Forests and Their Management
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Module – 06
Forest Protection
Lecture – 17
Forest Fire

[FL] We move forward with our discussion on Forest Protection. And in this lecture, we will have a look at Forest Fires.

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So, what is the forest fire? This is a forest fire. So, what you can see here is that there is a large-sized forest and this is a hill, and here you are seeing that you have a fire here and then this looks very much like a waterfall and then the whole hill is burning. Actually, the fire started down here and then it moved up the hill and then it started burning these areas as well. So, this is the kind of situation that we normally find in the forest in the summer seasons.

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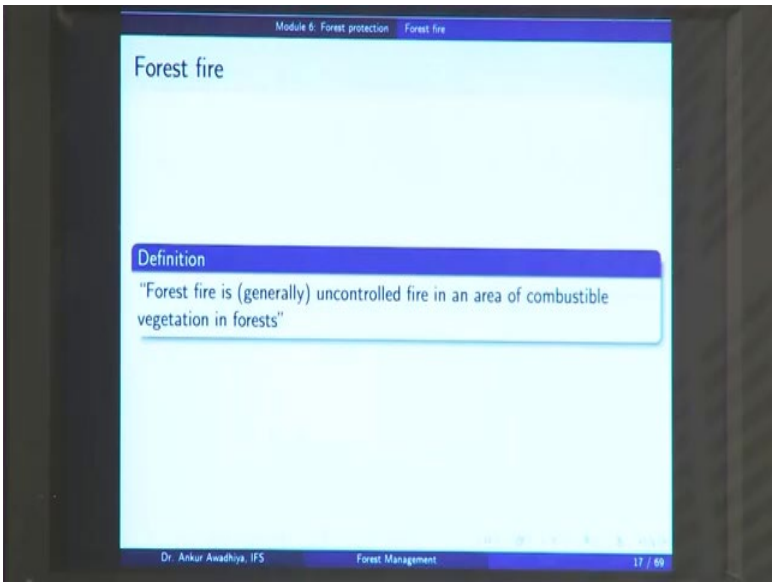

So, how do you define a forest fire?

“A forest fire is a generally uncontrolled fire in an area of combustible vegetation in the forest.” It is generally uncontrolled; at times, you might be able to control it, but in general it becomes very uncontrolled because the terrain that we work in is generally undulating. And, at the same time there is such a huge amount of fuel load that is available that it becomes difficult to control the fire.

So, it is a generally uncontrolled fire in an area of combustible vegetation in the forest. Now, what is combustible vegetation? Combustible is something that can burn. Now, in the forest we have dry leaves; we have twigs; we have a number of trees that have bole; we have grasses and so on. And, all of these are combustible materials; they are all combustible fuels.

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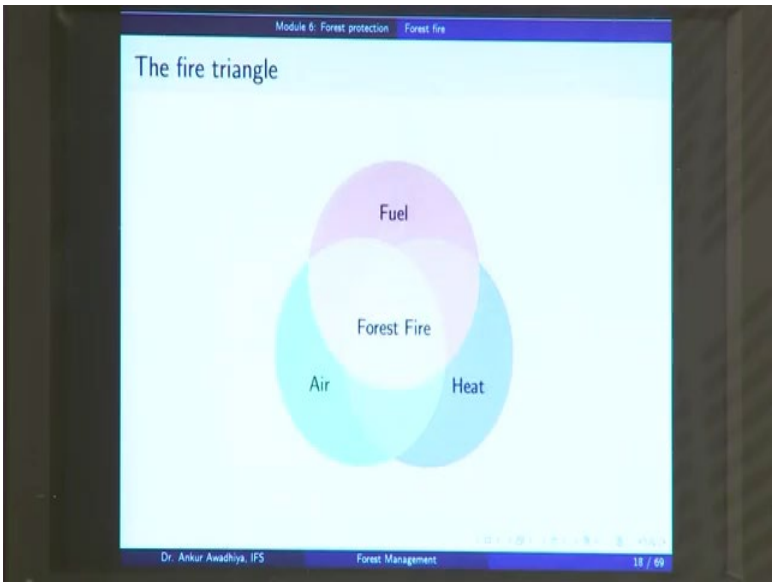

A fire happens when you have a combination of three things. So, here we have the fire triangle. You have the fuel, air and heat. So, if these three combines together, you will have a forest fire. So, to have a forest fire you need a fuel. So, if there is an area that does not have any fuel, then you would not have a fire in that area. If you are able to cut the air supply, there will not be a fire in that area, and if you are able to reduce the temperature, there will not be a fire in the area. Only when all three of these come together you get a forest fire, and this generally happens in the summer seasons.

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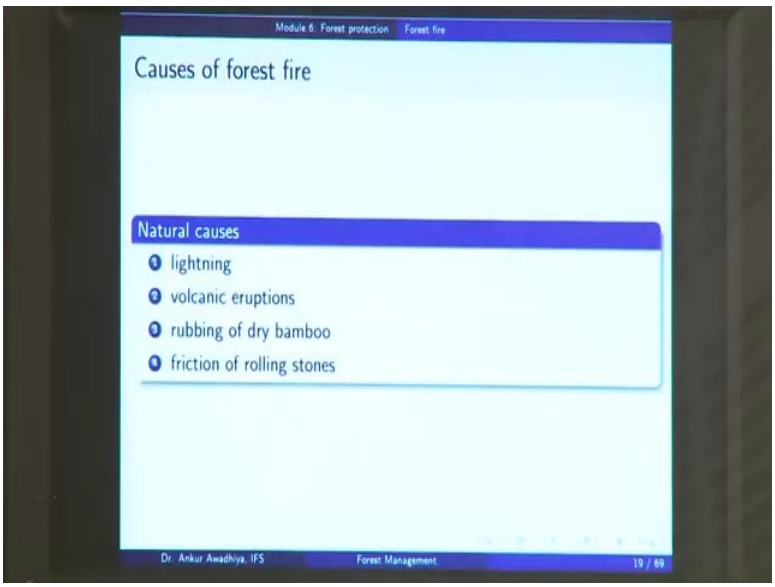

Now, why does a fire happen in a forest? There are a number of reasons both natural and man-made, but typically what we find is that most of the for most of the forest fires are occurring because of man-made reasons. So, let us have a look at the causes of forest fires.

The natural causes include lightning; so, if there is a lightning strike, then it might lead to the start of a fire. Though this is a bit difficult because typically lightning happens together with rains and so, when you have the fuel that is wet, it does not ignite. But, in certain circumstances we do have situations where lightning has resulted in forest fires. If there is a volcanic eruption, that can burn the trees and start a forest fire.

Similarly, if you have the rubbing of dry bamboo, then this is known to have started a few forest fires. How does this happen? If you have dry bamboo, then it is a very good fuel. And, if you look at a clump of bamboo, you will find that there are a number of bamboo curves that are rubbing against each other, if there is any amount of air movement.

So, there is this bamboo, there is another bamboo and they are rubbing against each other. Now, if that happens there will be friction and because of the friction, there will be the generation of heat. So, in this case, you have dry bamboo that is the fuel, you have heat because of the friction and you have air. So, when you have all three of these there could be a forest fire.

Another reason could be the friction of rolling stones, in which case again, because of the friction you have certain amount of heat, and if there are dry grasses nearby, then it might lead to the start of a fire.

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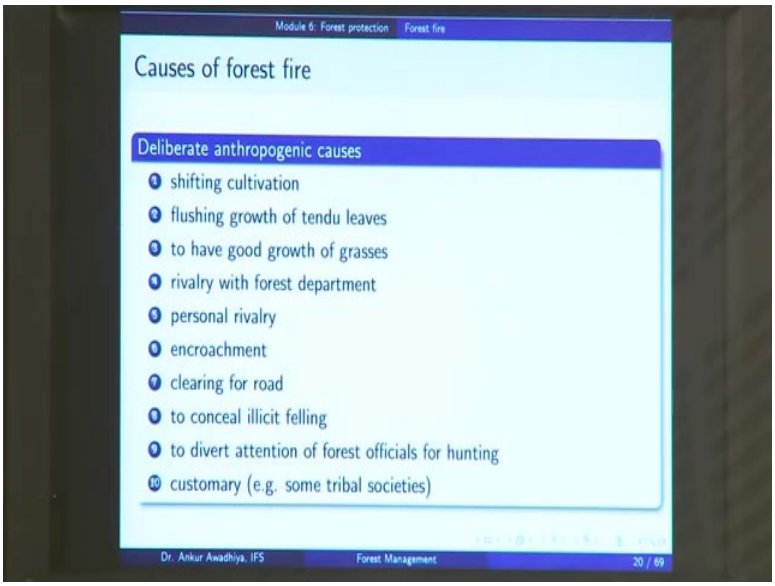

But as we just saw, most of the forest fires are caused by man-made factors both deliberate as well as accidentally.

Now, why would somebody deliberately want to add fire to the forest? Well, a common reason's shifting cultivation. Now, what happens in the case of shifting cultivation is that there are certain communities that clear up the forest, so, they will they will cut the trees, then they will burn those trees. Now, once these trees are burnt, as we saw in one of our earlier lectures, that the mineral resources that are there in the soil are used by the plants to make the biomass. So, you will be having all these minerals that are now there in the in the form of the biomass. For example, in the case of chlorophyll, we have magnesium.

So, if you take these logs and if you burn them, what will happen is that, you will get you will generate ash and that ash will have all the minerals now. So, on the surface of the land, now you are having ash that is full of minerals that acts as a fertilizer, if you want to grow any agricultural crops. So, shifting cultivation is a very common reason by we can have forest fires; because in the case of shifting cultivation people cut trees, then they burn these trees to get the ash, and then they perform agriculture. And, when they are burning these trees, it is possible that the fire might even spread to larger areas.

Another reason is the flushing of is flushing for the growth of tendu leaves. Now, tendu is a very important non-timber forest produce, and its leaves are used for a number of purposes, mostly for the manufacture of beedis. Now, if people want to have good

quality of tendu leaves, they would want to go for a flushing. Now, what happens in a flushing is that people will cut the branches of a small size tendu tree or to make it in a bush like fashion, and then they will add fire to the to the cut area. So, they will just show the fire to the cut area and that is known to result in a very good flushing of new leaves. But then when people are doing such activities, it is very easy that this fire might even spread to other areas and result in a large-scale forest fire.

Another is to have good growth of grasses. Now, just as in the case of shifting cultivation, people also burn dry grasses that are there in the forest. So, once you burn these grasses, all the minerals that were there have are now in the form of ash which is there on the surface of the soil, and that would lead to a new growth of grass. Now, typically in the case of those communities that are using cattle that are pastoralist, so, they will burn these grasses so that new grass comes up. And, this new grass which is very soft which is very tasty for the animals that is then eaten up by the animals. So, people add a fire to the forest deliberately to have a new growth of grass.

Another reason is rivalry with the forest department. So, if somebody has done poaching of wild animals and the forest department goes and catches this person; puts this person in the jail and when this person comes out, then because he is bearing a grudge against the forest department, there have been cases in which this person would go into the forest and deliberately add fire to the forest. So, the personal rivalry against the forest department is also one of the reasons.

Another reason is personal rivalry or rivalry between two people. So, there have been cases, in which there are two rivals in a village and one rival burns the crops of the second rival. So, he goes to the fields of the second rival and adds fire to the crops that are standing there. Now, in cases, where you have certain amount of wind that is flowing, or if the fields are very close to the forest, there is a good chance that this fire that was added to the field will also enter into the forest,, and you will also get a forest fire.

Another reason is encroachment. So, encroachment is the activity in which people try to grab up the lands that belong to the forest department. So, there will be people who will go into the forest cut the trees, burn those trees and start cultivating there. Now, mind you, these are not people who are doing shifting cultivation because their aim is to just

stay in this particular place; they are trying to grab up the land. So, just to perform an encroachment also there have been instances in which people burn the forest; because in that case, you will have a situation in which there are no trees is standing on the forest land; and in that case people, will start growing the agricultural crops.

Another reason is clearing for road. So, there have been instances in which people wanted to clear the areas that are that could be used as roads and to clear the area people add fire to the forest, so that the trees burn and then they can make a road there.

Or to conceal illicit felling – now, this is at times done even by the departmental staff. So, you will find situations in which there is a forest guard, and probably there was a large amount of illicit felling in his area; and, he does not want his superiors to know that there has been a case of illicit felling. So, what will he do? He will just go and burn that area. So, once the area is burnt now, you cannot tell whether there was a felling in that area, whether there was a legal felling or an illegal felling or whether this area was all full of trees. So, to hide illicit felling, departmental people burn the forest; and, also people that are doing the illicit felling at times they also burn the forest just to hide their crimes.

Another reason is to divert the attention of forest officials for hunting. Now, this is something that we see very commonly in the forest.

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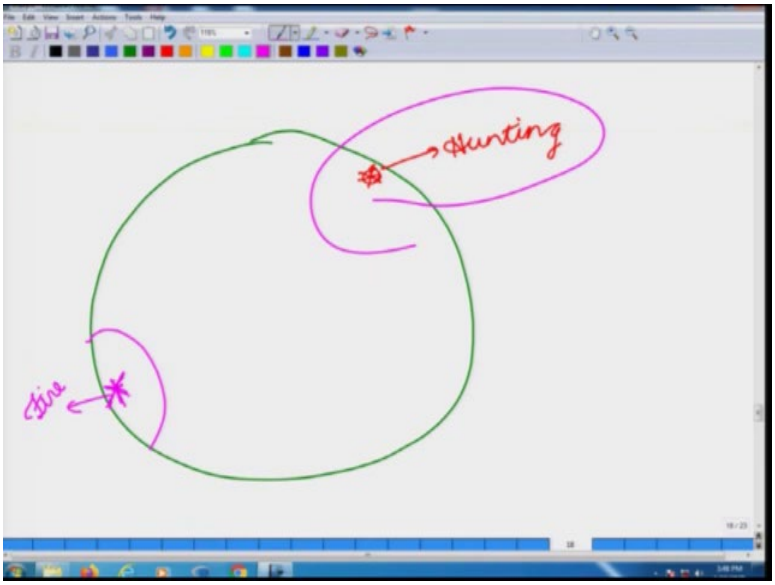

So, suppose this is a forest area, and people want to do hunting or poaching of animals in this area. So, this area they are they want to do hunting. So, what will they do? They will start of fire in this area. So, now here you have a fire. So, if there is a fire, and the department wants to ensure that this forest does not become uncontrolled. So, what will the department do? Will send all the officers, will send the staff to the site of this fire, to control this fire.

Now, when all the staff are concentrated in this area, if the persons or the poachers are doing hunting in this area that will go undetected. So, there are they have been instances in which people burn a forest, so that the officials and the staff go to that region, and their hunting or other illegal activities in other region of the forest goes unnoticed. So, this is also another reason why people would deliberately want to burn a forest.

Also, there are some customary reasons, for instance, there could be certain tribal societies, in which there is a tradition that in certain season the forest has to be burnt probably for some religious activities; but then this is a very minor region.

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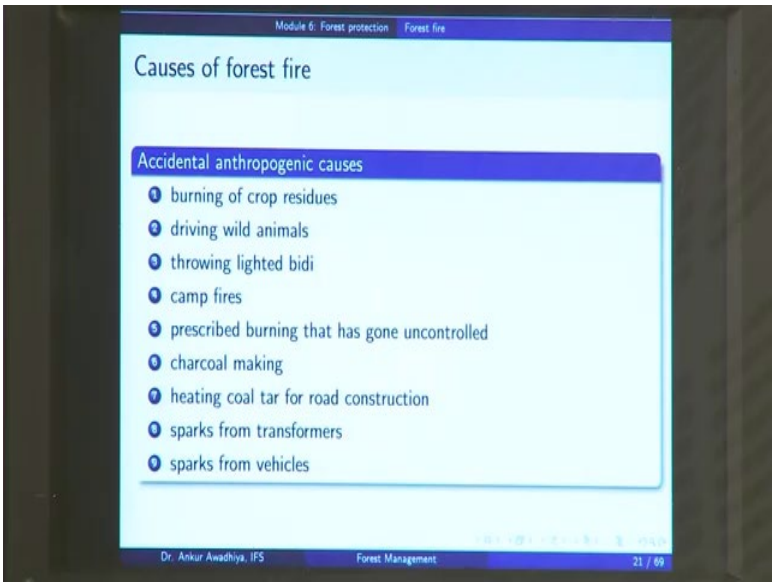

Now, apart from the deliberate man-made reasons, we also have certain accidental anthropogenic causes or accidental man-made causes, such as the burning of crop residues. Now, what a number of farmers in our country are typically do doing these days is that, once the crop has been harvested typically using machines, so, the small

amount of stubble that remains on the ground, it is difficult to take it out. So, what people do is they burn that crop residue.

Now, no doubt it leads to a heavy amount of pollution; but at times, it is also seen that these crop residues when they are burning, and if there is any amount of wind activity, you might have a small amount of fire that enters in the into the forest and starts burning the forest. Now, in this situation, people did not want to burn the forest, but as in act as an accident, as a part or of the process of burning the crop residues, they have started a fire in the forest.

Another reason is to drive wild animals. So, it is seeing that sometimes when elephants enter into the villages people try to scare them away by lighting fires. And, when that happens, there is a good chance that out of accident this fire enters into the forest and burns the forest.

Another reason is throwing of a lighted beedi. So, there might be people who are moving on roads or probably they have entered into the forest, to collect certain forest produce, typically a non-timber forest produce. So, we typically see it in say the days of mahua collection or tendu collection.

So, people are getting into the forest, and there might be some people who even smoke beedis. And, when they have a lighted beedi they have smoked that beedi, but then the small stuff that remains it is lighted, and they threw it in into the forest. So, that is also another accidental reason; accidental man-made reason for the starting of forest fires. This person did not want to burn the forest; but because this person was not careful, it led to the start of a forest fire.

Another reason is campfires. So, people get into the forest for ecotourism purposes, for tourism purposes; and at times, people start up a campfire and if they are not careful, then there could be an accident and the forest will burn down. Another reason is prescribed burning that has gone uncontrolled.

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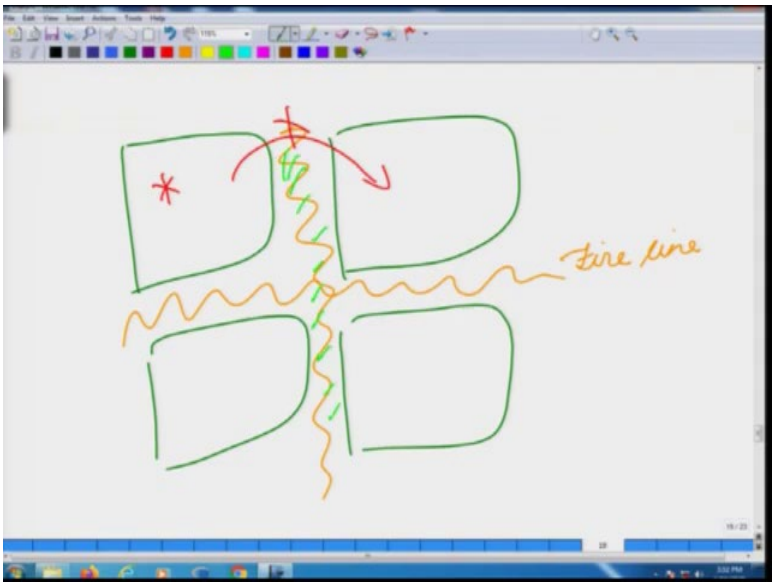

Now, what is a prescribed burning? Suppose you have a forest and typically we divide forest into different sections. And in between, this is a region that you wanted to maintain as a fire line. So, this is a fire line. Now, what is the fire line? A fire line is a section of the forest that you have cleared of all the vegetation; that you have cleared of all sorts of combustible materials, so that, if there is a fire in this section, it will not be able to jump to the other section.

Because once you have a fire and that has reached the fire line, because you do not have any combustible materials there, so the fire triangle is disrupted, and now you do not have any fire that can move to the other area.

But, then to maintain a fire line what people do is that they will cut the vegetation in this area. So, the vegetation will be cut, then it will be left to dry and then it will be ignited. Now, at times, it is seen that this prescribed burning also leads to fires in the other forest areas. Another prescribed burning is the operation of reducing of the fuel load. So, for instance in the winter season, when the when the temperature is less and the leaves that have fallen to the ground, they have not become completely dry. So, then the department might want to go with a prescribed burning.

Now, in that prescribed burning, we will burn the leaf litter that is there on the ground. Now, because the season is such that, you do not have high temperatures or the leaves are not very dry; so, in this case, the fire will be in a controlled this fire will burn in a

controlled manner. Now, this sort of a prescribed burning; it is possible that it that there might be an accident and it might also lead to the start of a forest fire.

Now, another accidental reason could be charcoal making. So, in the process of charcoal making people cut timber, put it into a container. So, a typical charcoal working making works like this.

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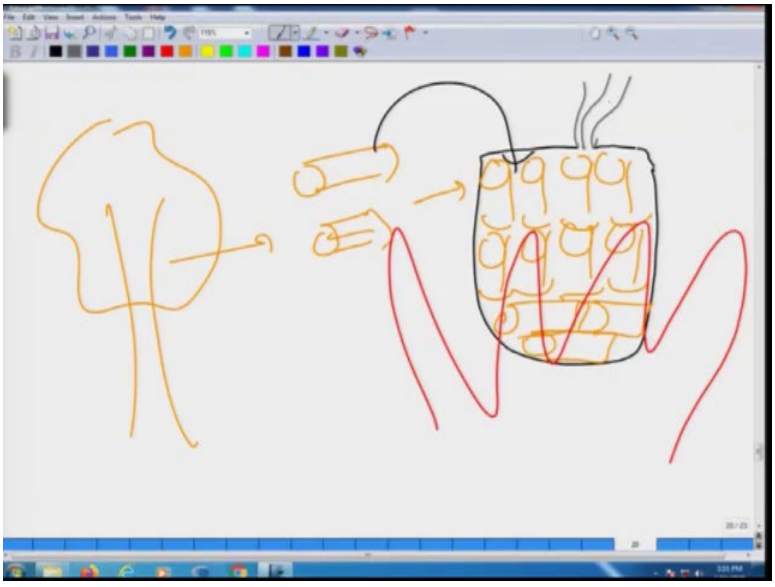

So, you have this tree; this tree will be cut and it will be converted into logs. Then, these logs will then be added to a drum. So, you have this drum and all of these logs are put inside. So, now, this drum is all full of the logs, then you add a top with a small hole and then you light a bonfire around this drum. So, what happens is that, now the logs that are inside this drum, they are getting heated in an anoxic condition; you do not have sufficient amount of oxygen inside. So, slowly and slowly your logs get converted into charcoal.

Now, this sort of activity is typically done inside the forest by some villagers, because they want to have charcoal; because it is a much cleaner fuel as compared to wood. So, in this case, the gases will escape out and you will get charcoal inside. Now, at times, it is possible that when the villagers are doing this charcoal making, then because of some accident, this fire might spread to other areas. So, this is also another man-made accidental cause.

Or, heating the coal tar for road construction. So, many of you would have gone through a road that is passing through the forest and this road is topped with coal tar. Now, to apply a layer of coal tar, you have to heat the coal tar you have to melt this coal tar and then apply it on top of the road.

Now, this heating, when it is there near the forest area, this heating is typically done using wood or at times coal. So, when you are again you are you are setting up a fire that is inside the forest area, you are not setting fire to the forest; you are only setting a fire to heat and melt the coal tar. But, then because of accident, this fire might spread to the forest areas and burn down the forest. So, that is also another reason why you can have an accidental manmade cause of fire.

Another is sparks from transformers. So, at times we have high tension wires that are going from the forest; there could be a transformer nearby, and if they if there is any sparking in the instrument, then it might start a fire. Or sparks from vehicles; so, at times there are sparks that come out near the wheels. If there is a vehicle that has lost it is tire and the person is still driving, then there could be a spark. Or at times, the engine is malfunctioning and that leads to a spark. So, these different reasons might start a forest fire.

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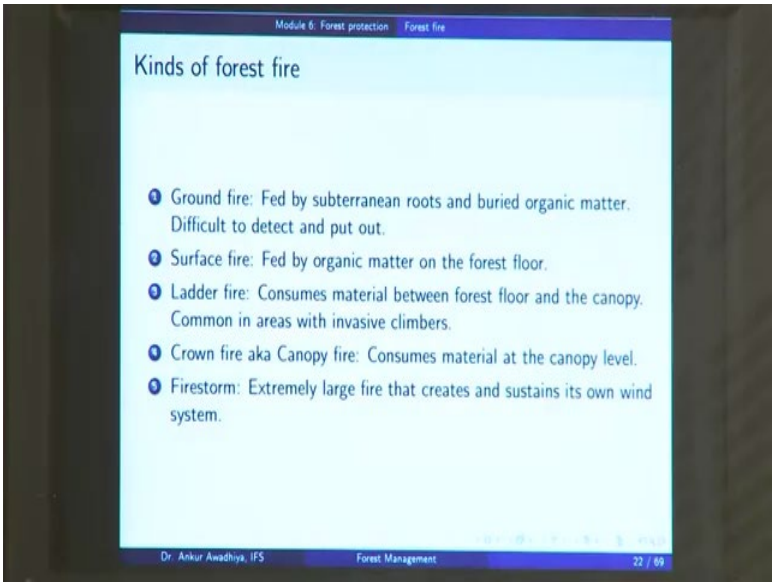

Now, when there is a fire in a forest it is not a uniform fire. So, you can have different kinds of fires, depending on which area of the forest is getting burned.

So, these are the kinds of fire a forest fire. The first one is a GROUND FIRE. A ground fire is fed by subterranean roots and buried organic matter, and it is difficult to detect and put out.

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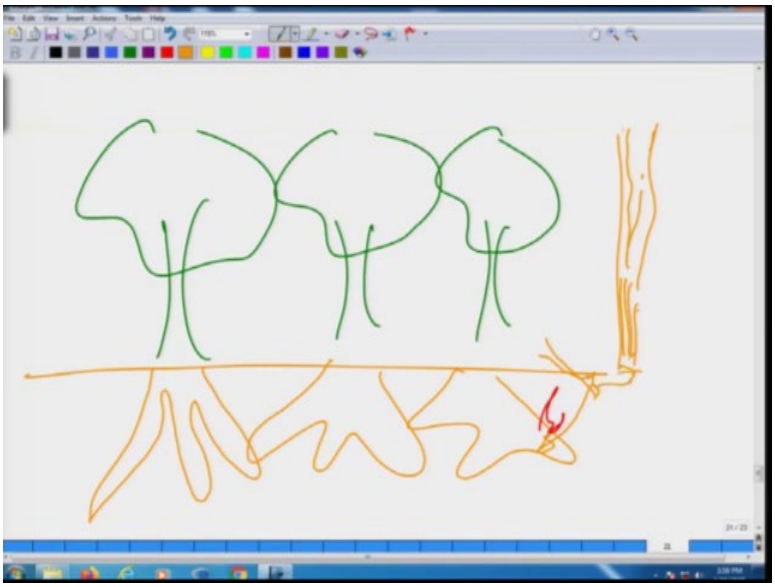

So, what we are saying here is that in a forest you have different trees. This is the ground level. And, below the ground, you have the roots; and, suppose you have a soil that is sufficiently porous, that is permitting some amount of air to get inside; because remember in our lecture on soils, we said that the soil is comprised of the mineral particles, the organic particles and also air and water. So, you have air inside the soil.

Now, suppose there is a fire that starts in the roots. So, probably there was somebody who is who was making a charcoal here; and because of this charcoal and there was some root or some tree that also caught up fire, and then this fire is now getting spread with other roots. So, in this case, you will find a fire that is going below the soil surface and this is known as a ground fire. Now, because this because you cannot see this fire you, you will be able to feel that the ground is very warm. At some - at certain areas, you will find that that there is smoke coming from the ground.

And, if there is a snag tree; if there is a dead tree that is hollow from inside. So, here you have a dead tree that is hollow from inside; so, when the ground fire reaches into this area, suddenly you will find that there is a dead tree that has started to burn. Now, this is a ground fire, and it is very difficult to detect, and it is very difficult to put out. Now, this

is the fire that happens below the ground surface. If there is a fire that happens on the surface, then we call it a SURFACE FIRE, which is fed by organic matter on the forest floor. Now, typically this matter is dead leaves, grasses, twigs, stems and other dead parts that have fallen to the ground surface. But, in this case, the fire is above the ground surface, and so we call it a surface fire.

Next, we have a LADDER FIRE. A ladder fire consumes material between the forest floor and the canopy, and it is common in areas that have invasive climbers.

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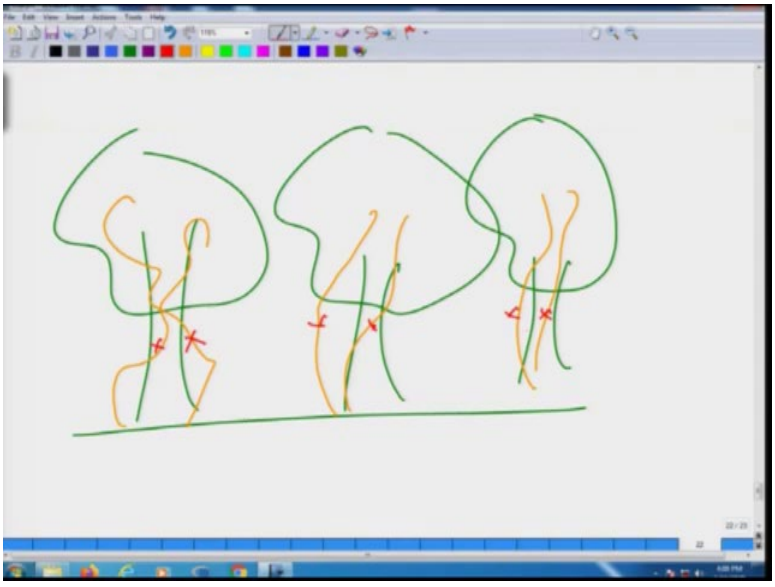

So, what we are saying now is that you have these trees, and some of these trees are having climbers that are going over them. Now, if there is a ladder fire, it is consuming these climbers. So, when you see a climber burning; it is a ladder between the surface and the canopy. So, if this ladder is burning, we call it a ladder fire.

Or at times you might even find CROWN FIRE or CANOPY FIRE. In which case, the canopy or the crown of the trees has started to burn. So, the fire has now reach to the top of the trees. So, when you have a fire on the top of the tree now, it has become very difficult to control because you cannot put a lot of water on the top of the trees. It is difficult. Your you do not have access to all of these trees, and at times, when it becomes even more grievous, then you might even have a firestorm; in which case, you have an extremely large fire that creates and sustains its own wind system.

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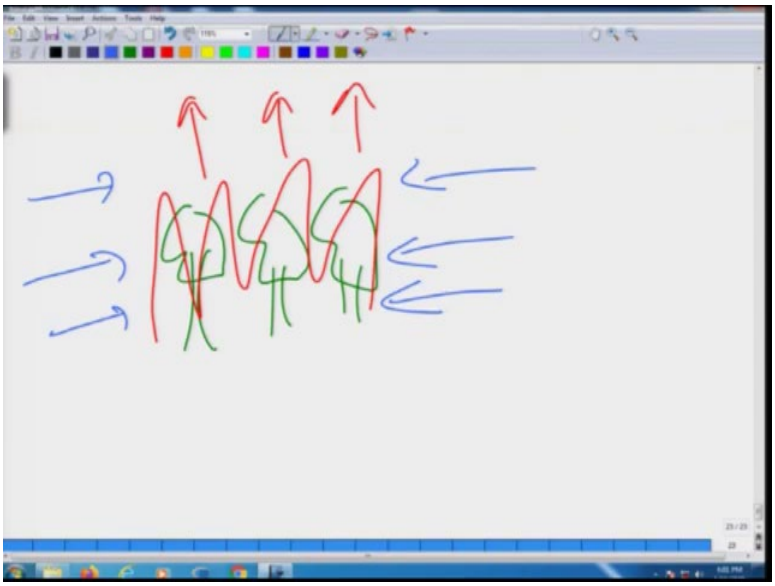

Now, what we are saying here is that, you had a number of trees and there is a fire in this area, and the fire is so intense that now the hot air is moving up, and it is pulling the cold air from the surroundings, and so, you have in your own wind system that has been generated. So, what this firestorm is doing is that it is bringing in fresh air from the outside. So, you have now more and more supply of oxygen and so, the burning is getting intenser and intenser; the intensity is increasing. So, that is a fire storm – "an extremely large fire that creates and sustains its own wind system."

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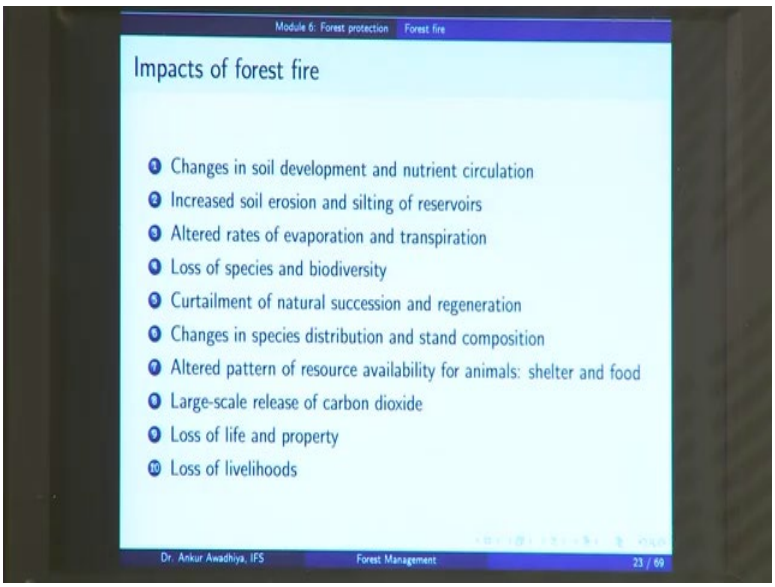

Now, when you have these kinds of fires you have several short-term and long-term impacts on the forest ecosystem. So, there can be changes in soil development, there will be changes in nutrient circulation because a number of nutrients such as nitrogen that were there in the soil; because of the intense heat, they get converted into the gaseous nitrogen and they get and they are able to escape.

So, there will be changes in the nutrient circulation, there will be changes in soil development. So, earlier you were having a very healthy soil that was all full of living organisms; it was all full of humus; this intense fire and so, now, there is no humus left there are no organisms left in the soil. It can also lead to increased soil erosion and silting of the reservoirs. Why increased soil erosion? Because of the fire, the cover of vegetation over the soil is now lost and so, the soil is now denuded; it is lying bare. And so, wind and water will very easily be able to erode this soil.

And, when there is soil erosion, where will the soil go? It will move along the streams and then it will get into our reservoir, and it will start silting the reservoir. There will be silting of dams. Now, forest fires also lead to altered rates of evaporation and transpiration. Why? because you have lost the vegetation cover or you have altered the vegetation cover and so, it leads to altered rates of evaporation and transpiration, in the whole area. There will be loss of species because a number of organisms will die off; a number of organisms will get burnt; because of which they will get debilitated and there will be a loss of biodiversity, because you are losing the organisms.

There will be curtailment of natural succession and regeneration. So, if you remember our lecture on the succession; then on ecological succession, there we had talked about a situation in which you have a secondary succession. Because the succession which had happened before that had developed the forest; because of certain activities such as large-scale forest fires all the trees are gone; and so now, ecological succession has to start again. So, there will be a curtailment of national succession; there will be will also be a curtailment of regeneration, because all the young plants that were there in the form of regeneration in the forest, they are now dead.

There will also be changes in the species distribution and composition. Because some species are better able to tolerate the forest fire, some species are less able to tolerate forest fire. So, in this case, those species that are better able to tolerate forest fire

typically, because they were they have say bulbs or tubers or they have certain seeds that are able to resist the impact of high heat, they will be able to regenerate quickly as compared to other species, that do not have these protective mechanisms. So, the species composition will change in this area.

Next, you have altered pattern of resource availability for animals, especially shelter and food. So, typically before the forest fire, you had a very good forest and the animals were used to certain areas that were providing them shelter and food. So, there were certain animals that were living in the canopy; now after the forest fire, you do not have any canopy left. So, what will happen to those animals? They will show a very altered pattern of resource availability or they will they will have to move to other areas that are now able to provide them with certain resources.

There will also be a large-scale release of carbon dioxide which will in turn also impact the global climate. There will be loss of life and property, and also loss of livelihoods especially of people, who are dependent on the forest. So, for instance, you have a plush green forest in an national in a national park and people are visiting every year. So, the tourists that are visiting are also sustaining the local economy, because people are getting jobs in the form of tourism operators; in the form of gypsy drivers; in the form of guides; in the form of people in the hospitality sector.

Now, if this forest gets burnt; so, after this burning very few number of tourists would want to get into this area, because there is nothing more to see. So, this will lead to the loss of livelihoods of people in this area.

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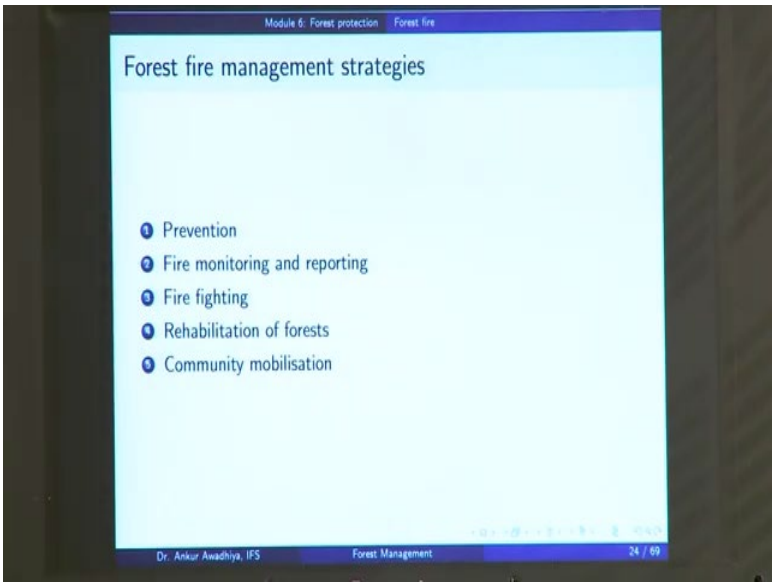

Now, because of all these reasons, it is very important to manage the forest fires, and here are the forest fire management strategies. The first and the most important one is the prevention. How can you prevent a forest fire from happening? So, we saw what are the different reasons because of which a forest fire can come up. Can you play with these reasons? Can use, for instance, if people are getting into the forest area, then can you ensure that they are not lighting a beedi there? If people are camping an area, can you ensure that the campfires are well looked after, so that there is no accident. So, there are so, the primary way in which a forest fire is managed is by including more and more of preventive steps.

Now, apart from prevention the next strategy is fire monitoring and reporting. So, why do you need to monitor a fire and what is reporting of the fire?

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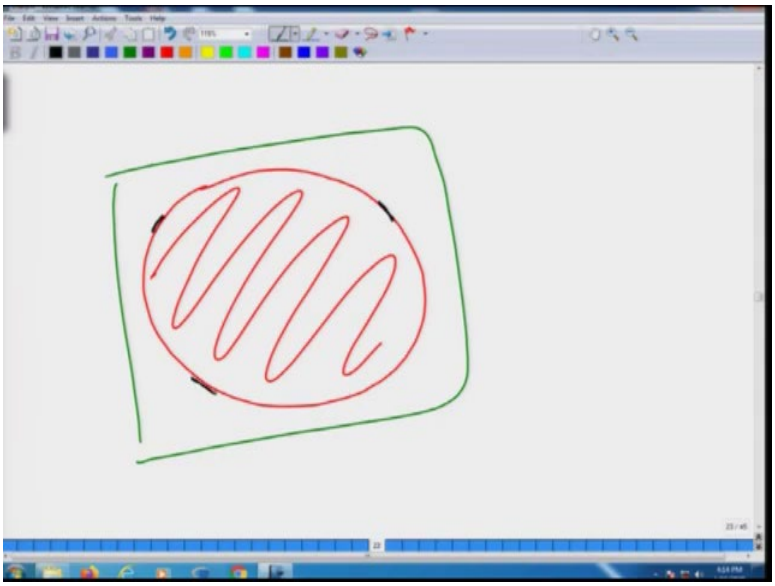

So, if you have a situation in which, let us say that this is your forest and there is a fire that has started, in this region. Now, if you are able to detect this fire and if you send your people here so, they might be able to quash this fire. But, suppose you were not able to detect this fire; so, what will happen is that, this fire is now moving in concentric rings and suppose you are able to detect this fire, when it has reached to this large size. So, now, all of these regions are either burnt or they are burning.

Now, if you send your staff where will your staff work? Will your because your staff is limited your resources are limited; so, will your staff work on this front, or on this front, or in this front; because the staff cannot be there everywhere. You have resources that are limited. You cannot have an infinite amount of resources. So, the better strategy is that you should be able to detect your fire as soon as possible, and this did this fire that has been detected should also be reported to the higher ups; to the hierarchy in the channel. So, you need to have a good system of fire monitoring and reporting.

Then, you need to have a good system of firefighting; because once you have detected a fire, what are you going to do with it. So, you will have to train your staff, you will have to equip your staff so that they can go to this to this region quickly, and they are sufficiently capable of fighting the fire or extinguishing the fire. Now, once you have firefighting, but there is some amount of forest that has been that has already been burnt, so in that case, you will have to go for a rehabilitation of the forest.

Now, how will this rehabilitation work? Probably, you will have to regenerate the forest; probably you will have to go for an artificial regeneration, so that you are able to reach your the stage of your matured forest, as soon as possible. And, in all of these, you will also require community mobilization is important; not only because you want to sensitize people that that there are certain activities because of which there can be a forest fire, but at the same time you also need to mobilize them so that they lend you a hand when you need it.

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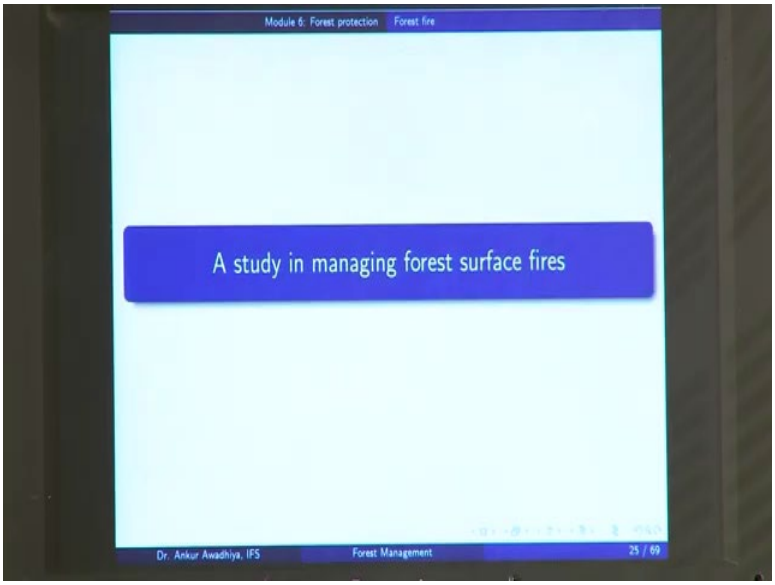

Now, on the topic of surface forest fires we had conducted a study.

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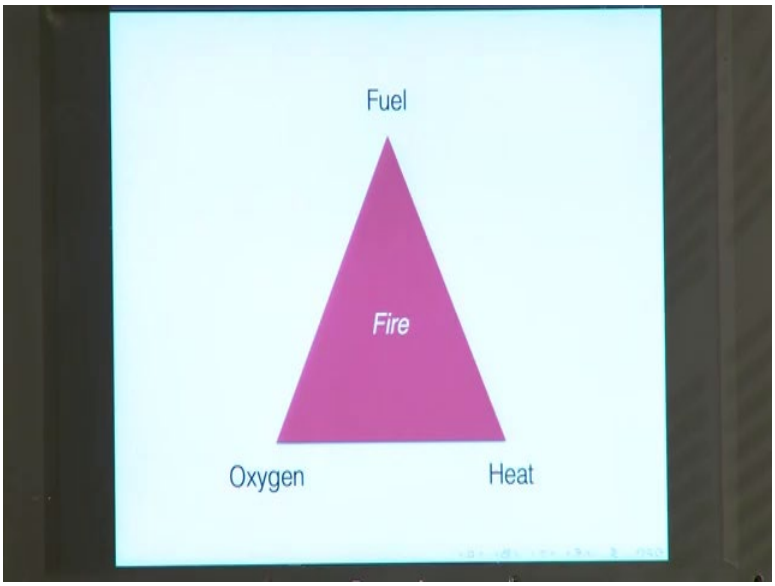

So, as we have seen that a fire happens when you have the fire triangle – the fuel, the oxygen and the heat.

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Now, in the case of Madhya Pradesh, we have a large number of surface fires. Now, why do we have a large number of surface fires? Because of two reasons. One – Madhya Pradesh has drier forest and so, you have a huge number of grasslands. And, in the summer season, these grasses dry out and so, there is enough amount of combustible material that is available.

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Secondly, we also have a number of deciduous trees which shed their leaves. So, if you go to the to a forest area, typically say in the spring season, you will find that the ground is all covered with dry grasses, drying grasses or a lot of the dry leaves.

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So, if you have a forest that is all full of these dry leaves, it is very easy to for a surface fire to prop up.

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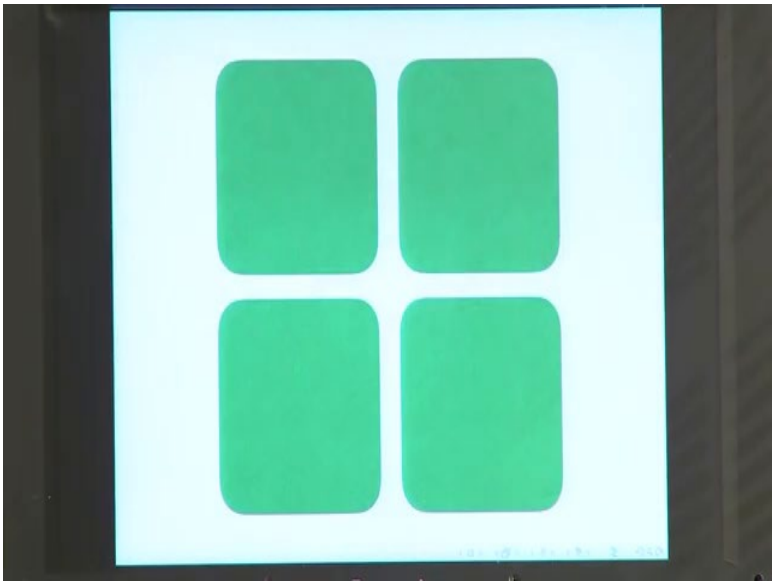

Now, typically to control or to manage these forest fires, we divide our forest using the fire lines. Now, in the case of a fire line, you will have certain areas in which you do not have any fuel.

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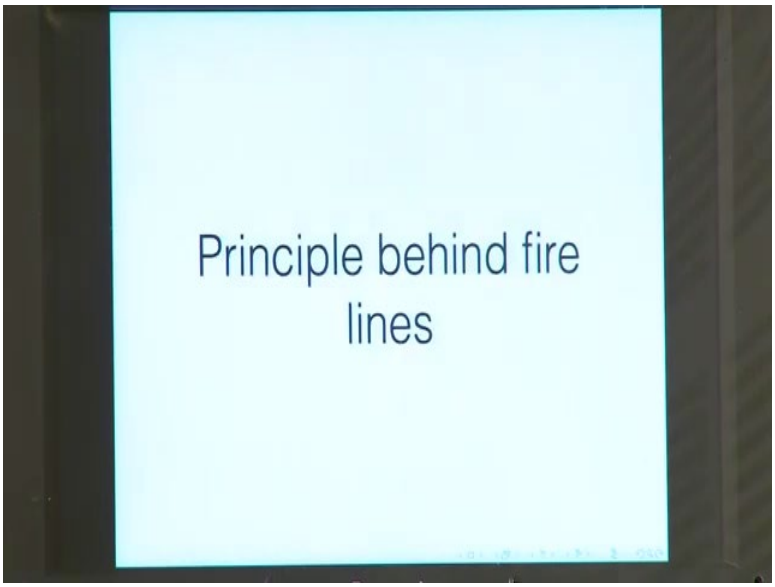

So, how will a fire line work?

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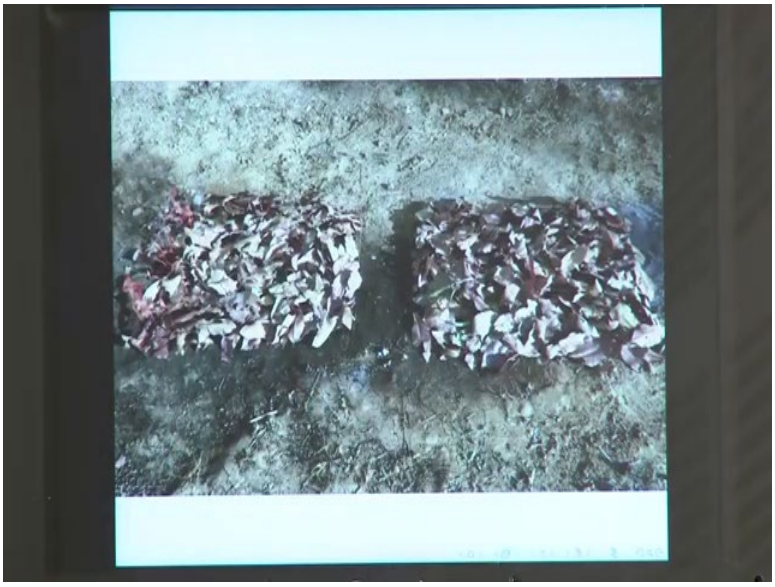

So, to illustrate the working of a fire line, let us say that these are two patches of forest and both these patches are having leaves.

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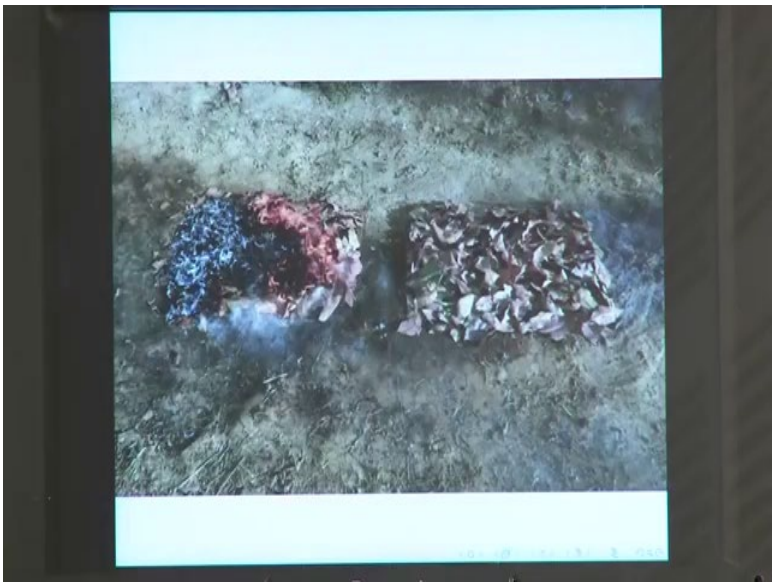

Now, if you have a fire that it starts in a patch; so, it is moving towards this fire front is moving towards the second forest floor.

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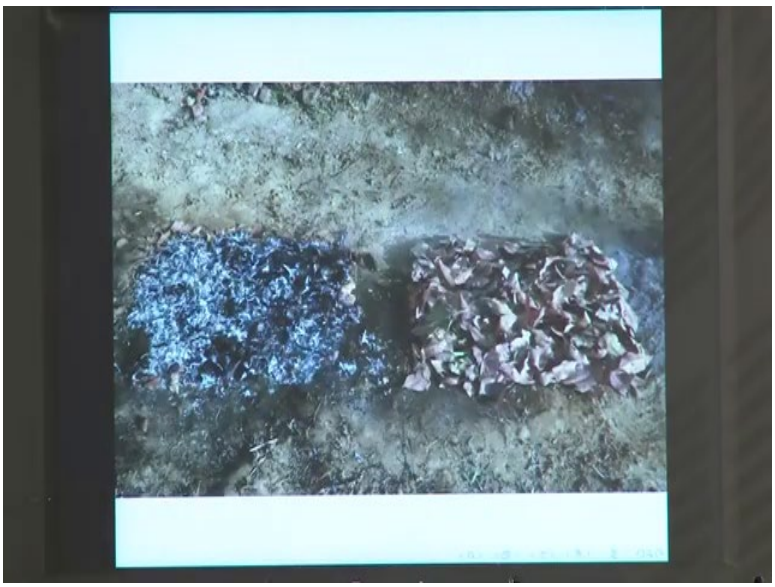

But, then in this region because you do not have any fuel, so, the fire triangle gets disrupted and the fire ends there; and so, the other portion of the forest is protected.

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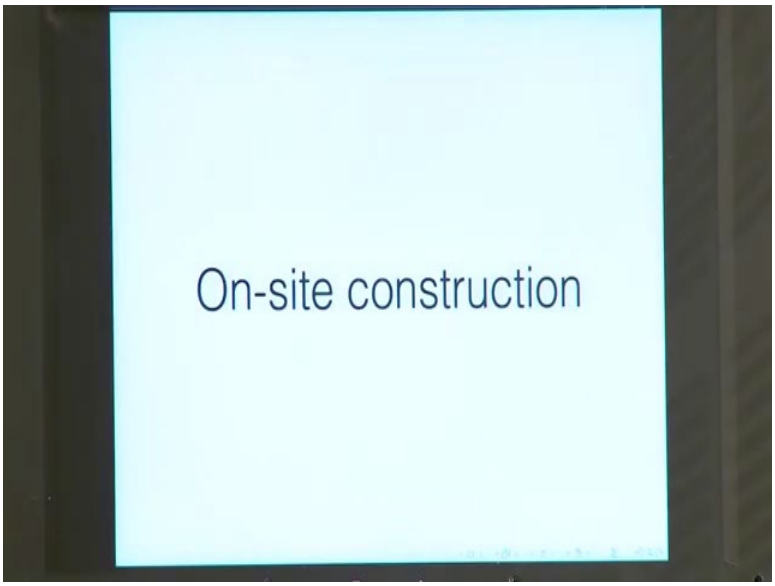

But, then how do you construct a fire line; actually or practically in the field?

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So, this construction typically begins in the months of October and November, in which case, in certain areas, you will employ labor to cut up the grasses or to cut up the small herbs and shrubs that have come up, and you leave them there on the forest floor.

Now, why do you want to leave your cut grasses and your herbs and shrubs on the forest floor? So that they dry out; and once they get dried out, you burn them.

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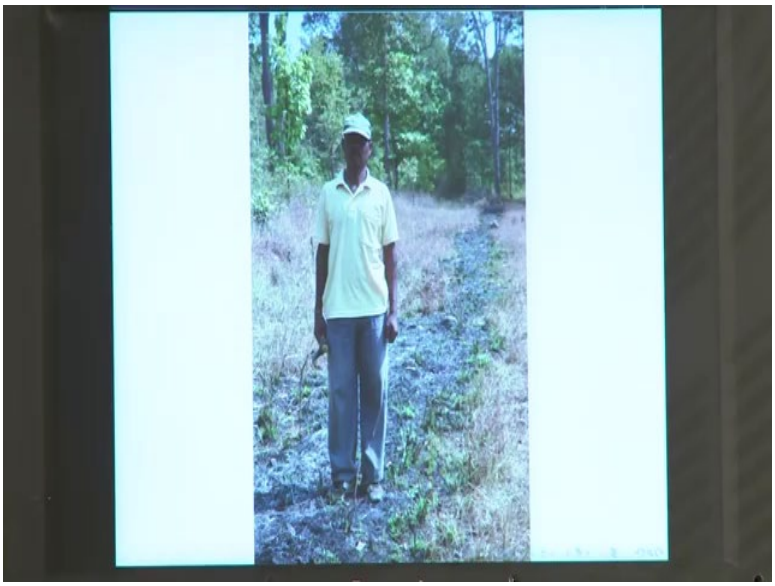

So, when so, this is again another matter another prescribed burning that is happening inside the forest to construct a fire line. So, once you have burnt these dry grasses; so, now, there is a fire line that has been constructed.

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Now, fire lines are of different sizes. And in the case of large size for fire lines; so, here you can see that you have trees on the right, you have trees on the left; but this whole area in the form of a thick strip, is now devoid of trees. It has this good quantity of leaves

that are available, but there are no trees. This is a fire line. So, how is this fire line managed?

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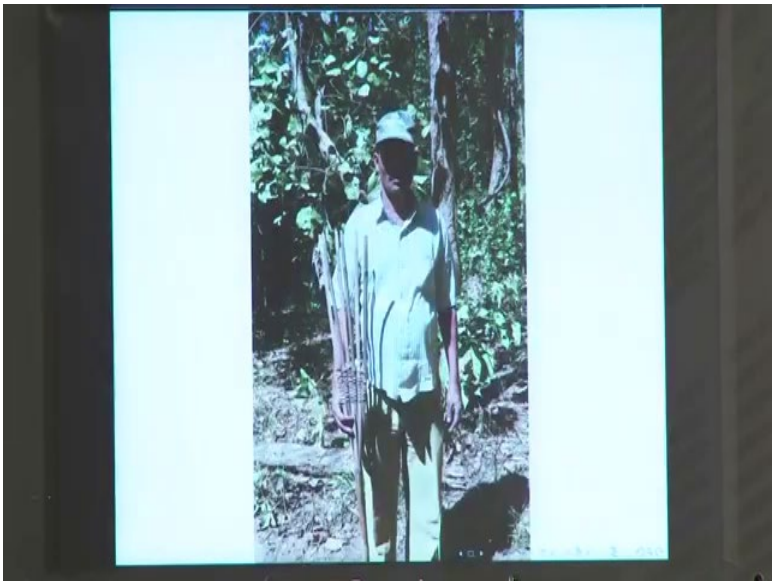

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So, you will have people who will use rakes, and using these rakes, they will put up all these dry leaves towards the center of the fire line. So, they are now piling up these leaves; they are accumulating these leaves towards the center.

Now, once you have all these leaves at the center of the fire line, now you can light it up you can add fire to it, so that all these leaves get burnt out.

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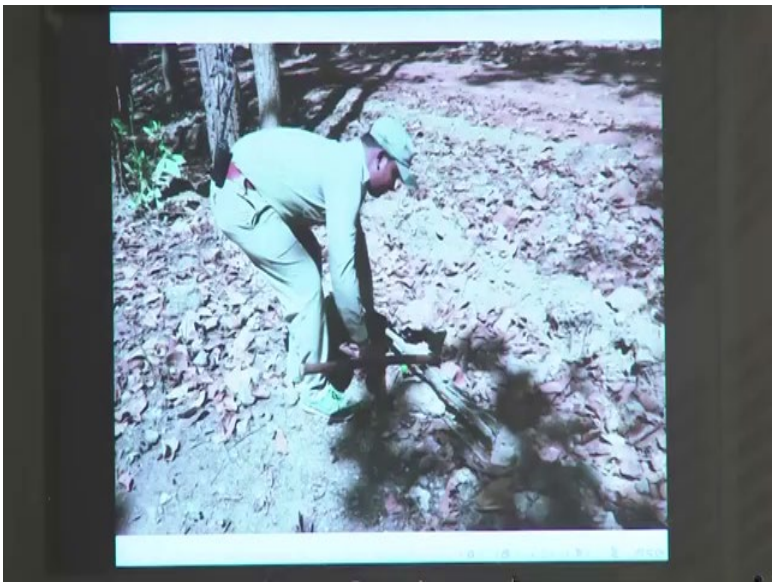

Now, this burning is typically done using a wooden stick. So, this guy is now you having this stick and he is breaking this stick, so that it can be used as a torch.

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And, so, this stick will be lighted and then this will be used to burn these leaves.

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And this burning will be done from one side. So, he is burning from this section.

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And, then he is also putting a fire on the other side. So, now you will have two fires one is moving in this direction; the other is moving in this direction; both of them will meet in the center, and after that because you have no more fuel left so, there will be no longer fire.

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So, this is the end result. Now, as you can very clearly see, this is not a very optimum result because even though we have some amount of some reduction of the fuel load, but still here in the center, you can see that there are certain leaves that have been left out. So, now, this process needs to be optimized, it has to be improved.

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But, for now we do these fire lines, we construct these fire lines on a very large scale. So, like here we are standing on top of one hill; this is another hill, and you can see that you

are constructing this fire line which will go from here through the other hill to another areas.

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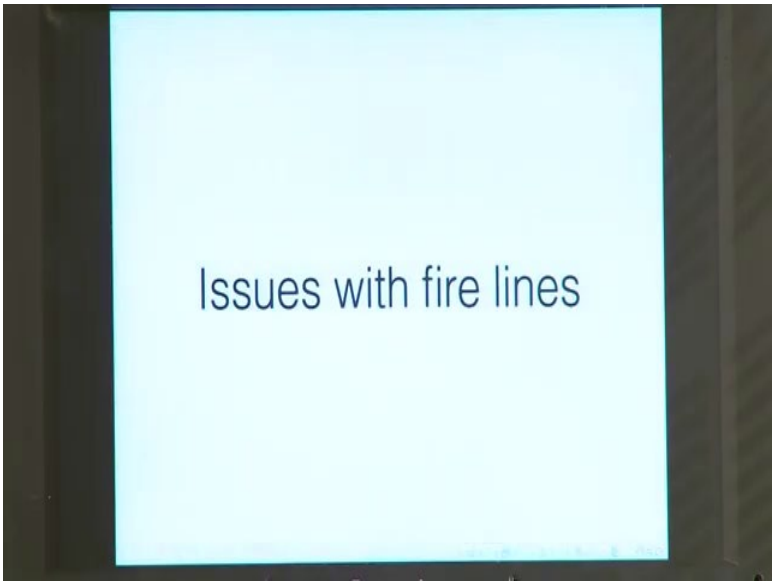

But then, these fire lines are not completely foolproof because they have certain issues with them.

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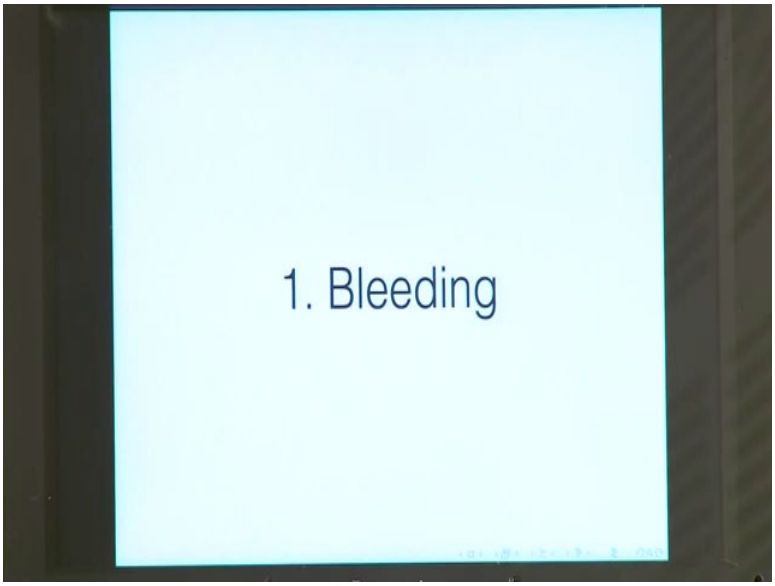

The first issue is that of bleeding of the fires.

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So, for instance here, the people were constructing a fire line. They added fire to the to the dried fuel and this fire entered into this forest area and it burnt this forest. So, in this case, you were constructing a fire line to protect a fire to protect your forest. But, then in this process of construction of the fire line, you burnt the whole forest. So, this is known as bleeding.

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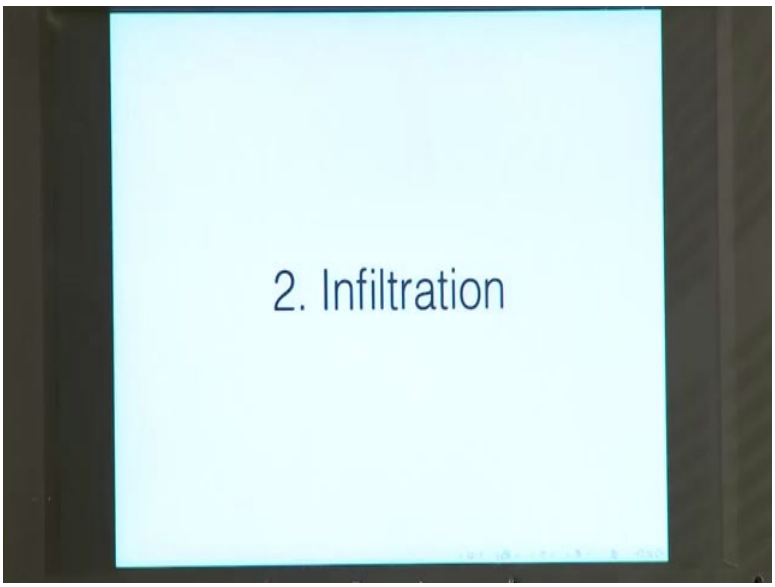

Another aspect is that of infiltration.

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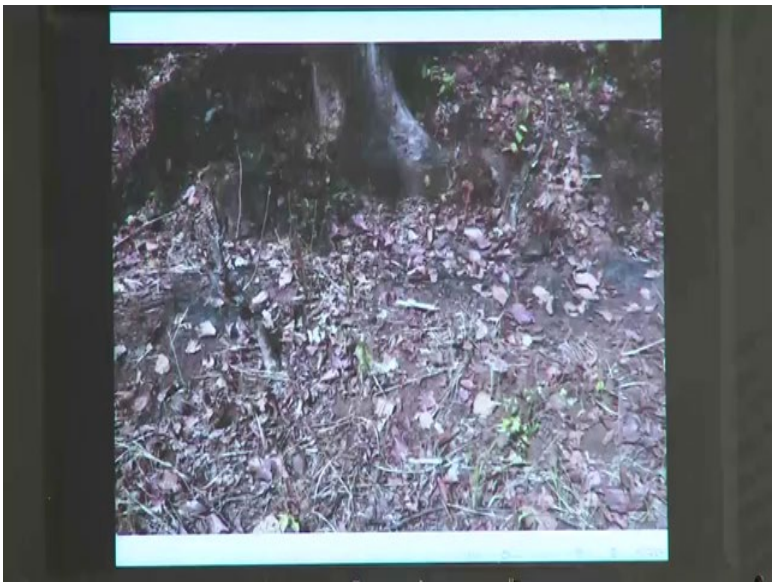

Now, what is infiltration? You constructed a fire line. Trees which are shedding the dry leaves.

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And, in this case, after your fire line was made, the trees are still shedding the leaves; and so, now, on top of your fire line, you have fuel back again. So, that will now reduce the efficiency of the fire line of the fire lines. So, in this case, you constructed a fire line, so that there should not be any fuel in that region; but then, after you have constructed the fire line more fuel has been added.

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Another issue is that of repopulation.

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Now, in the case of repopulation – so, here you have a road and on both sides of the road you are constructing a fire line.

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But, then after a while what you see is that there is a new flush of grasses that has come up. Now, you have this new growth of grasses.

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Because once you burnt the earlier batch of dry grasses, the minerals that were there in the bodies of those grasses, have now come to the surface of the soil. And, in the nighttime due to the cold, you will be having certain amount of dew that gets formed. So, now, you have a soil that is rich in minerals; that is a very fertilized soil or a substantially fertilized soil; you have water there; and you also have certain dry grasses nearby that are

also releasing the seeds; so, you have a very good situation in which you can get a new crop of grasses.

So, if you have constructed a fire line, so that there was no more fuel in that area now. In that particular area itself, you have a new flush of grasses; a new growth of grasses. And, once these grasses dry up, they will defeat the purpose of the making of your fire lines.

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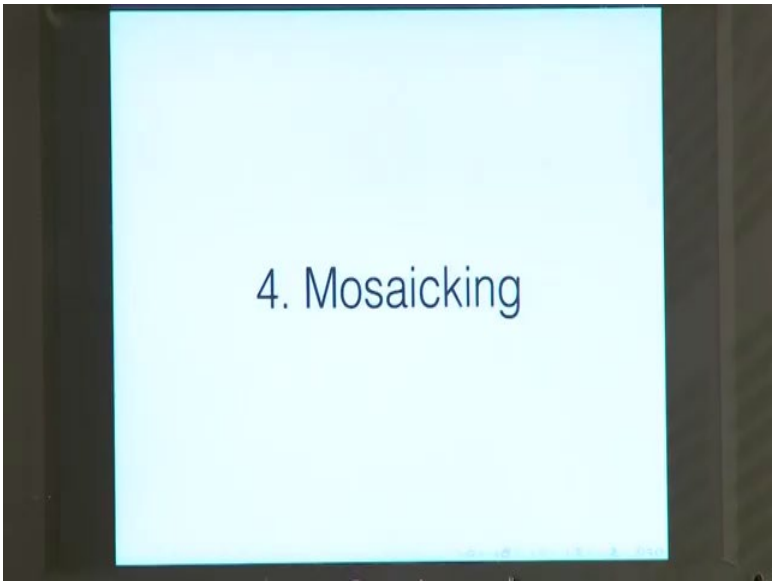

Another issue is that of mosaicking.

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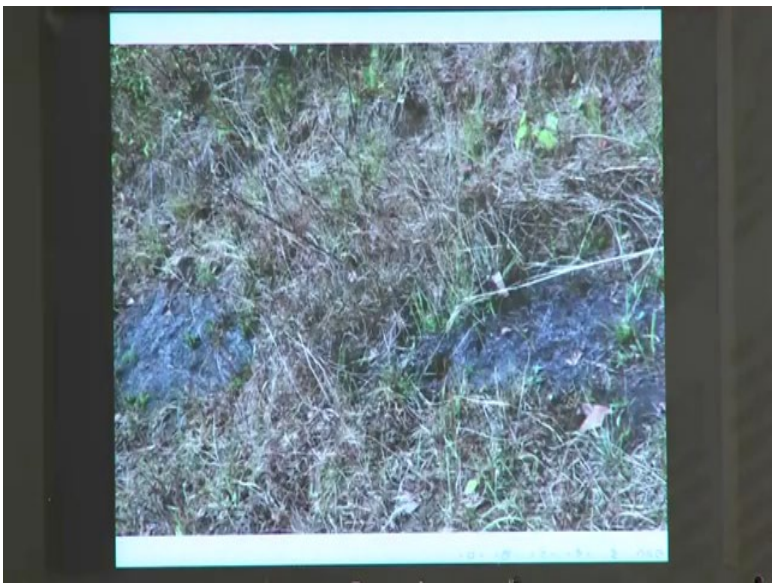

So, as we saw before whenever there is the construction of a fire line, there will be certain leaves or certain areas that will get left out; probably because they were having a bit more amount of moisture; because of which they did not burn completely. Now, in this case, what we are having is that the people constructed a fire line, but this area did not get burnt and so, now, there is a break in your fire line.

But, then are these issues so important that we should worry about them?

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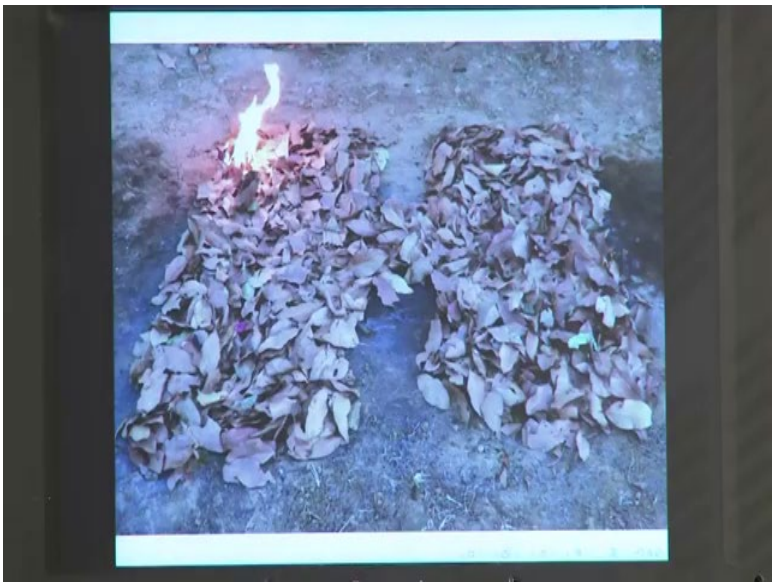

So, to look at it in more detail, we did a simulation. So, in this simulation, you are having these two patches of forest floor. So, these leaves are depicting the forest floor and then there you have this fire line that is separating both of these. But then, there is some leaves amount of leaves or some amount of infiltration that has come up into this area.

Now, let us see what happens to the forest, and how does the fire, how does the fire line work?

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Now, in this case, the fire reached into this area and now it is using this patch of infiltration to move to the other side.

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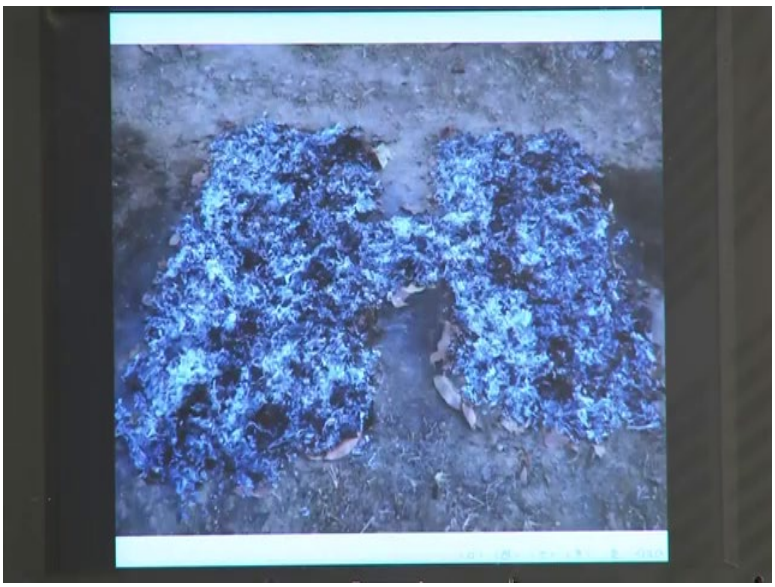

And now, both the forest floors are completely burnt. So, if you have even a small amount of infiltration or a small break in your fire line, that defeats the whole purpose of making the fire line.

So, in that case, what can you do?

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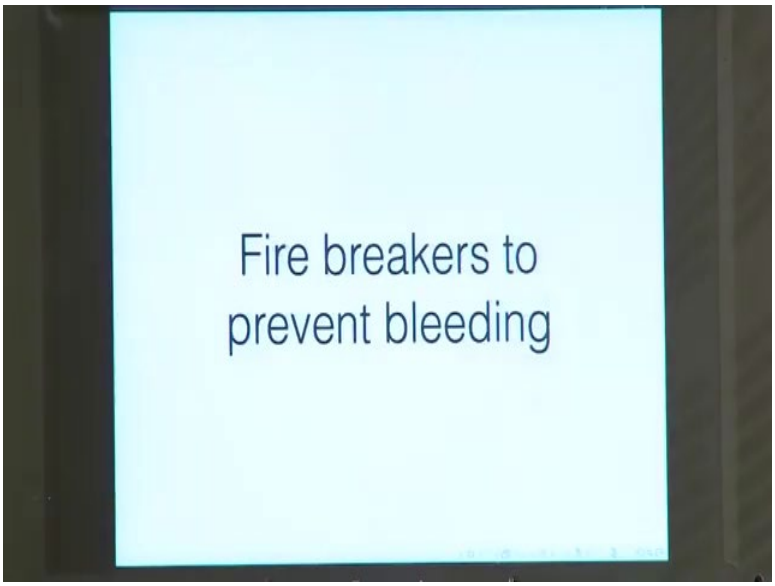

So, we thought of making fire breakers; constructing something else that would be able to prevent bleeding of these fires into the forest areas.

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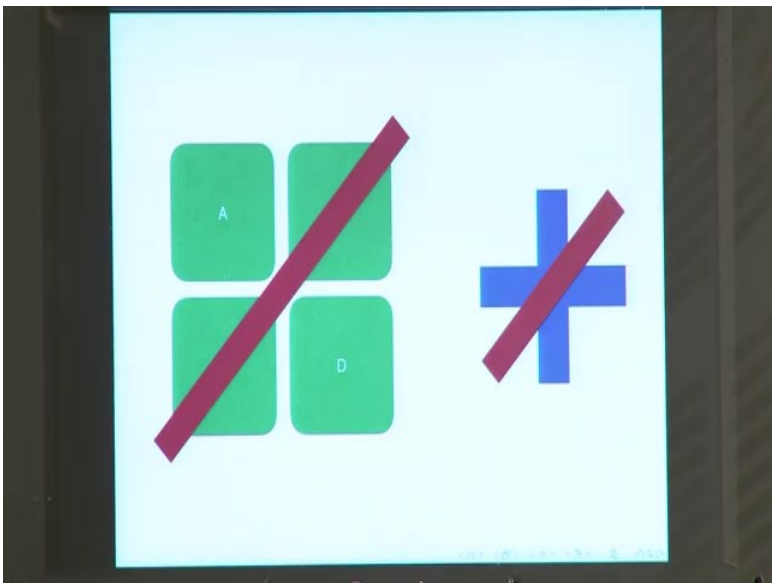

So, one requirement was that, in most of our forest, we are having very good number of wild life and so, there should not be a fragmentation of their habitat. So, what we mean by a fragmentation is that we should not divide the habitat into two different parts, that the animals are not able to cross.

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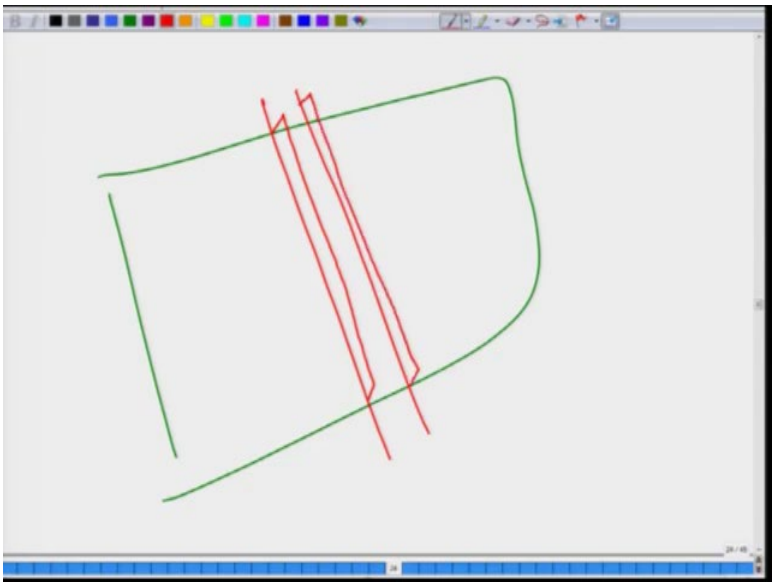

So, for instance if you wanted to prevent these forest fires. So, when you constructed a fire line what you could do is that, you could construct a wall here probably made of bricks. And if you construct a huge wall, so that will prevent fires from moving from one side to the other side.

But, then the drawback with a wall will be that it will also prevent the movement of a number of other animals. So, that will defeat the purpose of panicking the forest not only for the trees, but also for the wildlife. So, the first design criteria was that we should not add anything to a fragmentation of the forest.

Secondly, we should not add anything to the forest. So, when you are constructing a brick wall, you are bringing bricks from outside, you are adding cement into the ecosystem; and, we do not know what will be the long term impacts of the addition of cement to an ecosystem, because we want to preserve our forest in as natural a condition as possible.

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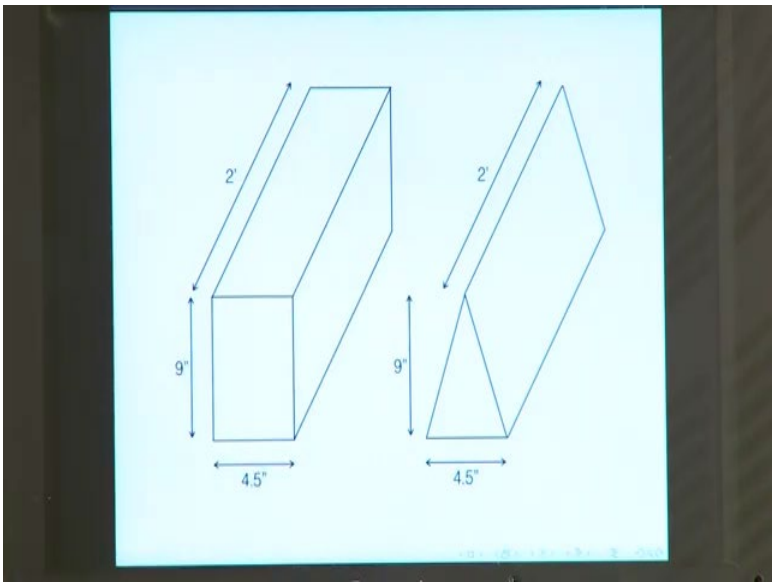

So, then we desire we decided that we will go with mud-based fire breakers and we decided that we are going to make them in two different shapes. So, one is a cubical shape and the other is a prismatic shape.

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So, here we are having a control in which you do not have any fire breaker that is made. You just have an area of land that will not have any vegetation as we do in the case of a fire line.

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Then, we have cubical structure of fire breaker and we also have a prismatic structure of the fire breakers.

Now, let us see how these fire breakers work.

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So, in this case you have this cubical fire breaker and on both sides we are simulating a forest floor and there is fire on one side.

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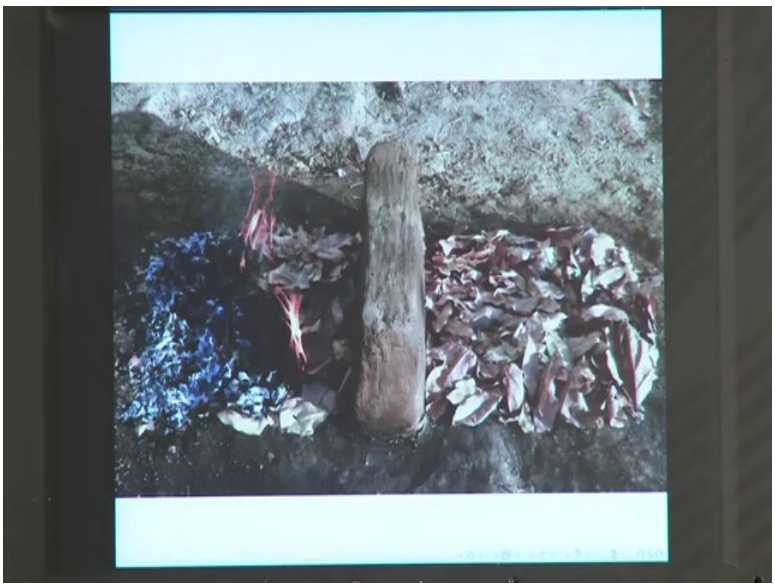

So, this fire will move towards the front; will move towards the fire breaker and because this fire beaker is made out of mud; so, you do not have any combustible material here.

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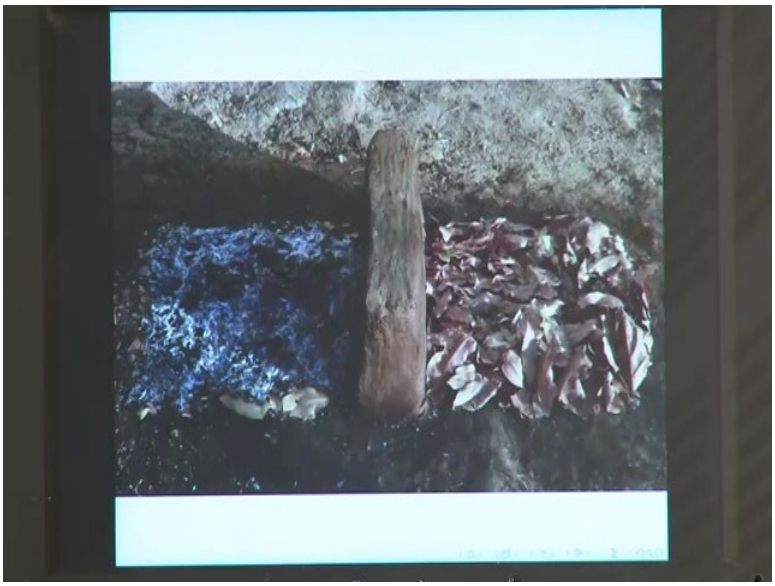

So, once your fire has reached to your fire breaker, it will die off.

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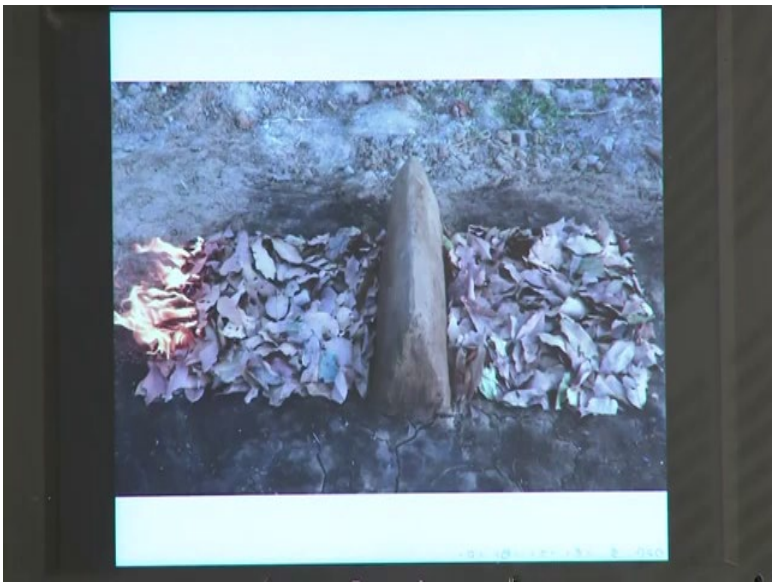

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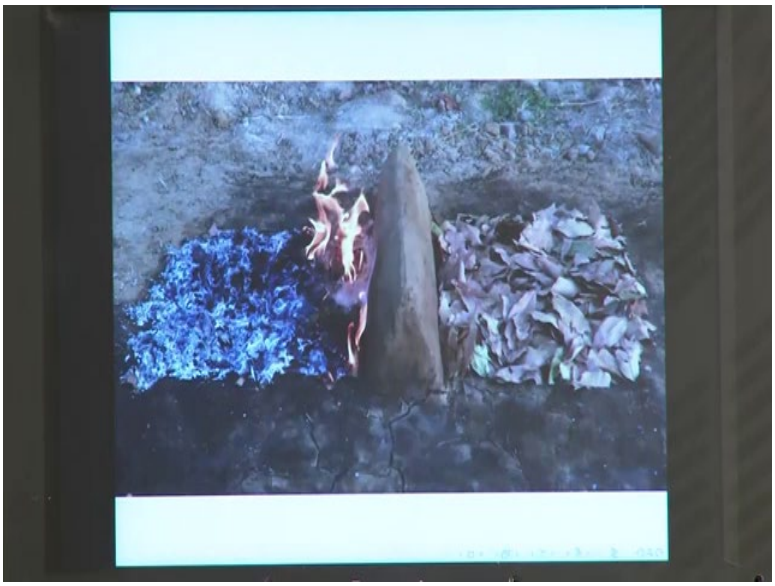

Now, similarly if you use a prismatic fire breaker, here also the fire front will reach to your fire breaker.

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And, then the fire will get extinguished. But then, this is also something that we saw in the case of the fire lines; so, why it go for such a construction? Because we wanted to see if our fire breakers are able to resist the impact of the leaf fall, specially in the case of deciduous forests.

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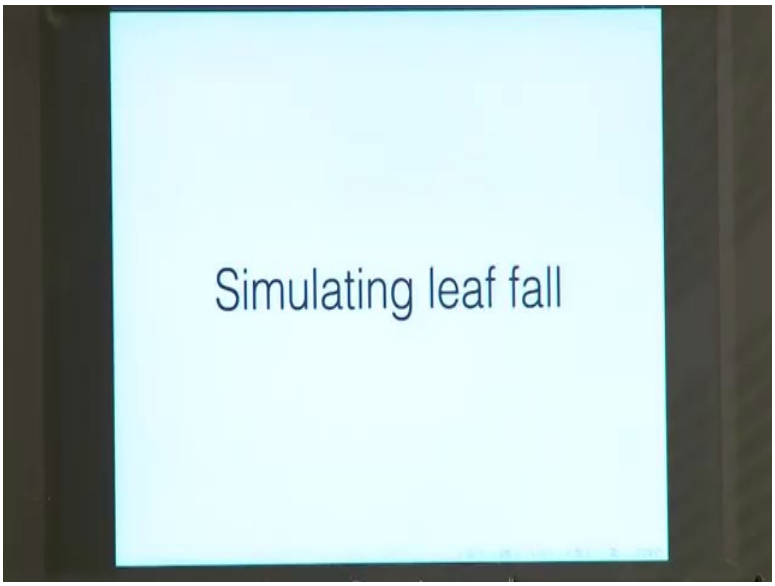

So, let us say now simulate a leaf fall on these fire lines and all the fire breakers.

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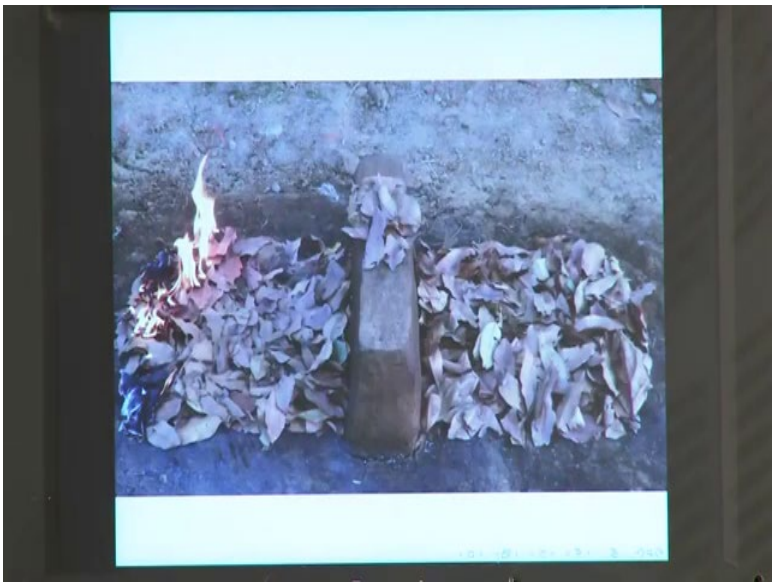

Now, in the case of the fire line, we saw it just a while back, in which case, if there was any amount of infiltration, it defeated the purpose of a fire of a fire line.

Now, in the case of this cubicle - this cuboidal fire breaker, now you are adding leaves on the top, which is mimicking the infiltration. So, there will be trees on top of this fire breaker, and these trees will be shedding the leaves which now is there on top of the fire breaker.

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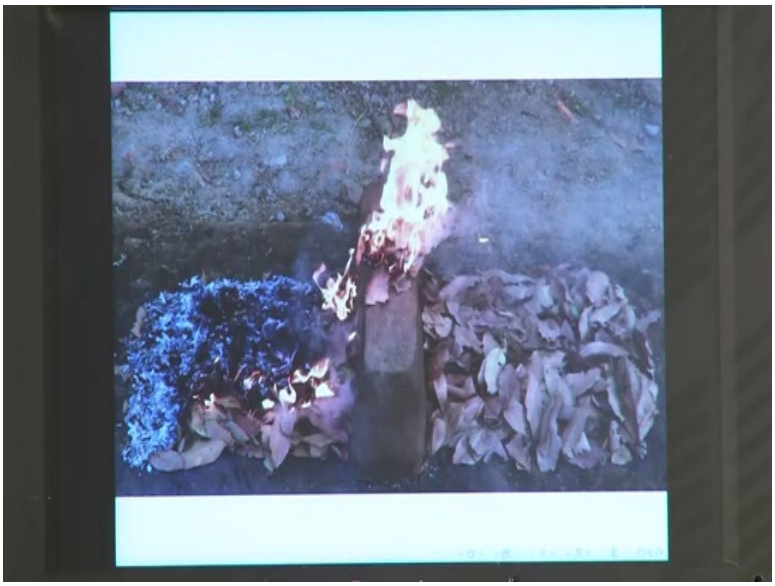

Now, when the fire front reaches to this side, then at times, you will have fire that is able to reach to this top leaf accumulation.

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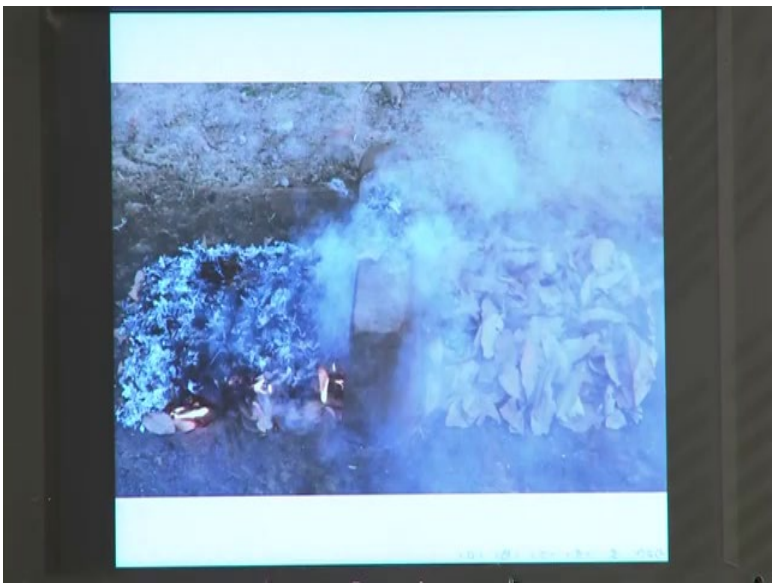

Now, in certain cases, the fire will die off at that point, because you have this region that has been burned; you have this top that has been burned; and after that the fire stops, because you have no more area where you have the fuel.

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But, in certain circumstances, if there is a small amount of wind that is blowing then you might have that then you might have a situation in which a burning sprinter falls to this side.

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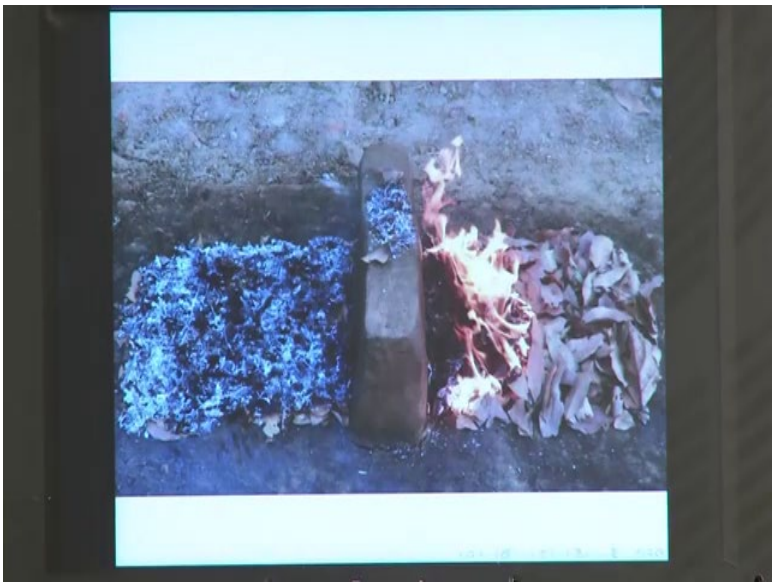

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And, once that happens, the fire starts again and breaks and it burns the whole of the forest.

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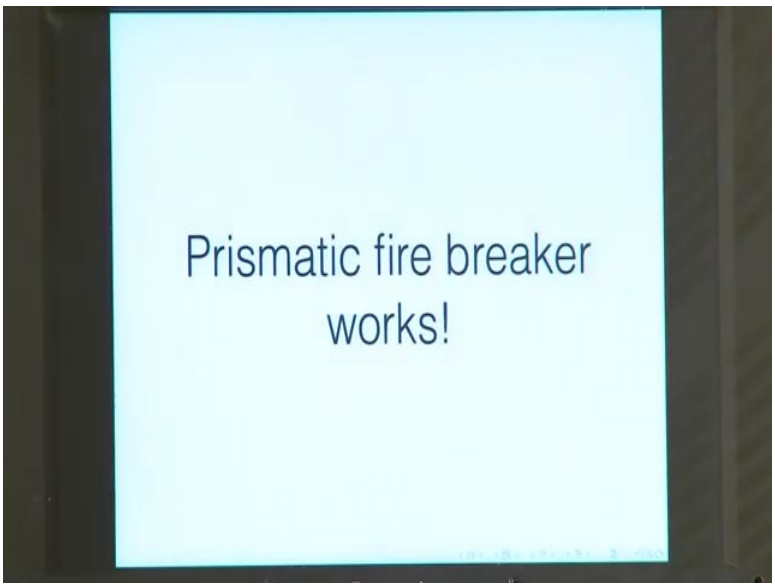

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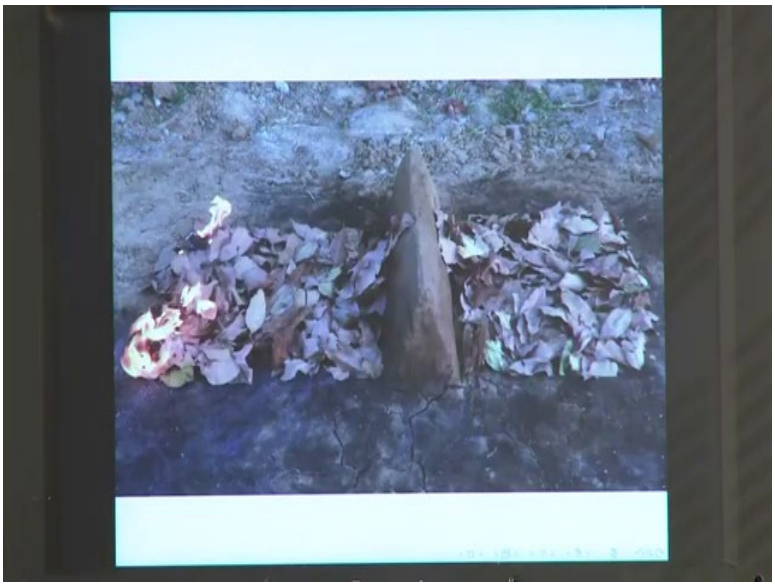

But, in the case of a prismatic fire breaker what we see is that because it has two sloppy sides. So, you will have leaves that accumulate on this side, you have leaves that accumulate on this side. But, then if the fire burns here the fire is not able to come down, because the flame always goes up.

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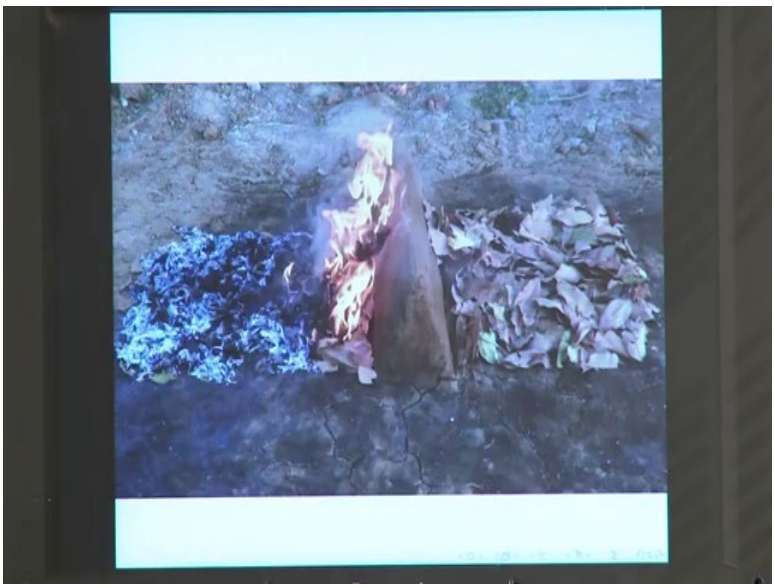

So, in this case, when you when the fire front reaches the fire breaker, then it starts burning the leaves that are there on that side.

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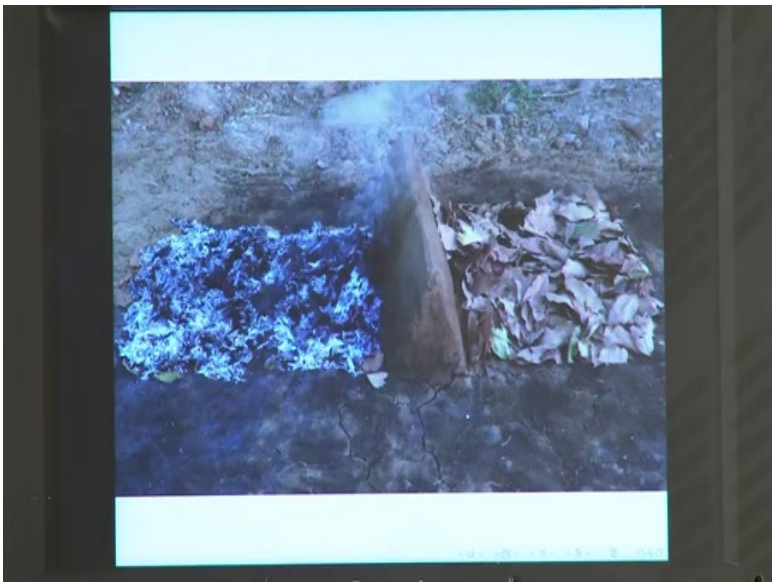

But is it is not able to move to the other side.

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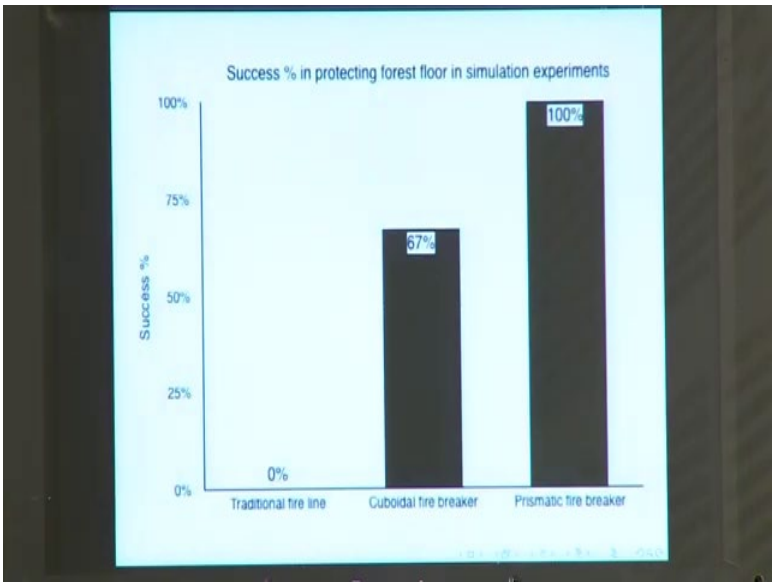

So, we looked at the success percentage of the in protecting the forest floor in the simulation experiments. In the case of a traditional fire line, if you have any infiltration, you the whole purpose of the fire line gets defeated and you have a 0 percent protection.

But, if you go for a cuboidal fire breaker, the forest or the simulated forest was protected in 67 percent of the cases. And, but in the case of the prismatic fire breaker, it was protected in 100 percent of the cases.

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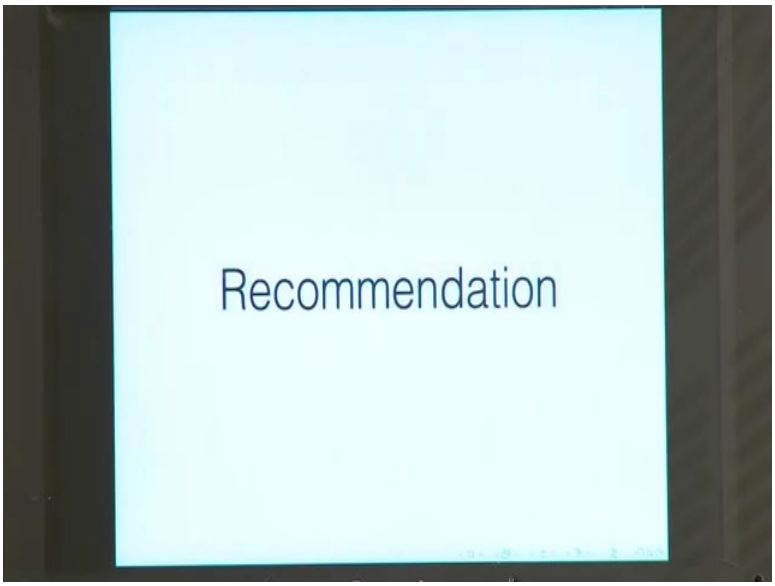

So, what can be a recommendation that we can come up with such a study?

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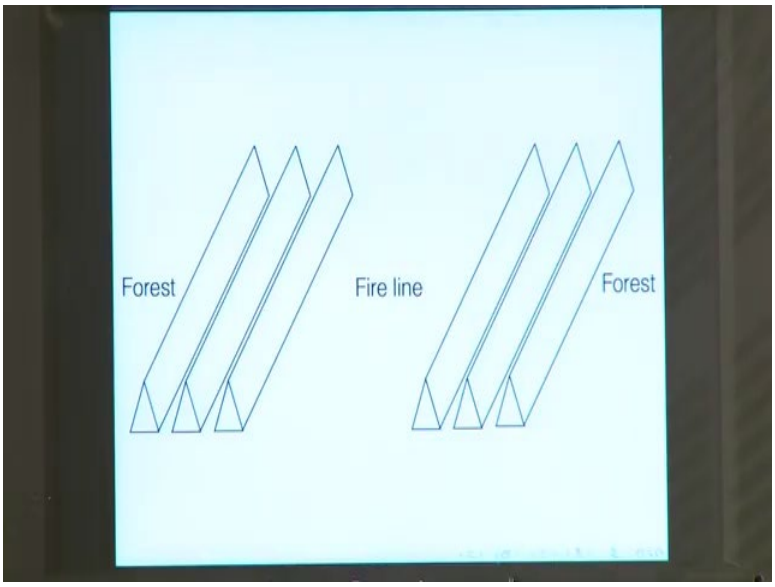

We can say that even if you are making a fire line why not construct fire breakers on both the sides, so that if there is any leaf fall that happens later words. So, the leaves will get accumulated in these stenches, and in that case, the fire will not be able to bleed to the other side.

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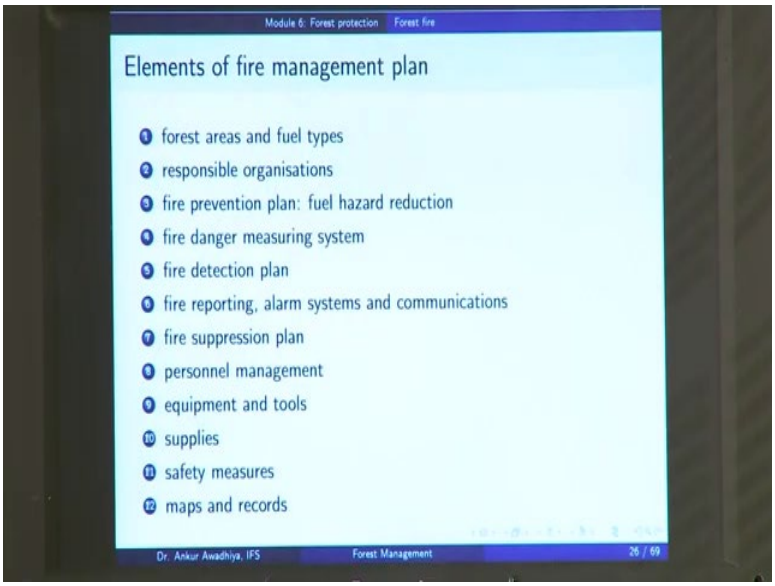

Now, with this let us now come to the elements of a good fire management plan. Now, to make a good fire management plan, you need to keep in mind a number of points. You need to know the forest areas and the fuel types; you need to know the responsible organizations that can lend you a hand or that you can approach, when you have a crisis situation; you need to have a fire prevention plan, especially one that has fuel hazard reduction; you need to have a fire danger measuring system which will tell you which are the areas that you should concentrate your efforts on.

Then, you need a fire detection plan that is able to detect your fires as soon as possible; then you need to have a fire reporting system which might even comprise of alarm systems in communications, so that once you have detected this fire, the person who detected it; so, if there is a fire in the center of a forest, the person who is there in the center of the forest, must be having a means of communicating it to the headquarters or to the higher ups. So, the fire management plan should also incorporate a fire reporting system.

Then, you need to have a fire suppression plan or a firefighting plan. Now, all of these will be done by people; so, you require personal management. You need to provide them with equipment and tools; you need to provide them with supplies. And, very important supply, in this case, is food and water; because typically when you are out there in the forest to tackle a forest fire, then there the temperatures will be very high. You will get

exhausted very quickly, and so, if you want people to work in such a situation, you will have to provide them with adequate amounts of water, so that they do not get dehydrated and they do not faint down.

Then, you need to provide them with safety measures. You need to have maps and records so that you are able to plan your system properly.

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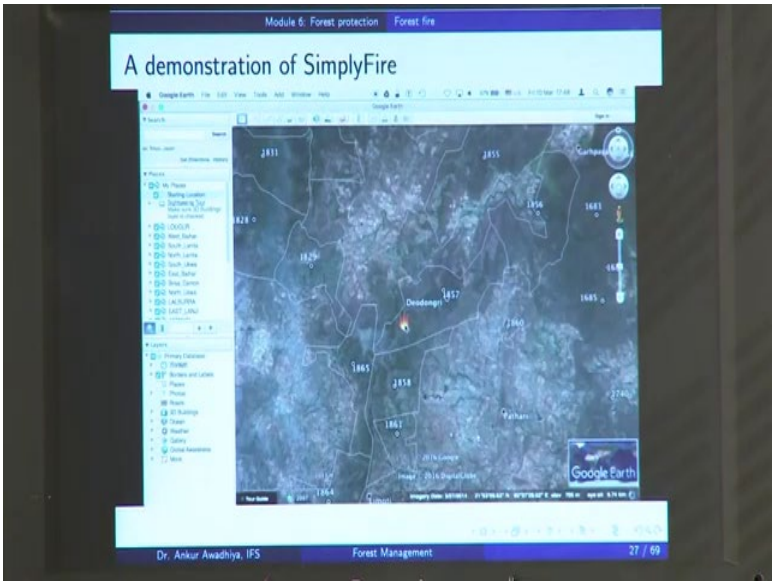

Now, for meeting such some of these purposes, we also devised a system in Madhya Pradesh that is known as the system of "SimplyFire." Now, typically what this system is doing is that, if there is a fire in say this compartment and the fire is at this spot, you should be able to get info-this information you should be able to detect this fire as soon as possible, and you and you should also be having a system to report this fire as soon as possible to the headquarters.

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So, how does the system work? So, this system when it is installed in your computer; so, once you double click this icon the system starts.

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Now, what this system is doing is that it is taking data; it is taking satellite data from the NASA servers, and at all times you are having certain satellites that are out there to detect the forest fires. So, if there is a forest fire, you will have infrared radiation which gets detected and which gets quantified, and which is made available to you.

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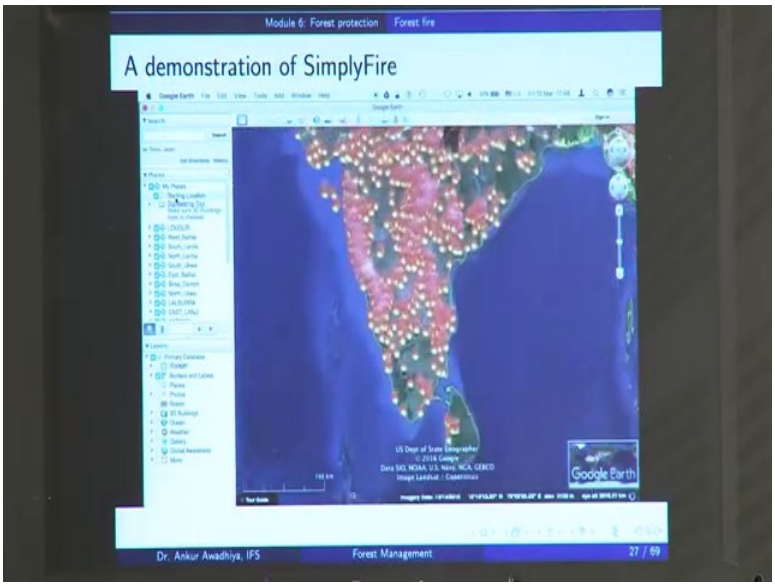

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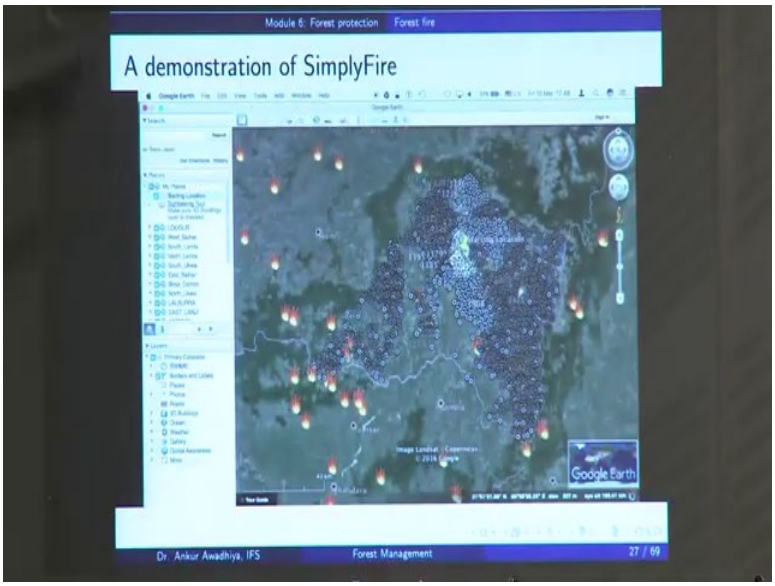

Now, that information is downloaded and then it is plotted on the map.

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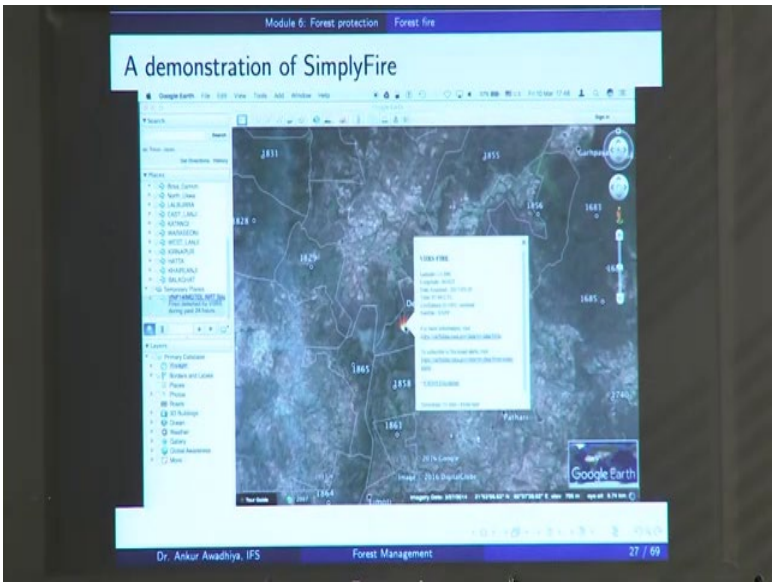

And, here we are seeing the South Balaghat division in Madhya Pradesh, and this system which uses Google Earth; so, you are very easily able to move this system and you are very easily able to see what are the locations where you are having a forest fire. And, typically we this system receives data, every hour. So, every hour you get an information about which are the areas in which you are getting a fire signature.

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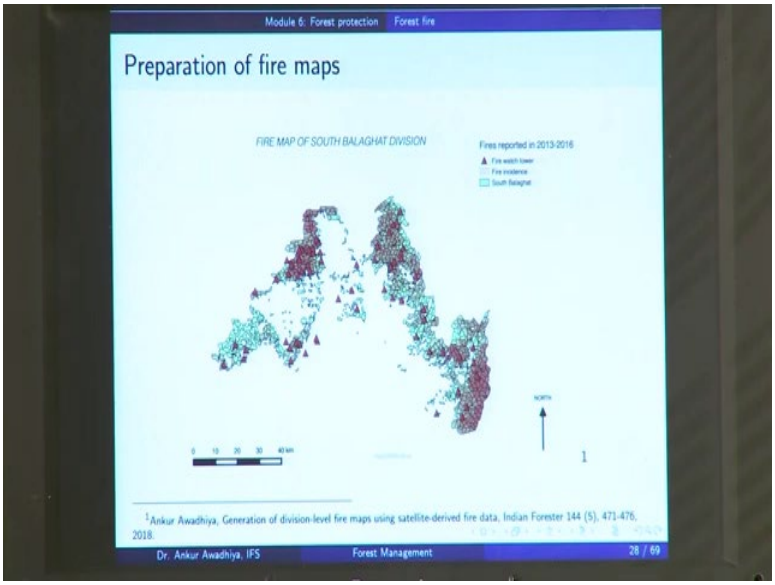

Now, for planning purposes, we also develop fire maps. Now, what is the fire map? A fire map is a is a device or is a is a map that tells you which are the areas in your forest

that are more susceptible to forest fires. Now, what this system is doing now is that, in the case of south Balaghat division of Madhya Pradesh; if you have more number of fires, so, this map is a compartment map; and in those areas, where you did not find any fire between 2013 and 2016, so, this is a four year fire map. If there was no fire; if there was no fire that was detected, then it shows the compartment in green color.

If in one out of 4 years you had a fire; so, there will be a slightly reddish color, and if you have more number of fires it will make it more and more deeper in color. So, in at in one glance, you can say that this area, this area and this area - these are the three areas that are highly susceptible to forest fires, whereas this area or this area are less susceptible to forest fires. We are getting less number of incidences in these areas.

Then, in this map, you also plot the location of the fire watchtowers. So, this gives us an indication of what are our our and management capabilities in those areas. So, that will make it much more easier to deploy the staff as soon as possible as and when required. So, in this lecture, we had a look at forest fires; we began with what a forest fire is, what are the kinds of forest fires? why do we have forest fires? and how do we manage these forest fires. And, we also looked at certain interventions that are being done in the field for the control and management of the forest fires. So, that is all for today.

Thank you for your attention [FL].