Natural Resources Management (NRM)
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Week - 02
Lecture - 08
Biodiversity & Conservation of Natural Resources Part 1

Welcome participants. Today's topic is Biodiversity and Conservation of Natural Resources. If you recall the previous classes, we were discussing about various paradigms of natural resource management. We also discussed about how different approaches are being used in the field of natural resource management.

In great detail, we also discussed with example, about those approaches, how it could be best utilized and the different factors responsible for efficient natural resource management. Today, we will look at biodiversity and conservation of natural resources. If you recall that in previous classes, we also discussed about the importance of biodiversity for the sustainable livelihood as well as the very existence of human kind.

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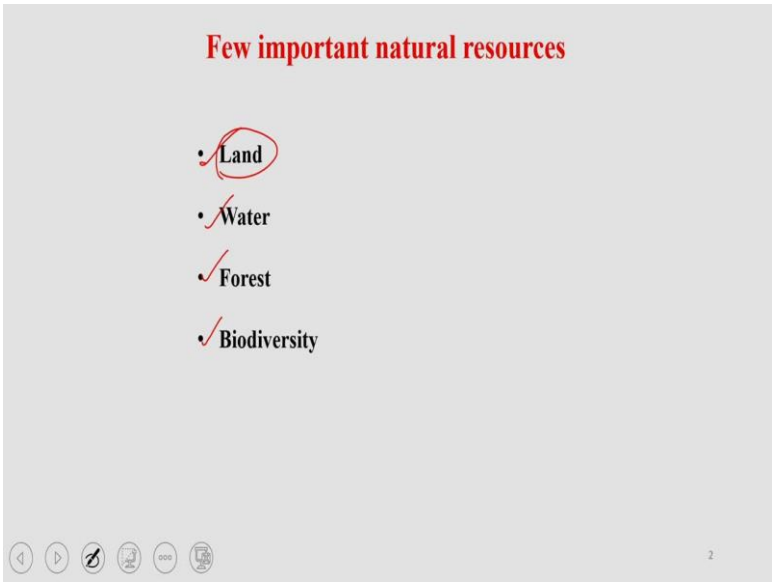

So, if you look at few important natural resources that we require for our sound life and sustenance and also a good quality life, and those are land, water, forest and biodiversity. So, I will look at the first resources, the first natural resources and one of the most important one that is land in great detail. Now, we all know that land or good quality soil is the very basic

need for human civilization, whether it is food production, whether it is some infrastructure development, you need always good quality soil and good quality lands also help us to have a efficient land use management.

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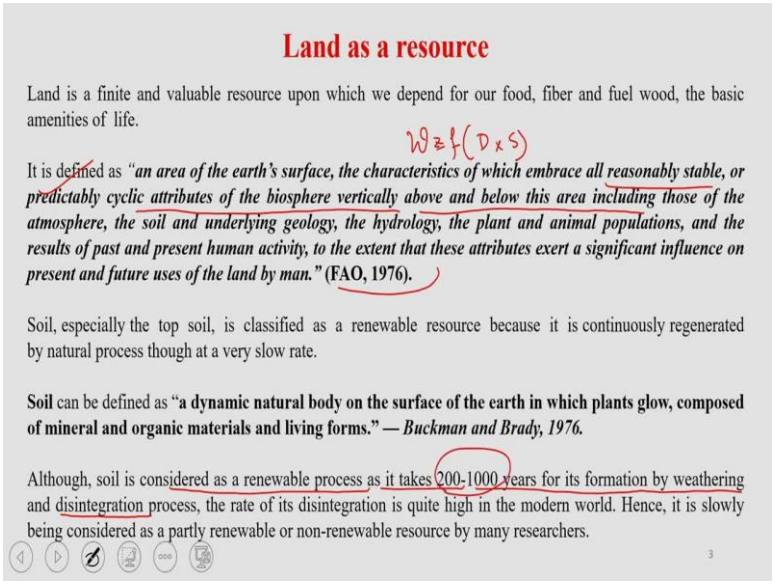

Now, if you look at land as a resource, land is a finite and also a very valuable resource and on which we largely depend for our food, fiber, wood and various other amenities of life. And often you will see that any adverse society they are largely regulated, or their advancement is largely depend on good quality land, fertile land, good quality soil.

Land is often defined as an area of the Earth's surface and the characteristics of which embraces all reasonably stable predictability cyclic attributes of the biosphere, vertically above and below this area, including those of the atmosphere, the soil and underlying geology, the hydrology, the plant, the animal populations, and the result of past and present human activity, to the extent that these attributes exert a significant influence on present and future uses of land by man.

This is how Food and Agriculture Organization, FAO describe land. Land, or soil especially the top soil is classified as a renewable resource because it is continuously regenerated by natural processes, though at a very slow rate. If any topsoil in any location or any site, it is lost, it could take thousands of years at time to get the same quality of top soil. So, soil can be defined as a dynamic natural body on the surface of the earth, in which plants grow composed of mineral and organic materials and living forms.

Although it is considered as a renewable process as it takes 200 to 1000 years for its formation by a very time taking process of weathering, which we know weathering as a function of disintegration and synthesis. So, through this weathering process, we get the soil but as I said that it is a very long process and a lot of time, almost thousands of years could be taken to be formed.

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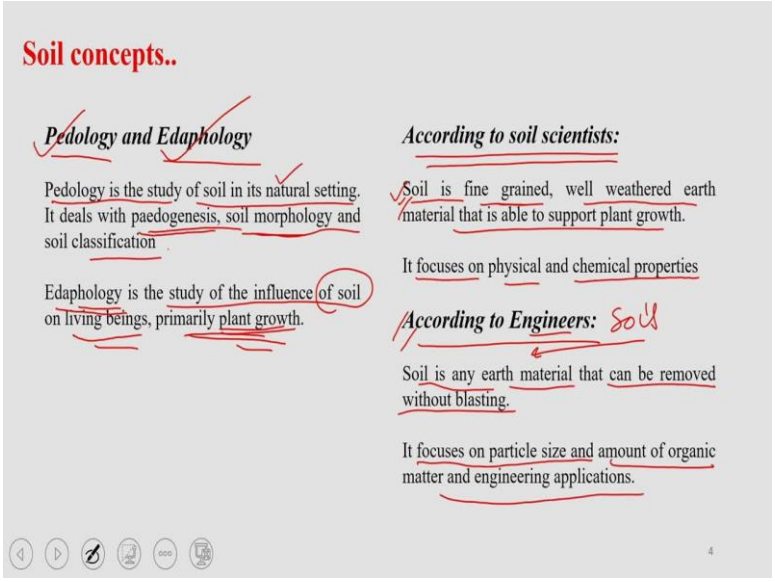

Now, in the field of soil or soil science, or to discuss about land, often few important concepts come into picture. One of them is Pedology, the other is Edaphology. Now Pedology is the study of soil in its natural setting, and it deals with the paedogenesis, the process of soil formation, soil morphology and its classification, whereas Edaphology it is the study of the influence of soil on living beings primarily plant growth.

So, the major difference between Pedology and Edaphology is that here, it supports the plant growth, the idea of supporting plant growth comes here Edaphology, whereas Pedology is basically a very physical process of soil formation, soil genesis and classification. So, soil by different discipline looked through different philosophy, while a soil scientist when he looks at soil, he defined soil as a fine grain, well weathered art material that is able to support plant growth. So, soil scientists also focus on the physical and chemical properties, but according to engineers, the same definition of soil becomes a little different. Engineers looks at soil as any Earth material that can be removed without blasting.

So, the way of defining a single thing that is soil by two different communities is very different. Engineers also focuses on the particle sizes, amount of organic matter and various

engineering applications, whereas soil scientists will look at the soil as a more biochemical chemical processes sustaining the life like plant, microorganism. So different discipline, look at land or soil through different way.

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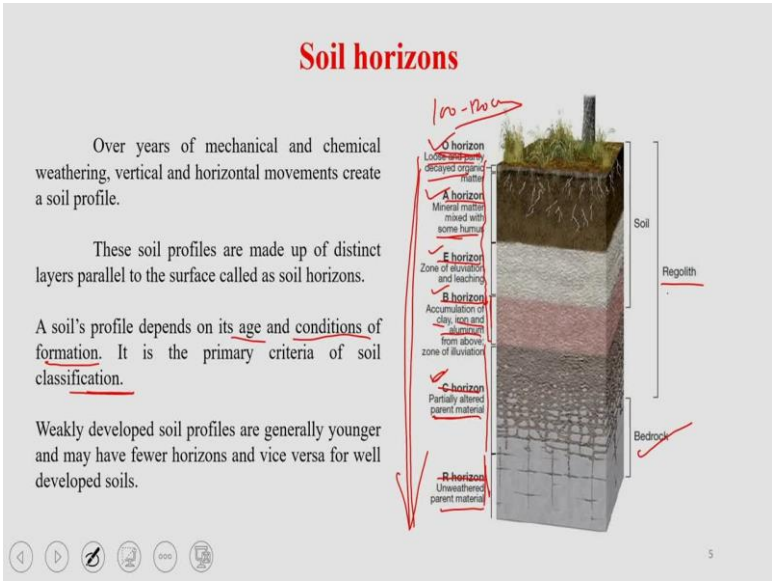

Now, I would like to just discuss here a soil profile, how actually it looks like, when you look at is a piece of land as a natural resource. So, how we can actually manage that resource unless until we know about their different characteristics, their compositions and how soil behave in different conditions to know that we need to understand soil profile very well.

So, this is a unique soil profile, if you dig kind of a profile in a area. So, then ideally, we go around 100 to 120 centimeter of depth, and this actually profile shows the processes through which the soil is getting developed and different characteristics of individual horizon. Now, if you look at in a soil profile, we have different horizon, the main horizon divided into bedrock, then we have regolith.

Now, if you look at this profile, as a different horizon wise from the top it starts with O horizon; O horizon, it composed of lose and partly decayed organic matter, then next, A horizon which is composed of a mineral matter mixed with some humors then we have E horizon zone of eluviation and leaching then we have B horizon is zone of accumulation, where all the nutrients and other things from the top tries to come and get accumulated in this region. So, accumulation of clay, iron, aluminium, all you find in zone B or horizon B.

Then comes horizon C, partially altered parent material and the bottom most horizon is R horizon, which is unweathered parent material rocks. So, this is the total profile and there are

different origin wise characteristics. So, a soil profile, it depends on its age and conditions of formation, the primary criteria for soil classification, so, from soil profile only, then we go into soil classification, we will not have opportunity or scope to go further detail into various aspects of soil here, this is the only opportunity for us to have a look soil or land as a natural resource and some basic characteristics, so, that we can understand how we should actually manage these important resources.

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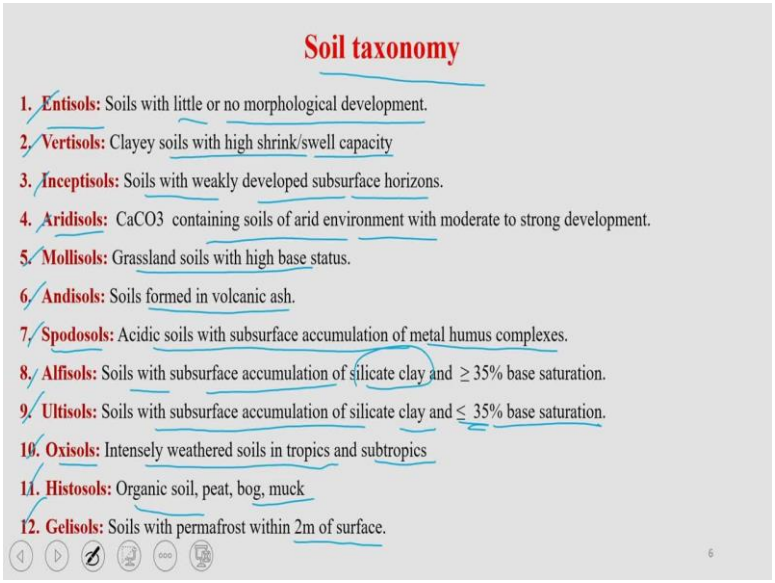

So, taxonomy is another important part of land and soil management. So, there are various different types of taxonomy are detailed in about particular soil. So, it starts with Entisols, Vertisols, and so on and so forth. And if you look at that, each one of them is having a very special characteristics and from this taxonomy we can understand that which type of soil or land resources, how it should be managed because the taxonomy tells us the nature and characteristics of a particular soil resource. If you look at the first one Entisols, it is soils with little or no morphological development. Vertisols, it is clayey soils with high shrinking and swell capacity.

So, you expect these Vertisols mostly in an around where human civilization comes up. Inceptisols, soils with weakly developed subsurface horizon. Then we have Arisols, calcium carbonate containing soils of arid environment with moderate to strong development. Mollisols, grassland soils with high base status. Then Andisols, soils formed in volcanic ash. Spodosols, acidic soils with subsurface accumulation of metal humus complexes. Then Alfisols, soils with subsurface accumulation of silicate clay. Then Ultisols, soils with subsurface accumulation of silicate clay below 35 percent of base saturation.

Then we have Oxisols, immensely weathered soils in tropical countries, tropical place or subtropics. Histosols, organic soils normally available in peat, bog or murk. Then finally, we have Gelisols, soils with permafrost within 2 meters of surface which you expect to be more into Arctic region. So, these are overall the soil taxonomy and this taxonomy gives us an idea that what kind of soil it is and how it needs to be taken care of.

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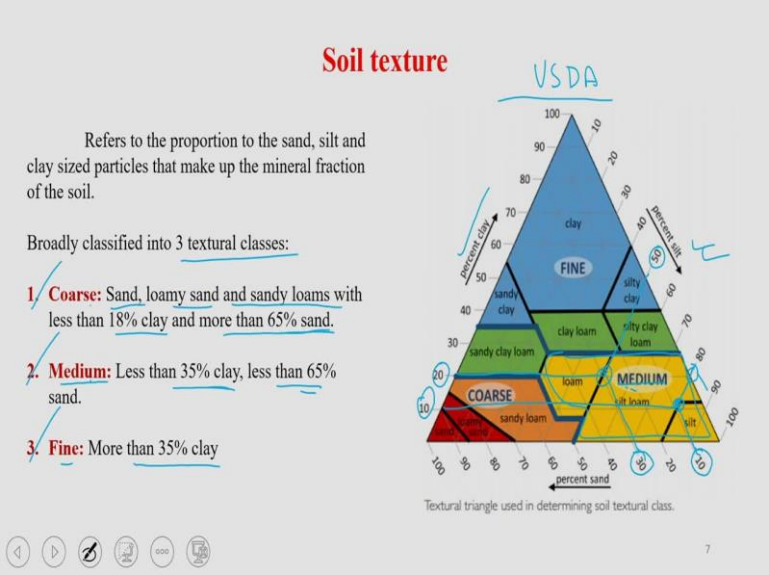

Next is soil texture, soil texture is another property which helps us to know the nature or the property of a particular soil. The three major division of a classification of textural classes are coarse, medium, and fine and these classification are largely depending upon the size of the soil particle.

So, coarse soils are largely sand, loamy sand and sandy loams with less than 18 percent Clay and more than 65 percent sand because the size of the sand particle is larger. Second is medium, medium texture soil, which is less than 35 percent of clay and less than 65 percent of sand and then comes fine soil, here more than 35 percent of clay is available and surface area of the soil is also very high because of its fine texture.

So, this is a USDA textural classification triangle. So, from this triangle, one can very easily identify that in which particular group particular soil will fall in mean the textural class. So, you can analyze a particular soil and find out the proportion of coarse, grain medium, grain and fine grain and then you can actually plot.

Suppose you have a soil which is having suppose clay say around 20 percent of clay, you have suppose sealed around say 50 percent of silt and then rest 30 percent you have sand then

which textural class your particular soil will fall in. So, we can go in this way this is 20 percent line, this is 30 percent line and this comes your 50 percent line. So, this is the point your particular soil sample falls in, now this region comes under this yellow color patch medium type.

So, that means this belongs to silty loam and loamy soil in between. So, you can call it as silty loam soil. So, this falls right here. Same way suppose you have 80 percent of silt and suppose 10 percent of sand and 10 percent of clay. So, where your soil comes in, you can easily find out so this is the point. So that means again it belongs to within this yellow color. So, it becomes a silt loam or you can also call it silt depending upon the position of your class.

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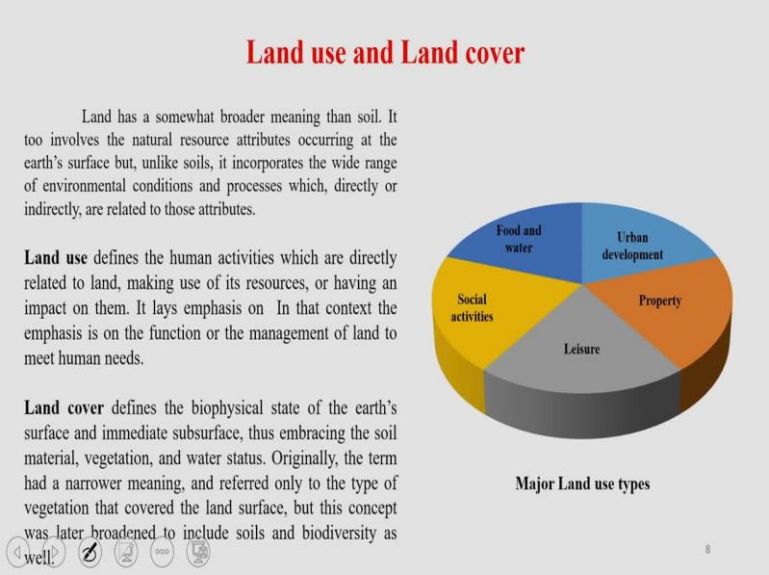

Now, coming to land use and land cover. Now, depending upon all these properties of soil, different land use, land cover is often decided and also seen across the world. Now, land use defines the human activity like agriculture or supposes you go for fishing, fishery, animal husbandry. So, it depends that which land is used for which purpose and accordingly the land use is decided.

Land cover, it defines the biophysical state of an Earth's surface and how that particular land or soil material vegetation and water in that particular area is available originally the term had a very narrower meaning of land covered refers only to the type of vegetation in a particular area, but this concept later broadened and it included soils and biodiversity as well. So, land

use and land cover of an area, it also talks about that how the resource is actually distributed, and how it needs to be managed.

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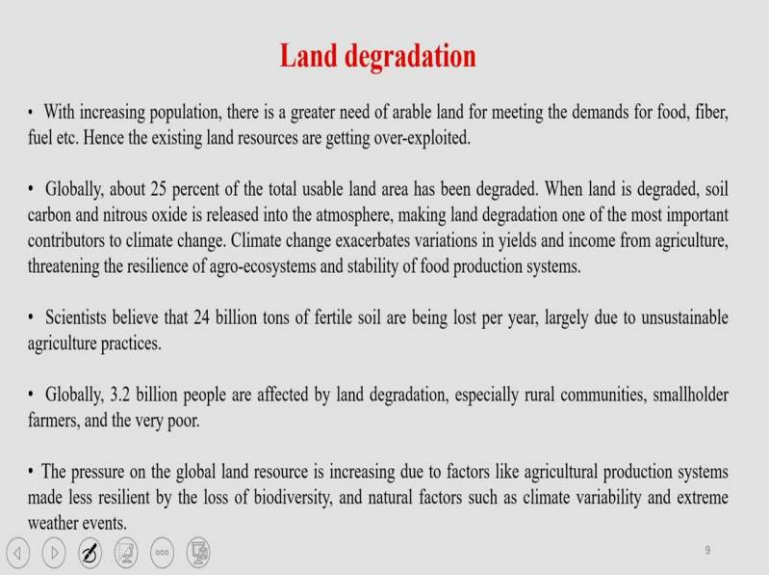

Now, when we have land as a resource, so, definitely there will be some issues also involved with that, land degradation is one of those issues which often Natural Resource Management specialist face this challenge. With increasing populations and demand for high amount of food, fodder and fiber there is an enormous amount of pressure on the land resources.

So, on this pressure definitely lands starts losing its inherent property fertility, productivity, because a particular piece of land if continuously utilized for certain production system without providing enough inputs or nutrients into the soil to rejuvenate it or to regenerate its capacity to grow quality food or fodder or fiber, then that particular piece of land or soil is bound to lose its quality.

At that point, we say that soil is degraded or the land is degraded. Scientists or researchers believe that 24 billion tones of fertile soil are being lost per year. And this is largely because of unsustainable agriculture practices or inefficient natural resource management practices. So, globally around 3 billion people are affected by land degradation alone, especially rural communities, smallholder farmers and people who are poor and depend on this land for their survival.

So, the pressure on the global land resource is increasing with increasing population and demand for food demand for fodder demand for fiber. So, agriculture production system

somehow is getting more and more on heavy production, heavy utilization of chemical pesticides fertilizers.

So, there is a concern about that, that how this intensive agriculture system will be managed in a sustainable manner. So, what we need is that today, an agricultural production system with higher resilience and efficient management system to produce food, but also manage the inherent capacity of the soil to reproduce, biodiversity should be preserved, natural factors such as climate variability, extreme weather events, those also should be taken care of, while going for a smart planning for land management. Land as a natural resource needs to be taken care of for our own good.

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What are the major causes of this land degradation, the major causes are human activity, deforestation, poor agriculture practices, drought and climate change? That is a new addition now, which actually has aggravated most of the problem significantly.

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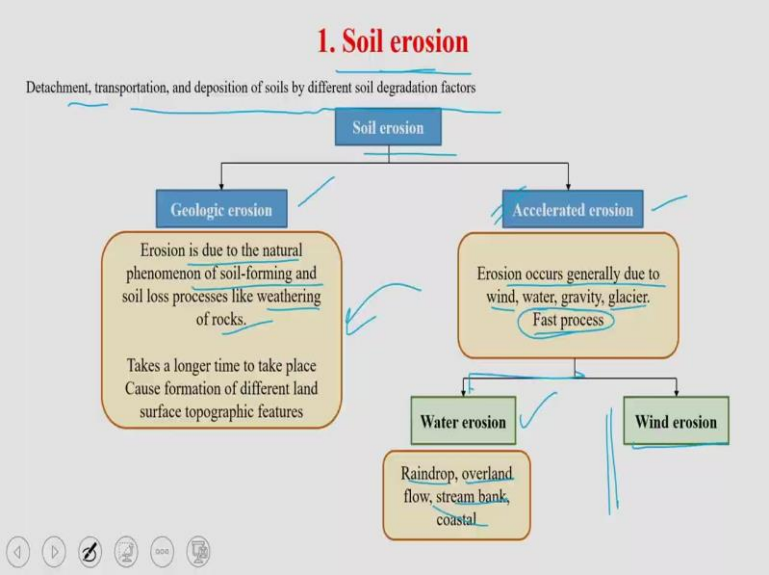

Now, the first problem if we look at is soil erosion. One of the major concerns for today's, natural resource managers, agricultural scientist, soil scientist, geologist is that how to manage soil erosion. Soil erosion is basically the detachment or transportation deposition of soils by different soil degradation factors.

So, I will introduce today that how soil erosion what are the different types of soil erosion and how actually this erosion takes place, mainly geological erosion and accelerated erosion, two different types of soil erosion that are of major concerns. So, geologic erosion is takes place due to the nature natural phenomenon of soil forming and loss processes like weathering of rocks, this process takes longer time to take place and is formation of different land surface or topographic feature is also a very time taking process.

Accelerated erosion, this erosion occurs generally due to wind, water, gravity, glaciers actions, and it is a very fast process in comparison to geologic erosion. Now, accelerated erosions are largely carried out by water erosion, water and wind. So, in case of erosion, which is carried out mainly by water, we find that raindrop action, overland flow stream bank or coastal erosions normally come under water erosion. In case of wind erosion, they are the soils when it is taken off from the system by the action of fast wind and there are also various kinds of wind erosions, which are coming under different type of wind. So, these all actually create an enormous pressure on the soil and it somehow creates soil degradation or land degradation and that requires enormous amount of effort to get it back to his earlier face.

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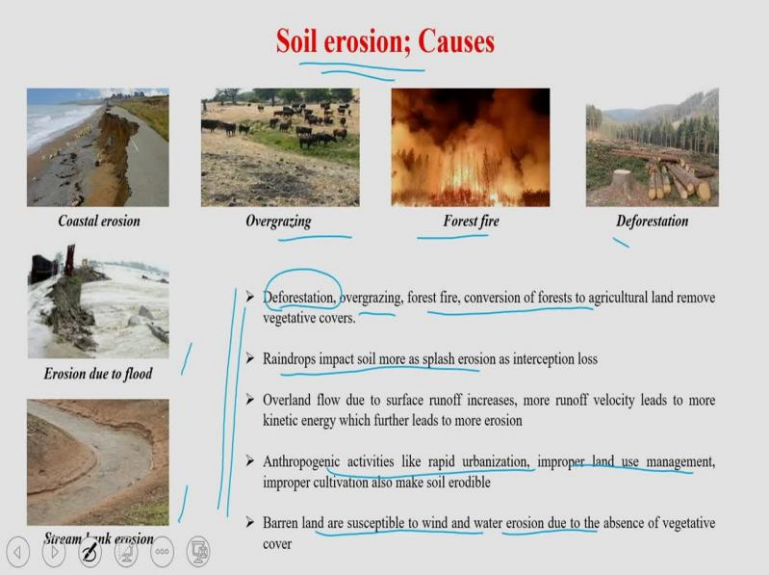

So, what are the causes of soil erosion; coastal erosion, overgrazing, forest fire, deforestation, flood and also steam back erosion. Deforestation is one of the major cause over grazing also forest fire, conversion of forest into agricultural purposes is also another, heavy rainfall or infiltration, anthropogenic activities like rapid urbanization, improper use of management, barren lands are also susceptible to wind and water erosion. So, these are the major causes for soil erosion. And so, to reduce these degradation and to make our land and soil much more resilient, we need to manage these causes significantly.