**Soil and Water Conservation Engineering**
**Prof. Damodar R. Mailapalli**
**Department of Agricultural and Food Engineering**
**Indian Institute of Technology, Kharagpur**

**Lecture - 55**
**Sediment and its Transportation**

Hi, this is a week 12 lecture number 3; we will be focusing on Sediment and its Transportation in this lecture. So, as the course content here in 12 we are at 3.

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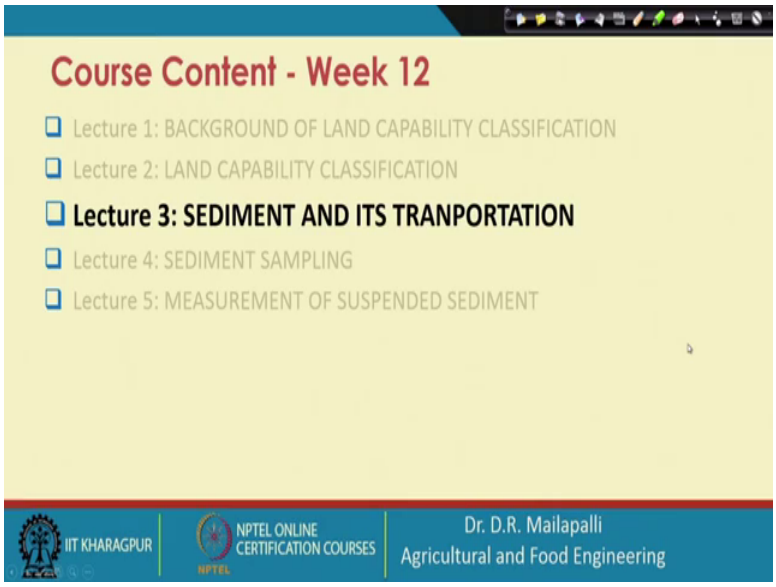


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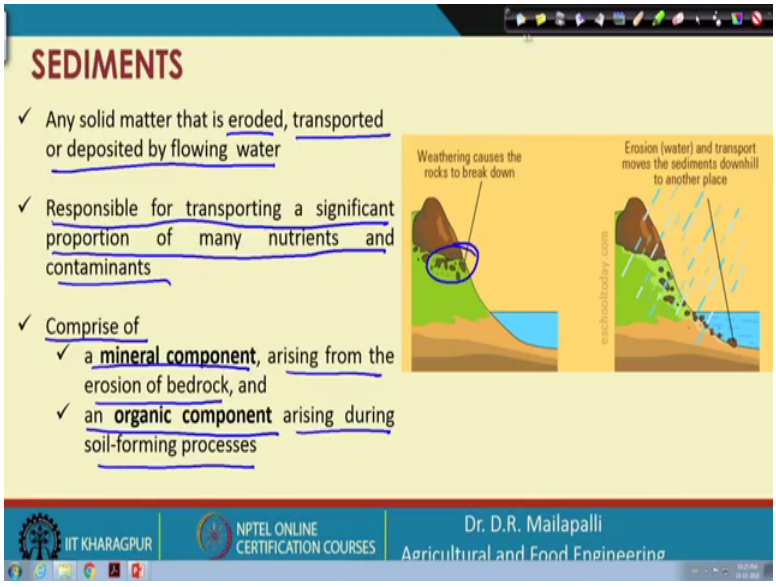

So, sediments; so what are the sediments? Basically the sediments any sediment which has a source like it eroded and then transported to or deposited by flowing water.

So, water is basically the driving force to you know you know displace the sediment from one place to another place. And this is the responsible for transporting a significant proportion of many nutrients and contaminants. So, since the sediments which has both solid as well as a mineral part; so, the mineral part; that means, there is a nutrients. So, when that sediment is transporting; that means, the nutrients also will be transported along with these sediments.

So, and so basically the sediments comprise of a mineral component which is arising from the; erosion or bedrock. So, if you see this; so this is during weathering what happened these small rock fragments are going to break down. And then it is going to divide into you know solid as well as mineral fractions and the other one is organic component which is rising during soil formation processes. So, because the soil has you know inbuilt microbes; as well as you know any dead animals on the plant material.

So, anything which will be packed by soil and over a period of time; so that will be converted into that will be decomposed into you know organic material. So, that is why the soil also contains the organic compounds along the mineral as well as the solids.

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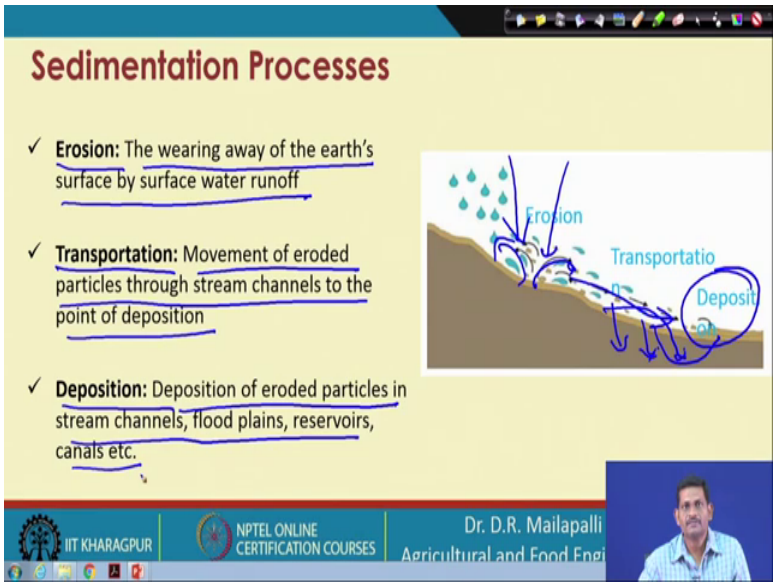

So, then; so the next is the sedimentation process. So, the sedimentation process basically; so first thing is the erosion then or transportation the other third process is the deposition.

So, the erosion is basically the wearing away of the earth surface by surface water runoff. So, once the defragmented particles which are staying on our neighbor area; so, because of the rainfall or any other you know the flooding flooded flows, so, the loose particles will be transported from one place to another place. So that is the transportation, so movement of eroded particles throws stream channels to the point of deposition.

So, here mostly so due to the rain so the, this kind of a flash erosion; so, it takes away the particles along with the flow then, they and then the transportation of particles because the flow will have enough transport capacity and they will take away the particles from one place to another place. But you know due to the capacity the flow or maybe due to the infiltration right and then or if there is some depression where the sediment is going to you know trap down.

So, then the flow capacity is not going to be enough to transport the particles and there is a deposition of the particles are going to takes place at the, at some place. So, so it contain consists of both erosion to acquire or to or result the particles and then transportation to displace the particles and the deposition to deposit the particle. So, so deposition of eroded particles in the stream channels floodplains reservoirs canals etcetera, where there is not enough the flow where the flow has not enough transport capacity to carry out.

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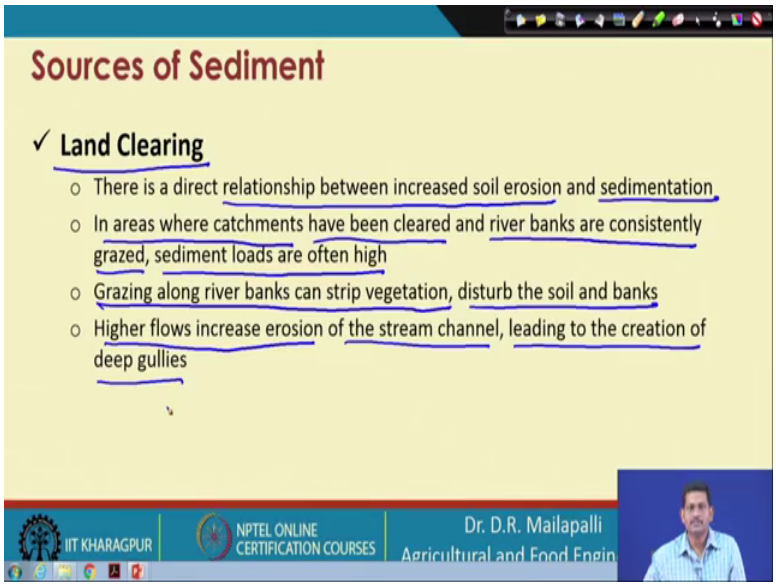


So, and then the sources of sediment basically one is the land clearing. So, there is a direct relationship between the increase erosion and the sedimentation.

So, once the erosion is increasing definitely the sedimentation will increase. So, land clearing, in areas where catchments have been cleared because it has deposition of sediments and the riverbanks and consistently grazed sediment loads are often high. So, when the river banks are grazed what happened, the; when the vegetation which is intact with soil will be loosened off.

So, then this once the soil is loosen, so the definitely where the when the rainfall definitely the runoff due to rainfall will take about the loose sediments and that so, the land clearing will be the source of sediments. And the grazing along river banks can strip vegetation disturb the soil and banks of course, higher flows increase erosion of the stream channel leading to creation of deep gullies.

So, when the flow is tremendous. So, what happens it has it definitely will you know result in eroding these stream banks and the taking off the bed load. So, all other things are going to happens and forms finally, the gullies. So the land clearing is one of the sources and the road building.

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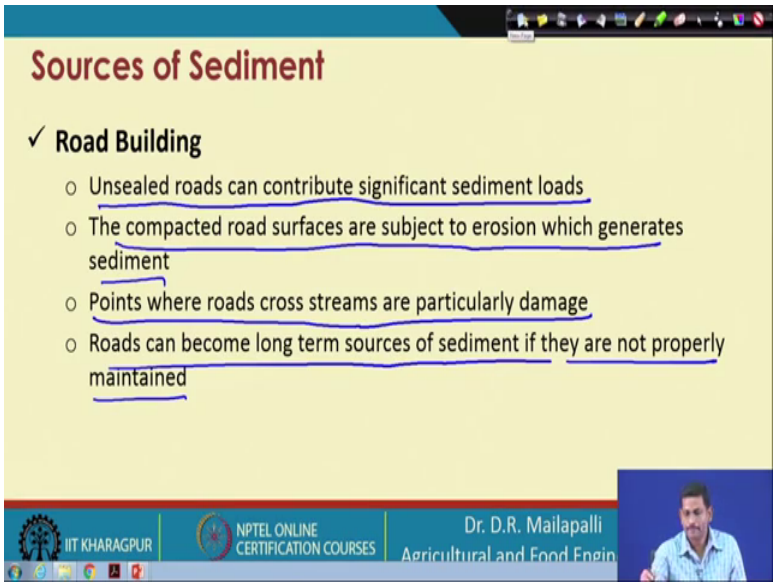


So, nowadays if you see the construction of the roads or construction of the houses leave lot of sediments out at the site and when there is a rainfall so definitely the particles or the sand or any building material that will be transported to the, I mean the drainage ditches.

So, the unsealed roads can contribute significant sediment loads of course, so unsealed which is exposed to water definitely will erode and the compacted road surfaces are subjected to erosion which generate the sediment. So, unsealed and compacted; so without putting any you know the impermeable layer. So, definitely a simple compaction definitely may not you know helpful in protecting these I mean you know protecting the sedimentation.

So, the points where roads cross streams are particularly damaged. So, the if you see during flooding the roads which are across the stream flow definitely going to damage first. And the roads can become long term sources of sediment if they are not properly maintained. So, I mean the, this is the regular practice if you see in summer season the all roads will be you know laid off like the maintained very well and then there are next rainy season I mean because of the poor maintenance.

So, the roads will be damaged due to the heavy rain and the flow flooding and that definitely causes you know they removing the concrete material or removing the fine particles from the roadside.

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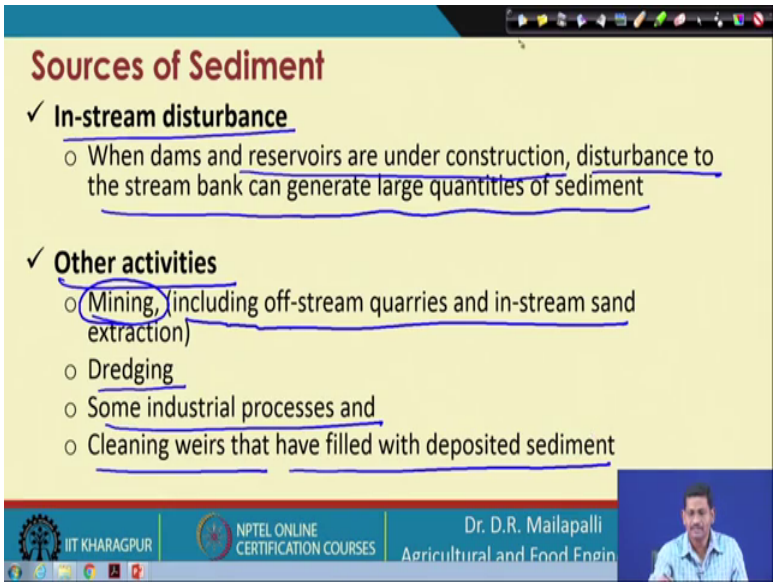


And then the in stream disturbances this is another source of sediment in stream disturbances. So, when the dams and reservoirs are under construction; so disturbances to the stream bank can generate large quantity of sediment. So, under (Refer Time: 08:06) condition; you may not be seeing you know sedimentation transport to the you know downstream, but while constructing the dams or while doing any in stream operations; definitely that disturbs the you know bad sediments and definitely that causes the and because the flow; so, the disturbed sediments will you know pass from one place to another place.

So, other activities like a mining; so the mining is another you know terrible event in removing the sediments. And the dredging this is another operation some industrial processes; so like which contains like sediment using you know dirty. For example, waste treatment plants and all those things and cleaning weirs and other field deposit sediment. So, weir; weir cleaning also because weir can has lot of deposits. So, once you clear that then definitely that will be mixed in the water and causes sediment transportation in that.

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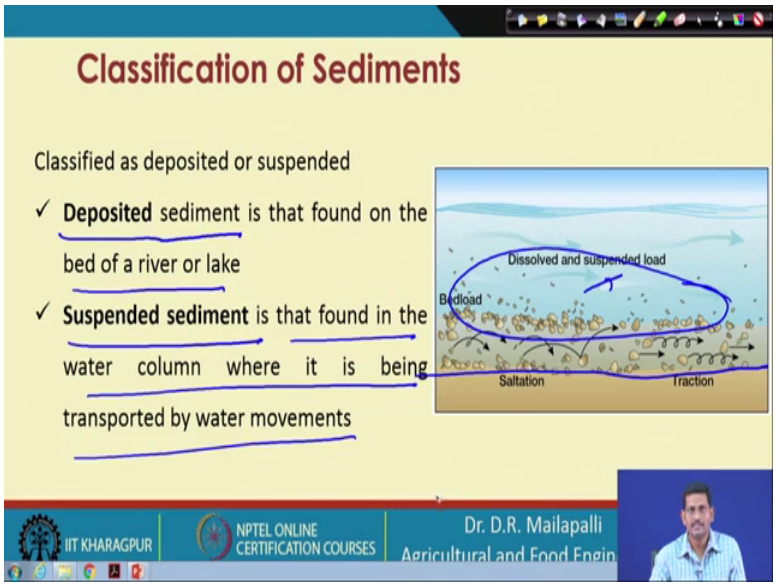


So, the classifications of sediments we are talking about you know the; what I mean river. So, the classification basically the deposited sediments and suspended sediments.

So, deposited sediments also known as the bed load and it definitely will be staying you know here in the bed and the suspended sediments will be staying you know I mean here. So, the mostly the suspended sediments will be suspended in the water. So, is the found in water column where it is being transported by water movement. So, mostly the suspended sediment will be transported from one place to another place; whereas, bed deposited sediment unless there is a you know the heavier flow which can take away or which can affect the bottom of the river; so the bed load will be staying in place.

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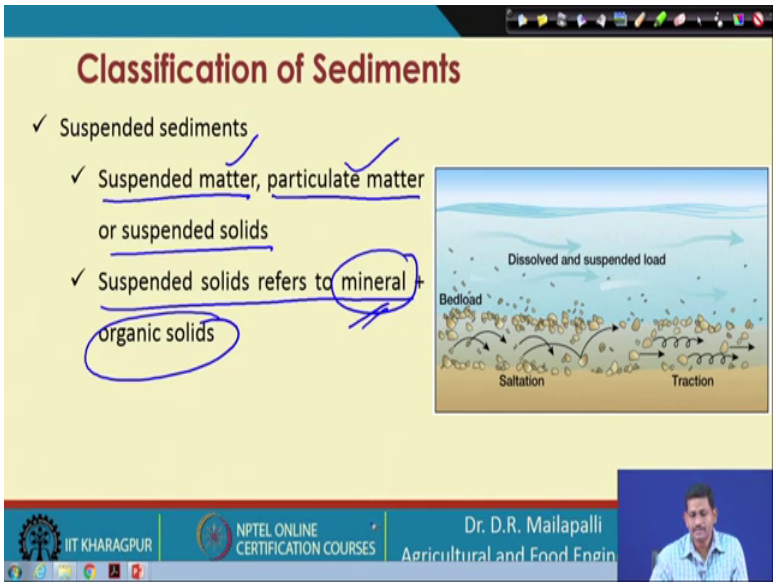


So, the and then suspended sediments; so the basically the suspended it contains contain suspended matter is also called as particulate matter or suspended solids.

So the, it has different names suspended matter, particulate matter and suspended solids ok. The suspended solids refers to both mineral as well as organic solids; so since it is dissolved or suspended inside. So the mineral portion as well as organic solids, they are also attached to the suspended solids that is why the suspend solids refers to both mineral as well as organic solids.

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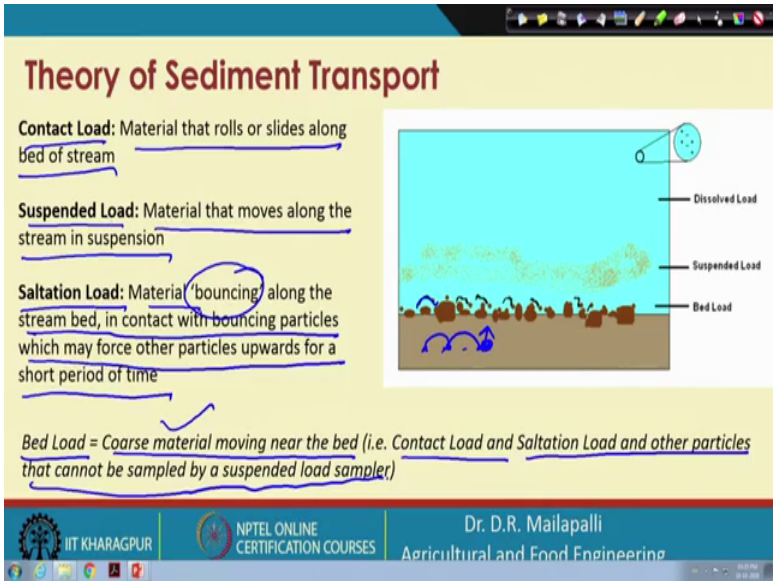

So, then sorry; so if you the types of I mean theory of sediment transportation if you see so, basically it is a contact load that is mineral that rolls or slides along the bed stream. So, this is called this is called contact loads contacts to the surface and suspended load this is also another type of the suspend loads the material that moves along the stream and suspension just I mentioned and saltation load.

So, this saltation load is the bouncing I mean some particles or some solid or eroded particles they bounce. So, just like here; so they simply bounce from you know one place to another place that that is called and the streambed, contact to the bouncing particles which may force other particles upwards in short period of time.

So, once if there is a particle here and this particle comes in bounce here and impacts and this you know goes up for short period of time. So, that is that the saltation ; so, the bed load which is equal to the coarse material moving near the bed right. So, the contact load and saltation load and other particles that cannot be sampled with suspended load sample this is also.

So, the coarse material which is not sampled by suspension or suspended device expended sediments that is called a bed load. So, the bed load contains the both contact load and saltation load and in the next is the sediment transport.

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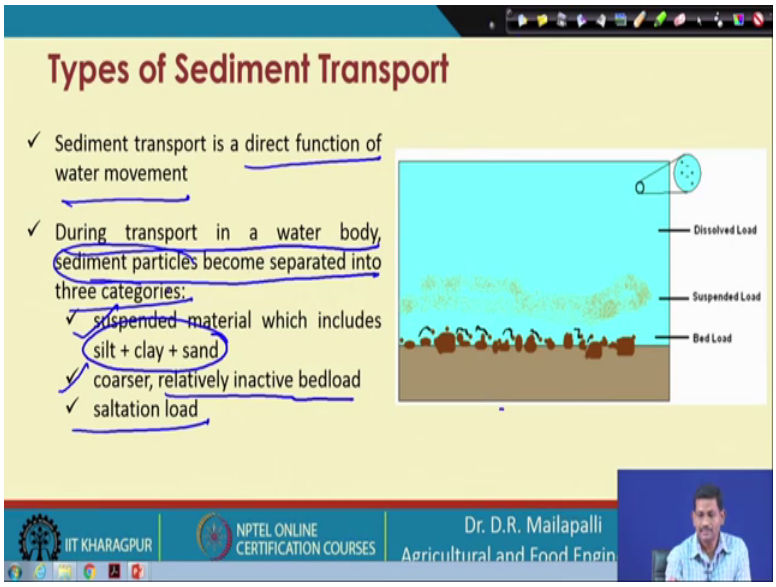

So, the basically the direct function of for water movement; so if you increase the water from definitely the sediment transport will increase; so, during transport in a water body the sediment particles become separated into three categories; the suspended material that which includes silt, sand, clay and coarser material; so, relatively inactive bed load and then saltation load ok. So, the suspended load this is I mean the sediment particles basically of three kinds.

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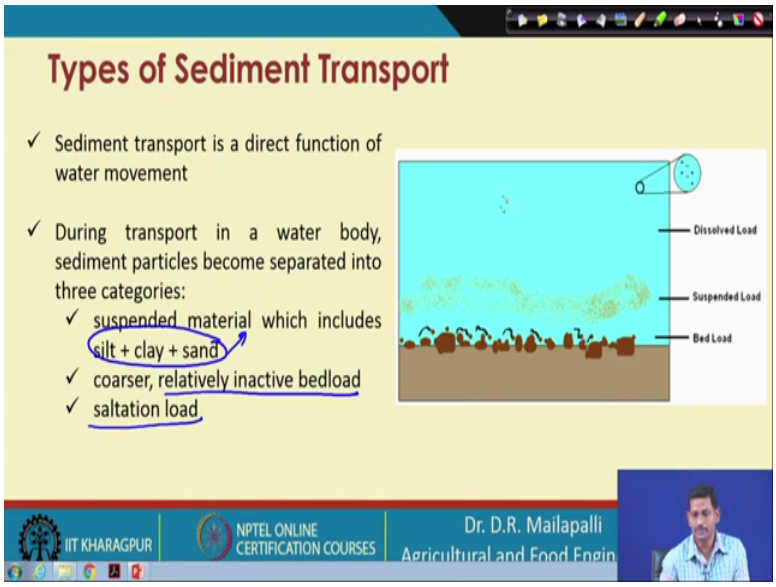


One is the sand silt clay; mostly this will be under suspension and a little coarser particles they will be inactive you know the bed load. So, they will be staying nearer to the bed and saltation load; so, they will be you know bouncing and rolling is taking place here.

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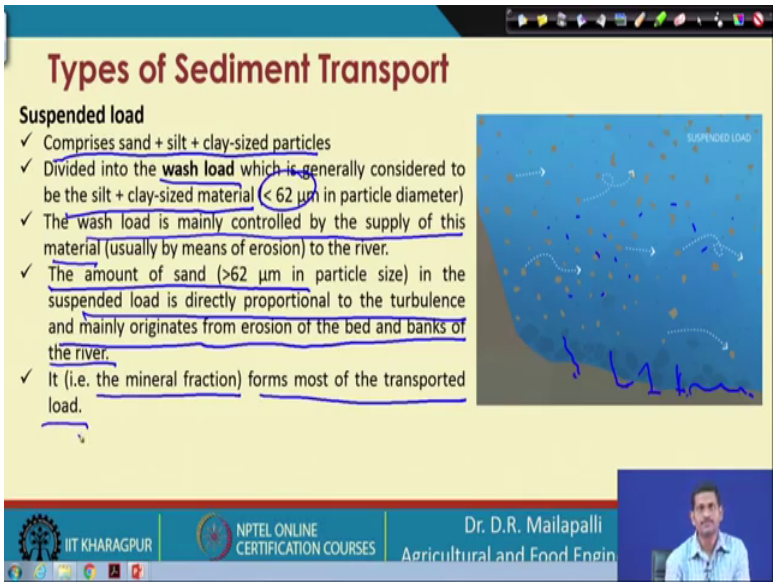


So, the suspended load basically comprises of as I said sand, silt, clay sized particles. So, this is all suspended in water right and then it divided into wash load; which is generally considered to be silt clay sized particle which is less than 62 micron or 60 micron in particle diameter. The wash load is mainly controlled by supply of this material; so the basically the wash load is suspended load; suspended load which contains you know mostly the particle size which is less than 62 microns.

So,; that means, if you do sieve analysis ; so the last like if you have like 62 micron sieve at the bottom. So, the pan which collects the sediments that is called you know suspended load whatever. And the amount of sand which is if suppose more than 62 microns; so, that is called sand; in the suspended load directly proportional to the turbulence and mainly originates from erosion of the bed load and banks of the river.

So the mostly the coarser particles which are not part of the suspension; so that that means, more than 62 microns will be you know depositing here as the coarser particles and staying in the bed of the river. So the, and the mineral fraction forms most of the transported load; so the mineral fraction of for suspended load will be mostly transported from one place to another place ok.

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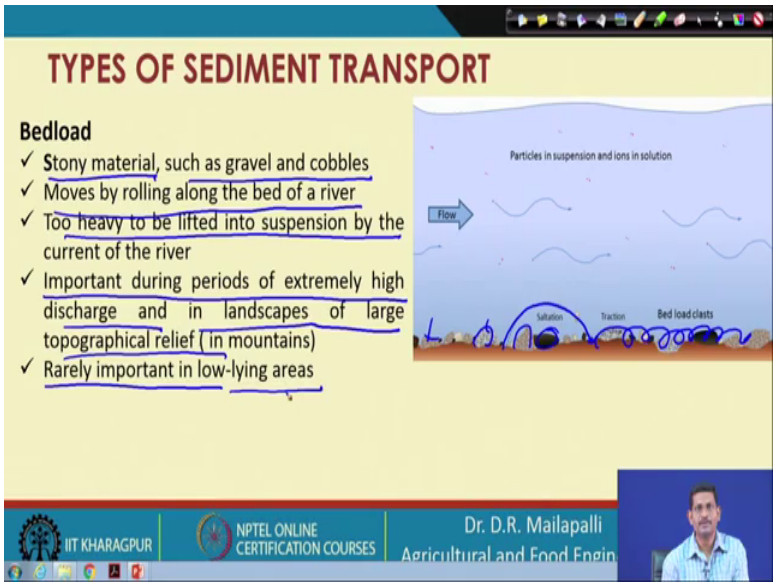


And there is the bed load; so the bed load it is a stony material such as gravel and cobbles most by rolling along the bed of the river. So, if you see this is mostly all these things have bigger particles and they bounce that is I mean the bouncing is the saltation and also the roll from you know one place to another place; so too heavy to be lifted by suspension by current of the water; current of the river important during the period of extremely high discharge in the landscapes of the lost topographic relief.

So, if you have you know steep slopes and you have a higher flow rate; so definitely the bed load is going to move or they are definitely there is an importance of bed load. So, rarely important in low lying areas; so this we even in hydrology we will be not focusing on bed load, but rather the sediment I mean suspended load is more important.

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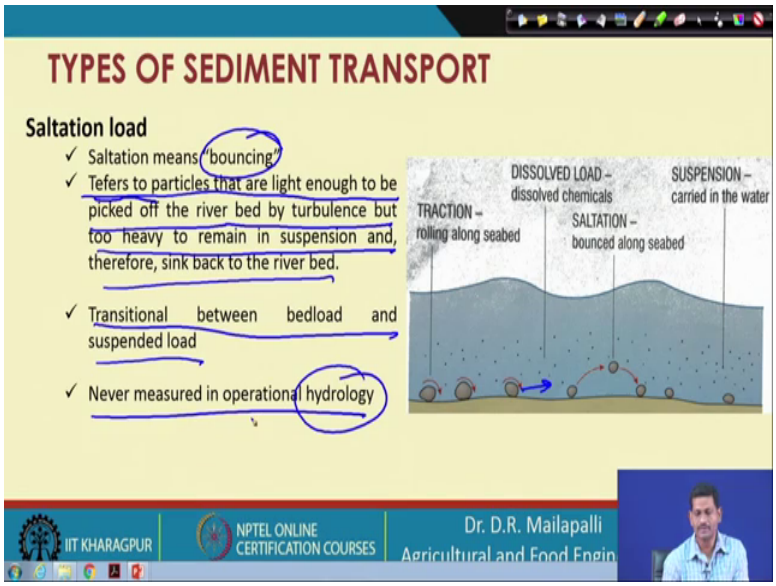


So, then a saltation load; so the saltation means the bouncing as I mentioned before; so it refers to, so it basically refers to particles that are light enough to be picked off the riverbed by turbulence, but too heavy to remain suspension and therefore, sink back to the riverbed.

So, what happens? So, the turbulence; so turbulence is I mean causing, but it is a heavier to lift. So, that is the reason it will be staying in the ground; staying on the ground and just moves just rolls. So, the transition between bed load and suspended load; so, this is in between bed load and suspended load. So, suppose if you too much turbulation this will be lifted up, but because of heavy heaviness; so it will again come down. So, never measured in you know hydrology this thing.

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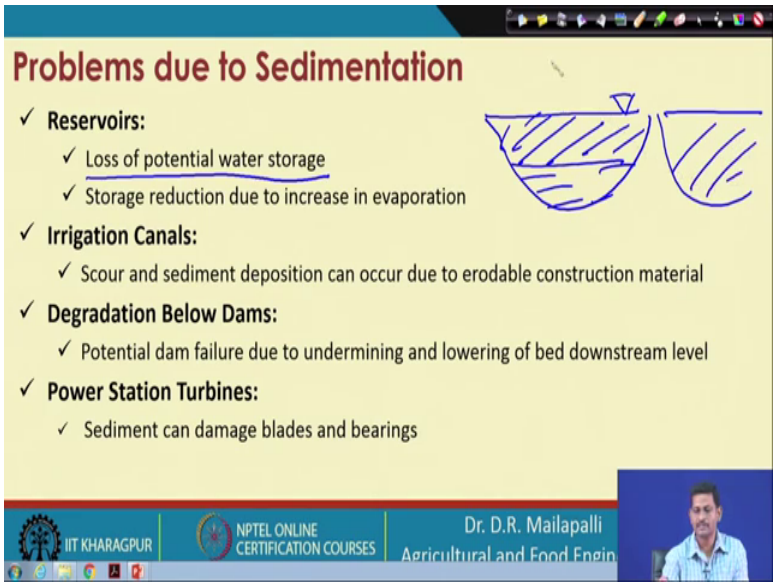


So, the problems due to sedimentation- so reservoirs if you see, so loss of potential or water storage because when there is a deposition here, so definitely the capacity of water will be reduced. So, only this is the capacity now compared to the actual capacity. So, that is the; so, definitely loss of potential water storage.

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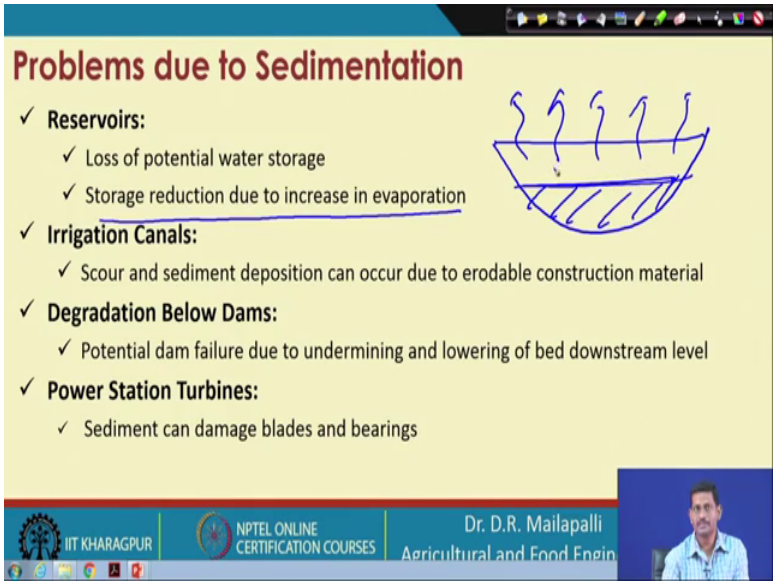


And storage reduction due to increase in evaporation not only that because it is; now it is a shallow right. So, this is a sediment deposition now it is shallow and it is easier to

evaporate ok; if it is shallow and then and it is easier to heated up and then evaporate same operation will be more.

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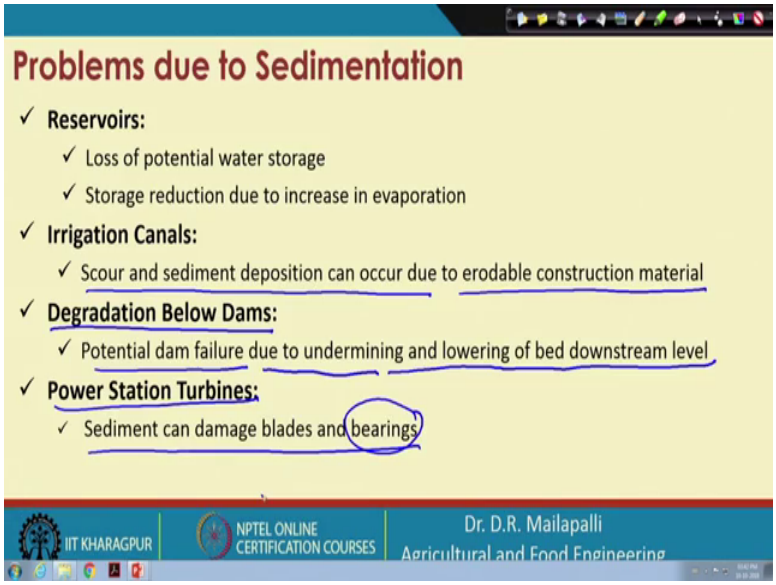


And irrigation canals irrigation canals a scour and sediment deposition can occur due to erodible construction of material. So, if you construct you know irrigation related you know structures right; so, definitely that will scour and deposit the sediments in the irrigation canals.

So, again the canal you know capacity will be reduced and degradation below dams. So, potential dam failure definitely influences the quality of water you know downstream the dam and it is a low lying a bed stream level. And power station turbines the sediment can damage the blades and bearings. So, when you compare the clean water versus you know the water with sediments; so, definitely that you know scour the blade of an impeller or blade or for and also the bearings of the; you know turbines. So, because the turbines are intact with you know water which is coming in.

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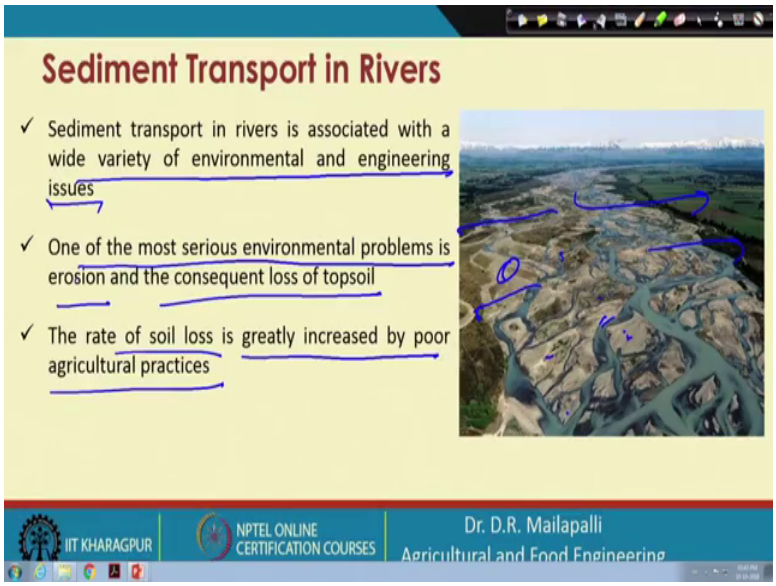


So, then in reverse; the sediment transport in reverse is associated with a wide variety of amount and in the engineering issues. So, if you see here this river; so it has a lot of you know driblets; if you see here, so it is supposed a single river, but because of the in the sedimentation. So, the river the capacities or width effective weight is been reduced and the depth of river is going to be reduced and definitely if there is large flows and there is a chance of you know flooding nearby areas.

One of the most serious environmental problems is erosion and the consequent loss of topsoil; the rate of soil loss is generally or greatly increased by poor agricultural practices. So, nearby areas if there is a poor agricultural practices and lot of tillage is taking place. So, definitely that will influence the water quality of the runoff water which is taking from the; agricultural fields to the rivers.

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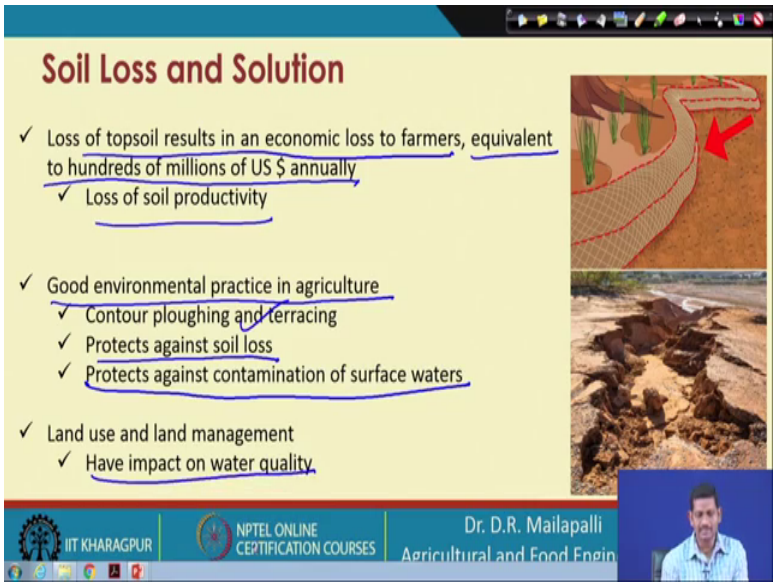


And soil loss and; so the solutions if you see, so the loss of topsoil results in economic loss to the farmers of course, because the loss the top soil is fertile soil. And once the topsoil is been removed from the fields eroded from the fields definitely the fertility of the land will be you know decreased and that affects the crop yield.

In the equivalent to hundreds of millions of US dollars annually; so, that is because a loss of soil productivity and the good environmental practice in agriculture like contour and terracing in; you know the steepy landforms and protects against soil loss. So, if you have some measurements or the conservation measures against is erosion controls that really protects the soil loss and protects against contamination of surface waters. The land use a land management this has an impact on water quality.

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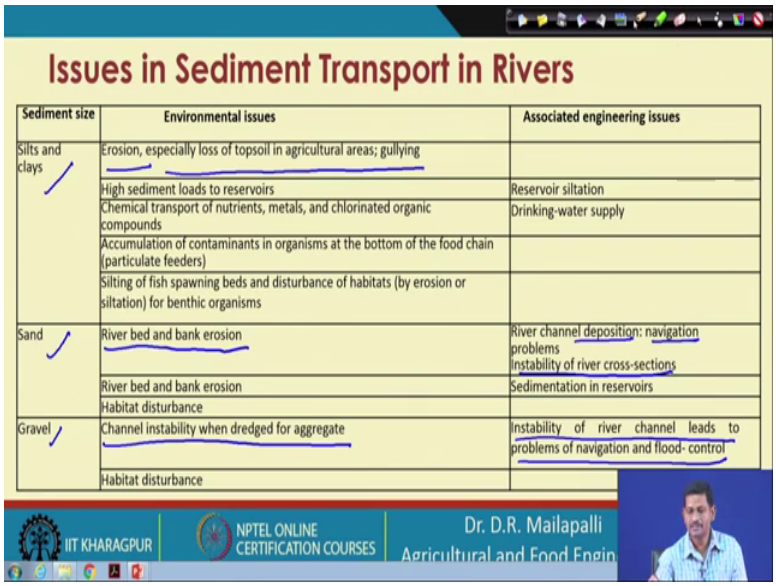


So, issues in sediments; so here this table will definitely show some and the problem number 1; sediment size; so, we have silts and clays and sand and gravel if these sediments.

So, environmental issues with silts and clays or definitely erosion especially loss of topsoil agricultural and gullies so, and sand yeah basically in the riverbed and bank erosion. So, river channel deposition navigation problems and instability of river cross sections. So, cross section maybe not stable if it is sand and the gravels channel instability when dredged for aggregates instability of river channel beds; so problem in navigation and flood control.

So, similarly we can go through this table for different sediment types and the environmental issues can be caused due to particular sediment type and associated engineering issues also can be seen in column number three. So, with this the lecture number 3 on sediment transportation. So, the basically in the river; so three processes one is the erosion.

So, the first thing is the because of the rain event or any soil disturbances; so the particles will be loosened off then and then if there is a enough you know stream flow or runoff from the surfaces so, that will carry the particles. And it has since it has enough transport capacity; so it will carry further long and when there is not enough transport capacity of that particular sediment node and the sediments are going to be deposited there right.

So, here erosion, transportation, deposition; so these three processors are important here and there are lot of each there are there are several sources of sediments and the problems which are causing due to sediments. And then how to tackle this sediment I mean load in the rivers, as well as the banks right, as well as in agricultural fields so.

Thank you so much.