make investment in cleaning the environment.

So, government's capability to invest more with the increase in economic growth would lead to better environment conditions after a particular level of economic development. Third point influence of environmental lobby in public policies. So, when a countries grows when economic development of the country increases, then environmentalists becomes more active. They also put pressure on the government; they also use as a lobby in the government to formulate the policies in favor of environmental protections.

So, environmentalists also becomes more active environmental groups. Then fourth point is role of judiciary judicial system also take action related to environmental protection. So, sometimes people may file public interest litigation on certain issues and the court may also give federal discussion and through this the new policies or programs may be formulated by the government and last point is international influence.

International influence is also responsible like trade and environment. So, when the economy of a country grows, then many consumers they also put restriction on certain kinds of goods where environmental conditions are not good. So, that is called environmental standards. In WTO, this is a major debate; so, how to bring environmentalists a standard to the multilateral trading system. So, intellectual influences also has some positive effect on environmental protections.
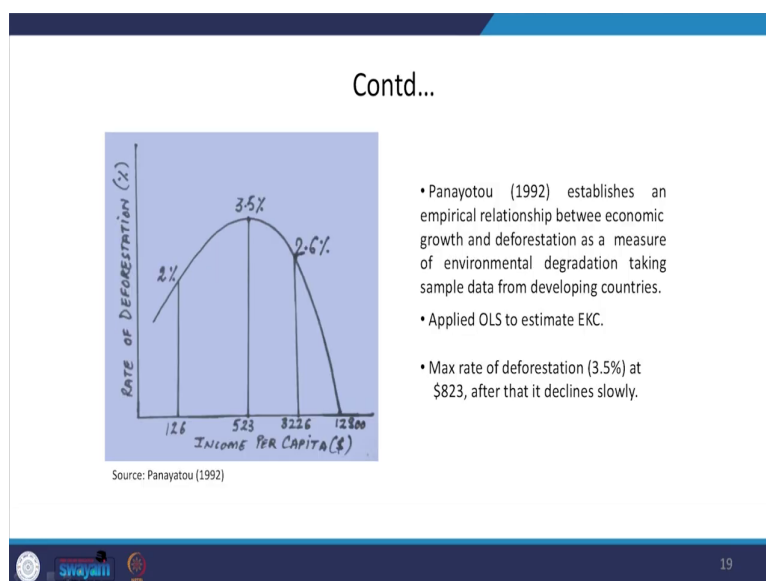
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Now, there are two three pioneer in establishing this environmental Kuznet curve. One is Rogers, he tried to establish the environmental Kuznet curve by taking per capita income and so, two emissions. And according to him when the per capita income of a country crosses 3000 US dollar then SO2 emission per capita in turns is start declining. He also examines that depending on the nature of environmental problem there may be variation in this critical per capita income at which the environmental condition began to improve.

So, although on an average 3000 dollars per capita is the threshold income after which the SO2 emissions in major cities of the world start declining. But this threshold income may vary from city to city or even country to country.
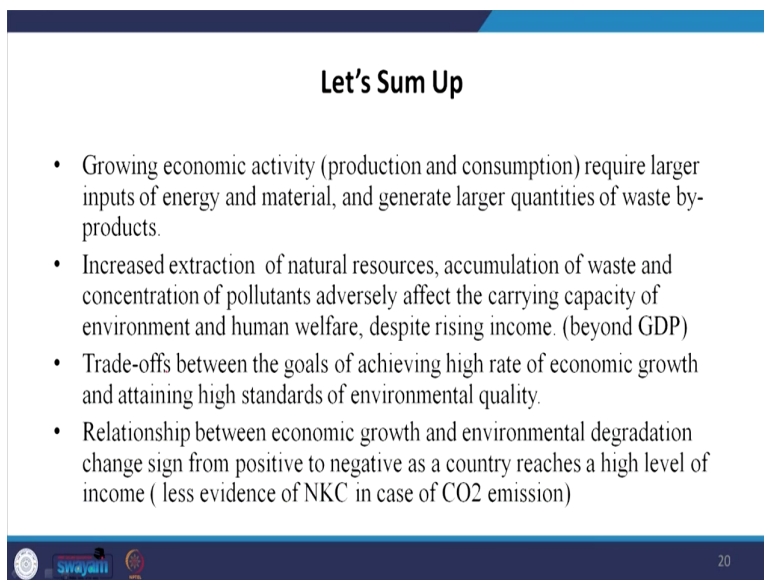
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Second is Panayotou you and first time he gave this concept of environmental Kuznet curve. He establishes an empirical relationship between economic growth and deforestation as a measure of environmental degradation taking sample data from developing countries. He applied ordinary least square method to establish the environmental Kuznet curve and on horizontal axis income per capita is taken in US dollar and on vertical axis rate of deforestation is taken in percentage.

And he found that at the per capita income of dollar 823, the rate of decline of the forest is highest that is 3.5 percent and after that if the per capita income of a country increases, then rate of decline of deforestation also declines.

Finally, let me sum up this topic. Growing income activity income activity include both production and consumption require larger inputs of energy and material and generate larger quantity of waste byproducts. So, this is that is why we should be more concerns about our production methods, consumption method, our how to increase our GDP.

Second increase extraction of natural resources, accumulation of waste and concentration of pollutant adversely affect the carrying capacity of environment and human welfare even if the GDP of the country increases. That is why now many economists thinking about beyond GDP and people are developing a new method of or new measures of economic welfare other than the GDP because GDP is not a true indicator of well being of the society, you can generate your GDP by cutting forest selling it as a timber or extracting more natural resources, polluting your environment, polluting your water and generating GDP.

So, this kind of process of generating GDP is not sustainable that is why economists are now thinking of developing alternative measures of economic well being of the society. Third is tradeoff between the goal of achieving high rate of economic growth and attaining high standard of environmental quality. So, there is a tradeoff between environment and development and since there is a trade off and resources are limited, we have to make a proper balance how much environmental protection we should achieve and how much economic growth we should follow to achieve the intended goals.

And finally, relationship between economic growth and environmental degradation chain sign from positive to negative as a country reaches at a high level of income that is called environmental Kuznet curve. But as far as empirical evidences are concerned, most of the studies as I mentioned are either taking SO_2 or for a degradation, but CO_2 studies is also the important issues.

And in terms of global warming and now all gasses are clubbed together and sure to equivalent is taken in order to address the issue of climate change and global warming. So, how much CO_2 is increasing or decreasing with the level of economic growth is a major challenge before us.

Thank you very much.