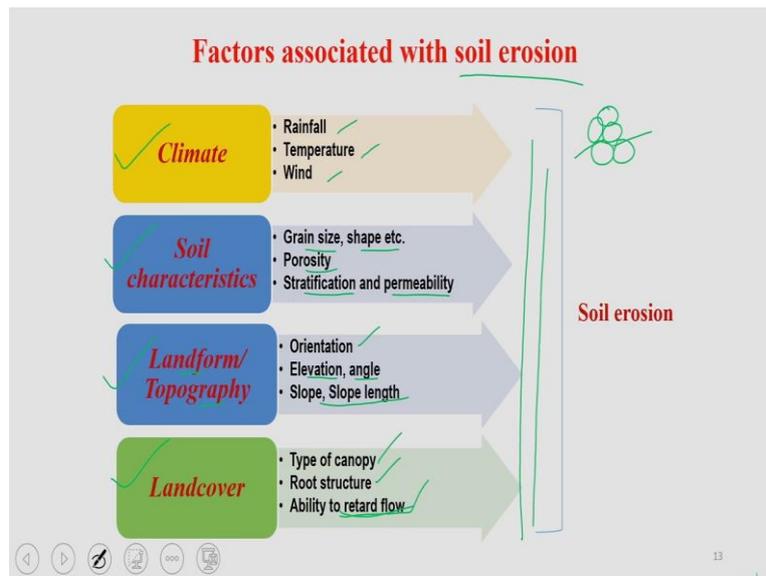


Natural Resources Management (NRM)
Professor Sudip Mitra, PhD
Center for Disaster Management & Research (CDMR)
Head, School of Agro & Rural Technology (SART)
Discipline - Agriculture Engineering
Indian Institute of Technology, Guwahati, Assam, India
Week - 02
Lecture - 09
Biodiversity and Conservation of Natural Resources Part 2

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So, alright participant next, following the soil erosion, different causes and processes, we are now going to discuss about the factors which are associated with soil erosion. Now, if you see that there are few very important factors associated with soil erosion, one is climate, second is soil characteristics, third land form or topography and then last one is land cover. Now, if you look at that each one of them has very important role to play to cause soil erosion.

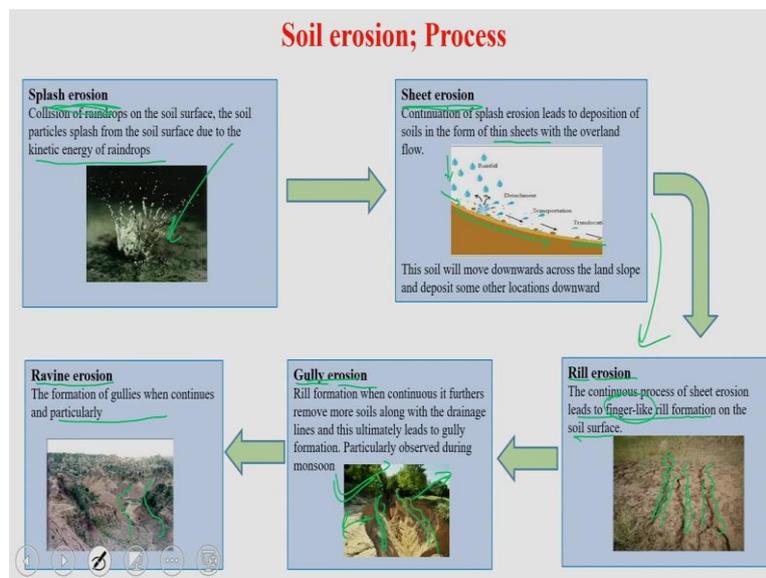
Now, in climate, the parameters which are very important to look at; rainfall, temperature, wind. In case of soil characteristics, we need to look at grain size, shape, porosity means the spaces between soil particles, suppose if you have soil particle like this. Now, this is your porosity, this gap between two particles, this one is the pore space percentage of that pore space we call as porosity.

Then stratification and permeability, permeability means again if suppose, rain is taking place, then how much of that rainfall water will actually percolate or go downwards, that we actually can measure to permeability, land form and topography as you all understand orientation of the land elevation and angle, slope and slope length. So, these are few factors

under landform topography that we need to look at. Finally, land cover, type of canopy, root structure, roof structure of various plant species and ability to return the flow of water.

So, when the rainfall takes place, it actually hits the ground with certain amount of momentum. Now, then the water flows across the slope and that speed of water need to be somehow reduced to reduce the soil erosion by the running water. So, that is what is ability to return the flow of water so, these are the factors which basically impact soil erosion.

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Now, the processes which are largely involved for causing soil erosion, first splash erosion; as from the name itself you can understand that when a rainfall drop hits the ground with certain amount of momentum and that splash the soil from the surface due to the kinetic energy of the raindrops. So, that is one way of erosions, soil erosion can take place.

Second sheet erosion, sheet means paper like A4 paper printing paper, paper that is also called sheet. So, that kind of a layer of soil will be removed by this erosion.

So, continuation of splash erosion which leads to deposition of the soils in the form of thin sheets with the overland flow. So, as you see in this picture, so, the rainfall is taking place hitting the ground and then across the slope the soil is moving away from top to the below. So, when it comes get detached, then a thin layer will be formed down there at this level. So, that thin layer of soil when it is taken off from the top of the land surface, we call them sheet erosion.

Next Rill erosion, now, this is again a continuous process of sheet erosion, where it leads to a finger like rill formation on the soil surface. So, this is the important point to be noted as you see here. So, this is a form of erosion which we call as rill erosion. The next is gully erosion so, when the rill formation this is the small rill as you see that in between soil.

So, when this formation due to continuous process of erosion become bigger in size and ultimately leads to formation of gully as you see here. This structure we called Gully, the soil gets departed from each other and this area becomes larger and larger. So, we call it as gully. So, gully is formed because of extensive erosion takes place this erosion we call as gully erosion. Finally, we come to ravine erosion the formation of these gullies, the formation of these gullies, when continues then they become a ravine erosion as you see, so a much larger form of gully erosion. So, this is the way the soil erosion takes place under different impact of different factors.

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Soil erosion

□ Universal soil loss equation (USLE) (Wischmeier and Smith, 1965)

$$A = R.K.L.S.C.P$$

A = Average soil loss for a given period ($t\ ha^{-1}$)
R = Rainfall erosivity index ($MJ\ mm\ ha^{-1}\ h^{-1}$)
K = Soil erodibility factor ($t\ ha\ h\ ha^{-1}\ MJ^{-1}\ mm^3$)
L = Slope length factor
S = Slope steepness factor
C = Crop management factor
P = Conservation practice factor

USLE is an Empirical model that is limited to sheet and rill erosion and does not consider deposition of soils

Revised USLE (RUSLE) is the updated version of USLE. In RUSLE seasonally variable K factor has been developed. LS factor includes multiple slope segment computation, rill, inter rill, gully erosion. It also includes the deposition of soils.
C factor includes surface roughness, canopy cover, etc., and P factor includes subsurface drainage, contour effect, strip cropping, etc.

Applicable for US database. Regional modifications are going on

Now, how actually we can measure this soil loss because of erosion taking place, there is a universal soil loss equation, which is famously known as USLE Universal Soil Loss Equation, where A is equal to the product of R,K,L,S,C and P where A is the average soil loss for a given period, R stands for rainfall erosivity index, K soil erodibility factor, L is the slope length factor, S is your slope steepness factor, C stands for crop management factor and finally, P stands for conservation practice factor. So, these all factors are taken together here and we get universal soil loss equation.

So, you actually try to measure the ever soil loss which is a function of these factors as mentioned here. So, USLE is an empirical model and that is limited to sheet and rill erosion and does not consider the deposition of soil. So, the revised USLE which we call as RUSLE is the updated version of universal soil loss equation, where we actually consider seasonally variable k factor and LS factor includes the multiple slope segment computation.

So, that means, with experience and different kinds of calculation, people or scientist shas revised the universal soil loss equation into revised soil loss equation and here you see that these factors are modified a little bit. So, C was crop management factor here in the universal soil loss equation, in revised soil loss equation C stands for surface roughness canopy cover at cetera, and P here in universal soil loss equation, we considered that as conservation practice factor. Whereas, here P factor includes subsurface drainage as well contour effects, strip cropping at cetera.

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Soil erosion

Wind erosion

- ❖ Results due to the high wind velocity
- ❖ Generally occurs in bare soil, loose soil
- ❖ Dry soil more susceptible to wind erosion
- ❖ Depends upon particle size, roughness, climatic factor, vegetative cover, wind direction, wind barrier, soil texture
- ❖ Tillage practices, vegetative measures, windbreak are used to reduce the wind velocity



Empirical formula for soil loss estimation (Hudson, 1971)

$$S \propto (V - V_0)^3 d^{0.5}$$

S = Quantity of soil removed
 V = Wind velocity
 V_0 = Minimum threshold velocity to move the particles
 d = particles diameter

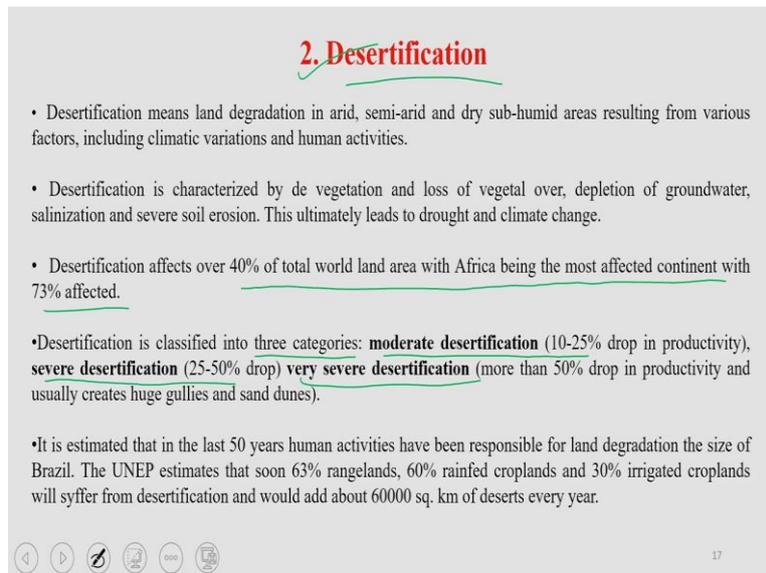
So, continue with soil erosion and other important agent or cause of soil erosion is wind, strong wind it will result due to the high wind velocity and that would cause soil erosion, a large proportion of topsoil will be taken off from the land surface, it generally occurs in the bare soil and wherever loose soils are available, it will be taken off by the strong wind. Dry soil are mostly susceptible to wind erosion. Now, the wind erosion also depends on the particle sizes, so, roughness of those particles so, if these are loose particles are more there definitely the soil loss or erosion by wind will be much higher.

Now, sometime at the land surfaces, we also carry out various cropping practices, agricultural practices like tillage land preparation. So, all those things also might enhance or aggravate the soil erosion. So, what is the empirical formula for these kinds of soil loss estimation? So, this is the formula that is being used,

S is approximately equal to the cube of the difference between V and V_0 , multiplied by the square root of d.

where S stands for quantity of soil removed from a surface, V stands for wind velocity, V_0 minimum threshold velocity to move the soil particles, D particles diameter. So, from this equation also you can measure under strong wind how much soil will be taken off from the surface.

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2. Desertification

- Desertification means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities.
- Desertification is characterized by de-vegetation and loss of vegetation, depletion of groundwater, salinization and severe soil erosion. This ultimately leads to drought and climate change.
- Desertification affects over 40% of total world land area with Africa being the most affected continent with 73% affected.
- Desertification is classified into three categories: **moderate desertification** (10-25% drop in productivity), **severe desertification** (25-50% drop) **very severe desertification** (more than 50% drop in productivity and usually creates huge gullies and sand dunes).
- It is estimated that in the last 50 years human activities have been responsible for land degradation the size of Brazil. The UNEP estimates that soon 63% rangelands, 60% rainfed croplands and 30% irrigated croplands will suffer from desertification and would add about 60000 sq. km of deserts every year.

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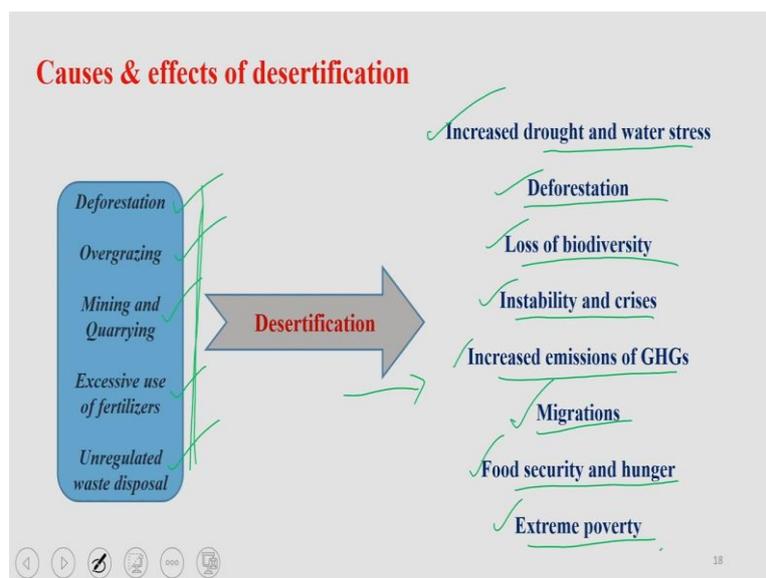
Now, let us come to the next important soil degradation or land degradation that is Desertification. After soil erosion, desertification is another problem associated with land resources that require enough attention from the scientific as well different management committees or managers of land. So, what actually desertification means, desertification means that land degradation in arid, means dry or semi-arid or dry sub-humid areas resulting from various factors including your climatic variations or human activities.

Now, desertification sometime can be caused because of de-vegetation or deforestation because of some other livelihood activities, which we discussed at the beginning that some time because of deforestation, also desertification will take place and if deforestation takes place, desertification takes place, there will be also depletion of groundwater, salinization

will increase. So, everything is somehow related to each other. Now, desertification, if you look at its effects over almost 40 percent of world land area, with Africa being the most affected continent with almost 73 percent affected, significant losses are taking place because of desertification.

So, desertification, three categories we can divide moderate desertification, then severe desertification and very severe desertification. So, these are the three classes of categories of desertification, it is estimated that in the last 50 years of different anthropogenic activities, the land degradation has taken place, almost to the land area of Brazil. So, you can imagine one Brazil, entire Brazil country, whatever landmass it has. So, in the last 50 years or activities has been responsible of the size of Brazil's land area has somehow got desertified. So, this is a significant impact on human civilization.

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So, desertification must be taken care of.

Now, before we go into the management of this is a big problem that land resources often face, we need to know the causes of desertification, what are the main causes, deforestation, over grazing, mining and queering, excessive use of fertilizers, unregulated waste disposal.

Now, these are few important you causes of desertification. Now, what happened is that desertification leads to increased drought and water stress, it would of course, lead to deforestation, loss of biodiversity, instability and crisis, different kinds of social dynamics is also going to be impacted, because of desertification.

A large proportion of people in various parts of the world depend on forest resources, as I mentioned in beginning that among the natural resources, land, forest, water, these are very critical for human sustainable survival. Now, increased emissions of greenhouse gases could also be enhanced because of desertification migration can take place because if certain area where people are leaving, if that area for some reason becomes desertified, or land degradation takes place, so, naturally, people are not going to be able to use that land for food production or for any other purposes. So, they need to look for better land. So, migration can also take place food security and hunger will be another outcome and extreme poverty. So, these are all very dangerous outcomes that could actually come out of desertification.