

Natural Resources Management (NRM)
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Lecture - 22
Community Based Natural Resources Management (Part 2)

In this lecture, we will continue with Community Based Natural Resource Management and in this part 2 of CBNRM lecture, we will be discussing largely about watershed management. Watershed management is a very effective and very important way of managing natural resources and also regulating all other aspects of community development of an area.

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Watershed management						
Watershed	<ul style="list-style-type: none"> Area or land which is separated from surrounded by ridgelines and the area drains into a common outlet Considered as an administrative unit for engineering and management practices 					
Watershed classification by size	Large watershed	Sub watershed	Mili watershed	Micro watershed	Mini watershed	
Area (ha)	>50000	10000-50000	1000-10000	100-1000	<100	
Watershed classification by land use						
Agricultural	Urban	Forest	Desert	Coastal	Mountains	Wetland
<ul style="list-style-type: none"> Changes in LULC leads to change in hydrological processes Tillage practices increase infiltration Vegetation lesser leads to increase runoff and erosion, depression storage Barren land have hard clod reduced infiltration 	<ul style="list-style-type: none"> Lesser infiltration due to built-up areas High runoff Flood occurs if improper artificial drainage exists as natural drainage has disturbed Lesser erosion 	<ul style="list-style-type: none"> High interception throughfall, stemflow Evapotranspiration dominant Low runoff, erosion, high infiltration, and groundwater recharge 	<ul style="list-style-type: none"> Lesser vegetation Lesser rainfall Sandy soils due to high porosity absorbs water High evaporation Runoff water also soaked during flow Negligible change of groundwater recharge Higher erosion (wind) 	<ul style="list-style-type: none"> Contains urban and rural areas Influenced by waves and tides Local flooding Sea water intrusion to aquifers Cyclonic type precipitation and high rainfall 	<ul style="list-style-type: none"> Both rain and snowfall Vegetation High runoff and lesser infiltration Runoff from snowmelt and rainfall causes flood (majority flash flood at downstream) 	<ul style="list-style-type: none"> Minimal erosion Minimal infiltration High rainfall Not too much erosion (except coastal wetlands) Rich in biodiversity Dominant evapotranspiration

Now, what is watershed? It is an area or land which is surrounded by ridge lines and it has kind of a catchment, which drains into a common outlet. And if you see that, it looks like a leaf and suppose, there is a river or major water which is coming from one entry point and this is the exit point, but there will be many branches of that. On the basis of slow you will find that this one small rivulet or drainage line can also create small watershed. So, this is the new area of a watershed and within watershed, you can have many different small watersheds and this classification is largely based on sizes.

So, we have large watershed, which is bigger than 50,000 hectare of area, then we have sub watershed, which is between 10,000 to 50,000 hectare of area, then mili watershed between 1000 - 10000 hectare of area, then comes micro watershed between 100 to 1000 hectare of

area, and finally, mini watershed, which is less than 100 hectare area. So, these are the, 5 classes of watershed, which is based on the size of it.

Now, watershed classification can also be done on the basis of land use. Now, if you see that in an area, as we discussed in previous lecture, there could be various land use. now how watershed can be classified on the basis of land uses:

First, agricultural on the basis of agricultural land uses, we can have a type of classes of watershed. So, this kind of watershed basically will be regulated or controlled mostly by different type of hydrological processes, tillage practices, vegetation cover, type of crops that you are growing, barren land which or not having any crops into that. So, basically, the different agricultural practices, cropping practices, those actually are the regulating factor of the watershed, which are classified under agriculture operation.

Then we have our urban type of or urban classes of watershed. So, these are the watershed, which are actually having lesser infiltration due to built up areas around them will have heavy runoff flood may occur also due to improper artificial drainage, a lesser erosion. So, largely this kind of watershed, you will find in an urban area are mostly at the tangent point or border area of an urban and peri urban area.

Forest land use can also have watershed there. So, we will see that those watershed are largely regulated by high precipitation, high evapotranspiration, low runoff, low erosion, high infiltration, and of course, high groundwater recharge, because forest will have lots of plant cover. So, that is another class of watershed.

In desert also we can have another classes of watershed which are characterized by lesser vegetation, lesser rainfall, sandy soils, high evaporation, runoff water, also soak during the flow, then negligible chance of groundwater recharge in the desert area. Higher erosion because of wind because the top soil in desert area because a strong wind will be taken off most of the time.

Then comes watersheds in the coastal area, what are the characteristics that you can expect it will content urban and rural both sides, it will be influenced by waves and tides, local flooding, sea water intrusion most of the time could happen there and cyclonic type of precipitation, very heavy rainfall. So, these are some of the characteristics of the watersheds which are located in a coastal area.

Then mountainous land use system. In mountainous land use system as you can imagine, that both rainfall and snowfall could take place, vegetation will be scarce, high runoff, lesser infiltration, runoff can takes place from snowmelt as well as rainfall which could cause flooding the downstream. So, these are typical phenomena characteristics that you can expect in the mountainous region of watershed.

Then comes wetland. In case of a wetland area, we can anticipate very minimal erosion, minimal infiltration, high rainfall, then less erosion and largely they are rich in biodiversity. Evapotranspiration can also be related the dominant in this kind of watershed.

So, on the basis of land use, how many different classes of watershed we could have one agriculture, 2 urban, 3 forest, 4 desert, 5 coastal, 6 mountain, and 7 wetland.

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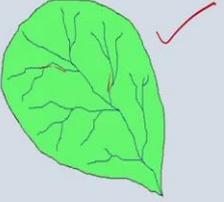
Watershed management

Causes of watershed deterioration

- ✓ Conversion of forest lands to agricultural land
- ✓ Improper agricultural practices
- ✓ Deforestation due to increment of built-up areas, road widening
- ✓ Overexploitation of groundwater due to urban growth
- ✓ Industrial extension, improper and unscientific mining

Effect of watershed deterioration

- ✓ High erosion due to runoff
- ✓ Seawater intrusion due to lowering of groundwater table in coastal areas
- ✓ Improper urban growth with inadequate drainage system causes more flood situations
- ✓ Overexploitation of groundwater causes water crisis and aquifer destruction
- ✓ Global hydrological cycle will be disturbed and causes frequent flood and draughts
- ✓ Agricultural production hampered, biomass reduction, water quality, and quantity deterioration
- ✓ Biodiversity degradation at riparian zones
- ✓ Overall global socioeconomic problems occur



Now watershed management as I just mentioned, that watershed actually it looks like a leaf as you see here and it will have different drainage line and slope plays important role in watershed management. So, let us see that, why actually, we need watershed management, if you look at that various causes of watershed deterioration, they are actually having lot of potential to affect the livelihood and the quality of life of the people living in those watershed. And what are those?

Conversion of forest land to agricultural land often creates a lot of problem and pressure on causes of watershed deterioration, because if you convert a forest land into an agricultural land use, certainly the amount of moisture retention in the soil and also the hydrological cycle

will be completely disrupted. So, definitely that is going to affect your watershed management.

Improper agricultural practices sometime create a lot of problem for watershed management. Deforestation due to increment of built up areas, road widening, even inside forest, because you need transport, communications. So, these also might create some kind of disturbances within a watershed. Over exploitation of groundwater due to urban growth, huge amount of water actually being pumped out of the groundwater for daily uses in these areas. Industrial extension improper and unscientific mining is another very major issue, which actually creates a lot of problem for Watershed Management.

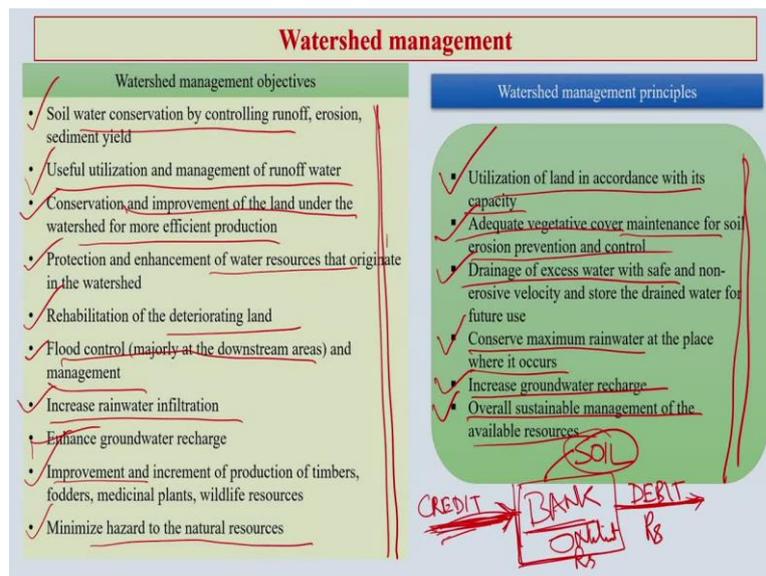
Now, this kind of problem definitely will affect also the watershed area. Now, how they actually impact the watershed area or what are the effects of this watershed deterioration. Because of these watershed deterioration, these causes, high erosion will take place and we are going to lose the very valuable topsoil.

Sea water intrusion can also take place due to lowering of groundwater table in the coastal areas. Improper urban growth with inadequate drainage system can cause more frequent floods situation, flash flood also sometime could happen in the urban areas. Over exploitation of groundwater could cause water crisis and aquifer destruction, global hydrological cycle will be disturbed and it could cause frequent floods and droughts.

We could also see that agricultural production may be hampered biomass could be reduced; biomass production, water quality and quantity also get affected. Most importantly, the biodiversity can also be degraded in some regions or some ecosystem. Overall, because of all these effects the global socio economic problems will occur. So, it will start with the local then, it will go to the global.

So, you can imagine that, that if an watershed is affected by some mismanagement of some resources, improper land use changes, then we could actually end up having even socio economic problems in an area and exactly that is what we see often happening in many parts of the world.

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Now, to address these issues, we need a very efficient watershed management. Now, what are the watershed management objectives? Why do we need watershed management? First Soil and Water Conservation by regulating controlling runoff erosion, because runoff or erosion the two of the major problems those actually deteriorate in watershed area.

Next useful utilization and management of runoff water. The huge amount of water which is actually flowing out of the watershed need to be also managed properly. Conservation and improvement of the land water that watershed for more efficient production that we can use it.

Protection and enhancement of water resources that originates in the watershed itself. Rehabilitation of the deteriorating land, how could you do that one of the easiest way to do it. Plantation of some trees which are useful and also suitable for any particular ecosystem that also need to be kept in mind. Flood control and management is very, very important.

Infiltration; increasing rainwater infiltration in the year so, that groundwater also can recharge. Improvement and increment of production of different timbers in the forest area, medicinal plant wildlife resources and minimize the hazard to the natural resources by various means, which we discussed in the earlier lectures. So, these are the various objectives under watershed management.

Now, any kind of management, when it has to take place, it should follow certain principles. Watershed is no different. So, watershed management has certain principles, let us see what are those number one utilization of land in accordance with its capacity, very important

means, we should utilize a particular piece of land on the basis of its capacity, say fertility, productivity, if suppose, a particular piece of land has certain amount of fertility through different kinds of soil analysis, we should know that and accordingly we should grow the crop.

If you grow some crop, which is which demands intensive amount of nutrients from the soil, then what happens is basically a situation like this. Suppose this is your bank account and every month your salary comes into in this account and you take it out. So, this we can call credit and these we can call debit.

Now, suppose in one month, for some reason, your salary does not come. So, that means, there is no credit in your account, but you are continuously debiting it what will happen? One point of time your this account will be completely empty. So, you cannot further extract any money from here because there is no credit into this account.

Exactly, if you imagine this bank as soil and if we do not put any kind of inputs, we do not manage the soil properly to enhance its nutrient which is equivalent to cash for us. So, if we grow plant that means, you extract nutrients from the soil, after certain point soil we lose all the nutrients the productivity and fertility. So, that is what we need to actually understand the capacity and accordingly we should choose the crop or plan.

Second: adequate vegetative cover for maintaining the soil, because vegetative cover helps to reduce erosion runoff. So, that means, the nutrient in the soil will remain where it should be drainage of excess water with safe and non-erosive velocity in slowly and store the drained water for future uses. In some places in India, we get more than the water that actually required there because of heavy rain.

So that extra amount of water which is flowing through the watershed, it should be stored somewhere so that at least when there is no rain, that water can be utilized for another crop. Conserve maximum rainwater at the place where it occurs right there in-situ at that particular place where the rainfall is coming, try to conserve the moisture, water in that particular area.

Increased groundwater recharge, no alternative for sustainable water management. Overall sustainable management of the resources, available resources in the watershed. So, these are the basic principle that we should follow for better watershed management.