Forests and Their Management
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Module - 08
Silvicultural Management - II
Lecture – 22
Shelterwood System – I

[FL]. Today we begin a new module which is Silvicultural Management - Part II.

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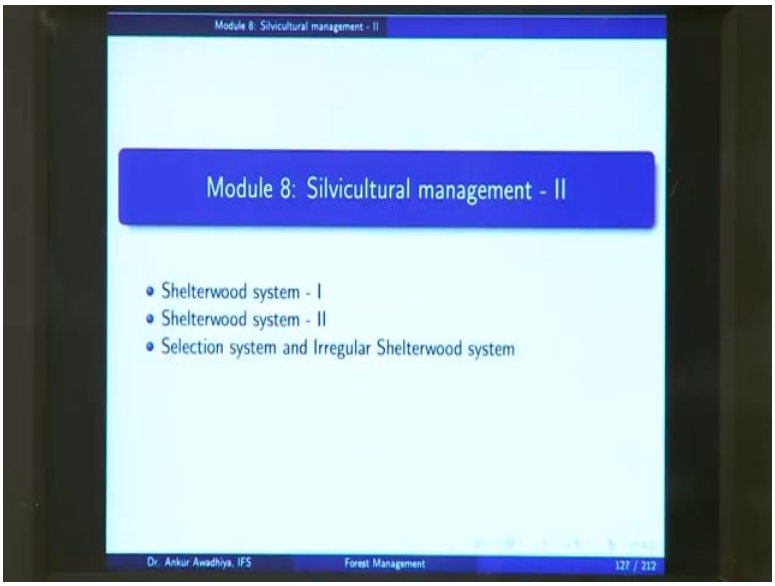

So, in this module, we will be having three lectures and we will be continuing from where we left in the previous module. So, these three lectures are Shelterwood system part I, Shelterwood system part II, and Selection system and Irregular Shelterwood system. So, in the previous module, we began with what is a silvicultural system. And, shelterwood system is one particular type of harsh silvicultural system.

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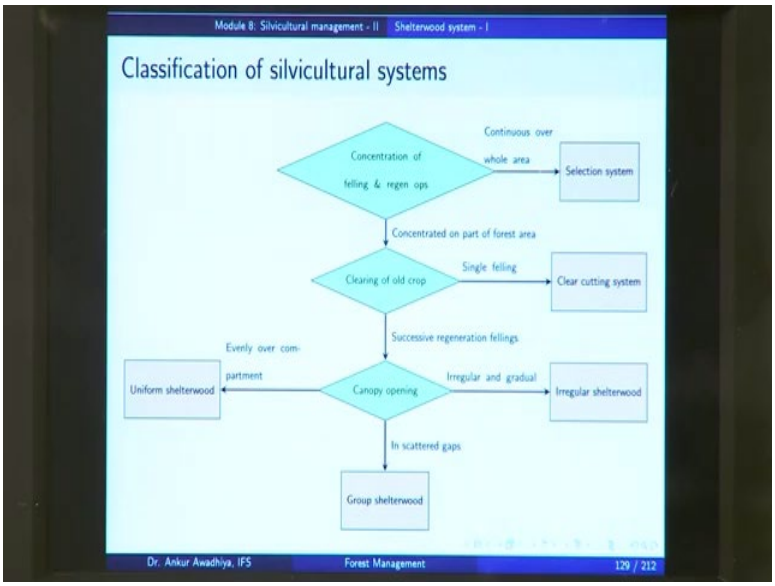

So, we had a look at this classification of silvicultural systems. So, here we have the three shelterwood systems. So, if you go through this flowchart, the first question that we ask concentration and concentration of felling and regeneration operations; is it continuous over the whole area or is it concentrated on the part of a forest?

So, in the case of shelterwood system, your concentration of felling and regeneration operations; these are concentrated on part of the forest area. They are not continuous over the whole area. Then, if you look at the clearing of the old crop, it is not done through single felling, but it is done through successive regeneration fellings.

So, we can say that a silvicultural system is a silvicultural system, in which the felling and regeneration operations are concentrated on part of the forest area, and the clearing of old crop is done using successive regeneration fellings. So, this is how we can define a shelterwood system using its characteristics.

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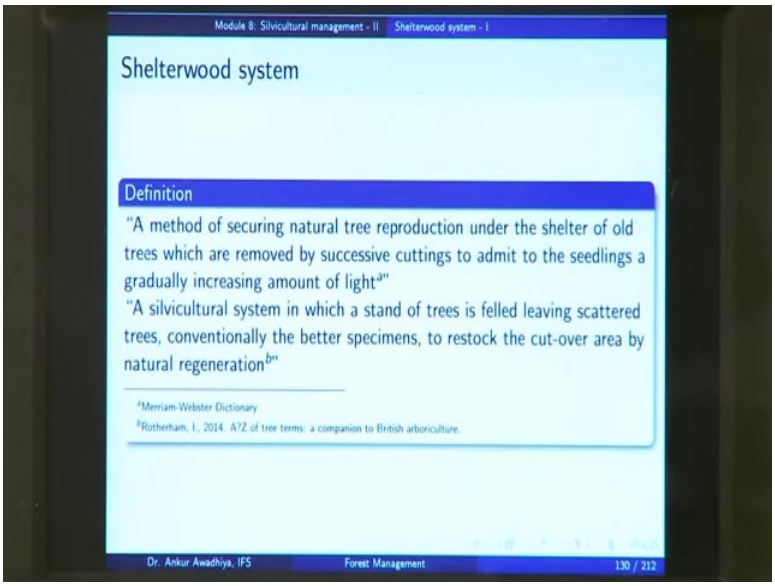

But more formally, we define a shelterwood system as, "a method of securing natural tree reproduction under the shelter of old trees which are removed by successive cuttings to admit to the seedlings a gradually increasing amount of light."

So, what it is saying is, it is a method of securing natural tree reproduction which means that, in the case of a shelterwood system, we are going with natural regeneration. You could even go with an assisted natural regeneration. But in the case of shelterwood system, we do not have artificial regeneration. The it emphasizes securing of natural tree reproduction, and this reproduction is done under the shelter of old trees.

So, you are not doing this natural regeneration in an open area; you are doing it under the shelter of the older trees which is why we call it a shelterwood system. So, it is the shelter of the old woods; under the shelter of old trees which are removed by successive cuttings. So, you are not doing these cuttings in a single go; you are doing it in several successive cuttings one by one to admit to the seedlings a gradually increasing amount of light.

So, another characteristic is that you provide your seedlings with a gradually increasing amount of light. So, in the very beginning, they will be having very less amount of light. Then, later on the amount of light will be increased, then later on it will be increased further till a time comes when they are getting the full hundred percent intensity of light.

So, a shelterwood system is a method of securing natural tree reproduction under the shelter of old trees which are removed by successive cuttings to admit to the seedlings a gradually increasing amount of light. Or, you can also define it as a silvicultural system in which a stand of trees is felled leaving scattered trees, conventionally the better specimens, to restock the cut over area by natural regeneration.

So, what we are saying in the second definition is, it is a silvicultural system in which a stand of trees is felled leaving scattered trees. So, when you are doing the felling, you are not felling it over the whole area. You are leaving certain trees in a scattered manner and you are conventionally leaving the better specimens. Why are you leaving the better specimen? So, that the next generation that comes up from the seeds of these specimens also has those desired qualities that were there in the trees that were left out.

So, it is a silvicultural system in which a stand of trees is felled leaving scattered trees, conventionally the better specimens, to restock the cut over area by natural regeneration. So, by these two definitions and with the flow chart, we can make a glimpse of what are the different characteristics of a shelterwood system.

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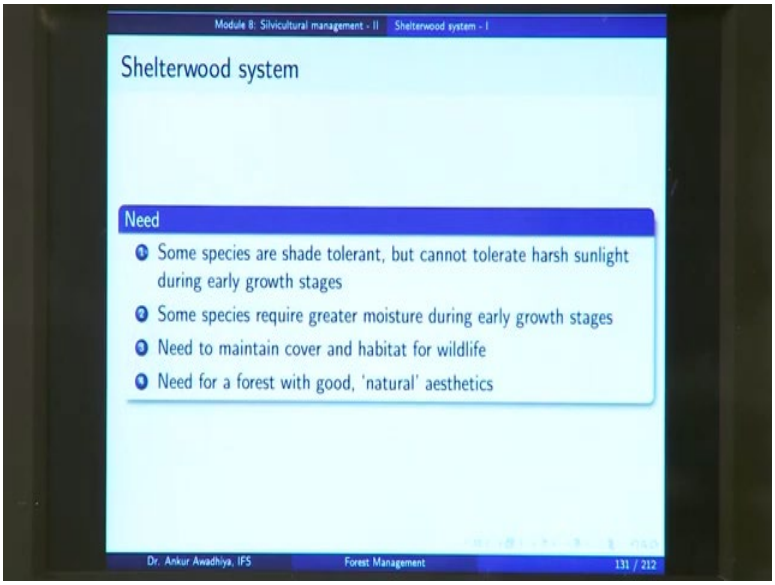

But the question is why do we need such a system? Why do we need to leave out certain trees? Why do we need to provide our seeds or a need to provide our seedlings with a shelter of the older trees? Why is there a need to provide them with a gradually increasing intensity of light?

So, we need a shelterwood system because there are some species that are shade tolerant. So, if you remember in an earlier lecture, we had discussed that we can divide the species into two parts. There are light demanders and there are shade tolerants.

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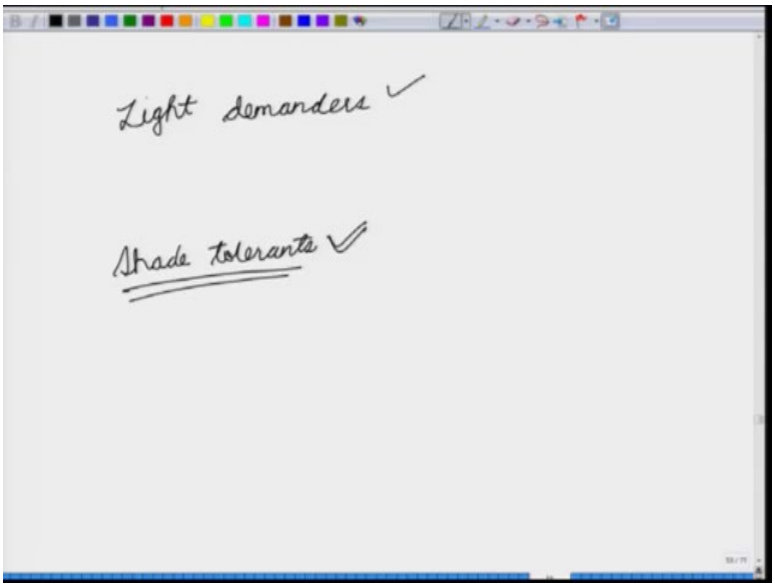

Now, in the case of light demander species, they require a huge amount of light; they require the full intensity of light. And, if they do not receive the full intensity of light, they will not be able to grow or to survive; so, those are the light demanders. But, in the case of the shade tolerants, here we have a very different characteristic of the species; they tolerate the shade. And, not only do they tolerate the shade, they also love the shade; they need the shade.

So, if you expose these seedlings to the full intensity of light, then probably because of desiccation, they will die out; or probably because of the high intensity of light, they will die out. So, there are these species of shade tolerant plants that require the shelter of older trees especially in the beginning of their lights. So, some species are shade tolerant, but cannot tolerate harsh sunlight during the early growth stages, for which you require a shelter, or some species may require greater moisture during the early growth stages.

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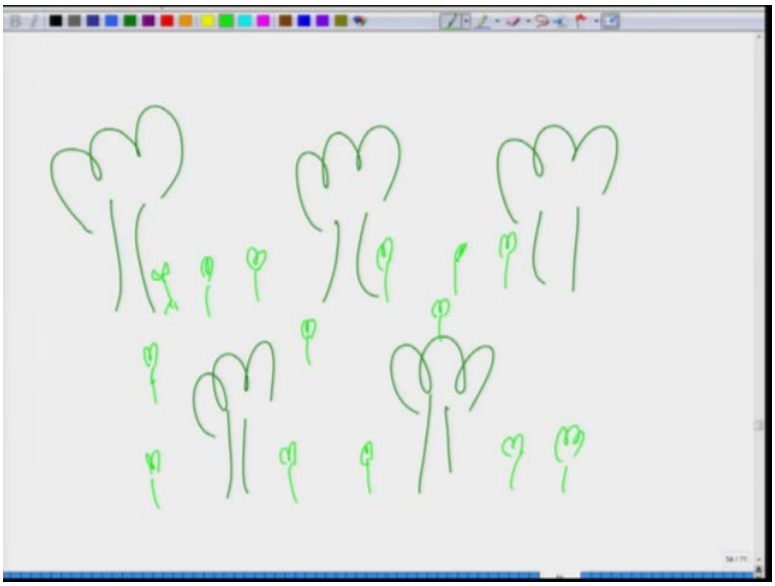

So, what we are saying here is, suppose you began with a stand, and in this stand you let it grow with natural regeneration. So, now, you have these seedlings that have come up. Now, if you do not provide them with shelter, if you remove all the mother plants at one go; so, you are removing all the regeneration. Now, you are removing all the mother plants and you are leaving out just the regeneration.

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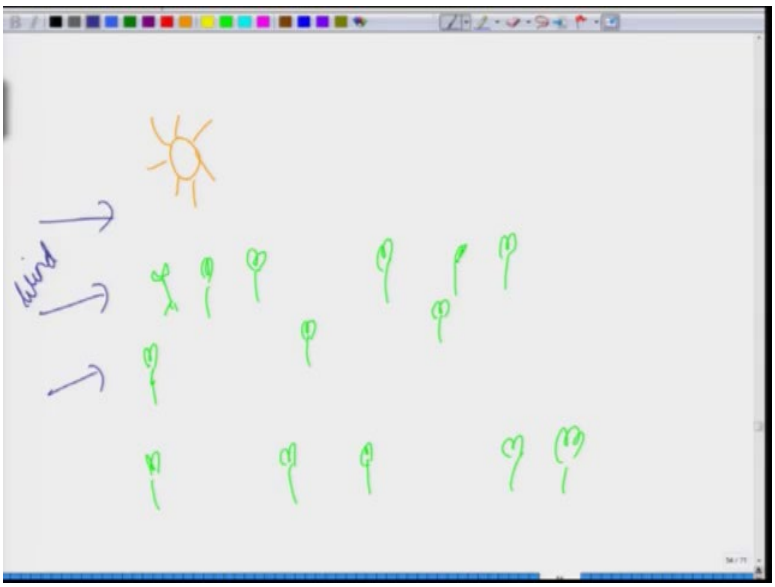

So, what is happening now? Now, if you have the sun then the sunlight, and the warms are going to suck out all the moisture from the soil. These trees are also now exposed to the wind and wind will also lead to desiccation.

So, if you remove all the mother plants, then your seedlings are now expose to the action of sun and wind, and in that case, your seedlings will dry out. And, when they dry out, they might probably even die. So, there are certain species that require a good amount of moisture in the early stages of their lives, and because of that we require a shelterwood system for these species. Then, there might be a need to maintain cover and habitat for wildlife. Now, if you remember we talked about silvicultural objectives. So, there are different objectives of management. Probably, you want to have your stand for the extraction of timber, but at the same time you also want to ensure that your animals that are living in these forests are also able to survive.

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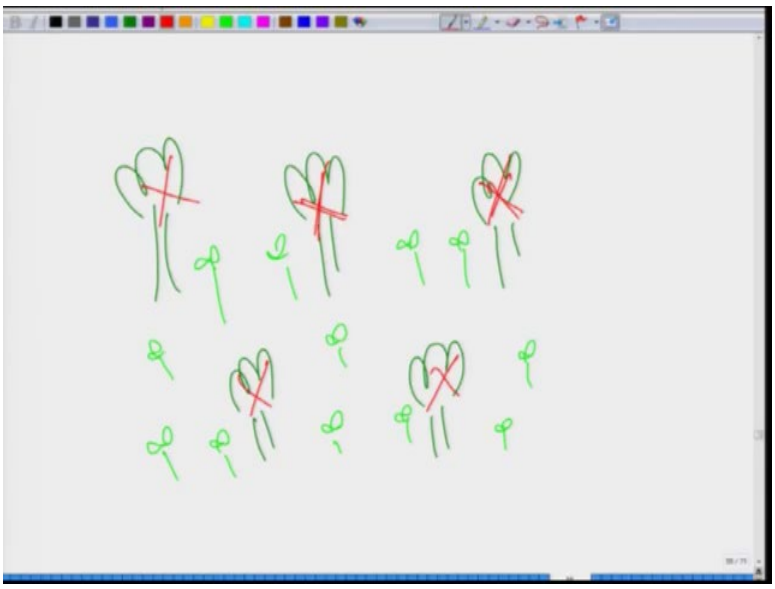

Now, if you went with a system in which you removed all the earlier trees in one go; so, in this case, what we are saying is that you have these trees. You have your regeneration and because you already have your regeneration, you can now say that, “Ok, I do not need the mother trees. I will just remove them.” But then, there are - your forest is not just being used for timber, you also have a number of wildlife that are there in the area. Probably, you have certain langur species in this area or probably you have a very nice bird population.

Now, if you remove these mother trees, in that case, all these species will not have a home to live in and so, to meet your silvicultural objective of not only extracting timber, but also conserving the wildlife, you might want to go with a shelterwood system. So, there might be a need to maintain cover and habitat for the wildlife or there might be a need for a forest with good natural aesthetics.

So, if you clear cut a forest, in that case, even though you will be getting an even aged forest, but then it will look very artificial because all your trees will look one and the same. So, if you want to have a forest that has natural aesthetics, it looks like a natural forest. In that case you, would probably want to go with a shelterwood system because, in this case, you have certain large sized trees. And, you also have the even aged crop that is coming up; and, you are cutting the earlier vegetation in successive stages and so, at all times, you are having trees of different age classes. So, the need for a forest with good natural aesthetics might also turn you towards a shelterwood system.

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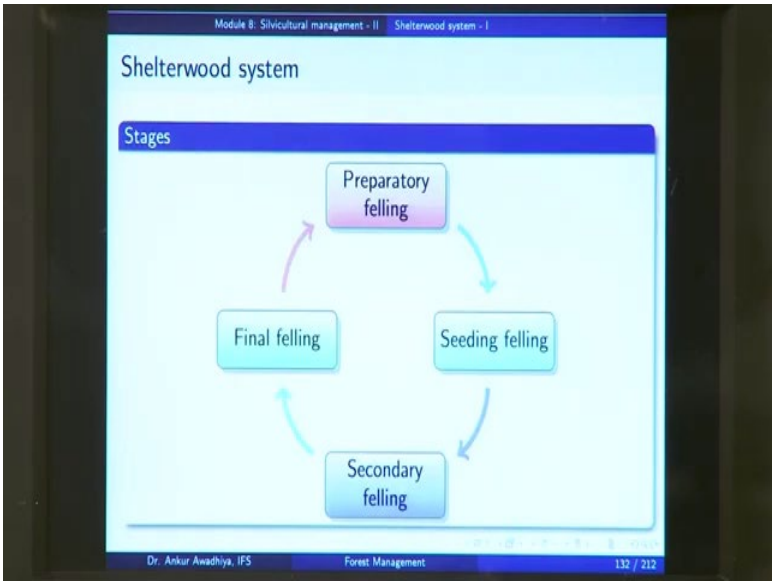

Now, shelterwood system has four stages. You have a preparatory felling, a seeding felling, a secondary felling and a final felling. So, this is how we can describe a shelterwood system that it has four different felling operations.

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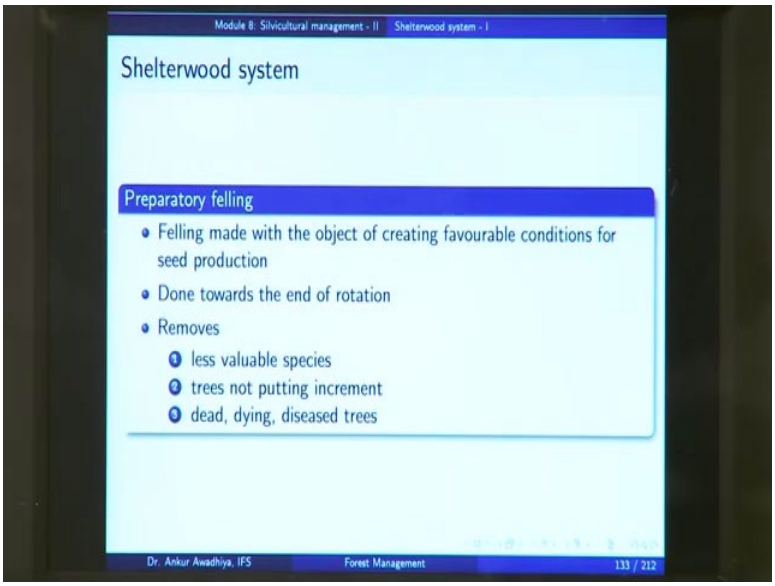

So, we will now look at each one of these. What is preparatory felling?

Preparatory felling is a felling that is made with the object of creating favorable conditions for seed production.

So, your aim for during a preparatory felling is to ensure that you have a very good seed production. So, when do we do a preparatory felling, we do it at the near the end of rotation. And, what do you do here? You remove the less valuable species; you remove the trees not putting increment, and you remove the dead dying and diseased trees. So, what is the aim of your preparatory felling?

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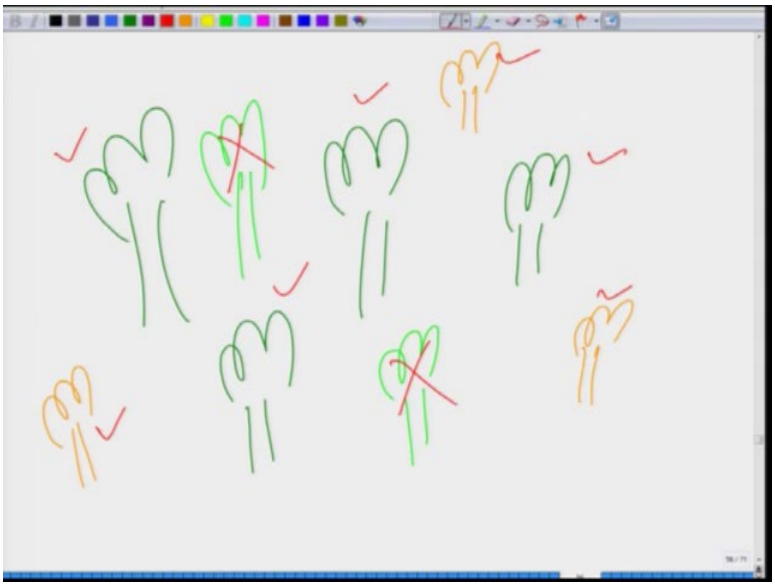

Here, what you are doing is that, you have your forest; probably there are multiple species, and in this case, you have decided that you these species that are dark green and the yellow ones are the ones that you want to keep, because these are the valuable species. You want you do not want these light green trees in the next regeneration. So, during the preparatory felling what you are trying to do is that, you want to have good amount of seed production by those plants that you want in your forest standard; so, here you will be removing those trees that you do not want.

So, that is the first stage. So, you remove those species that you do not want to be there in the forest. Next, even in the case of those species that you want to be in the that you want to remain in the forest, they will probably be certain individuals that are not putting up good growth or that are dead, dying or diseased trees.

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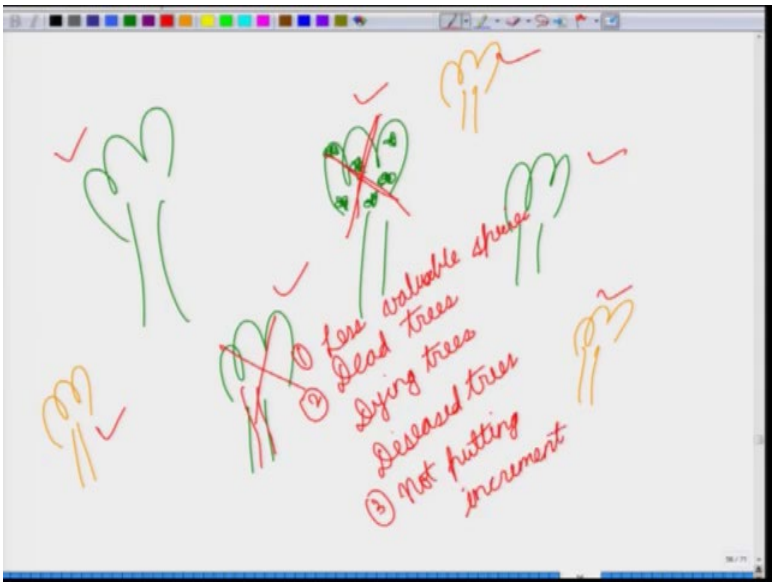

So, probably this is one individual that has certain diseases. Probably, it is having a fungal disease or probably it is suffering from a parasite. Now, if you let this plant remain or if you let this tree remain in the stand, then, when you have the next generation through the seeds, then these diseases or these parasites will also enter into the next generation; and so, you will try you will do an operation to remove these trees as well.

So, even though this tree belonged to a species that you wanted, even then you are going to remove this tree. So, you remove what trees; you remove the dead trees, you remove the dying trees and the diseased trees. So, all these trees are removed. At the same time, you also remove those trees that are not putting up increment. So, you are removing those trees that are not showing any further growth that if they have reached their maturity or they are showing a stunted growth. So, probably this tree was of a very small size and in that case, you will remove this tree as well.

So, you first removed the less valuable trees species, then you remove the dead, dying and diseased trees, and you also remove the trees that are not putting increment. Now, when you remove all of these trees, you have generated a condition in which you have only those species that you want to be in the forest. You have those trees that are not having any diseases or parasites, and you have reduced the density of your forests.

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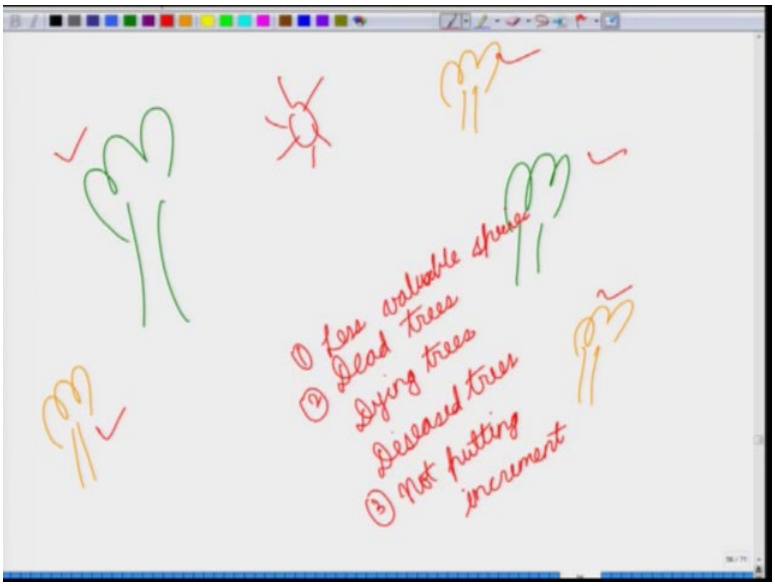

So, when you have a reduced density, another benefit is that, the sunlight or the nutrients that were earlier not available in plenty to the plants, are now available in plenty because you have reduce the competition.

And at the at this end is at this end stage of rotation, when you are giving the plants the full amount of nutrients, then the amount of seed that these plants will produce will be very large. So, you are doing this preparatory felling to ensure that you have seeds of good species seeds that are free of parasites and diseases, and seeds that come up in large quantity and with a large viability, because there their mother trees were receiving sufficient amounts of water, nutrients and sunlight.

So, this is the proprietary felling; felling made with the object of creating favorable conditions for seed production, that is removal of dead, dying, diseased trees, removal of parasitic and disease load, removal of less valuable specie, and removal of competition. So, that you have good seed production and it is done towards the end of rotation.

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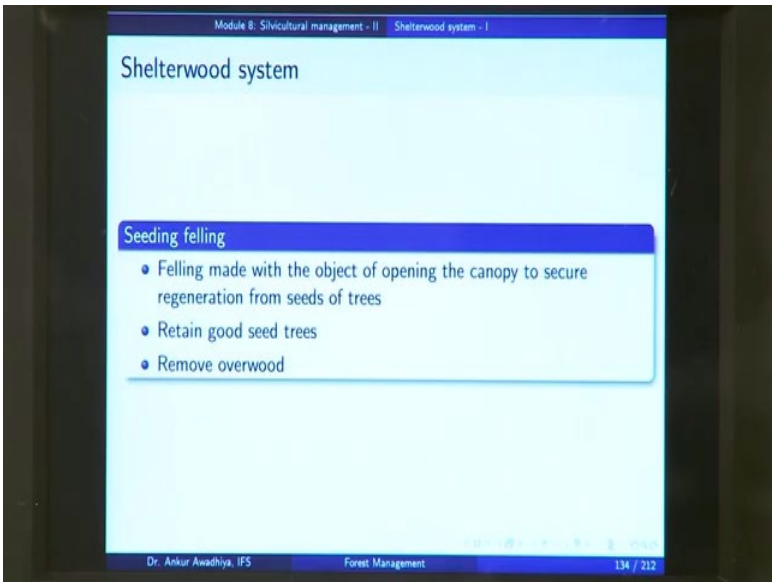

After preparatory felling, you have the seeding felling. Now, seeding felling is a felling that is made with the object of opening the canopy to secure regeneration from the seeds of trees. And, you retain good seed trees and you remove the over wood, in the case of seeding felling. So, what you are doing? You are doing a felling. So, you are removing more number of trees with the object of opening the canopy to secure regeneration from the seeds of trees. So, what we are saying here is that, after you have you are done with your preparatory felling and you are left with these trees.

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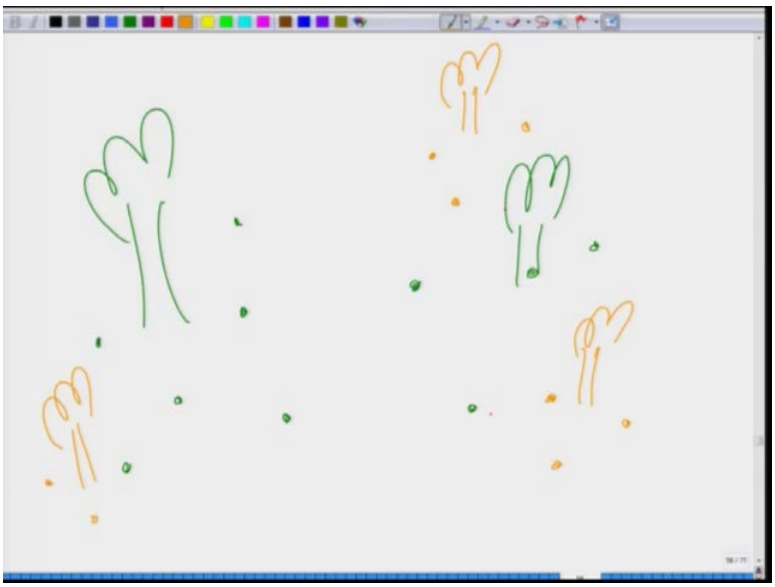

And now, these trees will be producing copious amounts of seeds. So, now, you have ample number of seeds that are there in your system, but then, if your seeds do not are not exposed to the sunlight, then probably they will not germinate. So, now, you would next stage of seeding felling is to ensure the germination of these seeds, and what you do here is that you open the canopy. So, what do you mean by opening the canopy?

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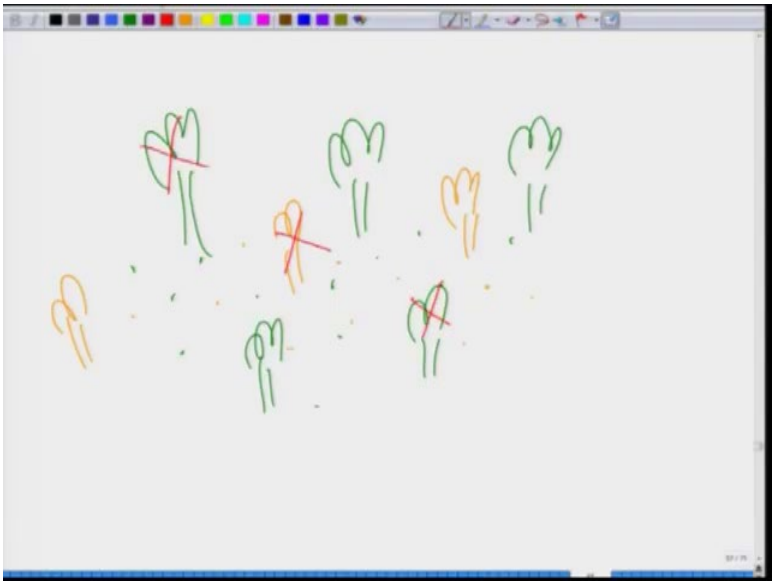

Opening the canopy, what we are doing is that, let us have another diagram. So, you have these trees that are in your system and you also have a large number of seeds, but because these seeds are not getting exposure to sunlight, they probably will not germinate. So, what you are trying to do now is that, once you have your seeds in the system; now, you are removing a few more trees, and you are removing these few more trees.

So, that there is ample amount of sunlight that is coming to the forest floor to enable the germination of these seeds. So, probably you will remove a few trees, and once you are done with that a little more amount of light is coming into the system, and your seeds are now able to germinate.

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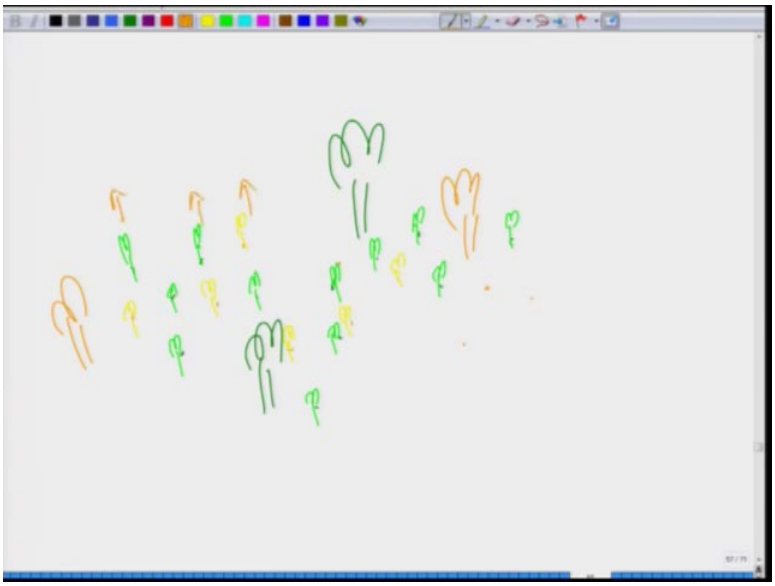

So, in the case of your seeding felling, you are opening the canopy to enable the germination of these new seeds; of these new seedlings from the seeds that were there in the system. Now, in the case of seeding felling, you retain the good seed trees and you remove the over wood.

So, you are still leaving a few good seed trees because you are never sure whether you will be able to regenerate it fully, or there might be some hiccups. So, you are still leaving a few seed good seed trees, but you are removing the over wood. So, that there is some more amount of light that is coming to the seedings.

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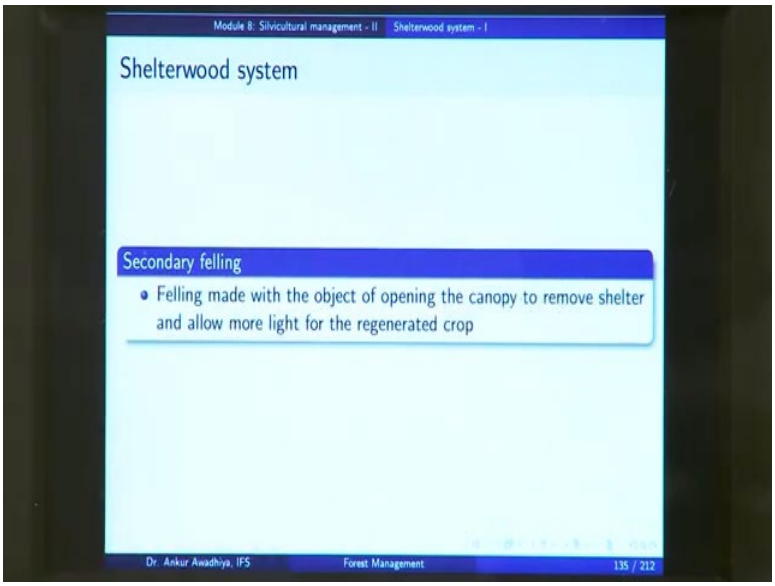

Next, we have the secondary felling. The secondary felling is a felling made with the object of opening the canopy to remove shelter and allow more light for the regenerated crop.

So, what you are doing in the case of a secondary felling is that, now that you have these seedlings that have come up; now, you want them to show more growth. Now, to have more growth you are removing a few more trees so that the amount of light that is coming into the system is a bit more. And, at the same time, the amount of competition that your that your regeneration was facing from the previous generation is also reduced, because the mature trees - they were giving up they were taking up more of some sunlight; they were taking up water; they were taking up nutrients; so, you are removing a few more trees.

So, that the amount of competition is lessened, but still you are leaving a few trees in the system, because your species are shade tolerant. So, you are gradually exposed exposing your seedlings to more and more amounts of light and while still protecting your seedlings with the shelter of the older crop.

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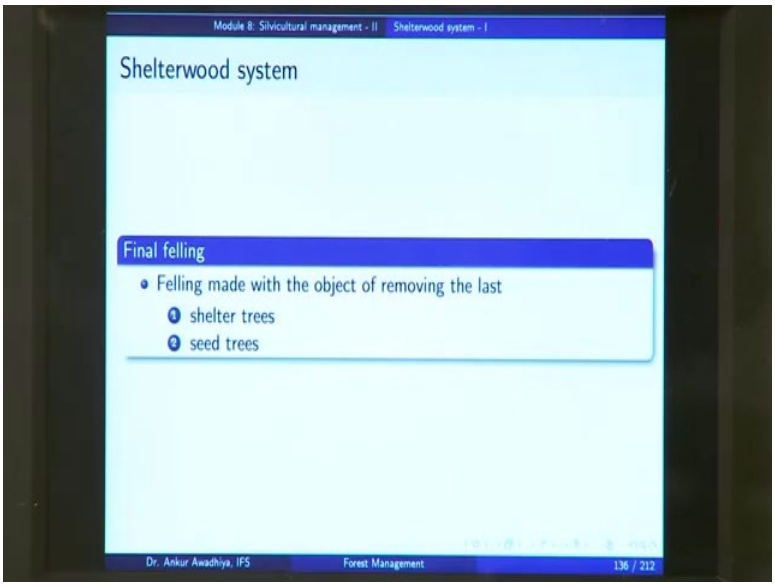

So, this is the secondary felling. And then finally, you will be having the final felling, which is a felling made with the object of removing the last shelter trees and the seed trees.

So, in the case of the final felling, you will remove all the trees that were left of the previous generation. So, now, you have a forest that has come up to a stage in which it no longer requires anymore shelter. So, now, your plants are able to survive on their own and so, you remove the shelter, you remove all the trees of the previous generation and so, now, you have a regenerated forest. So, this is a shelterwood system.

You begin with a preparatory felling to ensure that you have a good amount of seed production. You go with a seeding felling, then you go with a secondary felling and finally, with a final felling.

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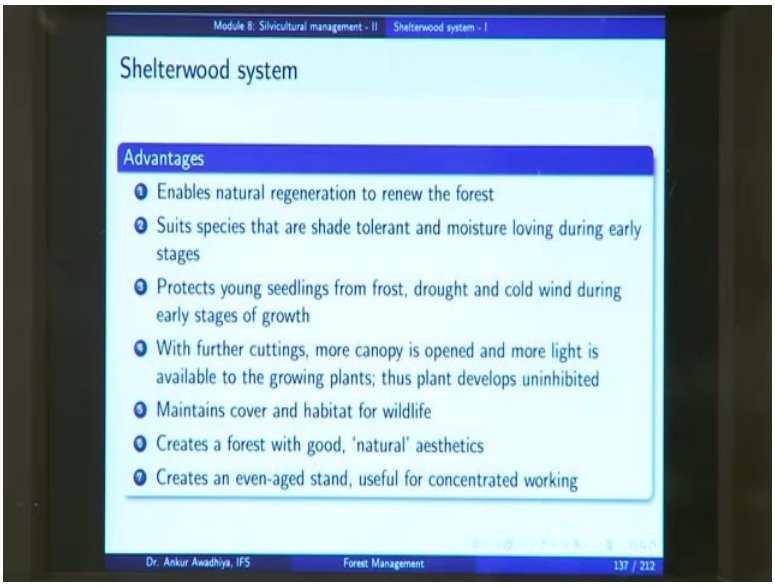

So, what are the advantages of this shelterwood system? Well one, it enables natural regeneration to renew the forest. So, as we saw in the whole process, we are not planting any new plants; we are not dribbling, we are not putting any new seeds into the system, but just the natural regeneration by the seed trees of the previous generation is enough to regenerate this forest.

It suits the species that are shade tolerant and moisture loving during the early stages. So, because you are covering them with the shade of the previous generation, they are able to get the shade and they are able to have more amounts of moisture especially, during the early stages.

It protects the young seedlings from frost, draught and cold wind during the early stages of growth. So, because in the early stages of growth, you are also having certain taller plants with more amount of canopy. So, cold winds are not able to blow over your new generation and so, it protects your young seedlings not only from the harsh sunlight, but also from frost, drought and cold winds.

With further cuttings, more canopy is opened and more light is available to the growing plants, and thus the plant develops uninhibited. So, even though you are providing it with shelter in the earlier stages of life, but then because you are giving it progressively more and more amount of light by progressively opening the canopy. So, the growth of the new generation is uninhibited and so, it is able to reach its full potential.

At the same time, it maintains cover and habitat for wildlife. So, it is a very good system, if you have a forest that also has wild animals, because the shelter trees that you are leaving for the seedlings, also serve as habitats and also serve as covers for your wildlife. So, it maintains cover and habitat for wildlife. It creates a forest with good natural aesthetics as we saw before, that you are getting a forest with an natural look.

Then, it creates an even aged stand which is useful for concentrated working. So, in this case, when you are doing your preparatory felling, you do not leave your forest to region for a very long period of time. Because after a while, you will move towards seeding felling, then you will move towards secondary felling, and finally, to the final felling. So, in this case, the seeds that came up on the forest floor and their germination is controlled by you.

So, when you perform your seeding felling, or on the your seeding felling, and your secondary felling on the whole of the forest stand, then all the new regeneration that has come up, will be even aged. And, when it is even aged, then the later on managerial operations can be concentrated, because all your plants have the same age and the same sizes. So, it creates an even aged stand which is useful for concentrated working.

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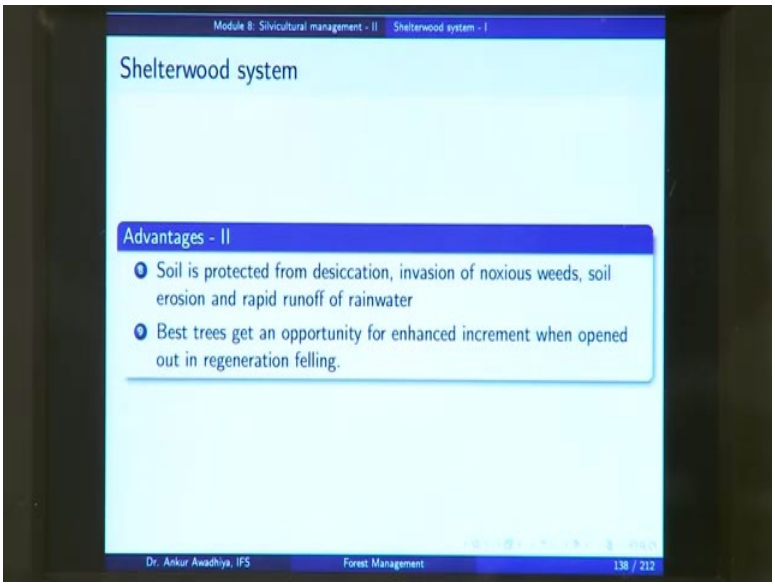

At the same time, the soil is protected from desiccation, invasion by noxious weeds, soil erosion and rapid runoff of rainwater. So, because you are because at no time are you exposing the soil completely, because you are having a shelter of the older generation.

So, your soil is saved from desiccation; you do not have large winds or sun or sunshine that is able to draw of the moisture from the soil, because it is covered.

So, the soil is predicted from desiccation. It is also protected from invasion of noxious weeds, because, when you clear up an area and you provide hundred percent intensity of sunlight, then there are a number of weeds that can grow up in that area, but because you are keeping it keeping the whole of the area covered, so a number of weed species are not able to come into this area.

It protects it against soil erosion and rapid runoff of water, because at all times you are covering your soil with the previous generation. And so, large winds and large amount of rainwater are not able to directly impinge upon the soil and remove it. So, soil erosion is also prevented to a large extent by the shelterwood system. And then, the best trees get an opportunity for enhanced increment when opened out in regeneration felling.

So, what it is saying here is that, in the case of the shelterwood system, we began with a forest - let us have two species.

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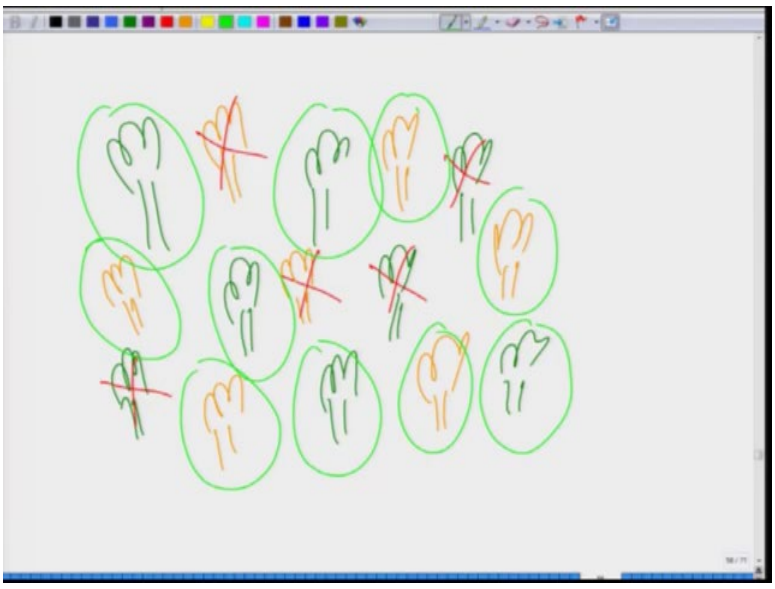

Now, in this forest, what we did for the next generation also has one other positive consequence. So, what we did here was, in the case in the case of your preparatory felling, we removed those plants that were not of a useful species. We removed those plants that were dead, dying and diseased. And, we also removed those plants that were

not putting up a good increment, but we left those plants that were healthy and were putting up a good increment.

So, essentially what we are saying is that those plants that were not putting up a good increment, but removed, but those plants that were putting up a good increment were left in this system. So, these plants are left out.

Now, even in the case of the seeding felling, we are still leaving out a few seed trees and those seed trees are those plants out of the ones that are left - that are showing the best characteristics. So, what we are seeing here is that, in the first stage, we removed these trees in the preparatory felling.

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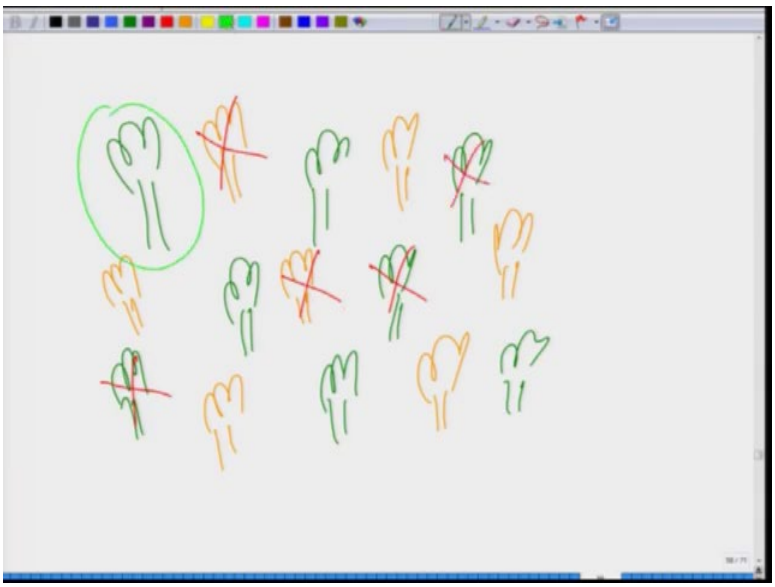

Then, in the seeding felling, what we did was the best trees out of the ones that are remaining. Say this is a very good tree; this is a very good tree, and this is a very good tree. So, what we are doing next is that we are removing the other trees that we did not classify as very good trees. So, these are the best trees that were there in the forest.

And then, during the secondary felling, we are removing a few more trees, but still we are leaving out a few trees, and then, only in the final felling are we removing the last trees of the previous regeneration. But look what is happening now. These trees which in other systems would have been removed in the very beginning, now have time to grow even further. So, these were those trees that were putting up the best amount of

increment; these were those trees that were very healthy trees, and we had left them out to protect the young crop. But at the same time, this period also provides them an opportunity to put up more amount of growth.

So, in this case, when we do the final felling, we have more amount of timber at hand because we provided these trees with more opportunity to put up more growth. So, this is another advantage of the shelterwood system. The best trees get an opportunity for enhanced increment when opened out in regeneration felling.

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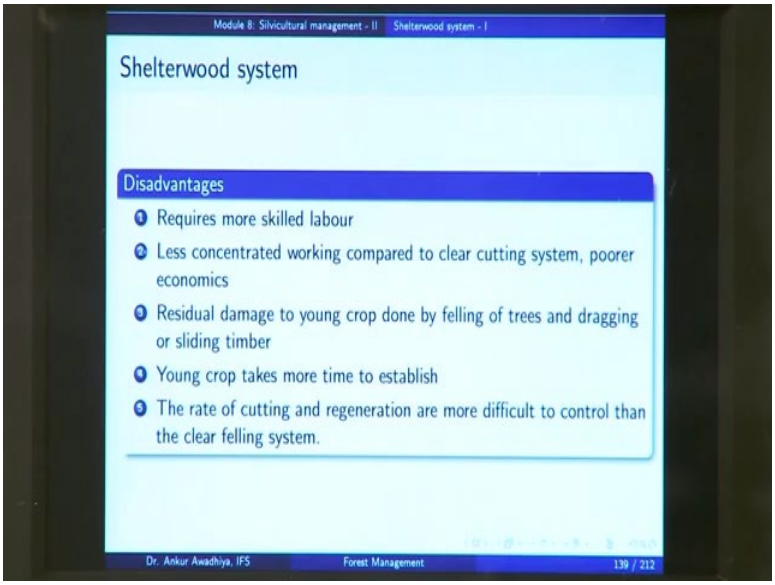

However, the shelterwood system also has certain disadvantages. It requires more skilled labour. Why does it require more skilled labour? Because, you need to identify those trees that have to be felled in any particular operation. So, for instance, in the case of a clear felling system, you just had to ask your labour to remove each and every of the trees that were there in the stand. But, in the case of a shelterwood system, during the preparatory felling, they will have to make a list of what all species are there. Then, they will have to remove those species that are not ah that are not of high value to you.

So, in this case, you want to you will have to teach them how to identify your species. You have to teach them how to make a record of which species is what, and where is it located, and then you will have to provide them with the information of which individuals have to be removed. And then, they will have to go to that particular area and remove that particular individual.

Now, if for instance in place of removing the dead, dying and diseased trees, they remove the healthy trees. So, in that case, your system will fail. So, you require a large amount of skill to be imparted to the labour for each and every of the stages of the shelterwood system. So, this is a major disadvantage.

Then, there is less concentrated working as compared to clear cutting system which leads to poorer economics. So, what this is saying is that, in the case of a shelterwood system, you have a very concentrated working because you are doing felling operation in a very concentrated way; in a very small amount of the area. So, you cut each every of the trees, but in the case of a shelterwood system, your concentration is much less because in say the preparatory felling, you are removing say 10 percent of the trees.

So, you will have to visit the whole of the forest area, but you are removing only 10 percent of the trees. Then, you are removing 20 percent more of the trees. So, again you have to visit the whole area.

So, the cost of cutting your trees goes up because each and every time you have to take your labour, your equipment, your machines to each and every area of the forest. So, your costs have gone up. Then, you also have the cost of recording the data; you have the cost of analyzing the data. So, these costs are much greater than in the case of a clear felling system.

So, overall the amount of profit that you that you would get from a shelterwood system is typically lesser than what you get in a clear felling system. So, there is less concentrated working as compared to clear cutting system. And so, it results in poorer economics. Then, there is a residual damage to young crop done by felling of trees and dragging or sliding of timber.

What it means is that, during your preparatory felling, you removed certain trees. You allowed the seeds to come up. Once the seeds have come up, then you perform the seeding felling, allow it to read allow your seeds to germinate, then allow them to grow a bit more and then you go for a secondary felling. Now, when you are doing a doing the secondary felling, your labour; your machines have to go inside the forest. And, when they go inside the forest, a few of your young crop will also get damaged because they will get trampled below the feet; below the tires of the machines.

At the same time, when you are doing the secondary felling, you will be cutting large size trees. And then, you will be extracting them out of the forest. Now, how is this extraction done? You cut this tree, then you oh you are tie it up with a rope and then you drag this tree out of the forest. Now, when you are dragging a large-sized timber, this again will lead to trampling of the young crops. So, because you are visiting your forest again and again, and especially, when you are young crop is already there in the forest; so, there is a greater chance of a damage to the young crops.

So, this is another disadvantage of the shelterwood system. There is a residual damage to young crop done by felling of trees and dragging or sliding of timber. Then, the young crop takes more time to establish. Why? Because, in a number of cases, you are not exactly able to tell how much is the intensity of light that should be permitted to your young crop. And so, if for instance you provided it with lesser amount of light that was that that your seedling was tolerant off. Suppose your you are young crop was able to tolerate say 30 percent intensity of light, but you only provided it with 20 percent, that is a possibility. But then, because your plant is not able to get the 30 percent intensity of light that it was tolerate, that it was tolerant off, and that it required; and it got only 20 percent. So, the rate of its growth will be much lesser.

So, typically the young crop takes more time to establish. The establishment as you remember is the stage at which your young crop is hardly enough that it is resistant to the natural ways of damage to the crops. So, it has to reach a certain height, it has to reach a certain level of maturity that we can say that now it is - leave these plants alone, but typically in the case of a shelterwood system, the young crops take more time to establish. Then, the rate of cutting and regeneration are more difficult to control than the clear felling system.

The rate of cutting and regeneration are more difficult to control, because in this system there are a number of intricacies; you have to make a number of calculations, and at times, things go wrong. So, your rate of cutting is difficult to control. It is not like the like the clear felling system that you say that you go into this forest and you cut all the trees.

So, in the case of a clear felling system, rate of cutting is very much in our control, but in this case it is not in our control. Similarly, the rate of regeneration is not within our

control, because it is happening in different stages and so, the amount of control that we have in a shelterwood system is typically lesser than the amount of control that we have in a clear felling system.

So, in this lecture, we saw that, in the case of a shelterwood system, there are certain species; there are certain requirements that will that will make you inclined towards a shelterwood system. If you have a species that is shade loving, if you have a species that cannot tolerate high intensity of sunlight in the early stages, if you have a species that requires a larger amount of moisture in the early stages, then you will have to go with a shelterwood system.

And in the shelterwood system, the primary characteristic is that your young crop comes up under the shelter of the older trees. Now, these older trees provide it with shade; they provide it with protection from the sun, from desiccation, from wind, from frost, from drought, and so on. The best characteristic is that, because you are never denuding the whole of your land; so, the land is protected or the soil is protected from desiccation. It is protected from the invasion of weeds.

But, at the same time, your young crop is able to show its full growth potential because you are gradually opening up the canopy, and you are progressively allowing more and more amount of light to reach your crop as and when it requires that. However, when you are using this shelterwood system, you have to make a number of modifications; you have to make a number of provisions.

You have to train the labour force; you have to reach to all sides of the forest again and again, and all of these make it a bit more intricate system; a bit more complicated system to be used in the general functioning. So, at times, even though your crops might require more amount of shade, it may be better to just clear cut the whole area, and set up and artificial shade. So, that is all for today.

Thank you for attention. [FL].