

**Conservation Geography**  
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**Indian Institute of Technology Kanpur**  
**Module - 1**  
**Introduction to Conservation Geography**  
**Lecture – 1**  
**Overview of the course**

Namaste and welcome to this course on Conservation Geography. I am Dr. Ankur Awadhiya, an officer in the Indian Forest Service and your instructor for this course. In this course we are going to learn about conservation - what conservation is, why is it necessary for us to do conservation and what are the kinds of benefits that we get from conservation? And we are going to learn about Geography.

What are the different processes that happen on our planet? What are the different phenomena that keep this planet going? We will understand these phenomena in the context of conservation. That is there is a certain phenomenon; how does that impact the survival of different species on this planet. We will try to understand why in different locations on this planet we have different species.

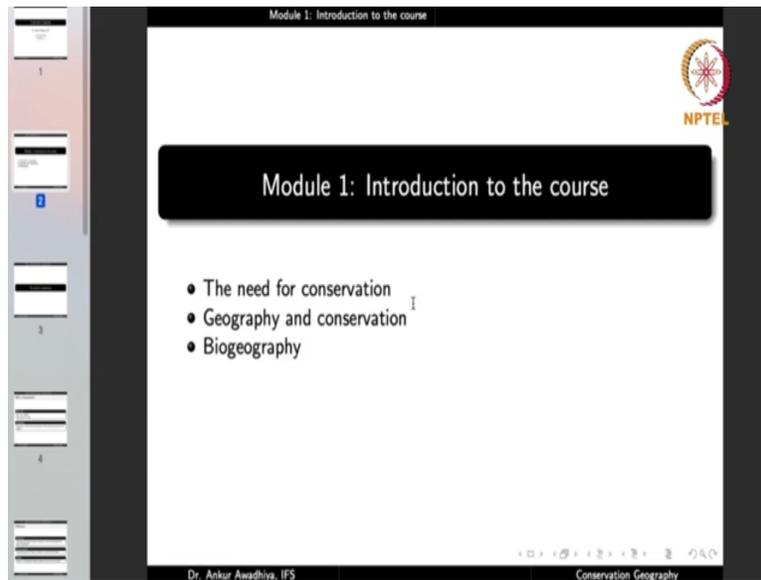
And we will also try to understand how we humans have brought a large number of these species to the brink of extinction. Now, at times you will hear people say that okay, even if a few species become extinct. How does that impact us? Let them be extinct. How does that matter to us? In this course will try to understand why that matters to us, how that matters to us; and how by reducing the biodiversity on our planet we perform harm to ourselves.

We will try to understand the kinds of ecosystem services that well-functioning ecosystems and biodiversity provide to us; the kinds of benefits that we get from conservation. Now, when we try to understand conservation or the lack of it, we can understand it by two ways. We can look at the cases where there was conservation not done as per requirements and the kinds of negative impacts that it brought to the people living in those areas.

And at the same time we can also look at the certain case studies, where conservation was done and the kinds of benefits that people in the area got from it. So, in this course we will look at a large number of such examples, and it will be full of case studies. Now, this course will be

divided into several modules and each module will have several lectures. So, with that let us now begin this course.

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The image shows a presentation slide with a white background and a black border. At the top, it says "Module 1: Introduction to the course". In the top right corner, there is a logo for NPTEL (National Programme on Technology Enhanced Learning) featuring a stylized sun or starburst. Below the title, there is a black rectangular box containing the text "Module 1: Introduction to the course". Underneath this box, there is a bulleted list of three items: "• The need for conservation", "• Geography and conservation", and "• Biogeography". At the bottom of the slide, there is a footer that reads "Dr. Ankur Awadhya, IFS" on the left and "Conservation Geography" on the right. There are also some small navigation icons in the bottom right corner.

The first module is introduction to the course, and we will have three lectures: The need for conservation, Geography and conservation and Biogeography. So, in the need for conservation will try to understand why do we need to perform conservation. In geography and conservation will try to understand what is this field of geography and how is it related to conservation.

And in biogeography, we will try to understand how different biotic phenomena are differentially distributed on this planet. That is why do certain areas have certain organisms and not others. That is how the biodiversity is distributed on this planet, and why is it distributed in the way that it is distributed. So, let us begin with the need for conservation.

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The screenshot shows a video lecture slide with the following content:

- Module 1: Introduction to the course The need for conservation
- What is Conservation?
- NPTEL logo
- Word roots
  - Latin *con*: together
  - Latin *servare*: to keep
- Conservation
  - Preservation, protection and restoration of [the natural environment and wildlife]
- Dr. Ankur Awadhya, IFS
- Conservation Geography

The term conservation is derived from two Latin words; 'con' which means together and 'servare' which means to keep. So, essentially conservation is to keep something together or to protect something, to preserve something, to restore something; and in the context of this course conservation is the preservation, protection and restoration of the natural environment and wildlife.

So, we are trying to preserve the natural environment and wildlife; meaning that we are trying to maintain it in the way that it exists. We are trying to protect the natural environment and wildlife. We are trying to protect it from harm; we are trying to protect it from degradation. We are trying to protect it from loss; we are trying to protect our wildlife from extinction; so that is protection.

And at the same time we are trying to restore the natural environment and wildlife. Meaning that if there are certain impacts especially certain negative impacts that have already occurred, can bring the natural environment and wildlife back to a good position. That is if in certain areas we have polluted the environment a lot. What are the mechanisms that we have with us to bring the level of pollutants down?

If we have diverted large segments of our habitats for uses other than the wildlife uses; then is there something that we can do to restore this environment back to a condition, where the wildlife are able to survive? So, conservation is preservation, protection and restoration of the natural environment and wildlife.

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The slide is titled "Differences" and is part of a presentation on "The need for conservation" (Module 1). It lists three concepts with their definitions:

- Preservation**: "allowing some places and some creatures to exist without significant human interference"
- Environmentalism**: "concerned about the impact of people on environmental quality"
- Ecology**: "Science of relationships between organisms and their environments"

The slide also features the NPTEL logo in the top right corner and the text "Dr. Ankur Awadhya, IFS" and "Conservation Geography" at the bottom.

Now, this term is different from other similar terms like preservation or environmentalism or Ecology. So, conservation is not the same as preservation. Preservation is allowing some places and some creatures to exist without significant human interference. That is if we say that we want to preserve the natural environment; then we mean that okay, this is the natural environment; let us keep it as such without any human interference.

If we do such things, we will say that we are trying to do preservation. So, preservation is maintaining the thing as it is without any further human interference. Whereas, when we talk about conservation, we permit human interference; we permit extraction of resources from the natural environment. Because we have a large population and we have a lot of aspirations associated with this population.

People need certain resources to exist to survive; everybody needs access to food, water, clothing, shelter. And in the today's world we also need access to things like internet or electricity or computers or mobile phones. Now, to make provisioning to these resources or these wants of people; we need resources, natural resources.

So, if you want to provide people with electricity; you will either have to dig out coal and use it in thermal power plants. Or you will have to say stop the rivers, create dams to get hydel power; or you would require solar panels, and solar panels again would require the extraction of several minerals. So, that you have the (materials) to be used in the solar panels and so on.

So, if you need electricity, you need natural resources. Now, these natural resources can only be had if we extract them from the nature. And so if we say that we want to preserve nature as it is; we will not be able to extract these resources. And such a situation will not be acceptable to most people. Now, in most of the countries in this world, we have democracy.

So, we cannot just say that we are going to preserve nature, and we are not going to provide any resources to people; that is not going to happen, and so we have shifted from preservation to conservation. Now, of course preservation also is needed in certain situations. For example, if there is a species that is extremely under the threat of extinction. If we do not preserve its habitat, the species will become extinct in no time; in that case we will go for preservation.

So, preservation also is needed; but, in it is very different from conservation. So, preservation is a more extreme form of conservation; where we do not permit any human interference. But, at the same time in certain cases preservation is not going to help us achieve our objectives. Because, in cases where the habitats are already extremely degraded.

Then, if we went for preservation, we will not permit any human interference; and in that case we will not be able to restore the environment back to a good state. So, in such situations conservation also becomes important, and we will have to let go of preservation. So, preservation, meaning allowing some places and some creatures to exist without significant human interference maybe necessary in certain situations, but not all; and it is very different from conservation. Now, similarly when we talk about environmentalism, we are talking about concerned about the impact of people on environmental quality. So, in this case the main objective is the environmental quality; the level of pollutants that we have in our air, in our water, in our land, in our food and so on.

So, when our focus is only on the quality of the environment; we will say that we are talking about environmentalism. When we talk about environmentalism, we are not that interested in knowing the level of extinctions, the sizes of populations of various species; and things like that we are only concerned about environmental quality.

So, this is related to conservation because if you perform conservation; the environmental quality also increases, improves. But it is different from conservation. So, when we say

environmentalism it is not the same thing as conservation. Similarly, when we talk about Ecology, Ecology is the science of relationships between organisms and their environments.

Now, Ecology is related to conservation; but Ecology is not the same as conservation. If you want to conserve wildlife, you need to know what they require; the kinds of food that they need, the kinds of shelter that they need; the kinds of resources that they need, the threats that they are facing; the predators that they have to deal with, the diseases that they have to deal with.

And all of these come under the topic of Ecology; because Ecology is the science of relationships between organisms and their environment. And this environment includes not just the abiotic environment meaning the air, the water, the land. But, it also includes the biotic environment other organisms that are living with the organism of interest.

So, when we say a relationship with the environment, we are talking about relationship with its predators, relationship with its preys, relationship with other competing species, relationship with pathogens, relationship with vectors, diseases and so on. So, Ecology being the science of relationships between organisms and their environment is a very important subset of conservation; but, it is not the same as conservation.

Ecology is necessary or the knowledge of Ecology is necessary to perform good conservation; but it is not the same. In other words, Ecology is the science and conservation is the application of that science for certain benefits, for conserving the natural environment, for conserving the organisms. So, conservation is related to preservation, environmentalism and Ecology; but it is not the same as preservation environmentalism or Ecology.

And this difference need should be kept in mind. Of late these fields of conservation, preservation, environmentalism have become very important; because we have understood that we have made a huge impact on the environment. And if nothing is done to undo those impacts, then we may be in a situation where there will be huge changes in the Ecology of different areas. So, we will have huge ecological consequences. The breakdown of ecosystems and so these fields have now become more and more important.

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Module 1: Introduction to the course The need for conservation

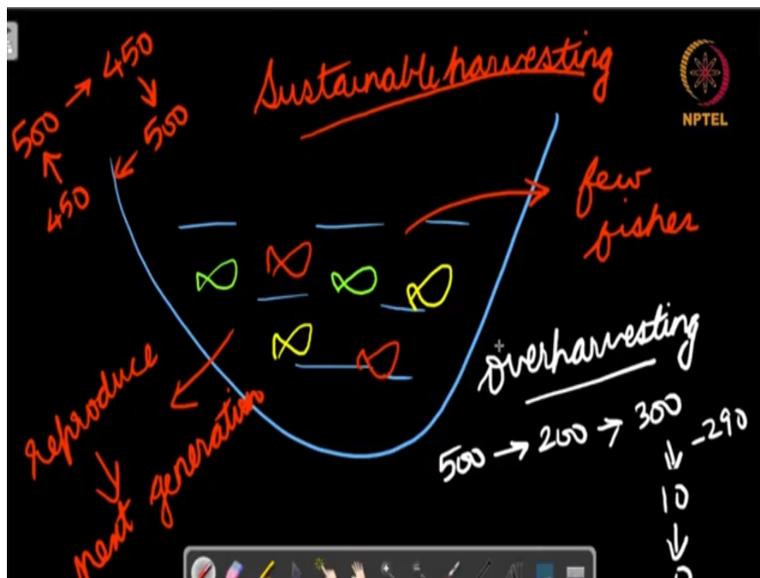
### Human impacts on the environment I

- 1 Overconsumption
- 2 Habitat destruction
- 3 Desertification
- 4 Ocean acidification
- 5 Ozone depletion
- 6 Changes in biogeochemical cycles such as nitrogen cycle
- 7 Loss of biodiversity and extinctions
- 8 Changes in distribution of organisms, changes in biodiversity
- 9 Climate change
- 10 Soil erosion and changes in geomorphology: deposits derived from concrete, lime, mortar or other calcareous material outside the cave environment

Dr. Ankur Awadhya, IFS Conservation Geography

So, what are these human impacts on the environment? The first one is overconsumption. Now, consumption of resources is necessary to provide people with their needs and wants; so, for instance we need to provide people with food. But, with an increase in our population and with a shifting towards those sources of food, that require more resources to be produced. We are now in a situation where we are over consuming the resources.

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Now, if you consider the example of say a pond. Now, in a pond you have water and you have several fishes; now, humans are taking out these fishes for food. Now, if we take out the fishes in a sustainable manner; so if we do a sustainable harvesting, it would mean that we take out a few fishes. And typically those fishes that have already grown in size, those fishes that have already become very aged.

And if we take out those few fishes, if we consume those fishes; then the other fishes that remain in the pond, they will be able to reproduce. And with this reproduction they will be reproducing the next generation. Now, suppose this pond has say 500 fishes; out of 500 fishes we take out 50 and so the pond is left with 450. We give it time and then this population of 450 will again bounce back to 500.

Once it has bounced back to 500, we can again take out 50; and this process can go on and on and on for a very long period of time. Now, this is sustainable harvesting. But, on the other hand, if we did an overharvesting; it would mean that from 500 we took out say 300 fishes, and now only 200 remain. Now, we give it certain time; but then because the number of fishes is very less.

So, there are less number of parents, with less number of parents, less number of offspring are born. Because remember that at every stage there are also other organisms that are eating these fishes. The fishes are also dying because of natural causes. So, if we bring them to a population which is 200; then after some time the population increases and say it becomes 300.

Once it has become 300, we again take out a huge quantity; we again take out roughly 300 fishes. But, we were able to take out 290. And when we take out 290 fishes; now only 10 fishes remain in this pond. And in a short period of time, this figure will go down to zero; so this is overharvesting. We are taking out resources at a much faster pace than at which the nature can replenish the resources.

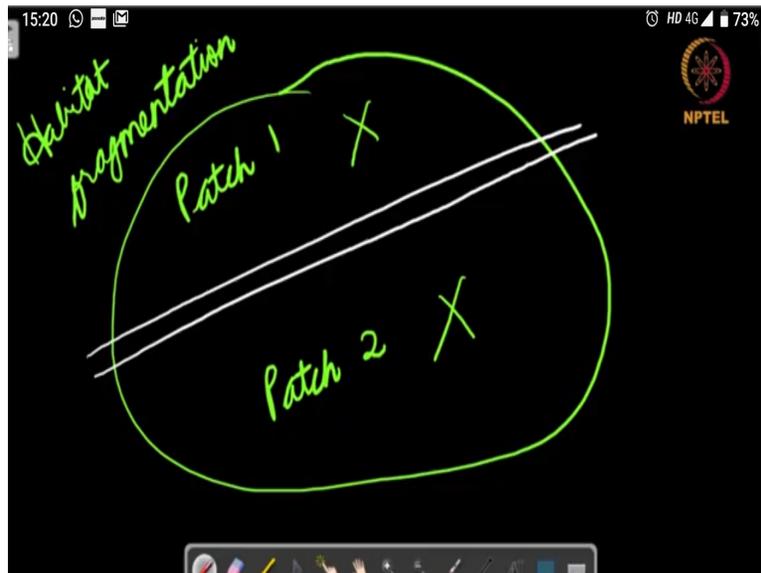
And today we are overharvesting several resources. We are overharvesting the fishes in our oceans because of which their numbers are going down. We are overharvesting the mammals like whales; their numbers are also going down. We are overharvesting the trees in the forest; because of which we are now observing huge scale of deforestation.

We are overharvesting our groundwater resources; meaning that we are taking out groundwater resources at a much faster pace than at which nature is able to replenish them. And in many areas now the water levels are going down; so this is overharvest of resources over consumption. Next we are also doing large scale habitat destruction. Now, habitat is the place which is a natural abode or the natural home of an organism.

Habitat is the place that provides the organisms with the resources that they need. So, habitats provide them with a place to live a shelter, some sort of a cover. They provide them with food, with water and they are those places where the predators are not that many. And so the species are able to survive in those areas.

Good examples of habitats include things like forests or grasslands. Now, we are doing a large scale habitat destruction; now why we are doing habitat destruction? It has got to do with overconsumption of resources; but it has also got to do a lot with faulty planning.

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So, for example, if you consider a large sized forest; so if this is a forest. And this forest is providing resources to several organisms. Now, what do we do? We construct a road through this forest. Now, once you have constructed a road, now you have two small patches of forest that remain; so, this is patch-1 and this is patch-2. Now, for the case of a large number of species like elephants or tigers; they require larger share of resources.

Why? Because an elephant is a mega herbivore; it needs to feed a lot. Because it has to sustain a large sized mass; and so an elephant feeds for like 16 to 18 hours in a day. The elephant feeds on leaves, branches or bark of different trees. Now, in a situation where you have a very small sized forest and you have a herd of elephants; in no time they will finish off all the plants, and then they will be no more trees that remain in that area.

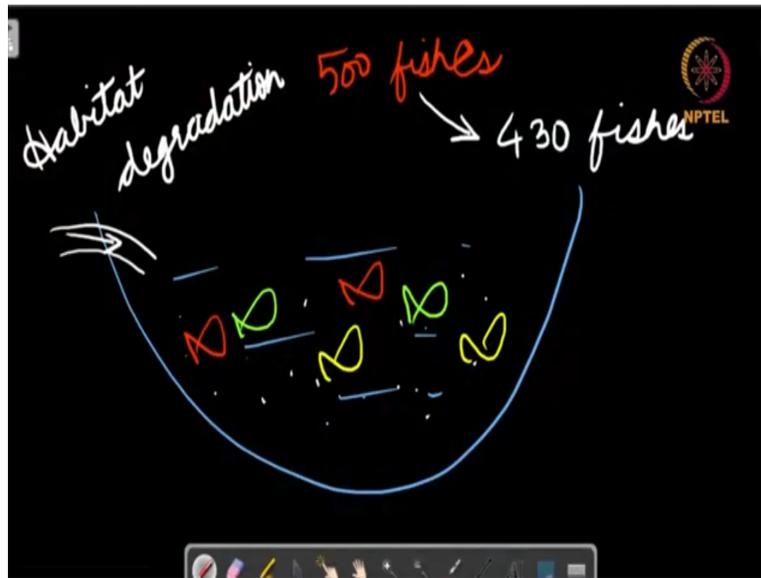
And so nature has provided them with a mechanism to avoid this overharvesting of resources; the elephants keep on moving. And so in a large size forest they will be eating up some parts of plants here and then they will move. After few hours they will start to eat at some other place, after some more hours they will start to eat at some other place; and so by the time they are able to come back to the first position nature has had enough time for the plants and trees to replenish themselves.

But, what happens if we convert the forest into small patches. Now, if we convert the forest into smaller patches, then in both of these patches there will be an overuse of resources by the elephants; because, the elephants are now no longer able to cross this road. Especially in those cases where you have a very high amount of traffic load on this road; so the elephants will not be able to cross.

Similarly, if we talk about animals like tigers, now tigers also require a large area; because they have a requirement of prey. And if you have a small sized forest, then the tigers would be overusing the prey resources; and in a short time there will no longer be sufficient prey available in the forest. So, the tigers also need a larger area.

But, once we have divided the forest into smaller patches; then you may have a situation where the first patch is no longer able to sustain tiger; the second patch is also no longer able to sustain the tiger. And this situation is known as habitat fragmentation; and through the process of habitat fragmentation, we are dividing or fragmenting the habitats into very small portions. Now, along with habitat fragmentation we are also doing habitat degradation. Now, habitat degradation can be explained through again the example of a pond.

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So, you have this pond with water and with several varieties of fishes. And these species are living in the water, and say the pond is able to support 500 fishes. But, now what is happening is that we have a town that has come up in the vicinity and the town is giving off sewage. And that sewage is now being thrown into this pond; that is we are now polluting this pond. We will come to this pond and near the pond they are throwing plastic waste.

Now, once we increase the pollutant load in the pond; then what do you think will happen to the number of fishes? Currently, the pond is able to support 500 fishes, but with more and more pollution - suppose, the number of fishes that the pond is able to support reduces; so now it is able to support 430 fishes. This situation is known as habitat degradation; that is we are reducing the quality of the habitat.

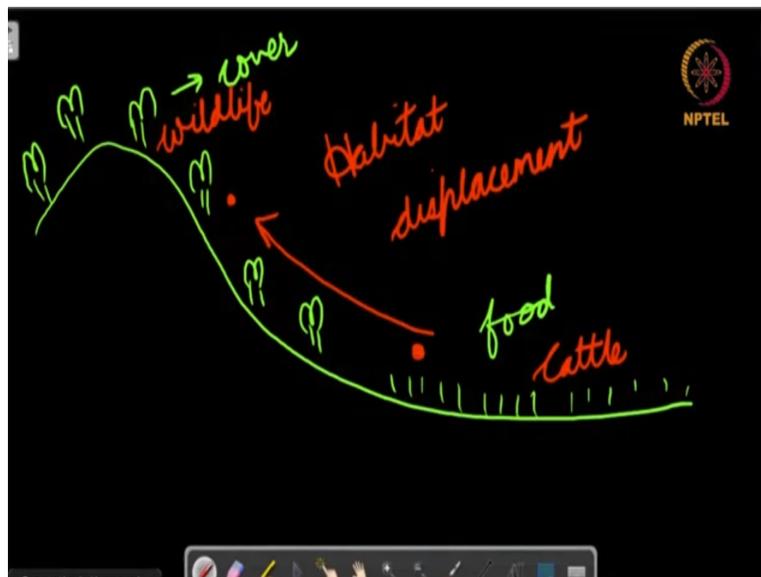
And we are reducing the quality of habitat through a number of ways, by dumping sewage, or by dumping industrial effluents into our water bodies without properly treating them. Through the exhaust of our automobiles, we are doing a lot of air pollution. Near our cities we are using so much of light that now the animals are unable to sleep properly.

They are now facing disturbances in their natural patterns. So, for example, there are a large number of animals that hunt in the night time. And if there is a sufficient amount of light that is available; they will not be able to hunt that efficiently. Because their cloak of darkness, their cover of darkness is now gone; so, light position is also becoming a major issue.

Sound pollution again is a major issue. So, through all of these mechanisms we are not killing off the animals; but, we are degrading their habitats. So that now the habitats are able to support lesser and lesser number of organisms. Now, if habitat degradation and habitat fragmentation are taken to their extremes; that is we spew out so much amount of pollutants into the habitat that now the habitat is no longer able to support any animal.

Or we fragment the habitats into such small portions that now animals are unable to survive in any of these portions. In those cases we will say that we have committed a habitat at loss, a complete loss of the habitat. Also in certain cases we are observing habitat displacement.

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Now, habitat displacement means that if you consider say a hilly area and a plain area. Now, in the plain area you will be having lots of grasses; and in the hilly area you will probably be having lots of trees. Now, there are a large number of animals that require both of these; because the trees provide them with cover that is a protection and the grasses provide them with food.

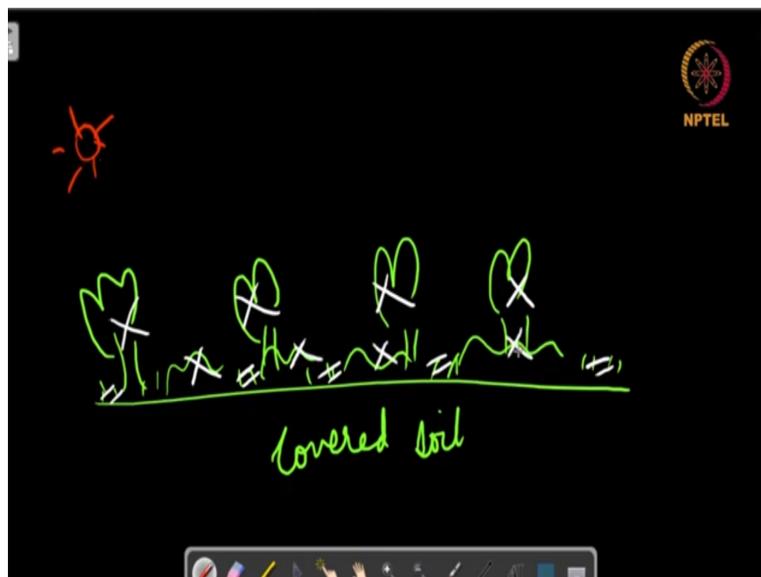
But, now when humans enter into the scene, they bring their cattle here; and with the cattle they are also bringing their dogs. And they are also bringing their sticks; they are also bringing their weapons. Now, a large number of wildlife is unable to compete with the might of humans; and so slowly and steadily we will find that all the wildlife are getting accumulated in these hilly areas. And in the plain areas, you do not find a single wildlife.

Now, this process is known as habitat displacement; that is you are displacing the wildlife from a position here to a position here. Now, what will be the consequences? The forests are able to support the wildlife; but, primarily in the form of a cover. So, they provide them with shade, they provide them with protection; they provide them with hiding spaces.

But, probably these forests do not have that much amount of food or water, as would have been available in the grasslands; because typically we have our rivers, our streams that flow in the low-lying areas. And because of the presence or abundance of water you have lots of grasses which the animal can use as food.

Upon the hills they will not be finding that huge amount of grasses. Now, if less food is available, if less water is available; the population that can be supported will also go down. And so habitat displacement is also leading to a loss of these habitats. So, through these four processes of habitat fragmentation, habitat degradation, habitat loss and habitat displacement; we are actually doing a destruction of the habitats. And because of that a large number of our species are now on the brink of extinction. Another human impact on the environment is desertification.

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Now, the desertification happens because in a natural situation; you have trees, you have shrubs and you have grasses. And with all of these the soil is always covered; so you always have a covered soil. That is when you consider the Sun which is giving out its Sun rays; the rays are unable to desiccate the soil, so the soil does not become dry.

But, with the coming of humans we are now cutting down the trees because we want timber, we want lumber. We are cutting down these grasses for our cattle and we are cutting down these shrubs; so that we can now make use of this space as an agricultural field. Now, if you consider any agricultural field in your in your vicinity, you will find that agriculture moves in certain seasons.

So, there will be certain seasons where the ground will be covered with plants; and in other seasons once the crop has been harvested, the ground will be left bare. Now, when this ground is left bare; you will have a situation where the rays of the Sun are able to desiccate the soil. Also we are overharvesting our groundwater resources; we are overharvesting our river resources, we are overharvesting our pond resources.

So, with the water gone from the soil, with the water gone from the water table, with the water gone from the ponds and lakes and rivers; what will be the situation? We will have a situation of dryness or a situation of desertification. And we are observing that in most of our deserts, the deserts are actually expanding; because near the deserts as well we are having an over use of resources.

We have large cattle population, goat population, sheep population, which are rapidly denuding whatever ground cover is left of plants. And this is another major human impact on the environment. We are leading to acidification of oceans. Why? Because we are spewing out so much amount of carbon dioxide into our atmosphere; when we are burning coal or petroleum or natural gas that now the concentration of carbon dioxide has increased a lot.

It has roughly increased by 30 percent in the last 400 years. And so now so much amount of carbon dioxide is available that when it rains, a large amount of carbon dioxide comes down into the oceans in the form of carbonic acid. And with more and more carbonic acid in our oceans, the oceans are now having a situation where the pH is going down; they are now becoming more and more acidic.

Now, why should that be an issue? That becomes an issue primarily for two reasons. One: similar to the spewing of pollutants; the pollutants degrade the habitat and they reduce the quality of the habitat. Now, similarly if you talk about many of the marine organisms; they require a certain pH. They are not able to survive in very acidic or very alkaline situations.

So, when you make the oceans more and more acidic; you are degrading their habitats. Now, at the same time the second reason is that a large number of ocean or dwelling organisms have their shells that are made out of calcium carbonate. So, when you think about a large number of shell organisms or when you think about corals; their bodies are made out of calcium carbonate.

And calcium carbonate dissolves in acidic conditions; and with more and more acidification of the oceans, now the organisms are finding it more difficult to create their calcareous shells, and whatever shell remains is now slowly and slowly dissolving away. Now, without the protection of these shells, these organisms will not be able to survive. And especially in the case of organisms like corals - the corals are keystone species meaning that they support a large number of other organisms; because a large number of fishes use corals for protection. A large number of fishes use corals for laying their eggs and with the coral stone. There will be no more laying of eggs; because the fishes will not find a suitable place to lay their eggs.

And with the corals gone, we are rapidly observing a very large scale destruction of a large number of species. So that is ocean acidification, another human impact on the environment. We are observing a depletion of the ozone layer; because we are spewing out chemicals like chlorofluorocarbons or hydro fluorocarbons. And these chemicals reduce the concentration of ozone in our upper atmosphere.

Now, ozone is a layer of gas, ozone is O<sub>3</sub>; so that is 3 oxygen atoms combined together. And once you have this layer, it protects the organisms on this planet from the ultraviolet rays of the Sun; because the formation of ozone requires ultraviolet light. And so when the ozone layer is getting formed, you have less amount of ultraviolet light that is coming to the surface of the planet.

But, with these chemicals, the ozone layer is now not getting formed; the ozone layer is getting thinner and thinner. And when the ozone layer becomes thinner, you have more amount of ultraviolet light that comes to the planet's surface. And so now the organisms are getting exposed to more amount of ultraviolet light; now, that leads to situations like cataracts.

So, the eyes become - the lenses in the eyes they become whitish in color; the organisms lose their eyesight. They increase the frequency of skin cancers and these are some things that we are

already observing in many populations. So, the depletion of ozone is another human impact on the environment.

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Module 1: Introduction to the course The need for conservation

## Human impacts on the environment I

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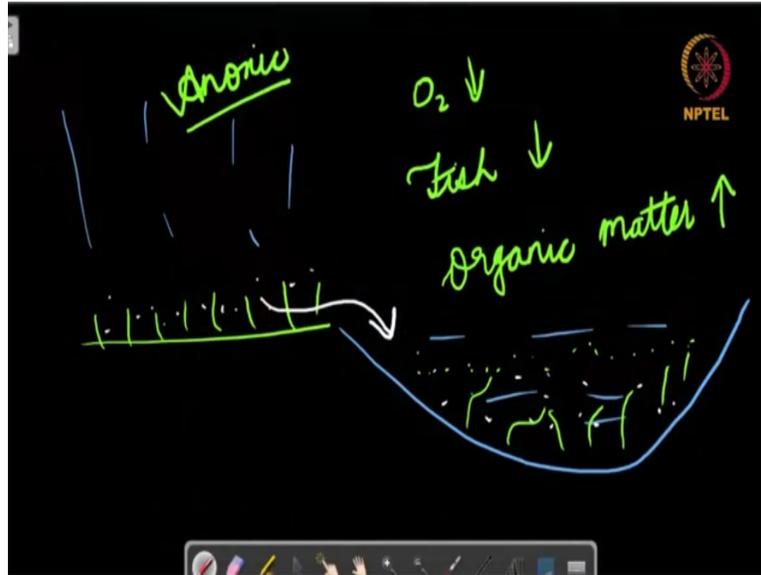
- 1 Overconsumption
- 2 Habitat destruction
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We are making large scale changes in biogeochemical cycles or nutrient cycles; such as the nitrogen cycles. Now, the biogeochemical cycles are cycles through which nutrients move through the lithosphere, hydrosphere and atmosphere and biosphere. So, they ensure that at all points of time organisms have access to different nutrients.

But, what we have done is that we have generated so much amount of fertilizers that now we are playing with this cycle. That is now we are putting so much amount of nitrogenous fertilizers in our croplands; that now a large amount of these nitrogenous fertilizers are making their way into the water bodies.

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So, what is happening is that you have this cropland, where you are putting large amount of nitrogenous fertilizers; and with the rains these nitrogenous fertilizers are able to make their way into the ponds. So, when whenever it rains, you have some amount of nitrogenous fertilizer that is coming into these ponds.

Now, the fertilizer is helping the plants to grow fast and similarly when you have the fertilizer in the water body; the plants that are there in this water body typically the algae. They will bloom like anything and the aquatic plants will bloom like anything. And so you will have situation where you have lots of organic matter in the water.

So, the amount of organic matter goes up, which is good in the short term; because we are also taking out carbon dioxide from the atmosphere. But, in the medium term what happens is that so much amount of plants are there or algae is there in the water bodies that now the fishes have less and less habitat. So, this is acting to degrade the habitat and so the fish population will go down; and after a while you will have a situation where so many plants are now dying.

Because you have a large amount of organic matter; now, that has to be decomposed. When that is decomposed by the microorganisms, you will have a situation where the oxygen concentration in water will go down. So, you are converting the lake into an anoxic lake; so now the lake has no oxygen. And when the oxygen is not there, all the plants and animals in the lake will die off.

So, because of these impacts, because of these changes through excessive use of fertilizers we are now killing off our lakes and ponds. That is another huge human impact on the environment. Because of all of these we are seeing losses of biodiversity and extinction. We are observing changes in the distribution of organisms and changes in biodiversity; especially because of things like climate change.

A large portion of climate change is occurring because we are overusing the fossil fuels. So, we are using so much amount of coal or petroleum or natural gas that the concentration of carbon dioxide in the atmosphere is now going up. Now, carbon dioxide happens to be a greenhouse gas, which means that it traps the Sun's heat on the planet.

Now, that is an important part for the survival of life; because in the absence of greenhouse gases we will have a situation, where the planet will cool down very quickly when there is the night time. And so it will literally freeze in the night time and the organisms will die off. And so the Earth actually requires some amount of carbon dioxide to maintain the climate.

But, with the concentration of carbon dioxide that is increasing; now we are having a situation where more and more amount of Sun's heat is getting trapped in the planet. And so the temperatures are now going up. We are not only increasing the concentration of carbon dioxide, but our activities have also increased the concentration of greenhouse gases like methane.

Now, methane is getting released when we do agriculture where the land is completely inundates with water. So, if you think about say a paddy field, then a paddy field will release lots of methane; because there is an anoxic condition that gets created and that leads to the emission of methane. Huge quantities of methane are also getting emitted because we now are maintaining a very large cattle population. Now, with an increase in the greenhouse gases with an increase in global warming; what is happening is that the planet is warming up and how does that matter.

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Consider a hill. Now, we know that the temperatures reduce when we go up that is near the Earth's surface; it is much hotter or let us say much warmer. So, this place is warmer and on the top it is cooler. Now, consider a species that requires a temperature of somewhere here; so it cannot survive in very hot conditions, it cannot survive in very cold conditions.

But, now you are increasing the temperature of the Earth and so with the increase in the temperature, this point is now warming up. So, what will these organisms do? They will shift their range; that is they will start to move upwards. So, this is a shift in the range where the organisms are found. So, in an organism that lives here will shift here, an organism with which lives here will shift here; an organism which lives here will shift here and so on.

But, the question is what will the organism that lives here do? This organism lives in a very cold condition; and now you are warming up its habitat. It has got nowhere else to go; and so this organism will become extinct. And this process in which the organisms are moving up the mountains towards their extinction is known as the escalator to extinction.

So, the organisms are moving up the escalator towards their extinction. And during this process we are observing that there are huge amounts of extinctions, and we are observing huge changes in the ranges of different species. So that is a change in the distribution of organisms and changes in biodiversity. Not only that we are also observing changes in the behavioral patterns of organisms, changes in the phenology of organisms.

So, for example, if there is a plant that blooms in late spring; now we are observing that it is blooming in early spring. Those plants that bloomed in early spring, they are now blooming in the late winters. So, the timing is changing; now that timing also has a huge repercussion on different organisms; because after blooming you will have the production of fruits, and these fruits are the food of other organisms.

So, if you have a situation where there is a bird that feeds on the fruits of a particular tree; then the bird will lay its eggs to coincide with this fruiting season. So that when the young ones come out of the eggs, then they have sufficient food that is available. But, now we are getting a situation where there is a loss of synchrony between both of these activities.

So, when the chicks hatch out, they are now facing a situation of food shortage; that again is leading to the extinction of large number of species. So, we are observing these human impacts on the environment; another impact is the soil erosion and changes in geomorphology. Because we are denuding the soil cover, we are removing all the trees and plants.

So, now it is much easier for the soil to get eroded. So, we are now observing that in many places, we no longer have the soils; and the soils that have been eroded, they move to other places and they get sedimented in other places. Now, how does that impact us.

(Refer Slide Time: 44:15)



Module 1: Introduction to the course The need for conservation

## Human impacts on the environment I



- 1 Overconsumption
- 2 Habitat destruction
- 3 Desertification
- 4 Ocean acidification
- 5 Ozone depletion
- 6 Changes in biogeochemical cycles such as nitrogen cycle
- 7 Loss of biodiversity and extinctions
- 8 Changes in distribution of organisms, changes in biodiversity
- 9 Climate change
- 10 Soil erosion and changes in geomorphology: deposits derived from concrete, lime, mortar or other calcareous material outside the cave environment

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Consider a delta; so in a delta you have a river that is breaking into its distributaries. And it is depositing the sediments; so the sediments that this river was bringing, they are now getting deposited here when it is reaching the sea. Now, when you have a situation where more amount of sediments come into this area.

Then that changes the geomorphology; because, now the delta will spread. On the other hand, we are also constructing dams in certain locations. So, if you constructed a dam, then all of this silt will get accumulated here, and less amount of silt will reach into the deltas; which would mean that the deltas would start to shrink.

So, we are observing changes in the geomorphology of the planet. We are now observing that deposits that are derived from concrete, lime, mortar or other calcareous material outside the cave environments. Earlier we used to find these calcareous deposits on the land only in the caves. But, now we are finding these everywhere because we are extracting these minerals; we are using them to make concrete and using them to make our homes.

And once the homes have finished their active life; then the houses get demolished and now we are getting an excess of calculus deposits everywhere. Now, that is also changing the habitats of several organisms.

(Refer Slide Time: 45:59)

Module 1: Introduction to the course The need for conservation

## Human impacts on the environment II

NPTEL

- ① Changes in stratigraphy due to increased sediment load and deposition (reasons: deforestation, construction activities, etc.)
- ② Changes in elements in the atmosphere: C-12 released from fossil fuels, radionuclides released from nuclear fallout and atomic reactors
- ③ Changes in soil: water logging, desertification, build-up of pesticides and other chemicals
- ④ Introductions and invasive species
- ⑤ Pollution, including light pollution
- ⑥ Coral bleaching
- ⑦ Wars

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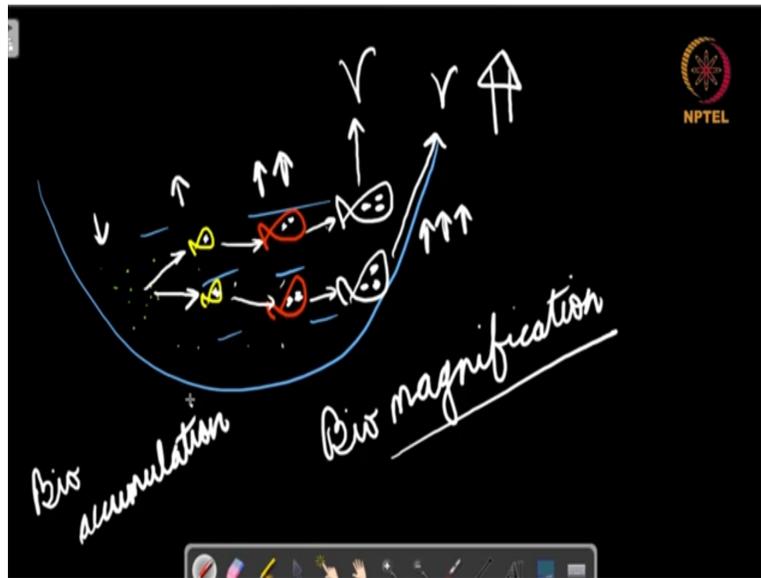
We are also observing changes in stratigraphy due to increased sediment load and deposition. We are observing changes in elements in the atmosphere; we are observing changes in the carbon-12, carbon-14 ratios. We are observing those radionuclides that were never observed before in the history of the planet; because we are now making atomic weapons.

We are now making atomic reactors. And so now, those radionuclides are being created and released that never existed before; that is also a huge impact on the environment. We are observing changes in the soil. Water logging in those areas where we are doing excessive irrigation, so especially in the desert areas if you bring lots of water by digging a canal.

And you put lots of water then your soil becomes oversaturated with water; because you have a layer of constricted nodules down below the soil. And once you put lots of water, the soil will become completely saturated. In a completely saturated soil, plants cannot thrive; because the roots of plants they require water, but they also require access to some amount of air. So, we observe things like the rotting of roots in those areas.

So, we are observing water logging, we are observing desertification, we are observing a build up of pesticides and other chemicals; and in a large number of cases, these pesticides also bioaccumulate and biomagnify. What is that mean?

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Again if we consider a pond environment; so in the pond you have algae. And these algae are eaten up or these planktons are eaten up by small fishes. Which in turn are eaten up by larger sized fishes, which in turn are eaten up by even larger sized fishes, which in turn are eaten up by birds. Now, when you have a concentration of pesticides that has come into this environment; then these pesticides reach into the bodies of these algae and the phytoplanktons.

From there they move into the bodies of the smaller fishes; then into the bodies of the larger fishes, then even larger fishes; and then to the bodies of birds. But, what happens in this process is that one fish is not going to eat just a single algae, or just a single plankton. It is going to eat a large number of planktons and so the pesticides that were there in the bodies of so many planktons.

They now get accumulated in the bodies of these fishes; and so the concentration has gone up. Here the concentration was low; now the concentration is high. Now, these fishes will eat a large number of these small fishes for food and so the concentration would increase even further. Then these fishes would be eating a large of red fishes and so the concentration goes up even more.

And then in the birds because they eat a large number of these large fishes; the concentration is so huge that now we are observing large scale changes. Huge amount of toxicity, as we move up the food chain; now, this process is known as bio magnification, because we are observing a magnification in all of these biological organisms. There is also bio accumulation that is

happening; because once the pesticides have reached into the bodies of these organisms. Now, the pesticides cannot be removed from the bodies.

The pesticides get accumulated in the fat tissues of the body, and so now they cannot be taken out of the body. So, once an organism has been exposed to these pesticides; these pesticides are going to remain in the body of this organism for a very long period of time. Probably till its death and with bio magnification at higher echelons of the food chain; we are now observing huge toxicities.

A large number of birds are now disappearing because of this bio magnification of pesticides; so that is another human impact on the environment. We are observing introductions and invasive species. Now, invasive species are those species that we have taken out of their natural habitats, and we have brought to some other areas. A very good example is the plant called Lantana camara which was brought from Africa into our country.

Because, the flowers look beautiful and so people thought we are going to use them for horticultural purposes; we are going to plant them in gardens. But, then Lantana camara is an invasive species in the Indian context. Why? Because the plant is toxic and so many animals do not eat up this plant; so, it has less number of predators.

But, then it produces a large number of seeds and the fruits are sugary in nature; they are sweet in nature. And so the birds will come, they will eat up the fruits, and then they will take the seeds with their bodies; and once the birds give out their droppings, the seeds are spread to very large areas. The seeds are extremely hardy. So, even if there is a forest fire, after the forest fire you will find that the seeds will be able to germinate.

They are extremely resistant and they are slowly replacing our native flora in the forest. So, the native plants are not able to compete with Lantana camara. Now, this would not have happened, if humans had not brought this plant from Africa into India. So, we are now observing introductions of organisms into newer habitats, we are now observing invasive species that are spreading into different areas destroying the habitats.

(Refer Slide Time: 52:32)

Module 1: Introduction to the course The need for conservation

## Human impacts on the environment II

NPTEL

- ⑩ Changes in stratigraphy due to increased sediment load and deposition (reasons: deforestation, construction activities, etc.)
- ⑩ Changes in elements in the atmosphere: C-12 released from fossil fuels, radionuclides released from nuclear fallout and atomic reactors
- ⑩ Changes in soil: water logging, desertification, build-up of pesticides and other chemicals
- ⑩ Introductions and invasive species
- ⑩ Pollution, including light pollution
- ⑩ Coral bleaching
- ⑩ Wars

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Another impact is pollution, including light pollution; we are observing coral bleaching and death of corals; and we are observing large scale habitat destructions because of wars.

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Module 1: Introduction to the course The need for conservation

## Quantum of human impacts

NPTEL

$$I = P \times A \times T$$

where

I = impact of human activity on the environment ;  
P = Population in an area. The area could be as large as the whole world.  
A = Affluence (average consumption of each person in the population).  
Affluence is generally measured through the values of GDP per capita.  
T = Technological advancement, a measure of how resource intensive the production of affluence is.

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Now, these human impacts on the environment can be quantified by this equation: I is equal to P into A into T. Essentially it says that the impact of humans on the environment is determined by the population in the area. If there is an increase in population, there is an increase in impact; because there are more number of people who can put on an impact on the environment.

It increases with affluence; affluence is the average consumption of each person in the population; we can represent it through GDP per capita. And it is influenced by the technological advancement; meaning how much resource intensive the production of affluence is. Now, if you look at our populations we find that the impact has been increasing; because our population sizes have gone up. We are now more and more on this planet, our affluence has gone up; because we now have more and more money.

We now have more and more things, we have more and more wants. And the technology has gone up, which now enables us to extract these resources from the nature to feed our population and our affluence. And because of that the impact of humans has gone up like anything; and because of that we have observed huge large scale habitat destructions, large number of organisms getting extinct.

And because of that now conservation has become more and more important. So, conservation is important because we have already had huge impacts on the environment. And now we are also facing the music, we are suffering the consequences. Our crops are failing; we are getting more and more diseased; our ecosystem services are now failing and so on. So, we need conservation if we need to survive.

(Refer Slide Time: 54:50)

Module 1: Introduction to the course    The need for conservation

In this course, we look at all of these: I

- 1 Module 1: Introduction to the course
  - The need for conservation
  - Geography and conservation
  - Biogeography
- 2 Module 2: The Earth
  - Origin and evolution of the Earth
  - Structure of the Earth
  - Features on the Earth
- 3 Module 3: Lithosphere and landforms
  - Rocks and minerals
  - Geomorphology and processes
  - Evolution of landforms
- 4 Module 4: Atmosphere
  - Structure and composition
  - Atmospheric circulation and weather
  - Climate and climate change
- 5 Module 5: Hydrosphere

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Module 1: Introduction to the course The need for conservation

In this course, we look at all of these: II

- Structure and composition
- Oceans and water movement
- Hydrological cycle
- 6 Module 6: Physical Geography in the Indian context
  - Structure and physiography of India
  - Climate and habitats of India
  - Drainage systems
- 7 Module 7: Biosphere
  - Soil
  - Life on Earth
  - Biodiversity
- 8 Module 8: Conservation of biodiversity
  - Threats to species
  - Ex-situ and in-situ conservation
  - Benefits from conservation
- 9 Module 9: Human population and conservation
  - Population and population growth - I

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Module 1: Introduction to the course The need for conservation

In this course, we look at all of these: III

- Population and population growth - II
- Human development and sustainable development
- 10 Module 10: Resources and conservation
  - Land resources and agriculture
  - Water resources
  - Mineral and energy resources
- 11 Module 11: Economic Geography and conservation
  - Transport and communication networks
  - Trade
  - Settlements
- 12 Module 12: Special topics in Geography and conservation
  - Remote sensing and GIS
  - Disasters
  - Valuation of natural resources
- 13 Module 13: Summing up and discussion

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So, in this course we are going to look at all of these topics; we have looked at the need for conservation. We are going to explore what is the field of geography, how is it related to conservation; and we are going to look at biogeography, which is the distribution of different organisms on this planet. In the second module, we will explore the Earth; we will look at the origin and evolution of the Earth from its very beginnings.

We will look at the structure of the Earth, what is the Earth from the inside. We will look at the features on the Earth or the geomorphology of the planet. Then in the third module, we will look at lithosphere and landforms; where we will look at rocks and minerals, which form the

lithosphere. We will look at geomorphology and processes that result in the evolution of various different landforms on this planet.

Now, this is important because different organisms are found in different landforms. You have very different organisms that are found in the plains as compared to those that are found in the hills. Then we will look at the atmosphere the structure composition, circulation, weather climate and climate change; and how that is playing a role in the survival of different species.

In the fifth module we will look at hydrosphere, structure and composition of the water bodies, oceans and water movement, and hydrological cycle. And we will sum up all of these in the sixth module, which is physical geography in the Indian context. Where, we will look at the structure and physiography of India, climate and habitats of India, and the drainage systems.

So that is more about the physical geography part; then we will move on to the biogeography portion and conservation. So, in the seventh module, we will look at biosphere; how are soils formed because soils support all life on this planet, life on Earth, biodiversity. And then we will look at conservation of this biodiversity; what are the threats to different species. And with the threats we will also make an estimate of the rate of loss of these species.

Then we will look at the options that we have to conserve these species; they are ex-situ, which is off-site conservation; and in-situ or on-site conservation. And why do we need to do this conservation? Because we get certain benefits from this conservation; so, we will explore the benefits in the next lecture. In the ninth module, we will look at human geography.

So, we will look at human population and its relation with conservation, population and population growth, human development and sustainable development. Then the tenth module is resources and conservation; where we will look at land resources, agriculture, water resources, minerals and energy resources; and how these are related with the topics of conservation.

The eleventh module is economic geography and conservation; where we will look at transport and communication networks, trades and settlements. And what are the options available with us to reduce our impacts on the environment. So, even in the case of things like settlements, we will explore how can we make our dwellings more environment friendly.

In the twelfth module, we will look at special topics in geography and conservation; things like remote sensing and GIS, which are now providing us with data to be used for conservation. We will look at disasters, and we will look at valuation of natural resources; and this will be followed by a summing up and discussion module.

So, basically in this course we are going to explore topics and conservation, topics in geography. And both of these are related because geography plays a role in determining where different organisms are found. And what are the processes that provide them with their own resources; things like food and water and shelter are being provided because of the phenomena of geography.

And when we are altering the phenomena of geography on this planet, we are creating a huge threat for different species. So, that is all for today; thank you for your attention. Jai Hind!