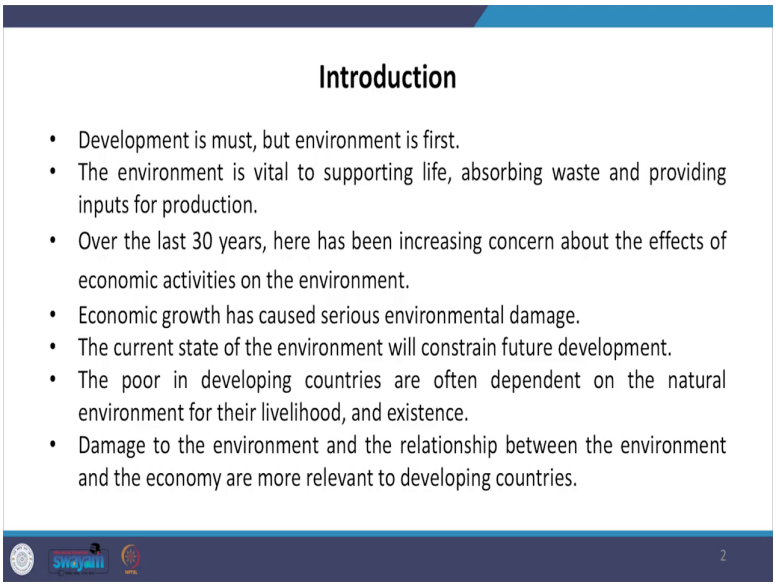
Introduction to Environmental Economics

Prof. S. P. Singh
Department of Humanities and Social Sciences
Indian Institute of Technology, Roorkee

Lecture - 19
Environment and Economic Growth Linkages – I

Today, you will study about the linkages between Environment and Economic Growth. As in the very beginning I made a statement, that development is must, but environment is first. So, now, you have to know the relationship between development and environment.

(Refer Slide Time: 00:57)



We know for eradication of poverty, for improving our living conditions, we must do development, but at the same time, we have to protect our environment. So, how to achieve

sustainable development, while maintaining our ecology and environment is a big challenge before us.

Today, you will study this relationship in terms of environmental Kuznet curve, which is a hypothesis developed by environmental economist taking an idea from a famous economist view on inequality and economic development. So, Kuznet developed hypothesis that with the increase in economic development inequality increases.

So, taking this idea environmentalist try to establish the relationship between economic growth and environment degradation. We know, the environment is a very vital for supporting our life, it also absorbed the waste, which we released into the atmosphere by way of doing production and consumption. And, also it provide us various kinds of resources inputs, which are used in the production process.

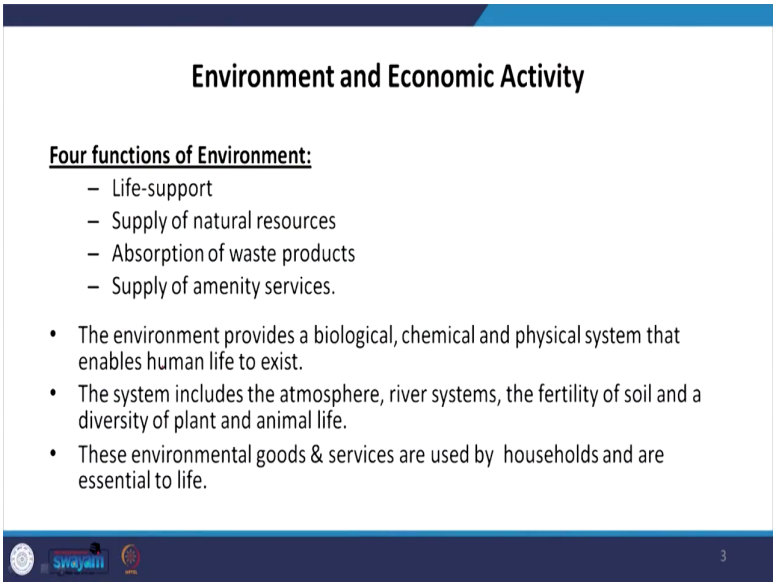
Over the last 30 years, here has been an increasing concern about the effect of economic activity on environment. Economic growth has caused serious environmental damage and therefore, how to achieve a sustainable economic growth is a major issue before the environmental economist. The current state of environment will certain feature will casting the future development.

So, as we know that, the way the process of development is going on, it is putting more strain more pressure on our environment and that is leading to the loss of many environmental resources. And, that is why our future growth is take may be affected due to the way we are utilizing our environment. So, poor in developing countries are often dependent on natural environment for their livelihood and existence.

So, especially in the developing countries, most of the poor people they draw their livelihood, they draw food folder fuel from the environmental resources. So, if environmental resources are degraded, that most sufferer would be the poor people, who are getting their livelihood based on their environmental resources.

So, damage to the environment and the relationship between environment and economic are more relevant especially for developing countries. I am not saying that these things are not relevant for developed countries. In developed countries, there are different kinds of issues related to a environment degradation, but for developing countries poverty, unemployment and livelihood these are the major concerns, which must be examined in relation to the economy and environment. So if you look at the environment and economic activity, then you will know that environment provide us four kinds of functions.

(Refer Slide Time: 04:50)

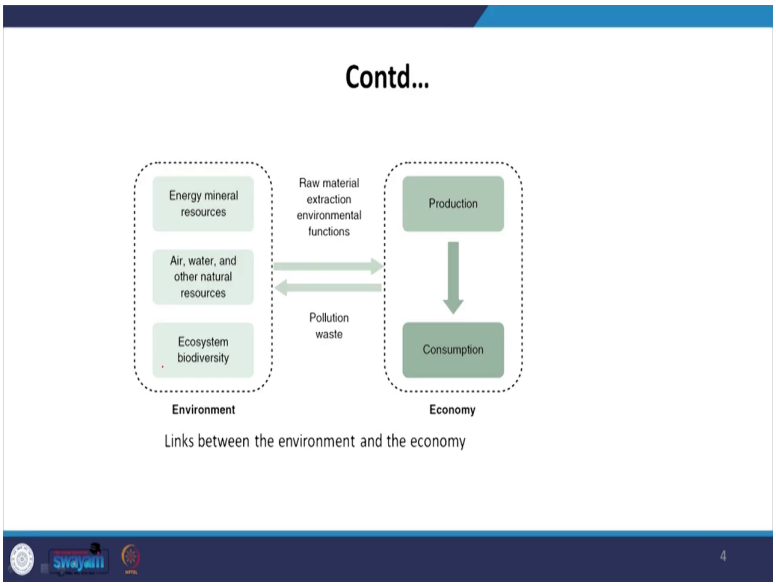


First is life support, second is supply of natural resources, third is absorption of waste products, and fourth is supply of amenity services. And, these four functions can also be interpreted in terms of four kinds of goods and services, which are provided by the environment. First category is supporting services. Second, category is regulating services, and third is assimilative capacity or regulating services, and fourth is cultural services. So,

these services are very very important for our lives, for our livelihood, for our survival, and these will be discussed in detail in the coming lectures.

The environment provide a biological, chemical and physical system, that enable human life to exist. So, that is a kind of support system that is provided by the environment. The system may include like our atmosphere, reverse systems, fertility of soil and diversity of plant and animal life. So, all these supportive systems of the environment help us to survive our lives and to sustain our livelihoods. These environmental goods and services are used by the households and they are very very essential to our life.

(Refer Slide Time: 06:35)



From this diagram, you can see the interrelationship between the economy and environmental. We can divide the economy into two sectors; one is actually the production sector and other is the consumption sectors. And, when we produce certain kinds of goods and services, we also

release certain waste. So, we get the resources from the environment, which are used as an input in the production process.

And, when we produce the final products, we also produce the bad product. And, these bad products are absorbed by the environment and that is called assimilative capacity of environment, but I would like to mention here, that this assimilative capacity of environment is not in finite. There is a limit to assimilate to capacity and therefore, if we are releasing more waste product into the atmosphere, then it becomes very difficult for the environmental system to absorb the waste.

For example, if we are releasing certain kind of waste into the river system. So, it is a characteristic of the river that river can clean itself up to a certain extent, but if you are releasing more waste into the river, then river may become sewer. So, therefore, the function of river to clean itself may be badly affected.

So, that is why you should know that this assimilative of capacity of environment or absorption capacity of environment is not absolute not in finite it is limited. Similarly, we get many mineral resources, energy resources, which are used as raw material for production process, and sometimes we also get directly certain kind of services or products, which are directly consumed by the household sectors.

So, household sector and production sector these are the two main sectors of the economy, which represents the entire economy and when we consume certain kind of product. We release certain waste, waste may be liquid waste, waste may be solid waste, waste may be gaseous waste, and this waste are absorbed by the environment, which is known as assimilative capacity of environment.

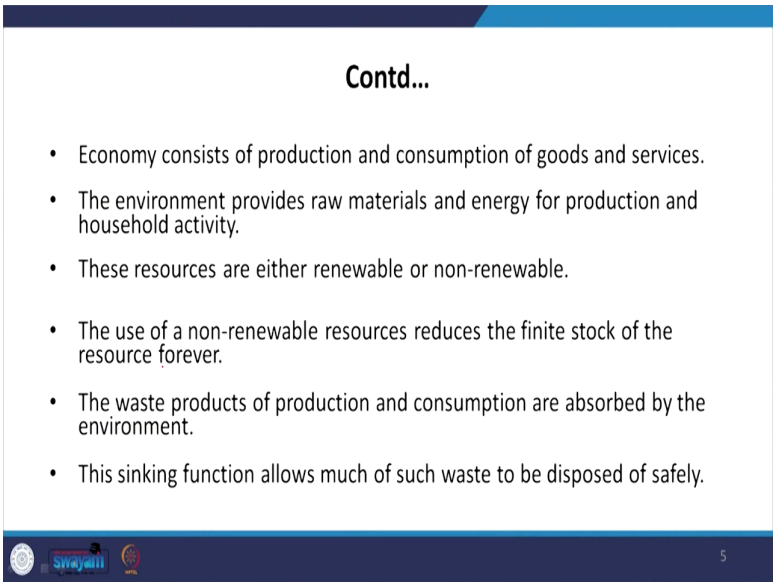
Similarly, environment also provide us various kind of bio diversities. And, biodiversity also affect our survival and affect our livelihood a biodiversity is declining, due to our extraction of our natural resources, then many activities, which are depending upon the biodiversity may be badly affected take an example of agriculture.

So, if agriculture biodiversity is affecting a monoculture is going on that will also affect our soil and water resources. So, this linkage can be established, I am again explaining this, that we have one side of the environment, which provide four kinds of functions, on the other side we have our economy, which is represented by the production and consumption. As we know why do we produce the goods; obviously, to consume the goods.

So, we cannot stop production, we cannot stop consumption, then what can we do? We can produce the goods with better technology, with better management practices, with the better conservation of resources. So, here comes the role of efficiency productivity etcetera. So, how to do our production with efficient manner, that can be studied in environmental economics. Similarly, consumption with a consumption cannot be stopped, but what we can do is we can follow better consumer practices, use and throw culture cannot be adopted by us.

And, if we are preserving our resources making a better practice of in terms of both production and consumption we can say the environment. So, this interface between environment and economic can be established by this graph like, raw material, extraction, environmental functions are done. And, similarly pollution waste are absorbed by the environment and at the same time environment also provides, certain kinds of goods and services to our production and consumption sectors.

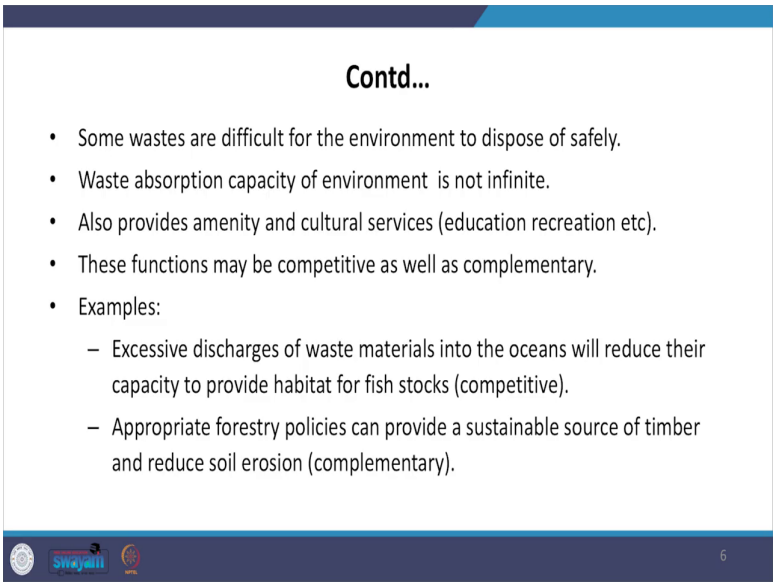
(Refer Slide Time: 11:31)



Now, we can understand that the kind of resources, which we get from the environment, they can be classified into two categories; one is renewable resources and others are non-renewable resources. Non-renewable resources are those resources whose supply once use cannot be augmented so, a stock of these kind of resources are fixed. But, renewable resources can be renewed, but here if we are extracting our renewable resources at the rate more than they are regeneration, then these renewable resources may also be disappears.

So, one point is clear here although some of the resources are renewable in nature, but they do not have unlimited capacity to renew. So, therefore, we have to make a proper balance between our basic needs and also the environmental needs in terms of it is capacity to regenerate itself.

(Refer Slide Time: 12:40)



Some waste, which are released by us into the atmosphere cannot be safely disposure. Even some waste cannot be even disposed at all like radioactive materials heavy metals. So, if we are releasing such kind of waste into the atmosphere, then they cannot be absorbed by the environment, even environment may take 100s of years to absorb them. So, therefore, waste absorption capacity of environment is not in finite.

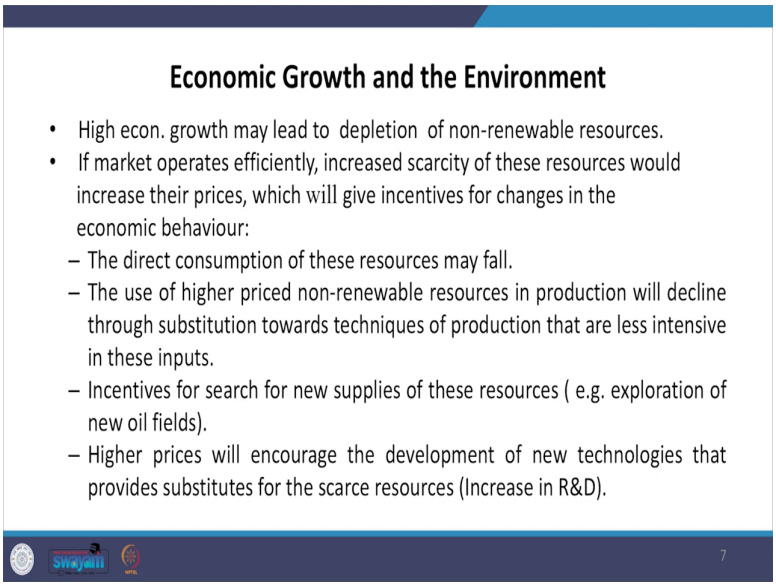
Environment also provide us various kind of amenity and cultural services like, recreation, education, etcetera many scientific advancements are based on the insights received by them from the nature. Like Newton law, when a scientist is looking that on the nature on apple, then he falling at the soil he get the inspiration to develop this law. So, many educational knowledge scientific laws are also get some insights from the nature.

So, nature provide beauty many poets write poem after looking at the beautiful nature, forest, rivers etcetera. So, these are called emulative services. These functions of environment providing services and goods to the economy are competitive as well as complimentary in nature.

Some functions are competitive take an example, access to discharge of waste material into the ocean will reduce their capacity to produce habitat for fish stock. So, the function is competitive. Similarly, we can also take the complimentary functions of the environment like, appropriate forestry, policies can provide a sustainable source of timber and reduce soil erosion. So, that kind of function is complimentary functions.

So, I can again emphasize that the goods and services, which are provided by the environment in terms of various functions, they can be classified into competitive as well as complimentary. Now, let me discuss in detail the relationship between economic growth and environment.

(Refer Slide Time: 15:26)



You know high economic growth, may lead to depletion of non-renewable resources. Now, in regard of economic growth and environment relation they are different views. One view is that, when there is a high growth of the economy and the economy is using non-renewable renewable resources to produce goods or services.

Then according to market principles if market operate efficiently, we in economics believe a competitive market. So, if there is a competitive market and if the depletion of non-renewable resources occurs, in that case in market operate efficiently, then there would be is scarcity of these resources.

And, when a scarcity occurs for the these resources then prices of the resources will go up. And, when prices increases cost of production will go up and when cost of production go up then it will lead to a change in the economic behavior. So, it will provide an incentives to the

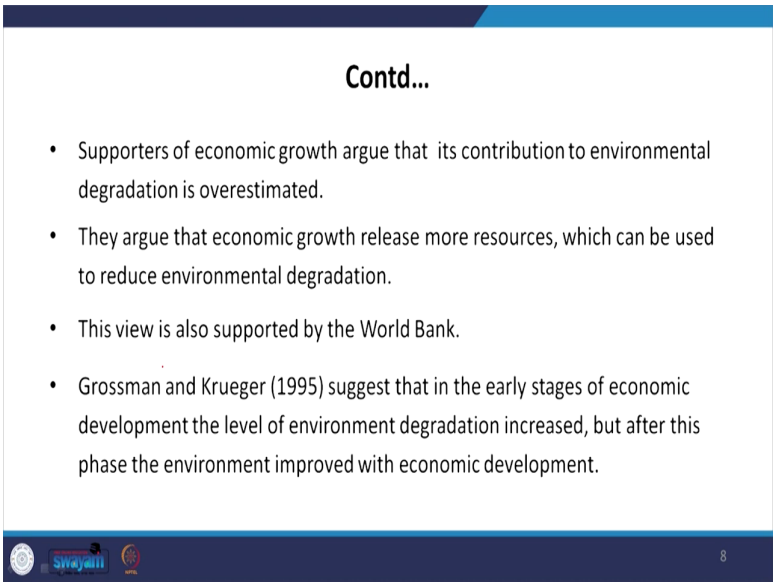
producers to export certain kinds of alternatives. And, this is the way how in any economy different methods of productions are evolved; different technologies are evolved, because of scarcity of certain resources.

So, main implication of this argument is that, when the prices of these product increases, due to the scarcity of these resources then the direct consumption of the resources may fall. So, direct consumption of non-renewable resources due to this may fall number one. Second is the use of higher priced non-renewable resources in production will decline through substitutions towards, techniques of production that are less intensive in this inputs. Look at any product today most of the products which are being manufactured, they are less energy intensive, they have less material content.

So, that is due to the scientific advancement. So, scientific advancement research and development is leading to the develop development of new sources of energy, new sources of production, methods or new exploration of oil fields, gas fields, etcetera. And, increasing the supply of alternative resources and then consequently the price of the scarcity resources will come down.

Higher prices will also encouraged the development of new technologies, that provide substitute for scarce resources. So, the argument here is that due to high growth of the economy, demand for resources will increase, their prices will increase, and that will encase research and development leading to the new technology cal change in our production, even in consumption also like, we can also use new methods of our consumption and say certain products or make a better use of our available products.

(Refer Slide Time: 19:12)



This is one argument and therefore, the supporter of economic growth they argue, that the contribution of economic growth to environmental degradation is overestimated. So, they are critical that high growth rate, may not necessarily be responsible for the environmental degradation. And, those who argue, that high growth rate would lead to environmental degradation, they overestimate the adverse consequences of economic growth on environment.

They argue that economy growth release more resources, which can be used to reduce environmental degradation. I can elaborate a bit this argument, that when we have high economic growth. High economic growth would lead to increase government resources. Even, if the tax GDP ratio remained constant government would be able to have more resources and these resources can be used by the government to protect the environment.

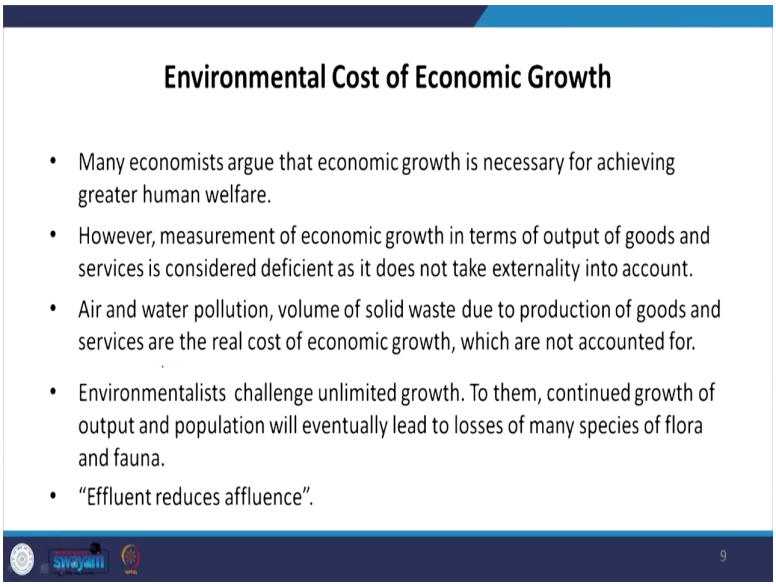
World Bank is supportive to this argument that a growth high growth of the economy would lead to better environmental protection. So, this is one argument, but as in the first lecture, I also stated that, there is a another view and far as the relationship between economic growth and environmental protection is concerned that is a view by environmentalist. Those who believe in preservation of nature, they think that there should be a limit to the growth. So, excessive growth may lead to environmental degradation.

But, third view is that we have to achieve the sustainable growth by making a proper balance between economic growth and environment. Grossman and Krueger in 1995 suggested that, in the early stages of economic development the level of environmental degradation increased, but after this space of environmental conditions improved with economic development. And, that is I will discuss in later on that is what is known as environmental Kuznet curve?

Which I will take in detail later on, but this is also one argument that, when economy growth increases. In the initial stage of economic development environmental degradation will increase, but after a critical level of income, that is called threshold income level, environmental protection is start engaging or environmental degradation is start, declining or environmental conditions improve with the increase in economic growth.

But, we have a huge cost of economic growth on environment. And, many economists argue, that economic growth is necessary for achieving greater human welfare.

(Refer Slide Time: 22:43)



But, at the same time economy growth also affect our natural resources. And, therefore, most important aspect here is how the growth is generated, how the growth is distributed? So, growth per se is not an idea that growth may not necessarily lead to environmental degradation or environmental protection, that depend upon how we are generating the growth and how we are generate distributing this growth?.

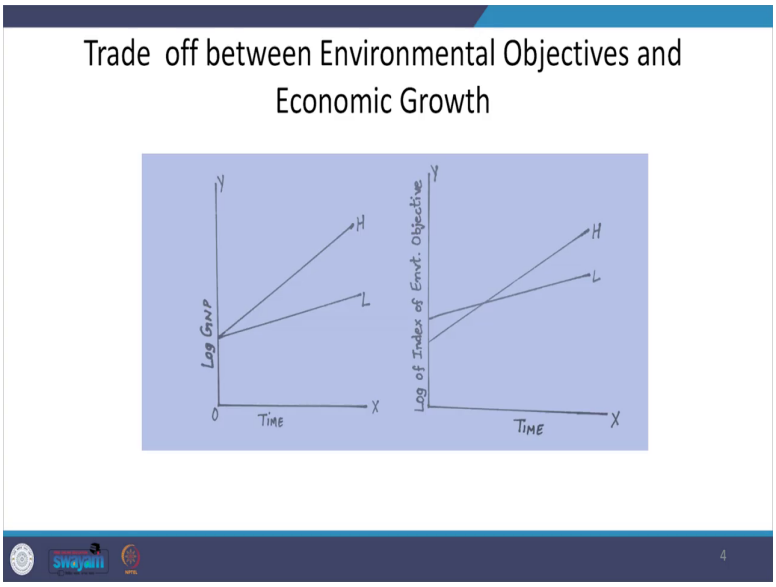
If growth is coming from most polluted industries; obviously, that kind of growth could have adverse impact on our ecology and environment. That is why now economist are thinking beyond growth, because growth is a quantitative improvement in the economic condition of the country. But, that quantitative increase in our GNP or GDP may not necessarily lead to a better living condition, better environment, that depend upon how this GDP is affecting our air and water qualities, generating solid waste into the economy etcetera.

And, whether the growth is coming from green sources or gray sources, that is also the important when we try to establish the relationship between economic growth and environment. So, therefore, environmentalists challenge, this unlimited growth, which is being propagated by a group of economist to achieve certain goals of power the unemployment and living conditions etcetera.

To them continued growth of output and population will eventually lead to loss of many species of flora and fauna. So, that is why they argue that affluent reduces effluence. This is also a kind of statement, that can be elaborated. Affluent means pollution, pollution generally reduces affluence means prosperity.

So, population pressure on our natural resources, then high growth rate of industrialization, urbanization, they all generate pollution. And, pollution also affect our affluence, also affect our prosperities, because if pollution level increases, then health of the people will also be badly affected, our water bodies will be badly affected, our air will be badly affected and that will be a huge cost on our lives. So, therefore, argument is made that affluent reduces affluence. I can explain the tradeoff between environment objective and economic growth by using these two graphs.

(Refer Slide Time: 25:50)



In the first graph, you will see that on horizontal axis time is taken as a variable and on vertical axis, we are taking GNP in log, log is taken in order to smooth the data. And, two growth path are shown in the graph; one is high growth path and second is low growth path. So, a country can follow a different kind of strategies to achieve the economic growth; one is strategy maybe that a low growth path or a period of time may be followed by any economy or high growth path.

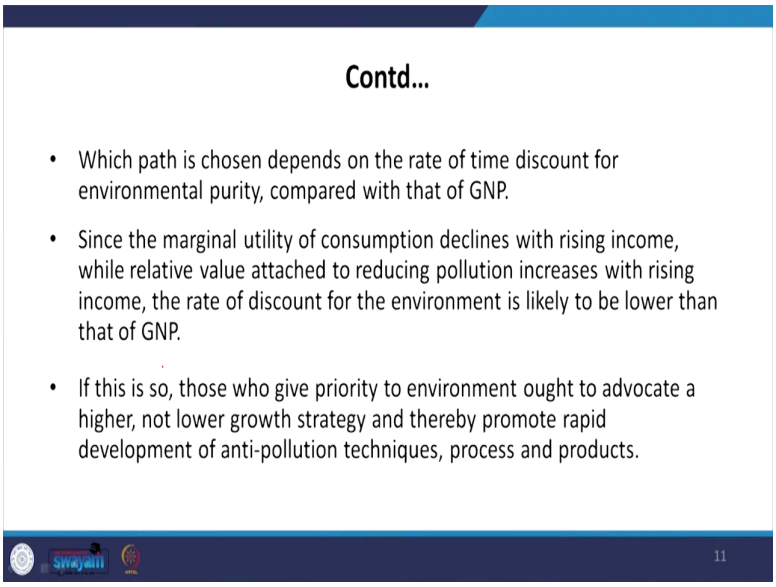
So, now after looking at the first graph showing the growth path high and low along with time, if you use these two growth path and take on vertical axis logo index of environmental objectives and time is taken as it is. Then, you will find that initially, after certain time period the low growth path would be generating less pollution in the economy.

So, environmental protection would be high as compared to high growth path up to a certain time period, if we are following low growth path, but if a certain time period is crossed, then the high growth path would be generating better environmental conditions as compared to low growth path.

So; obviously, this graph can also be interpreted in the same manner as environmental Kuznet curve hypothesis interpreted, that in the initial time period in the stages of economic growth, low growth part of GDP in any country would be a better option in terms of environmental protection.

But, over a longer period it is a high growth path, which would generate better environmental conditions in any economy. I will take it in detail, when I will explain the environmental Kuznet curve, but when we had these two growth path before us. Now, which path should we choose for our economy that, actually depend upon rate of time discount for environmental parity compared with GNP.

(Refer Slide Time: 28:58)



In economics we use the discount rate, we discount our future incomes at the current period or current time. So, now, if rate of time discount for environmental protection or environmental quality is lower than, the rate of discount of our GDP, then it would be desirable, that a high growth path would lead to better environmental protection in the long run, because we know that marginal utility of consumption declines with a rising income.

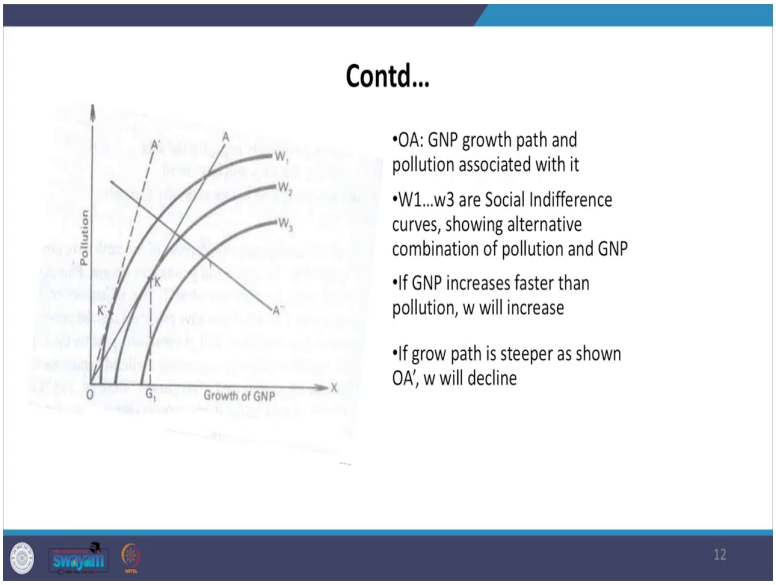
So, when we discount our GNP feature GNP at a discount rate, we have to keep in mind, that marginal utility of consumption declined with rising income. So, therefore, discount rate would be high. But, at the same time we as a consumer also give more at attachment to reducing the pollution with the increasing rising income.

So, when our income rises we give more weight to environmental protection so; obviously, the discount rate on environment will be lower than GNP and that is why, the economist who

always argue for high growth path for achieving the environmental sustainability, they say that since the discount rate of environmental quality is lower than, the discount rate of GNP, then it is better we have to focus on or we have to give priority to the high growth path is strategy to promote better environmental conditions.

And, in that case we can promote rapid development of anti-pollution techniques process and product in order to reduce the pollution. Now, another graph you can see here is.

(Refer Slide Time: 31:27)



I had shown here social welfare or social indifference curve. W 1 W 2 W 3, they are called social indifference curve. And, there indifference curve are prepared taking two products; one is pollution that is called bad products, that is taken on vertical axis and growth of GNP is on horizontal axis. In the economics you are studied indifference curve, but in economics when

we study indifference curve, we have both good product x and y. So, therefore, there is a tradeoff between these two products.

But, when we done indifference curve taking one bad product and other is the good product, then shape of indifference curve would be like this shown in the graph W 1, W 2, W 3 indicating that, if you want to generate more pollution or if you want to consume more good product, you have to consume more bad product in order to keep the utility constant.

So, your welfare throughout this indifference curve, social indifference curve will remain same, because as we move from one plant to another plant that clearly indicate, if we are generating more GNP, we are generating more pollution. And, therefore, we are able to get the same level of welfare that is stated by W 1, W 2, W 3. And, we also know higher that indifference curve higher will be the level of welfare. So, when we move from W 1 to W 2 to W 3, then welfare of the society will improve.

But, apart from these indifference curve, I also shown in the graph three growth path; first is OA growth path and this growth path is intersecting our tangent at point K. And, an optimum combination of pollution and GNP is identified is determined at K point. But, if we follow another growth path that is OA dash, then we are able to achieve another equilibrium point at K dash. Now, this clearly shows that, if we follow OA growth path, then society is getting welfare at point K, which is on W 2 welfare indifference curve 2.

But, if growth path is OA dash, it indicates that growth is high, but per unit of GNP created more pollution is generated. So, that is generating more pollution in the economy by using one additional unit of GNP produce. So; obviously, now the society will move to W 1 and that is a loss of welfare. So, welfare may be affected due to the different growth path, but another important argument, that can be studied from this graph is that there may be possibility.

That instead of having positively slope growth path with reference to GNP and pollution, there may be a condition, where growth path is inversely related with pollution and GNP and that is a key argument made by many economist. That there may be possibility in any economy, that we can reduce the pollution by increasing the GDP not necessary that pollution would increase

with the increase in GDP and that is possible, if we change the production methods, we change our consumption production practices, we use the technologies.

For example, in India, if a major part of the GDP is coming from green sources of energy. Like, based on the green sources or like solar energy and if we sustainable resources etcetera, then we can achieve higher GDP, but not necessary high pollution. So, that is one important argument made by economist, that there may be a possibility in an economy that a high growth rate of GDP may also lead to reduction in pollution ok. So, that I had just discuss the relationship between economic growth and environment, I would like to conclude this topic on environment and economic growth linkages.

In this topic I have discussed a four functions of environment, environment provide us life support system, environment also provides natural resources, which are used in the production process, environment also have your the different kinds of waste released by us and environment also provides different kinds of amenity services.

So, you have studied about the four functions or four activities that environment provide to the societies, you have also studied about the relationship between economic growth and environmental degradations. And, also the environmental cost of economic growth. And, you have studied that there may be different growth path; one growth path may be that if we are generating GDP and per unit of GDP generated is raising more waste into the atmosphere, that growth path would not be good for the society, because it will generate more pollution in the economy.

But, there may be a possibility that with the help of technology changing the model production and using better management practices, we can reduce the pollution per unit of output produced. And, there may be a possibility that a high growth path may not necessarily lead to the lower environmental degradation, or high growth path may release certain kinds of funds for the economy, which can be used for protective protection of the environment.

So, there is a actually both kind of situation that a high growth path may lead to environmental degradation and a high growth path may also help to protect the environment, if the growth is

coming from green source of energy, clean source of energy, if we are using new technology for resource conservation. So, you have studied all these aspects while discussing the relationship between environment and economic growth. In next lecture you will study more specifically the relationship between economic growth and environment through environmental Kuznet curve.

Thank you very much.