Rural Water Resource Management
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Lecture 47
Nature Based Check Dams

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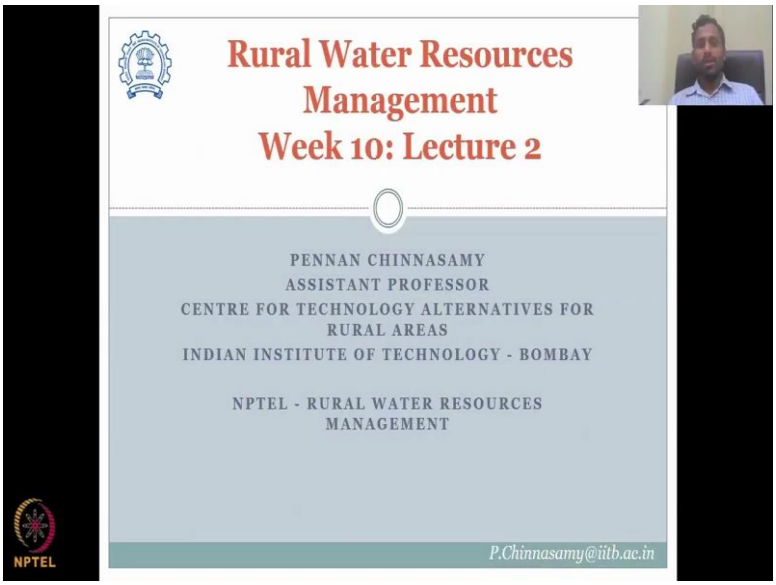

Hello everyone. Welcome to NPETL course on Rural Water Resources Management. This is Week 10 Lecture 2. In the last weeks, we have been looking at engineered structures for rural water resource management. In today's lecture, we will look at more concepts on nature-based solutions.

In fact, in Week 10: Lecture 1, we looked at how we can make leaky dams to store water and recharge the groundwater, also have water flowing so that it does not stop the ecosystem services. In today's lecture, we will look at more concepts for nature-based solutions. Let us move on.

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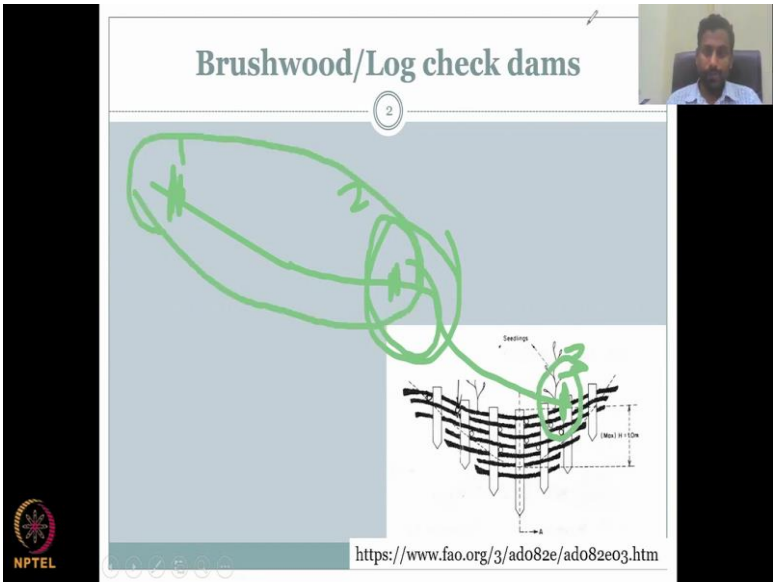

In the previous example, we looked at check dams which are based of rocks, soil, and some saplings in between. Today's lecture we could discuss about the brushy wood or brushwood log check dams wherein you could see that wood has been pushed into the ground which can always be removed, not like cement and concrete structures where if you take inside it stays there.

Here, you pushing these logs inside and you have seedlings and saplings going across the lateral position of the check dam. So it is the same check dam. You could see that you have a river cross section and you are putting inside the cross-section wood and along the woods some brushy material, brushwood and seedlings that can grow on it.

Remember, the wood also has nutrients, so which the plants can uptake. So water can pass through freely. You can see here water can easily pass through and also stop. So there is a balance, some water will be stopped; some water will go in slowly leaking in making the system more ecosystem friendly.

These are the dams which do not compensate the downstream losses may not compensate the downstream losses because you are still releasing water. So in normal check dams the water is stopped; large dams or small dams the water is stop and then it overflows to the next downstream people. Let us see what I mean as downstream.

So this is, this is your land mass and then you create a check dam here, you create a check dam here and you create a check dam here. So this is downstream of 1 and 3 is downstream

of 1 and 2. This is upstream. So when you block this water, number 2 would get less water and number 3 will also get more less water because the water is being stopped by 1 and 2.

So in this scenario, you should be very careful in identifying the networks that are going to be used for downstream users also and these kind of leaky or nature-based log and check dams are useful. You can also make this leak proof but because it is using nature-based materials, it is called a nature-based solution which is your rock and some rock and more wood and saplings, etcetera.

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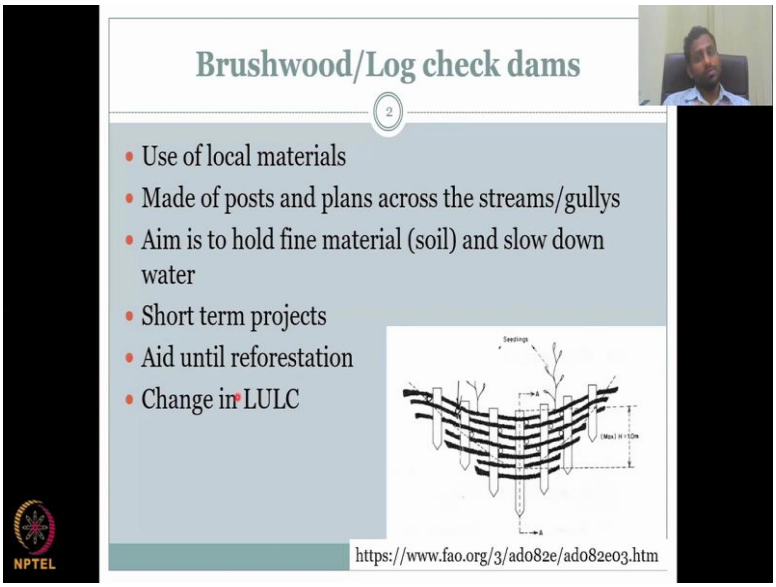

Use of local materials is how it is constructed, made of posts and plants across the stream, gully. So there are lot of posts which are wooden posts and then you have your plants and seedlings across the stream/gully. Aims to hold fine material soil and slow down the water. So because of the root zone, because of the soil plugs, it will actually prevent the sediments and slow down the water and more and more water would go.

So these are not only for water retention, it is also for soil retention and reducing the soil erosion. Because if water flows fast, it will erode the side of the river channels and then form more soil erosion along the downstream. So here you are arresting it so that more water flows without sediments because your sediments are depositing so the water can flow.

These are short term projects that can be done during your rainy season and after the rainy season it can be easily dismantled. What is the meaning of short term, is you do not have to put so much energy and money into making these check dams. Same thing it does not cost

much to remove it. You can just uproot it within you know your day's work to take some 4-5 people with the shovels and stuff and clear all the region.

This is not as easy as removing a check dam or an irrigation small project. For example, this can do for aiding in reforestation or change in the land is covered. So think about it. You have a forested area which has lost the forest. So it is kind of a barren area. You can make these check dams, based on nature-based solutions and slowly the water would be enhancing the growth of the forest and once the forest comes, you can remove these check dams.

It can also be useful in changing the land use land cover into more nature-based solutions. So this is where your ecosystem service comes in. So think about it. Your ecosystem service is preserved. In fact, it is enhanced because of these nature-based solutions.

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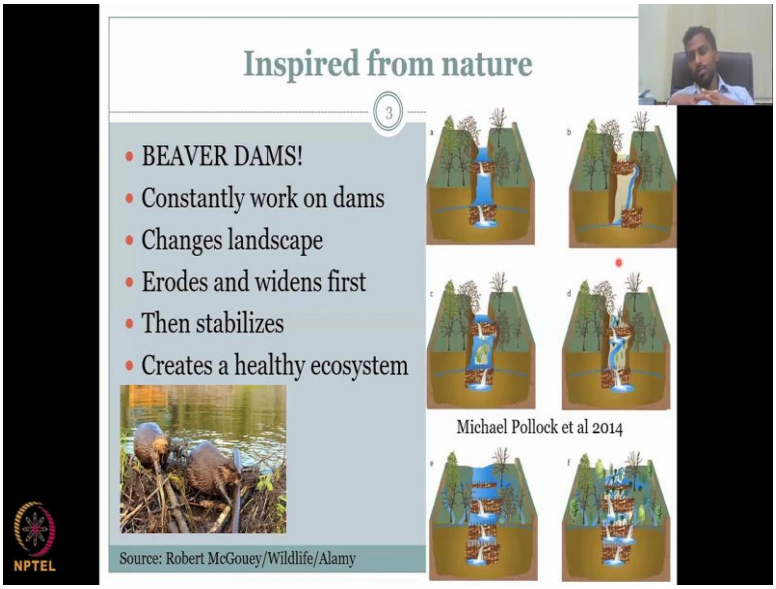

Where does this idea come from? These ideas of making these small check dams and also nature-based solutions comes from nature itself. Let us take how a beaver makes these check dams. A beaver is an animal. I have a picture of it coming soon. But let us see how a forest is initially there and how it changed into fully nature-based more forest.

So you can see A which is a forested land has less forest. And then F has more forests, more biodiversity, etcetera. What is biodiversity? Biodiversity is the phase where multiple trees and plants grow together and more life forms are present. Here there is let us see, it is barren land. The trees are not full with leaves etcetera whereas on the bottom part you have more trees and more plants and life forms.

So the beavers are the ones which actually made the first check dams, I would say because they eat the wood and then bring the wood saps and other things and make big dam across the river for fishing and also to store water because they like to swim etcetera. But they also use it for their you know dietary habits.

So let us look how it progresses, the beavers' dams. They constantly work on the dam. They slowly bring it with their partners and then they make these. You can see how it is carrying the wood, logs and stuff. This is the same concept I told in the previous slide. When you make a nature-based check dam, you actually install all these wooden structures. You bring soil, you can see soil is here, mud is there and then you make a check dam.

It changes the landscapes. First, let us see how it changes the landscape which means from A to F, the land has changed into a more forested land, more biodiversity land. Let us see what is happening? It erodes and widens first. So when you have these check dams which are made by the beavers what happens is the big water comes.

The big water comes and when it holds it, all these sides (you can see all the sides) are breaking. It breaks because it is fully with water and all the sides start to erode. That is what is very important to have bank stability in these kinds of dams. So in the flowing period, all these sides of the walls are getting cut because of the water. And in B when there is low flow, only preferentially the water will flow.

So you can see here only this part of the check dam is open because all the other parts are broken or more concrete, sorry not broken but more solid. Only where it is broken, the water will flow. So when the water flows, it channelizes itself. It erodes and widens. See from here it has widened the network. So this width is more here because it goes around the check dam where it is very easy to go.

It is broken on the sides, right? So it can easily go through the side rather than through the check dam. So initially the check dam was small but then it gets too wide apart. Then what happens is your beaver comes back and then builds it again. So you can see the beaver constantly building these check dams, kind of a beaver dam. So it makes another addition here. So now you can see in addition more.

But now, once the addition is done, there is more water stored and that water overflows and makes small, small islands and the sediments overflow. So you see all the sediments. It has

been cut through inside and then all the sediments would now have water and seedlings from the upstream and the forest is dropping all these seed into the ground, so those would start to grow. You can see here how more plants are growing. In first, only was water.

Only water was there so water was flowing across. The check dam made sure this area becomes dry first and when it is dry, the water would move around and cut through it and this sand which is exposed now can be dried to support the plants, seeds and other networks insects etcetera. Because when the soil is not fully saturated, your plants can grow. When it is fully wet and always wet, the roots cannot grow.

So slowly it stabilizes. You can see that in between now the plants are growing. And again, plants will grow on the side. It will cut. And now it is overflowing in this side, another plant is growing. So like this the network widens, your river network widens and also wherever the sediment has been deposited and now dry during the dry season the plant starts to grow. It still gets water from this water.

It still gets water so that water can be used to support the plants and you could see that slowly the sides get more plants and it starts to emerge. So now the forest has emerged. More beavers come and build more check dams. It was initially two. Now it became four. And as the beaver check dam increases, the water would go to another water, not the same pathway.

And when water goes another pathway sediments are deposited, water is being shared and more and more trees are growing. So you can see more trees. So this is a perfect example of nature at its best which is creating a healthy ecosystem by slowly changing the process. If you do not have check dams or these beaver dams, what happens? Water will continue to go straight. It will cut, cut go through straight and the forest would not expand.

But here by blocking it naturally; naturally means the water is always flowing through, it is not that it zero flow. The water can still flow. So when it is flowing through then the benefits are shared between the different players. It is not only one sector which is getting the water. All the people are getting the water.

So it creates at the end of the day a very healthy ecosystem where everyone enjoys the water. And all of this is from nature we learn from nature and then we building more concrete dams, concrete check dams, etcetera with an understanding that yes, it is going to create some impact on the downstream but there is some give and take which can be done.

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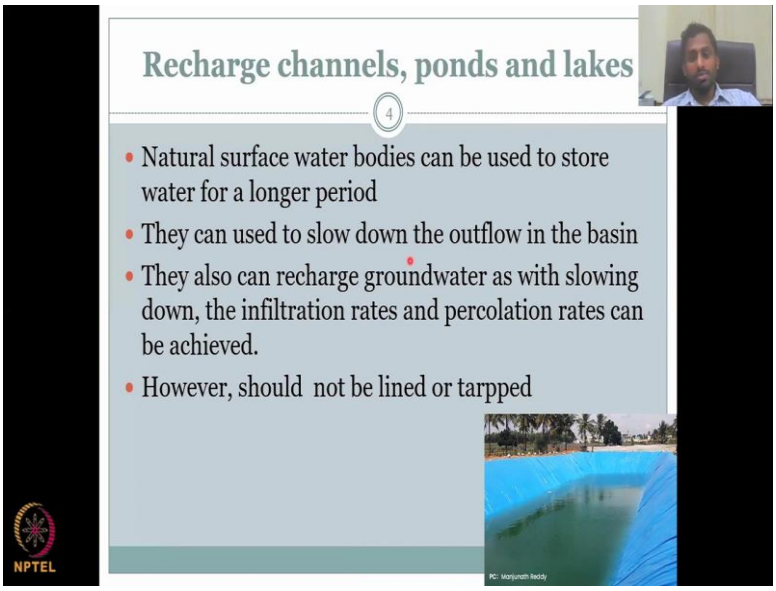

So now we are done with check, check dams. Let us move on to the next nature-based solution which is recharge channels, ponds and lakes. So the nature-based solutions of water bodies can store water for a longer period because those are smaller in size and it is already full of prevention networks. For example, it has a good tree cover on the top, the ponds and small lakes. So they are not exposed to direct evapotranspiration.

You can still have water there for longer time. So if you go to forest, these elephants and animals know where the water is always coming because those are naturally preserved. Unless you start to change it, water will still come. They can also be stored to slow down the outflow in the basin. These nature-based small surface bodies can slow down the water release and reduce the runoff out of the basin which is Q out.

And while it is making it slow transit, slowing or going down slowly; what happens is the water gets more time to recharge and that is the goal. We need water to recharge more into the ground. So how do you get it? By sending the water through these interfaces, slowly going through these nature-based solutions, enhancing the infiltration rate, percolation rate, so that more water can be used.

However, they should not be overridden by your construction activities. For example, you should not be putting lining which is concrete or putting ducts, ducts or plastic sheets like this. You can have these low-lying areas where you can store the water. Instead of putting

land putting soil and filling it up and then building a construction or building it into agricultural field, you can use these low-lying areas for water storage.

But once you put a tarp, then you are reducing the runoff. You are only using it to pump and irrigate which is basically a nature-based solution sorry, an engineered solution because your plastic product is used. So be very careful on what type of activities you are going around with the water. So how should it be? Can we think about how it should look like for a nature-based solution?

There is some, as I said, some changes you can make but no constructed item on it. Everything should be nature-based like this.

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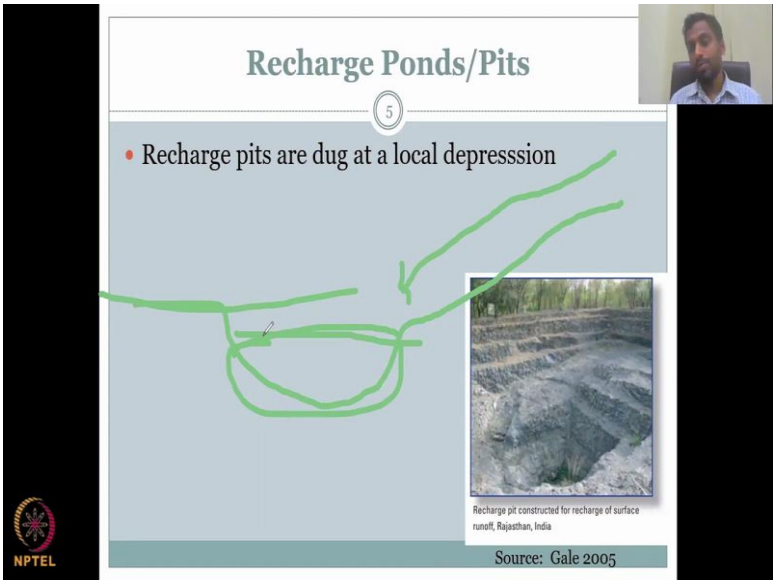

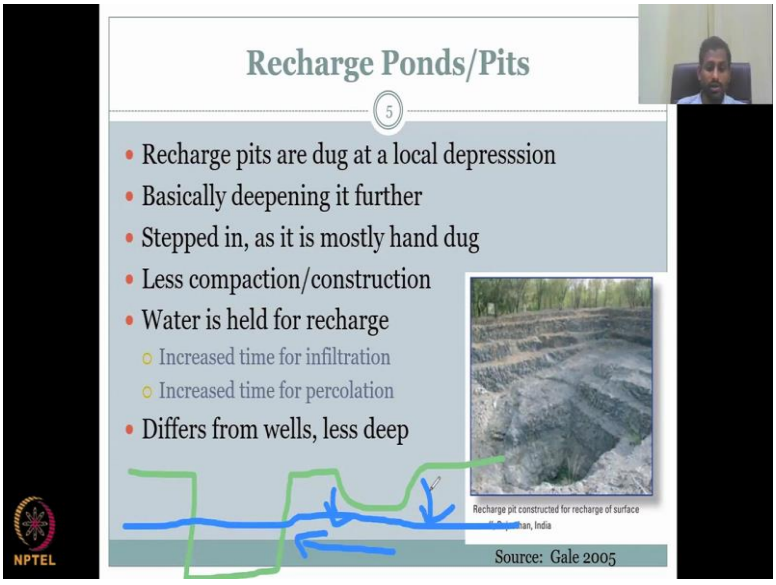

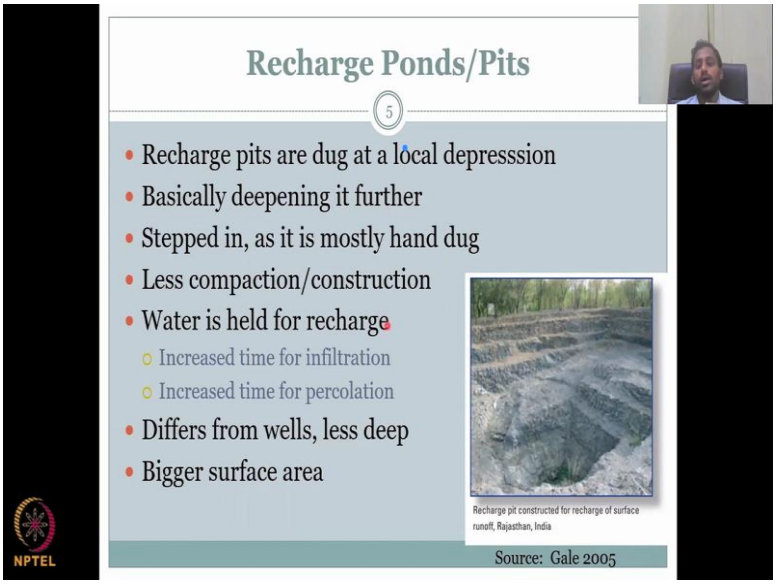

A recharge pit constructed for recharge of surface runoff in Rajasthan where the surface runoff is pooled into this recharge pit. And you can see that there is no concrete or no rocks and no cement etcetera. Everything is hand dug into the well and there was already depression there. So there was already a low-lying area. All they had to do is make it bigger, make it more into pooling water conditions and water would move slowly and then recharge.

So this is very important for understanding your recharge networks and creating a more sustainable recharge structure. Let us see how it is done. Recharge pits are dug at local depressions. So basically, the villagers or as I said, the animals know where the water is. You can ask the villages where do you find waterfalls or where does water stay for a long time. You can go there and then make sure that it is not a rock.

It is just because it is a low depression; I will again draw a depression just for example. So this is the land and water is flowing like this. It just stores here and then flows out. So this is a natural depression. That natural depression can be more structured. That is all they have done. They build some steps and then they build more space so that water can store rather than move out, basically, deepening it further. You already saw a depression.

You just deepen it and put those soil on the side to make it stabilized. Otherwise, it will just collapse and come in, stepped in, as it is mostly hand dug. You can see that it is not used by machinery. You are not disturbing the system. See if you use a big machine like a JCP or a bulldozer then all this land has to be cleared.

And when it is clear it does not grow well. Because the machine has to come in, right? You have to move; the road is being made and other things. And even if you use tractors and other things, you still disturb the soil. Here it is purely done by hand, a nature-based kind. You still use some instruments, less compaction, less construction. You are not putting too much weight on the soil to compact it.

When you compact it, infiltration is less, percolation is less. You are making sure water can still flow through because that is why you are making these nature-based solutions or infrastructures. So construction is less, less compaction. Water is held for recharge: increased time for infiltration, increased time for percolation.

So what do you see here is water is recharging and there is more infiltration and more percolation because you are putting water into the depression and from the depression water is leaking into the groundwater aquifer. Because of that, there is considerable increase in infiltration and percolation rates because you have identified where the depression is.

You build a head. You build a hydraulic head which is a water column on the top which would actually push. It has a force extending in the normal direction. It will push the water into the aquifers considering a normal water which is just standing on the top. If it is a height water, then it can push more into the ground, differs from wells, less deep.

These are not wells. Wells are more deep where water comes from groundwater into the well. here you are creating water to go from the recharge pit into the groundwater aquifer. Let me draw it. And your groundwater table could be here. Let us say this is your groundwater table. So what is happening is your water is moving into the well.

However, from the recharge pit it is moving into the aquifer or into the water table. So this is the basic difference. Both are dug but it is not too deep. If you dig too deep, it becomes a well and we are not doing well here. Bigger surface area, it is not small as well and it is like stepping down so it has a bigger surface area where water can be collected and recharged.

The source of the book is already given. Please; and the chapters are given. Please look into further more discussions on these different types in these FAO books. These are very important and can be a hand book for your field work. Please understand that not all matters can be covered in a 12-week lecture. However, I am covering the most important ones that can be used in villages.

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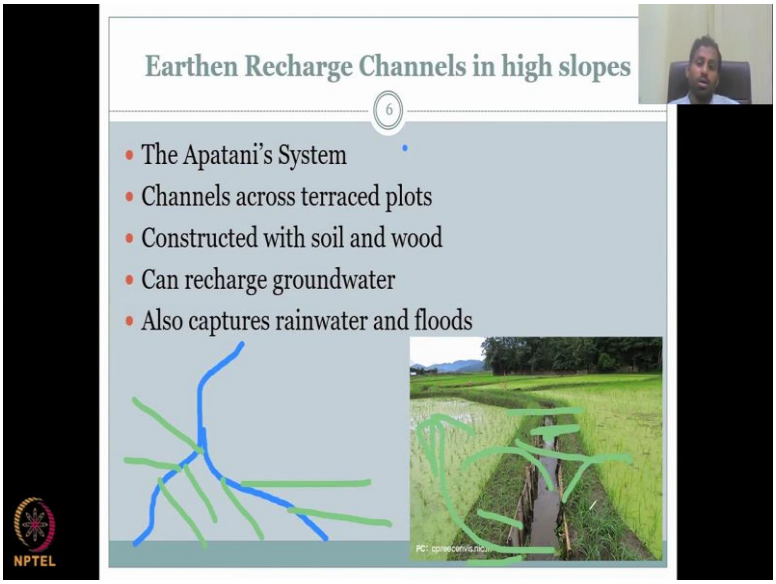

Then we have earthen recharge channels in high slopes. High slopes can have a small dam or a small check dam on the top and from there water is being sent to different locations. How are they sent? By channels, So the channels if it is coming as a concrete then it is not a nature-based solution, it is a constructed solution.

However, if you make earthen channels, earthen means earth soil, mud etcetera. If you make it with that and you can see here, they have used earth and then on the side to stabilize the bank they have used wooden planks. All are our nature-based solutions. Then what happens is water can flow and recharge and this is an example taken from the Apatani's system on the high plains. It runs through channels across terraced plots.

We also already looked at what is a terrace. You dig and take off the land and then you make sloppy lands into terraces. But the terraces still need water and the water can come from these channels through earthen recharge and also channelizing the water. Constructed with soil and wood, wooden planks, you can see. There is no big machinery needed to construct it, just digging with shovel and then hitting these small wooden planks along the sides.

This can actually recharge groundwater. Look at it. The water can go down into the recharge zone because it is flowing and it is mud. So water can easily go down into the groundwater aquifer. Also, these can be used for capturing the rainfall because in the low-flow season when the water is flowing was going through it can recharge. But what happens if it is a high flow season? In a high flow season, you are diverting the water across the channel.

Instead of going in the river and the river gets flooded, you are taking the water into channels and the channels are recharging everywhere and that would be very very beneficial for reducing the floods. So for example, this is your river network. And a big flood is coming. So now if you could change the flow in the in the river by making channels, okay, you making these earthen channels from the main line and everything will come down through the channels.

You do not have to pump it because through gravity water will flow and when water flows in through these channels, when it gets recharged, it actually converts the floodwater into groundwater recharge because all the sites have mud. All the lower regions, bed of the channels have mud which can easily take mud and soil which can easily recharge the groundwater.

You can also make some blocks. For example, you can block the water here and then make it overflow into the rice fields thereby increasing the rice productivity. Or you can channelize it. You can open along the bumps and let water come in for irrigation. So there are multiple uses of this earthen channel. If it is a concrete channel, you cannot open it anywhere you want.

You have to wait till the small specific openings are kept. And you cannot just build on top of it another small dam or checking point where water can be stored. All this can be easily done through these networks. There are multiple systems like this. I would request you to go to this website and also look at government recommended schemes for naturally recharging.

So what is artificial recharge? You create some networks, your shaft and then push the water in. Whereas these you are just spreading the water more. You are asking the water to go in and then channelizing the water for more recharge and also storing. These channels can actually store the water thereby reducing the flood peak, reducing the flood volume.

If you have time, you should also visit these kinds of structures to understand how they grow, support the local villages and stuff. It is easy to maintain. Suppose a big flood comes. Quickly the farmer can come, take some soil and then make sure the dam or the earthen bundt one is repaired. Repairing is easy, maintaining it is easy.

You can also have fish growing along these channels which can be done. Vietnam does that, And no land clearance. You are not clearing anything. Maybe the field was cleared. That is

fine. But inside the field, you are not putting another concrete element. You are not reducing the natural groundwater recharge. Everything is enhanced.

So with this I would stop on discussing the nature-based solutions for check dams where we understood it came from the beavers. They are the nature-based solutions. It is not documented but you can see the resemblance. People who work in the forest know very lot that these beaver dams help in the growth of the forest.

Here you can see that the water is channelized. And while it is channelizing it is also recharging all the areas nearby, thereby increasing the groundwater recharge. With this I will conclude today's lecture. I will see you in the next lecture. Thank you.