Rural Water Resources Management
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Lecture 49
Forests for water conservation

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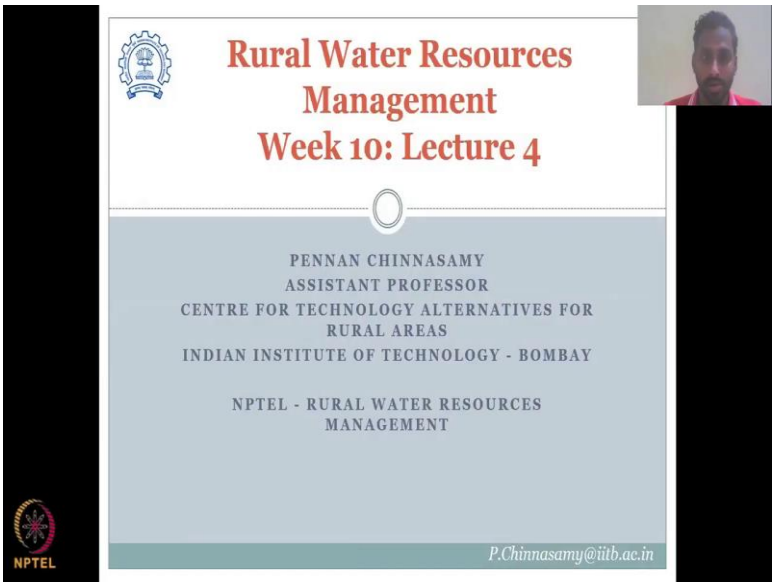

Hello everyone, welcome to NPTEL course on the Rural Water Resources Management. This is week 10, lecture 3. The past week, we looked at rural water resource infrastructures to manage water and store water. Using engineered solutions, we notice that not everyone can afford engineer solutions and it may have some impact on the ecosystem.

Therefore, in this week, we are focusing on alternative engineering methods, which are including natural resource management through nature-based solutions and decentralized or low construction resources. These infrastructure have been widely used across the world and most importantly, they have been traditionally used. However, the recent decades they are not being used much.

Therefore, in this course, we are highlighting these different systems. In the last class, we looked at check dams, rainwater harvesting through rainwater gardens or rain gardens, we looked at sponge gardens and we looked at multiple other methods that are all purely nature-based solutions. There is little construction, but still, it is less impact on the ecosystem.

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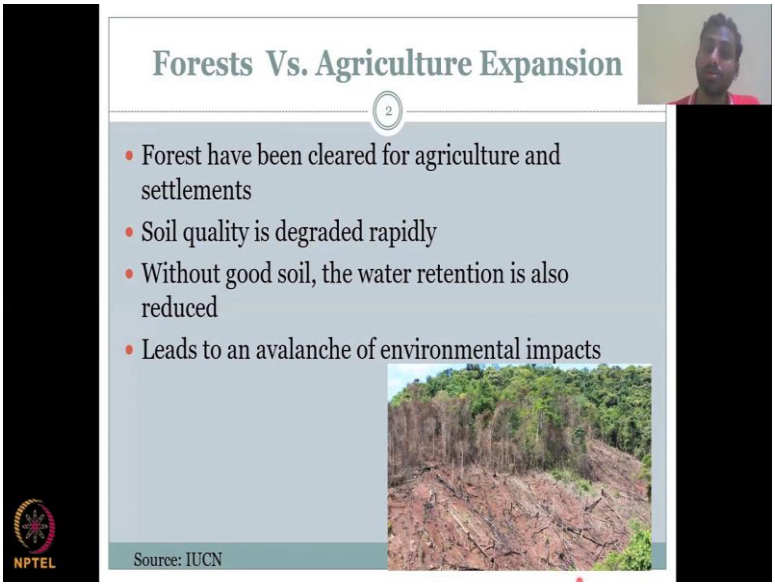

Let us continue our discussion on the same line. But before that, there is always land cleared from forests for agriculture. We need to understand what has these agricultural expansions done to forest because in today's lecture, we are going to see forests as an alternative nature-based solution for improving water resources.

It is mandatory to understand that there is difference between forests and agricultural expansion or forests and agriculture there are differences. To quantify that, it is very important to look at what is a forest and how it has been cleared for agricultural expansion. We all know what a forest is, forest is a composition of good soil, good trees, especially native trees and they harbor wildlife, birds, insects and all the other abiotic factors including rocks, water, etcetera.

So, even though we know so much benefits of forests, it has been unsustainably cleared for agriculture and settlements, which becomes part of the rural entity. So, now in a rural area, which was originally a forest, if it was clear and then converted to agricultural land, how are you going to minimize the impact on the ecosystem? Or how are you going to capture more water using different methods is a question.

So, we will go through some of these methods after we see how the Sustainable Agriculture expansion has been devastating the planet. Once forests are clear, the soil quality is degraded rapidly because trees and plants improve the soil condition. They break down the soil materials. They also let water go in through infiltration into the root zone and percolation.

And importantly, it provide the important biomass and take part in conversion of gaseous nutrients into soluble nutrients in through the root zone activities. So, there has been a lot of good soil quality because of forest because soil is not just the rock, which has degraded it is with living organisms, nutrients and water.

So, all of these are removed from the soil when you remove the forest, without good soil the water retention is also reduced, there is not much water that the soil can hold, if it is not healthy, if there is no biological activity in the soil, then the water tension is reduced. The tension is reduced then you have more floods, this is what you see on barren lands, barren lands, the soil is not conducive for agriculture or anything to grow.

So, now, when rainfall occurs on the barren soil, all the water goes out of as runoff where if it has trees and plants then water goes into the root zone and goes infiltrates. Lot of of negative environmental impacts happen because of removing the forest and all of this have been widely documented and study. For example, this forest you could see that the surrounding forest is very lush and green, the soil quality is good.

But once you cut down the trees and or burn here, they could have burned the trees or done something to reduce the trees cut it down, then what happens is slowly the soil loses its tendency on the slopes it tied together. They do not have anything to bind them together like roots normally bind the soil together.

So in that case, you are actually losing the soil, losing the trees and all the other plants that are supporting it. So by clearing this forest, you are also endangering the forest nearby. And when the sudden rain, what happens is all the soil will be washed away because there is nothing to hold the soil.

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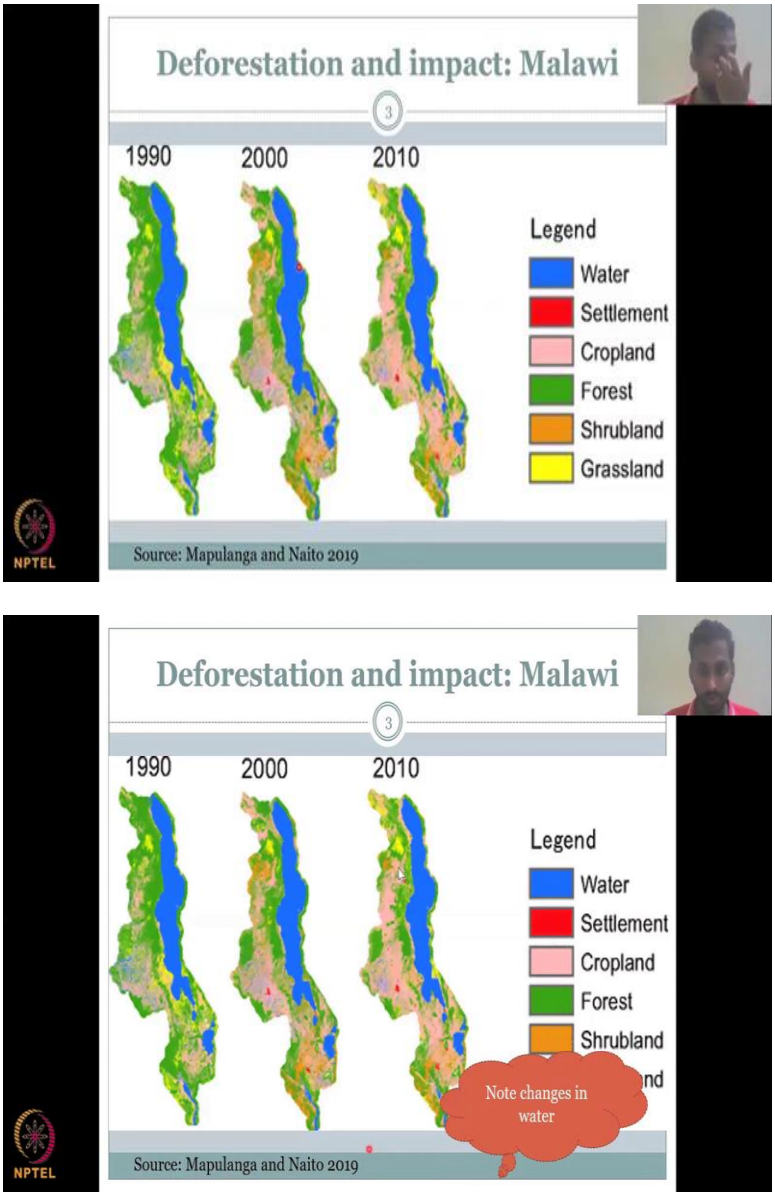

So, you can be sure that removal of forest and conversion of them into agricultural land is not long term sustainable. However, the damage has been done in most regions. Let us look at deforestation in Malawi and the impact. In Malawi, you can see 1990 to 2010, there has been considerable loss of forest, the forest is in green color in mostly the northern part and southern parts you see a lot of forest and all of them have been cleared or most of them have been cleared to support cropland, the cropland is in pink.

You can see the water body size also shrinking every 10 years because of the loss of forest and wherever there has been a good amount of agriculture there has been some development

of a village or city we call it as a settlement. So, urbanization can also lead, the major partners you see all these blue water bodies are lost, these blue water bodies are lost.

And these major water bodies also shrink in size. Initially, you see an increase in the water, why? Because forest take a lot of water. And when you cut them, suddenly what happens is all the groundwater which was going to the trees are not taking up anymore. So it comes to these water bodies. So initially five years six years, you see a flush of water coming into the water bodies. But then after that, there is not much water that can go into the groundwater, because you have cut down the trees.

So, thereby reducing the infiltration, reducing the net output into the rivers and streams and also no shades for the water bodies, so lot of evaporation and water loss. So, this has been documented as highly unsustainable, a classic cases in Bangalore, you would see a lot of lakes have been converted a lot of higher good trees have been cut, converted to cropland and cropland converted into urban cities etcetera.

See in the rural setting, it is not a sustainable way to cut all the forest and then convert to cropland. There has been some balance there needs to be some balance between a forest and an agriculture coexisting together. And that is what we will be seeing in this lecture. So we have understood that forests have been degraded have been cut down, unsustainably on the name of Agriculture and Rural Development, but that cannot be sustainable.

Sooner or later the same forests that you cut and converted to agricultural land, the clearing of the forest would lead to the loss of agriculture fertility also. All the land all the sand that is under the forest which have been cut will surely yield high because the land is highly fertile because of the forest. Now, if you cut the forest and then put in agricultural land, the fertility will be gone quickly.

So there should be a balance a given a win win situation, let us see what can be done. As I said the water bodies have drastically decreased especially in this area where the forest and other areas and mostly this area.

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Conservation of water and soil in degraded forests: Now we are going to start with a degraded forest in a rural setting and see what can be done to save them, save the forest or regenerate the forest and also bring back the water and soil conditions. First, let us look at the Afforestation. What do you mean by Afforestation?

So we will go through a lot of terms that are discussed about increasing the forest cover. Our goal is to increase the forest cover increase the water conservation activity and soil conservation to the forest cover. So the first we will see is Afforestation, wherein conversion of barren and degraded land to forest. This happens in a land which has been barren without any crops growing and degraded land into forests.

So you take a patch of land which has been not good for supporting plants and any type of life form. You have to do some activities or a till it or bring back water, bring back soil nutrients, and then slowly slowly develop the forest. This is called Afforestation. Reforestation is, replantation of trees in a deforested land. Suppose you have a forested land, and you have cut it and then you convert it to agricultural.

Now, after you know the importance of the land, you would go back and do Reforestation, which is replantation of trees, in the land where the forests have been cut. This is what tribals do, mostly, Tribals do not own all of these forests, what they do is they will go to a patch of land, they will clear the trees for some small patch where they do agriculture, they grow the

plants crops to feed like rice, millets, whatever it is, and then after one or two years, they would move to another patch, they will just leave and then go.

Since it is inside a forest land and since the forest is still active, it will reforest itself. There is plants and animals, the birds will drop the seeds, animals will drop the seeds. Then what happens is the forest which was clear that land, would regrow again by itself, because it is surrounded by forests and all these animals, plants, earthworms all helped help together, that is called Reforestation.

It naturally but very slow, what we are asking here in the conservation world is you need to do it by yourself go to the land, make sure the land is proper, bring somewhat initial stage, bring some shade and also high variety native seeds to grow. Both require considerable management and periodic maintenance. As I said clearly, the tribals they do not do maintenance, because the land is small and as I said, the entire area is forest, here, since the entire area is now converted to agriculture or plots, it is necessary to maintain periodically.

And for that maintenance since it is expensive, and people do not readily come together, this required to have a community participation wherein all the people in the village will come together. In reforestation and afforestation activities. Remember the entire village would get affected because of floods, flash floods, if your forest is removed, because of low water content, because of low soil fertility.

So, it is important to bring all of them on board who are directly or indirectly impacted and ask them for community participation. In some villages, every house should have to send one person a day to maintain the forest, at least until the forests can take care of itself. But doing that also increases livelihood options, that is what we are seeing in some villages in India. Like a model role model they are, very aspirational, very inspiring.

Where these community participation have created the forest and through the forest, they have created some livelihood options, it is a win win, the community gives time. And the forest gives it back by giving options. Some of them are like the trees, that are the trees and the branches that are falling down naturally, are taken up by these community people.

For firewood and other resources, the raising of their livestock is available, fruits and other essential things, for food can be taken and then used considerably and considering the sustainability and some livelihood options of herbal medicine, folk medicine, all that can be

possible. Let us take an example how a community takes part in community management of forest. Here you could see the locals, actually dowsing the fire which means forest fires can pick up by itself. A lot of factors relate to forest fire.

And once the fire hits, all the trees are burned, and then the soil is exposed to sunlight. So there is erosion. So what these do locals do, is find locations where these kinds of fire could start, forest fire, basically a lot of dry leaves and a lot of places without with open without shade. And a lot of sunlight due to climate change if it hits too much, and the leaves are very very brittle and dried quickly they could catch fire.

All it needs is a spark. So it is very important, once it happens, they know how to put down the fire. There is something called prescribed burning, where they would open up fire in some locations to cut down the fire. So all these are being done by some limited training and traditional knowledge by the locals in a community participation network.

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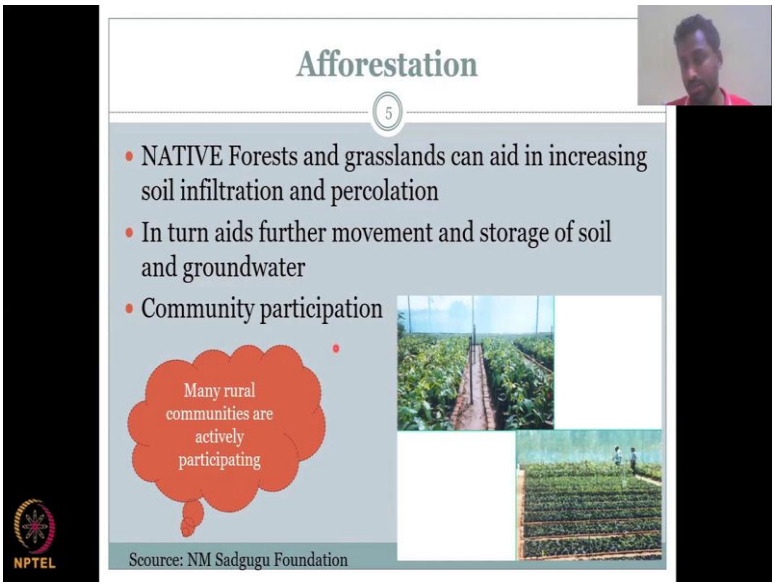

Then we go to Afforestation. As I have mentioned Afforestation you create a forest from a barren land. Native forests can and grasslands can aid in increasing the soil activity especially infiltration and percolation for groundwater management. Especially the native I put it in big, because a lot of people have started using invasive or quickly growing trees.

If you can, for example, eucalyptus, eucalyptus may be native for some regions, but for many regions it is not native. When you put those trees you disturb the water quality, you disturb the water quantity, same pine trees, they put it on the slope, the pine trees can turn the soil

acidic, it can bring the soil acidity up and then all the soil becomes acid content. So it is very important to bring the local trees from the local knowledge.

It in turns aids for the movement and storage of soil and groundwater, because the native forests can build the soil profile, remember the soil is built by breaking up of the rock material, parent material and the action of soil microbes, nutrients, organic matter, sunlight and water. So all these things mixed together to make the soil an organic matter is given by these forest. Community participation can help, many rural communities are actively participating in Afforestation.

The previous I said is forest maintenance, here a lot of people are actually participating in the afforestation efforts. The government can give free nursery, small saplings how you use it to get across on a hill slope or barren land is through community participation, Basically, every house in the village would collect these plants, go and plant them and maintain these plants for some years 2 3 years and then these plants will take up care of themselves, because they will become more mature.

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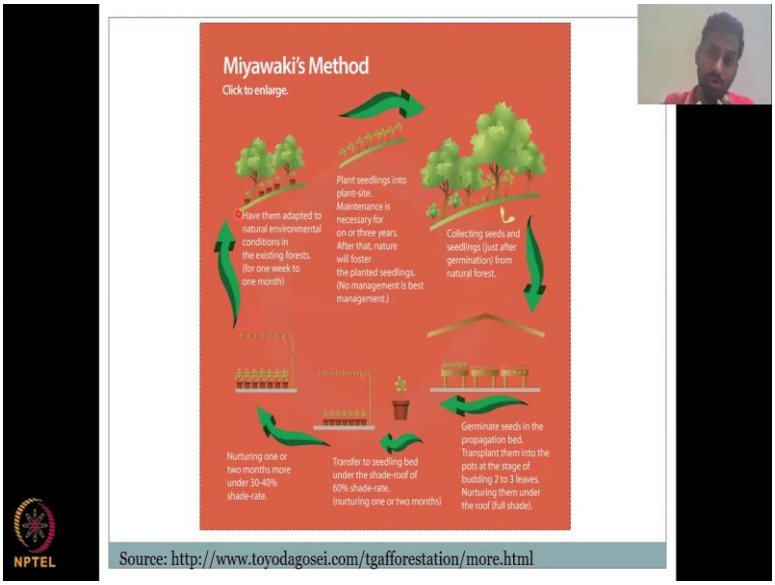

I am going to talk about the very successful Japanese model, which has been practiced in many, many countries, including India, on barren land or deforested land. Basically, how do you convert this land into a forest, it is called the Miyawaki's method. Very, very famous and many, many countries are taking up. Let us see how they start.

You start by collecting seeds and seedlings just after germination. Germination is when the seed starts to have the small plant growing up, that is the active seed which has been germinated. So they take up this germination from a natural forest. Not a artificial forest, not from your park or garden, you have to go to a forest, setting to make a forest, so you first take these germinated seeds, bring them to a greenhouse, where you put them on a bed and let them grow.

Because there most of these saplings will never grow full height, because already the trees are full. So they will just grow and then die within the soil and then convert to organic matter. But here, you will bring them to these greenhouses basically an isolated area with sunlight and water, where it can grow. So you let it grow to 2 3 3 leaves budding.

When it starts to bud, now you put it in a soil and then when it starts to three leaves coming, then you transplant into a pot, each plant takes one pot. Full shade, here there is full shade, not much sunlight coming, then you go to a 60 percent shade, you can see the shade is reduced. And each of these plants are kept, you nurture it.

Nurture it means, basically giving water, some nutrients, natural nutrients that you can give, and then slowly after two to three months, you have shifted to another location where the shade, the shade is only 30 to 40 percent. So what you are trying to do is slowly you are increasing the sunlight coming.

First, it was no sunlight, just your normal room temperatures and lights that can let the plants grow slowly and strongly it is competing, it is competing and then growing and then 30 to 40 60 percent shade, then you will shift to 30 40 percent shade. And then you put them into a natural environment. In an existing forest, you take it to a forest and then you put these in the small pots, you put them under the trees near the trees for 1 or 2 months.

And then these seedlings these small plants are taken and put it in the barren land where you want to do the forest. Plant seedling into the plant site, maintenance is necessary for 1 to 3 years. Necessary, it is very necessary, you cannot just plant and go, you will have to nurture it for 3 years after that nature will foster, no management is needed. So what you are trying to do is, you are not just taking a seedling and then putting it in the land.

You are taking it, letting it grow healthy initially, by pampering it by taking care of it and then you go and plant it in the forest. It is a long process, but a very sustainable for process

because after two three years, you can come out happily and the forest will grow by itself. It has been very successful in many countries including India. In fact, IIT Bombay also has one. So you should try it and see how this can work in the rural setting.

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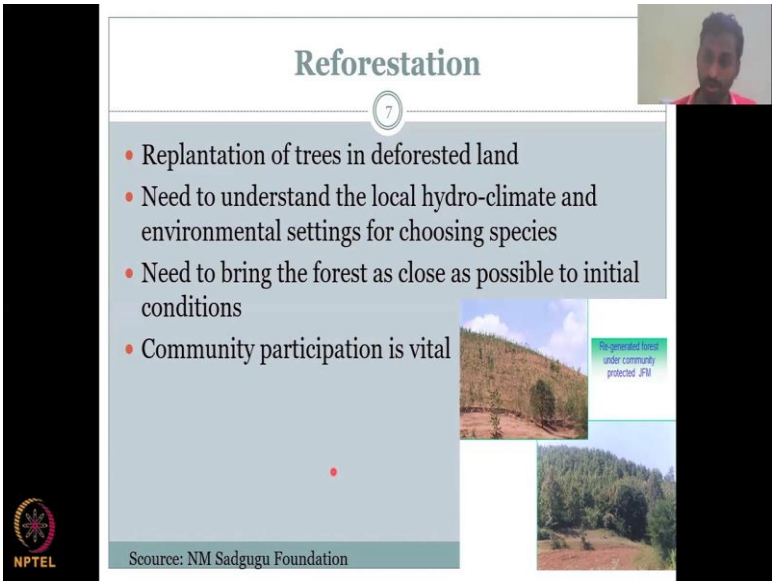

What happens here is the Afforestation is done to increase forests from, a land where the forest is not was not available first, was a barren land etcetera. Whereas Reforestation we are going to create a forest on a land which is originally a forest. You can call Reforestation or regeneration of forest. Let us see one by the NM Sadgugu Foundation, which I have covered a lot using the lift irrigation schemes.

They also indulge in reforestation because they understand that to get the water to the lift irrigation, to get the water to check dam, you need to have a healthy forest. The forest is the one which actually helps in condensation, bringing good water down to the earth and then converting it to groundwater and baseflow. So what do they do? Let us see, replantation of trees in deforested land. See, this was initially a forest.

And then they slowly started to take those saplings, which I showed you. In some of the previous slides, this is not the Miyawaki, this is much much before. So they just take saplings given by the government and or their own small small seedlings, etcetera. Native forest saplings, and then they will come and plant it and all of them take care of it. Need to understand the local hydroclimate and environmental setting it is choosing a species.

If you do not know the long term hydroclimate and environmental setting, it is best to use the native tree because the native tree types already was there. So you will be happy to use it. It will bring the forest as close as possible to initial conditions. You can never really do it to the original condition because change has been done when the forest was removed, the soil has changed the soil depth has changed because some of the soil would have been eroded there is no forest to hold the soil.

Soil would have been eroded, look at here, all these erosions and etcetera. You can bring it back to original state, but you can bring it as close as possible to sustainable level and that is through good reforestation. Community participation is vital as I mentioned. Community is the key, they hold the process when they understand water is important.

And for water, good soil is important good trees are important and they bring all of them together. There is also economic gains in doing a forest not only water gains, yes water would increase your agricultural activity, your domestic drinking, resources, but it also improves your life quality by giving good air and how can you put a price on good air. Now during COVID situations people understand, air is very important.

Air quality is very important. But forest give it to you naturally. And this is where the life changes, health changes, water quality changes, soil quality changes by growing good trees. And all of this has been documented scientifically. So if we can engage the communities in managing the forest, they will do a very good job in improving the soil condition, improving the water condition, and improving the economic viability.

I will see you in the next class on with more different types of forestation or increase the forest cover. And we will be wrapping up week 10. Thanks.