Forests and Their Management
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Module – 08
Silvicultural Management – II
Lecture - 23
Shelter wood System – II

[FL] In today's lecture, we will carry forward our discussion on the Shelter wood System that we left in the last lecture. So, this lecture is shelter wood system part II.

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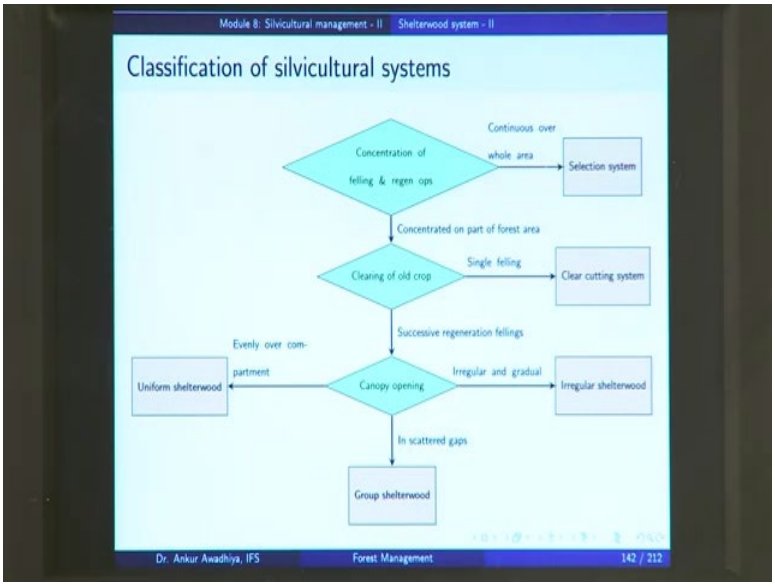

Now, as you remember in the last lecture, we discussed that how do we define a shelter wood system. A shelter wood system is a system in which we leave the mother trees to shelter for the young ones. This is especially used in the case of those species that are shade loving.

And, in this case, if we go through this flow chart, the concentration of felling and degeneration operations is there on part of the forest area; it is not there in the complete forest area. So, you do it in certain locations. And, you clear the old crop in successive regeneration fellings. So, you do not clear the old crop in one area completely; you do it in part by part. So, that you are able to open up the canopy in a phased manner, so that

your our seedlings are able to get light. And, at the same time, they are also protected against very harsh light or against wind damaged or damaged by frost.

So, this is how we define a shelter wood system. And, a shelter wood system is further lassified into three different categories. We have the uniform shelter wood, in which you do the on the canopy clearing evenly over the over the compartment. Or, you can do it in scattered groups, in the case of a group shelter wood system. Or, you can do it in an irregular and gradual manner, in the case of an irregular shelter wood system.

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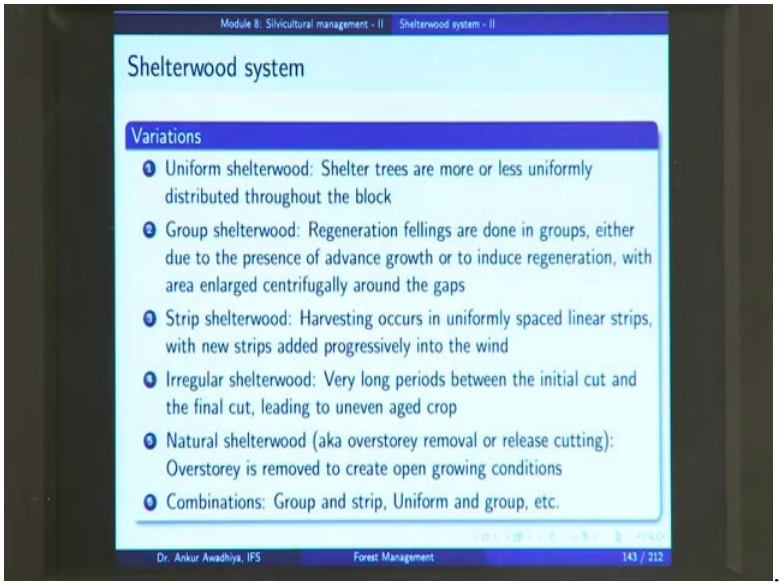

Now, shelter wood system these variations can be shown in this slide. So, in the case of a uniform shelter wood system, the shelter trees are more or less uniformly distributed throughout the block.

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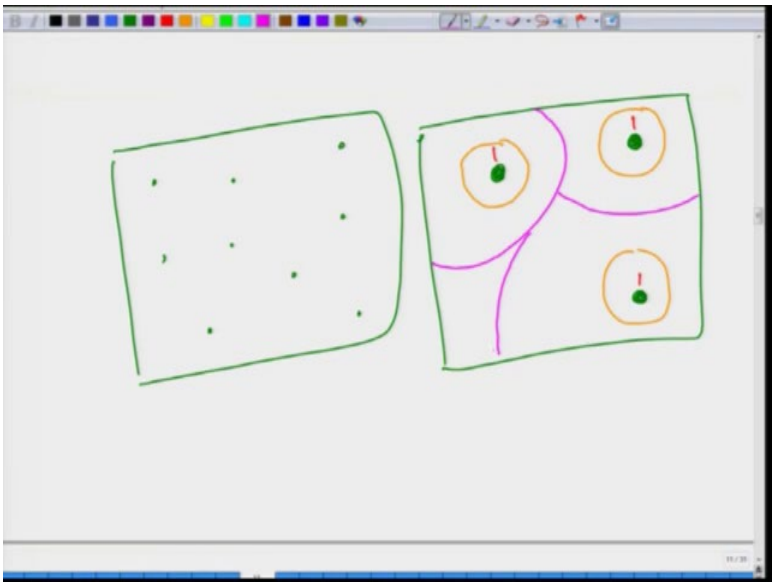

So, what we are saying here is that, you have this block, and you are leaving the shelter wood trees more or less uniformly in the whole of the area. Or, you could have a variation that is the group shelter wood, in which case, the regeneration felling's are done in groups either due to the presence of advance growth, or to reduce or to induce regeneration with area enlarged centrifugal around the gaps.

So, what we are saying here is that, in pace of doing it regularly, what you do is that in your forest block. Suppose, you have an advance growth here; you have an advance growth here; and you do have an advance growth here. So, in this case, you begin by felling these areas, in the first instance. So, in the first instance, you will fell it here. In the second instance, you will fell it in a centrifugal manner around these areas. In the third instance, you will further increase your centrifugal areas and so on.

So, this sort of a system will be known as a group shelter wood because you are doing the felling in certain groups. Or, you can have a strip shelter wood system, in which you are doing harvesting in uniformly spaced linear strips with new strips added progressively into the wind.

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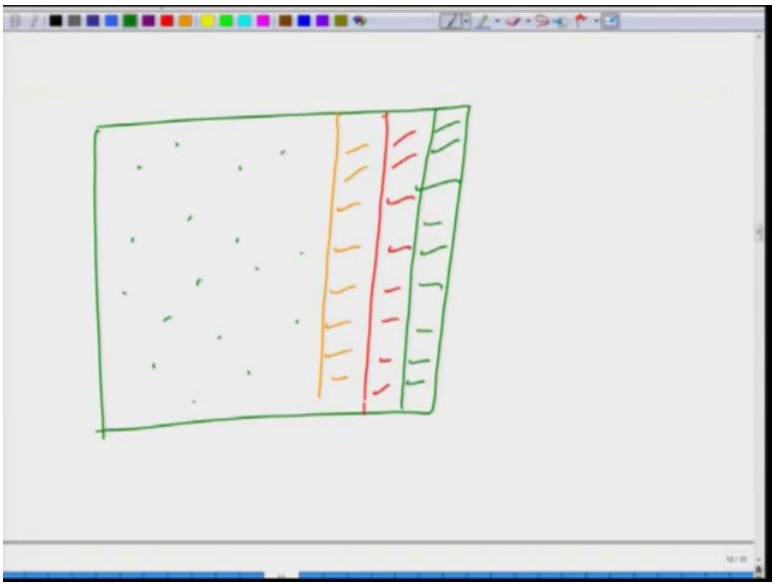

So, what we are saying here is that, in the case of a strip shelter wood system, you do a felling here in the first instance. Then, you do a felling here in the second instance. Then, you do a felling here and so on. So, in this case, the trees that are remaining on the left side they are providing the shelter. And, you are doing the felling progressively into the wind direction.

Or, you can have an irregular shelter wood system, in which there is a very long period between the initial cut and the final cut, which leads to an uneven aged crops, and this is something that we will look into greater detail in the next lecture. Or, you can have a natural shelter wood system that is also known as an overstory removal or release cutting. In which case, the overstorey is removed to create open growing conditions. So, what do we mean by that?

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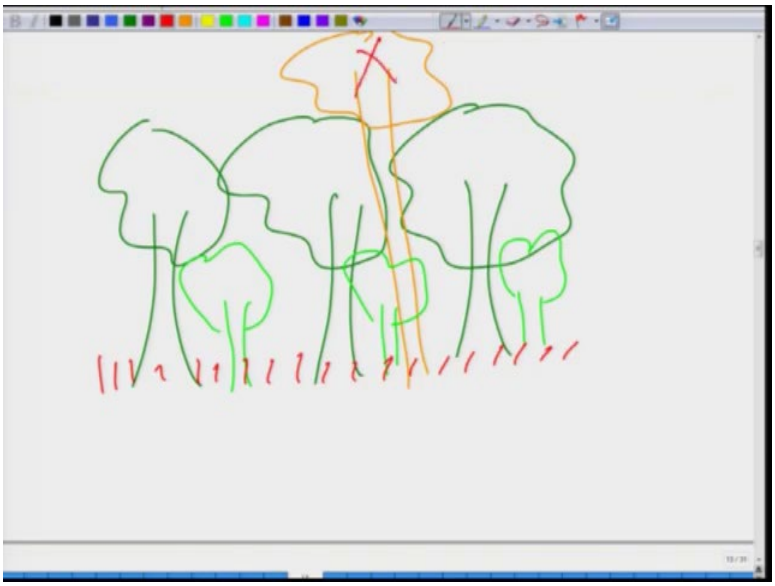

As we saw earlier, in the case of a forest, you have a canopy. But then, there are some trees that go over the canopy and form an overstory. There are also some trees that form the understory, and then you have the forest floor. Now, a natural shelter wood system would preferentially remove the over canopy. So, this over canopy will be removed.

So, in this case, you are removing the over canopy or the overstory to create an open growing condition, but you are leaving the canopy trees to provide the shelter, so that is a natural shelter wood. Then, you can also have different combinations. You can use a group system together with a strip system; you can use a uniform system together with a group system, and so on. Now, when we are doing a felling operation, in the case of a shelter wood system, we define a periodic block.

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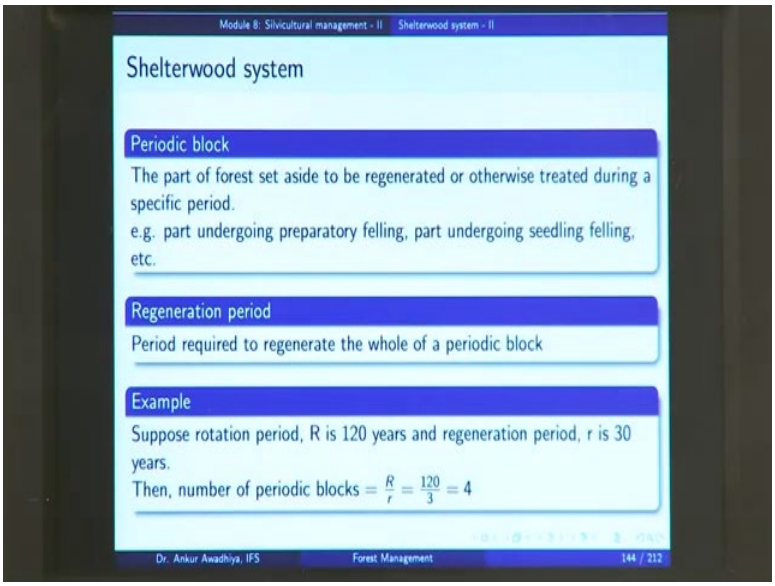

Now, what is a periodic block? So, periodic block is defined as, "the part of the forest that is set aside to be regenerated or otherwise treated during a specific period." So, as we saw in the earlier lecture, we have preparatory felling; we have the seeding felling; we have the secondary felling; and, we have the final felling. Now, those parts of the forest where we are doing one operation, say seeding felling. So, all those portions where we are doing the seeding felling, at one particular point of time, will be called as a periodic block. So, the part of the forest that is set aside to be regenerated or otherwise treated. So, you are doing any sort of a treatment, but you are doing it in the whole of the periodic block during a specified period.

Now, this period is not necessarily a single year, but it can be, say 10 years 20 years 30 years or so on. But then, during one period, you will be doing the treatment in one periodic block. So, example the part undergoing preparatory felling is a periodic block. The part that is a undergoing seeding felling is another periodic block and so on.

Now, we also have the regeneration period which is the period that is required to regenerate the whole of the periodic block.

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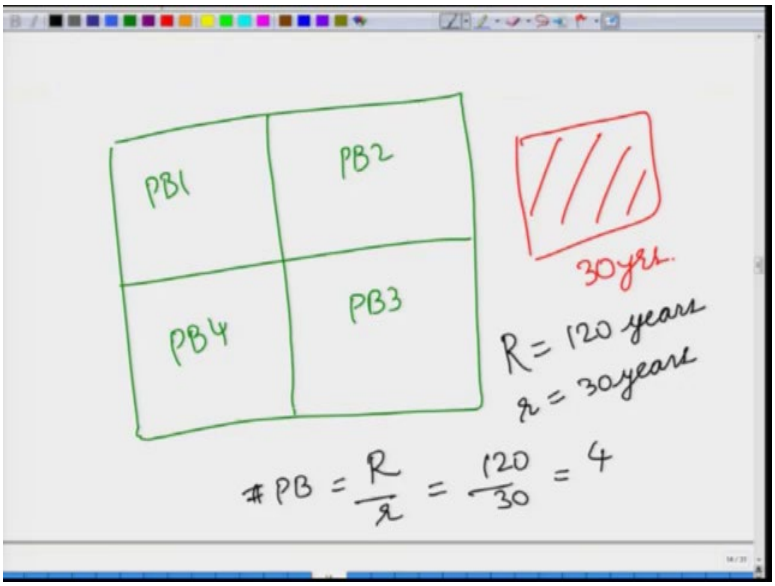

So, for instance, what we are saying here is that, suppose this is your forest, and you are dividing it into four periodic blocks. So, this is your periodic block 1, periodic block 2, periodic block 3 and periodic block 4. Now, regeneration period - ask the question how much time do I need to regenerate the whole of a periodic block.

Now, regeneration would mean that you that, you have the seeds that are coming into that area that, those seeds are getting germinated, then they are establishing themselves. So, how much time does it take for this for all these operations to happen in one periodic block, that is the regeneration period? How much time do you require to regenerate the area in one periodic block, that is the regeneration period?

Then, we had also defined the rotation period. So, rotation period is the time that at which your tree is considered mature for felling. Now, the number of periodic blocks is given by the rotation period divided by the regeneration period. So, suppose the rotation period is 120 years. So, what we are saying by a rotation period is 120 years is that, at the age of 120 years, your tree is now fully developed. It has the maximum volume that you want to extract from this tree; it is completely mature.

And so, now, it is economical to cut this tree and extract the timber out of it. So, we are saying that the rotation period is 120 years. So, it takes 120 years for this for this particular species, at this particular site to attain. And, suppose the regeneration period is 30 years; so, in this case, what we are saying is that, if you work on an area for 30 years,

then it will, if you have worked on this area, then it will take 30 more years to regenerate this area.

So, you had cut your trees in one periodic block. And now, to regenerate this area for your seeds to become germinated and then establish the seedlings, it is now taking 30 years. So, in this example, your the rotation period is 120 years and the regeneration period is 30 years. So, the number of periodic blocks is given by the rotation period divided by the regeneration period, which is 120 by 30 is equal to 4.

So, in this case, you will be having 4 periodic blocks, because every periodic block will take 30 years to regenerate. And, by the time you are done regenerating the 4th periodic block, the first one is now ready to be harvested and regenerated. So, this is what the periodic block concept means.

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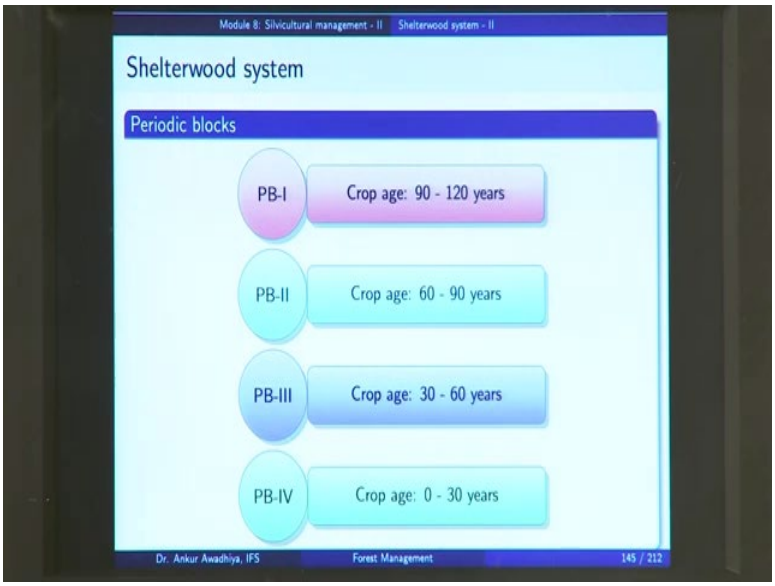

So, in the case of a shelter wood system, we define the periodic blocks as these. So, in this case for the maturity age is 120 years. So, the periodic block one 1 is that periodic block on which you are doing the regeneration operation. So, in this regeneration operation what you are doing is that you are extracting the timber. And, you are ensuring that your next generation is established in this area. So, if you have to do extraction, then your timber has to be fully mature. And, you do not want to leave any timber after 120 years.

So, the PB 1, in this case of 30 years regeneration period, will have those trees that are of the age of 90 to 120 years. So, in the next 30 years; so, in this year, suppose you remove all your trees that are 120 years of age. Next year you will remove those trees that have become 120 years of age in the next year; then in the. So, those trees are now currently in and of the age of 119 year, the year after that you will be removing some trees. So, those trees will be probably be having the year the age of 118 years now. So, all those trees that are in this age group of 90 to 120 years will form the periodic block 1. Now, in here, it is important to emphasize that it is nearly impractical to find out the exact age of every tree. And, to cut only those trees that are 120 years of age, because in practicality what you will find is that there might be a tree that is 120 years of age which is smaller.

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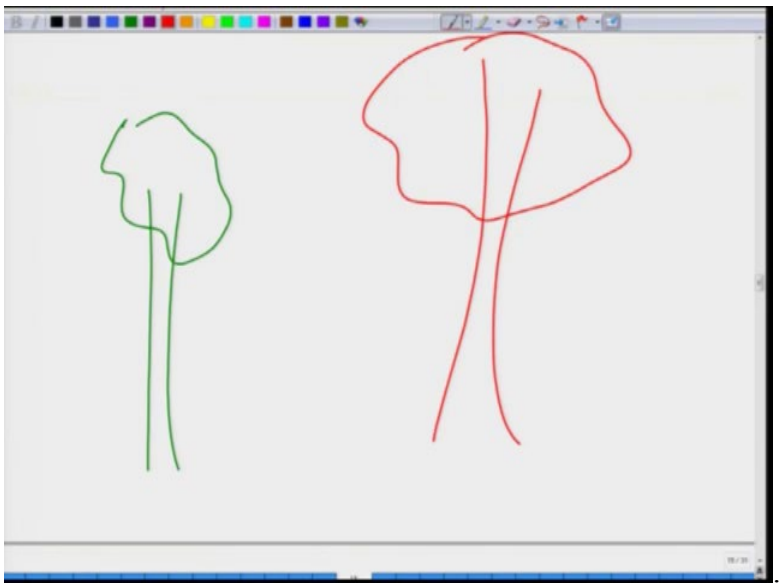

Then another tree which is say 100 years of age and that is the larger tree. So, in the field situations, you might remove those trees that are of a lesser age, and leave out those trees that are of a greater age. But then, overall what we are saying is that we will be working on those trees that are currently in the majority age; so, that is between 90 and 120 years. Now, periodic block 2 will comprise of those trees that have the age of 60 to 90 years. Periodic block 3 will have 30 to 60 years, and periodic block 4 will have 0 to 30 years.

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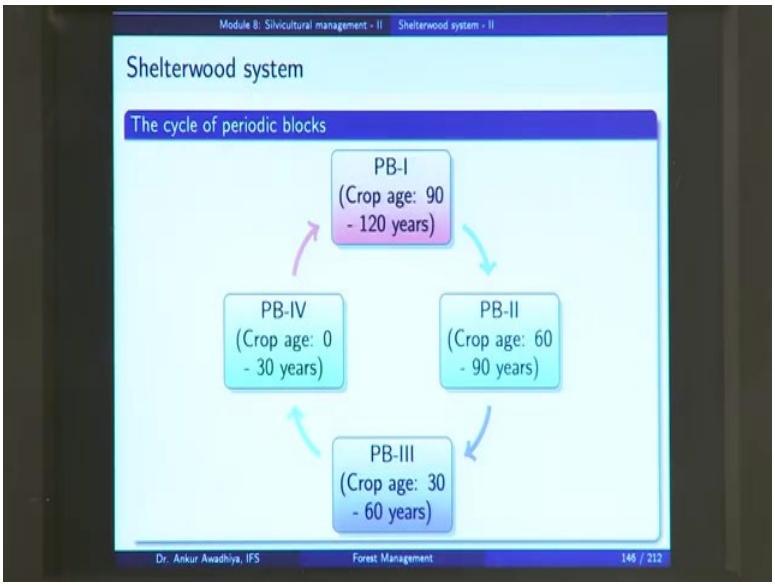

Now, how does how do these periodic blocks cycle? So, currently we have this this area the red area is PB 1, which has the crop age of 90 to 120 years. Now, once you have harvested and you have regenerated this red area, what will it become?

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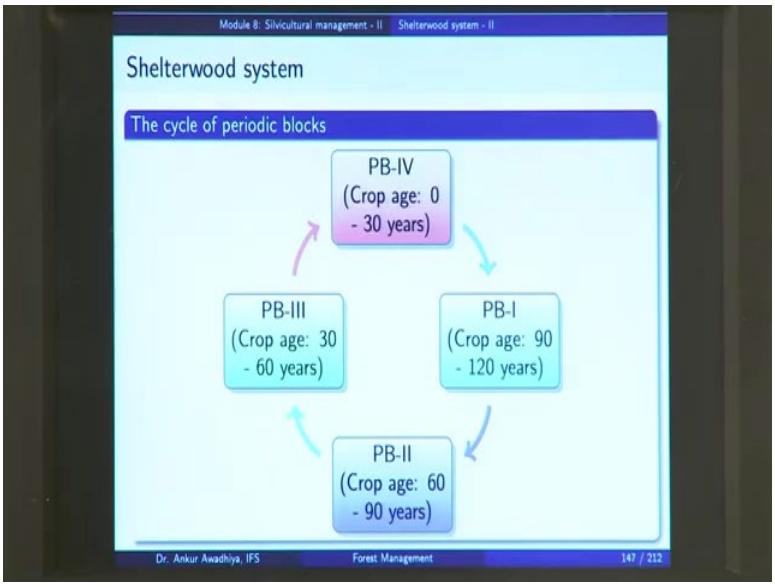

So, it will become the periodic block 4, because in the case of periodic block 1, you were having 90 to 120 years. Now, if you have cut these trees, you have regenerated this area.

So, now in this area, the trees of the next generation after 30 years will be having an age of 0 to 30 years and so, this area will become PB 4; it will not become PB 2, it will

become PB 4. And in the previous cycle where we had the trees of 60 to 90 years, which were PB 2 in that time, that will now become PB 1. So, if you look at any particular area this is how it will move; so, from PB so, from PB 1, it will become PB 4.

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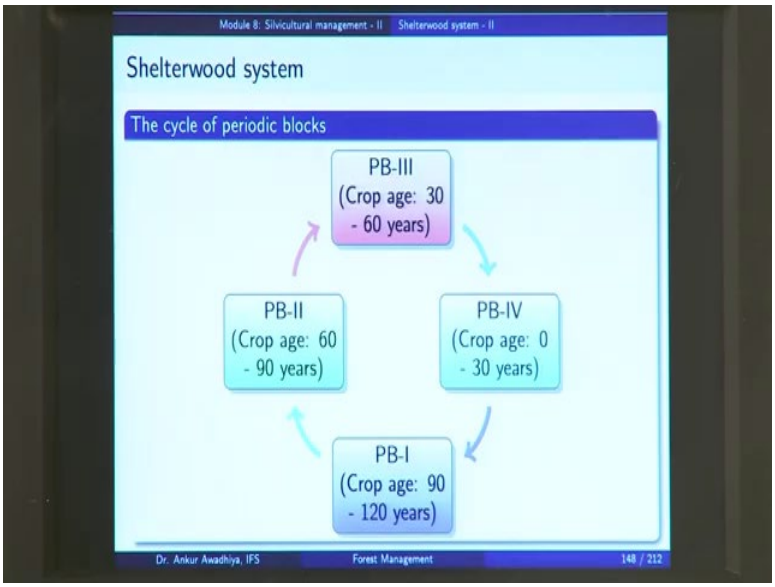

And then, it will become PB 3, then it will become PB 2.

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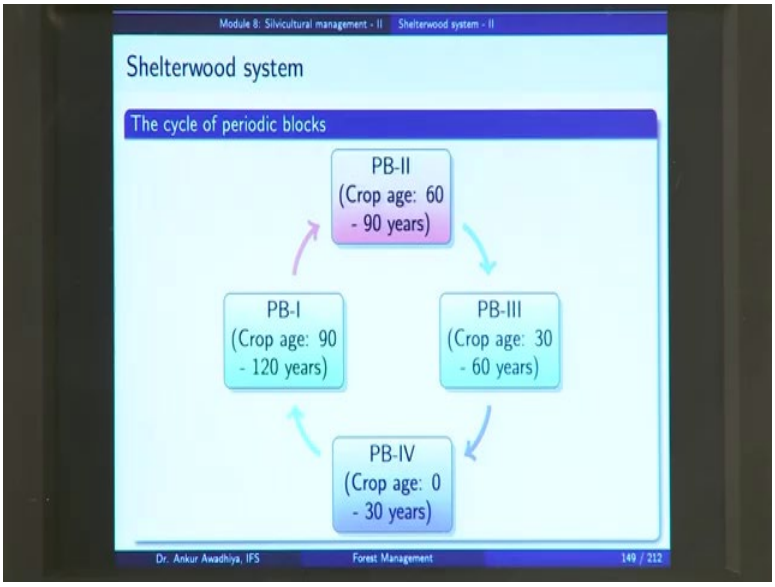

And then, again it will become PB 1 in the next cycle.

So, essentially what we are seeing here is that, the these periodic blocks move as PB 1 becoming PB 4 becoming PB 3 becoming PB 2 and finally, becoming PB 1. So, this is how we are going to process these different periodic blocks. Now, we defined the number of periodic blocks as the rotation age divided by the regeneration age. Now, rotation age is easy to fix that is the age of maturity. So, when you have trees that are of large enough size, they have large enough volume of timber inside it that is the rotation period.

How do we get to the regeneration period?

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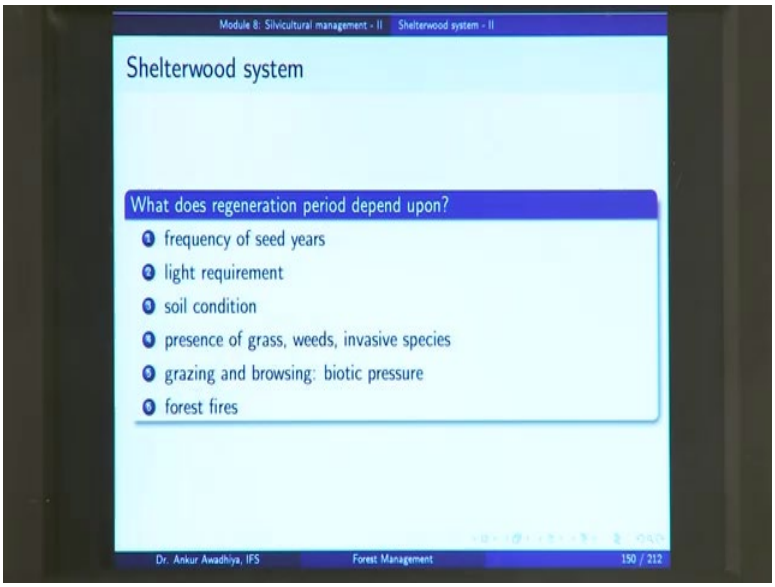

So, the regeneration period depends on a number of factors. It depends on the frequency of seed years. Now, seed years as we had seen earlier if you have a species.

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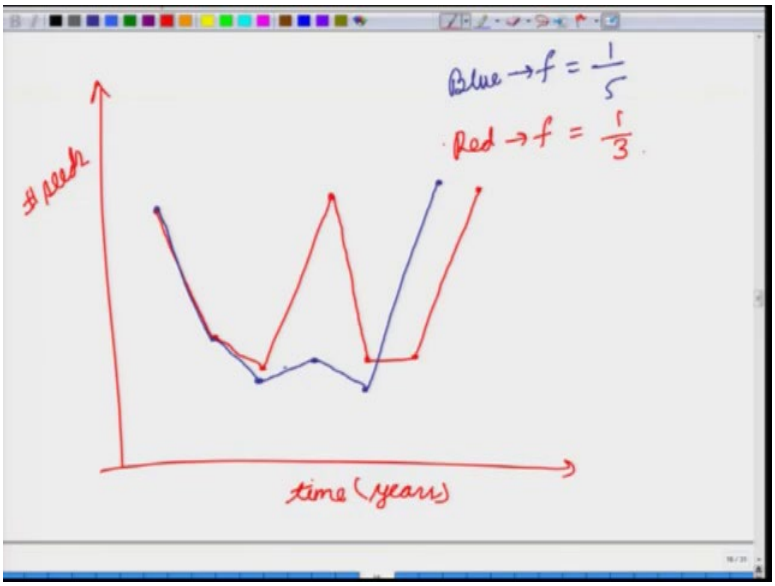

And, you are plotting the number of seeds with time in years, then probably you have a species that is giving out large number of seeds in this year, and then for next 2 years, it is not giving out large number of seeds. Then, it is giving out another large quantity of seeds. Then, for another 2 years, it does not give larger number of seeds and so on.

So, in this case, the seed year is coming as one in every 3 years, whereas you could be having another species where you have a large number of seeds in this year, then less number of seeds, then less number less number of seeds, then less number of seeds, then less number of seeds and then a large number of seeds.

So, in that case you will be having a curve like this. So, for the blue species the frequency of the seed year is one in every 5 years, whereas, in the case of the red species, the frequency is one in every 3 years. So, if you have a species at a particular site that is having a more frequent seed year; so, in that case you will be having enough number of seeds more quickly. And, in that case, the regeneration will be faster. So, the regeneration period is dependent on the frequency of the seed years. It is also dependent on the light requirement of your seeds to germinate.

Now, because in the case of a shelter wood system, we have those species that are shade tolerant. So, we are providing them with a shelter, but then if this shelter reduces the amount of light and a few species probably required a bit more amount of light. So, it will take a bit more time to germinate and to become established. So, the light

requirement also determines what is the regeneration period of this particular species at your particular site.

It will also depend on the soil condition. So, suppose you have a soil that is very well drained, which is able to retain adequate amount of moisture and that is full of nutrients. So, in that cas,e your seedlings will become established faster because they will be able to have a faster rate of growth. And, they will be able to resist the adverse influences in a better manner because they because they are getting sufficient amount of nutrition.

So, in that case, your regeneration period will be lesser than in a site which has a poor site quality and in where seeds take a bit longer to get established. It also depends on the presence of grass, weeds and invasive species, because if you have an area that is full of grass or is full of invasive species or weeds; so, in that case, your seeding your seeds will take longer to germinate. And, to get established, because they have to compete with these other species and so, the regeneration period will be longer. It also depends on the biotic pressure or the pressure of grazing and browsing.

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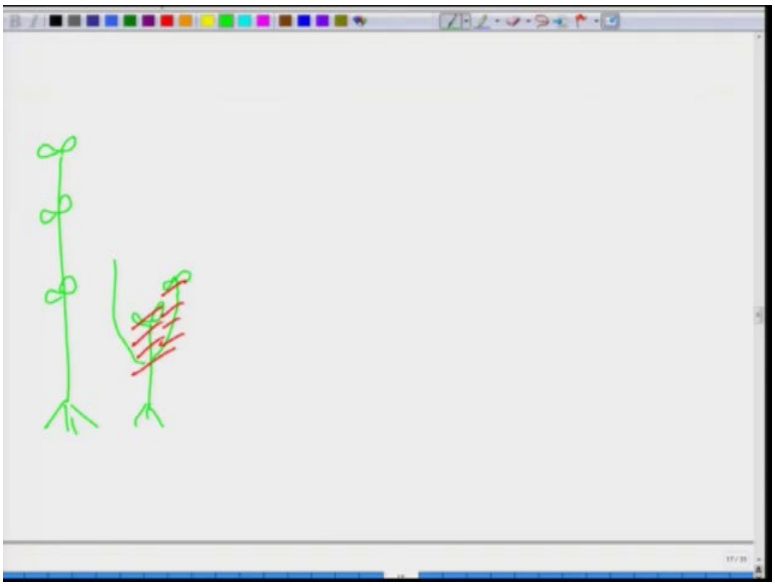

Because you had seed; you had a seedling; and, when it reaches a height of say this much, then we will say that it is it has become established. But then, when it grew to this height, there was a cow that came and ate away the top portion.

So, it will take some more time to grow up another shoot and reach the site, and then this portion gets eaten up again. Then, it will try to grow up another shoot, and so, it will take a much longer period to become established.

So, it will depend on whether it gets a chance to grow to the particular height to get established. So, if you have more amount of grazing and browsing, then you will take more amount of time to regenerate your area. So, the regeneration period depends on the biotic pressure as well.

It also depends on forest fires, because in the case of some, species you have a good root system that has developed.

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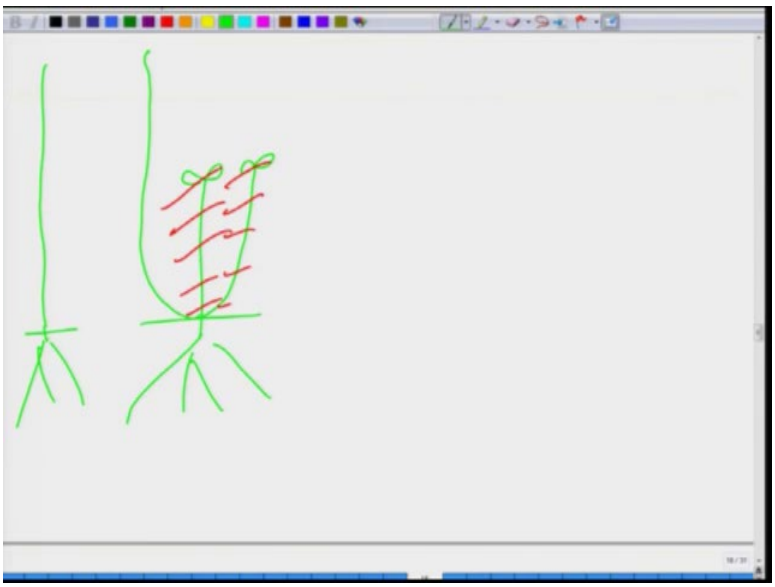

And again, if your plant grows to this height, then we say that it has become established. But then when grew to this height and then there was a forest fire, and the whole of the shoot portion got destroyed. The root portion remains that gives out another shoot, and then there is another fire, and then probably in the third year, it did not get any fire and so, it was able to reach.

So, something that it could. So, the height or the establishment that it could reach in a single year it took 3 years, because two years were fire years and so, the regeneration period also depends on the frequency of forest fires in that particular area. So, it depends on grazing, it depends on browsing, it depends on forest fires; it depends on invasives; it

depends on insects that might be eating up or devouring the young crop; it depends on the site quality; it depends on the frequency of seed years; it depends on the light requirement. So, it depends on a number of factors.

So, this is how we get to the regeneration period, and this is how we get to the number of periodic blocks, because we can fix up the rotation period as the maturity. Regeneration period will depend on all these factors and so, if you can control these factors, you can even reduce the regeneration period. And, in that case, you will even be able to reduce the number of periodic blocks that will be required by you.

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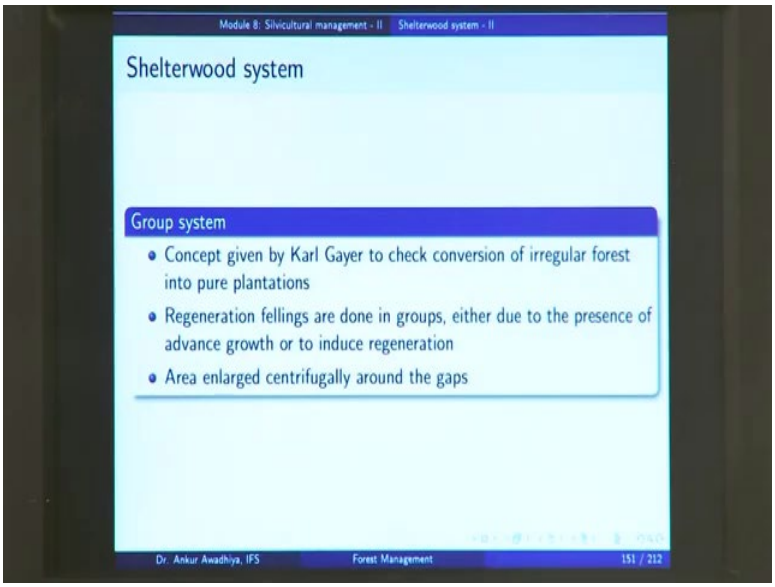

Now, next we look at the group system. Now, the shelter wood system has a number of varieties and one such variety is a group system. Now, group system was devised by Karl Gayer. And, it was there to check the conversion of irregular forests into pure plantations. Now, an irregular forest is a forest in which different age classes do not occupy roughly the same amount of areas.

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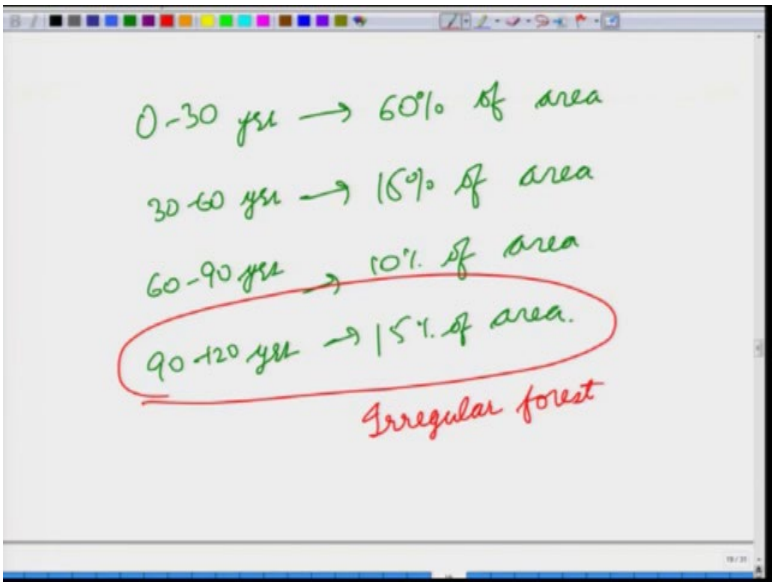

So, what we are saying here is that, suppose you consider trees that are 0 to 30 years, 30 to 60 years, 60 to 90 years and 90 to 120 years. Now, ideally in in a managerial sense, we would want all of these four age classes to occupy 25 percent area of the land. But suppose, you have a forest in which 0 to 30 years is occupied by say 60 percent of the plant - 60 percent of the area; this is 15 percent of area; this is 10 percent of area and this is 5 percent of area; fifteen15 percent of area.

So, in this case, we will say that this forest is an irregular forest, because different age classes do not occupy the same amounts of area in this forest. Now, in the case of a clear felling system, when you clear up this whole forest, you converted into a pure plantation and you have an even age class distribution. But then, suppose you have a forest that is an irregular forest and you want to maintain it as an irregular forest, because you do not want to make a large number of changes into your system; so, that was the question that Karl Gayer was addressing.

So, he devised the group system to check the conversion of irregular forest into pure plantations. So, in this case, at the end of all the operations, you will still have the irregular forest. So, in the beginning, suppose you had that 15 percent of the area was occupied by 90 to 120 years of age trees. At the end of all your operations, you will still have 15 percent of the area that is occupied by these trees with the age of 90 to 120 years.

So, you maintain the forest in its natural condition, and that was the aim of the shelter wood system. So, in the group shelter wood system, regeneration fellings are done in groups either due to the presence of advanced growth or to induce regeneration. So, what do you do here, you do your regeneration felling in groups and then the area is enlarged centrifugal around the gaps.

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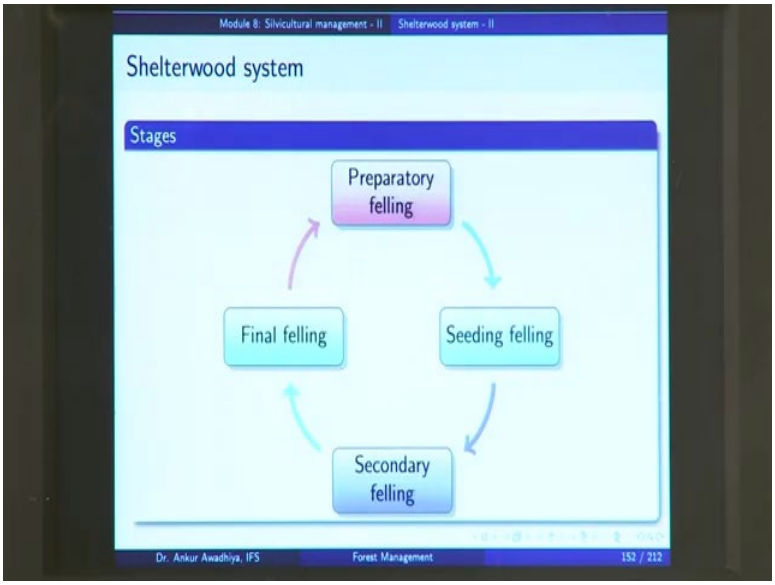

So, as we saw before we begin with a preparatory felling, so that you are removing the dead, dying and diseased trees. And, you are inducing the seed production; this is followed by the seeding felling, in which case, you are trying to go for a good amount of germination followed by a secondary felling, in which you are opening up the canopy, so that your plants are able to get a bit more amount of light, and are able to show the growth, followed by the final felling, in which you remove all the plants that are left of the previous generation.

So, how does the gear system or the group system choose which areas do we begin with for the preparatory felling?

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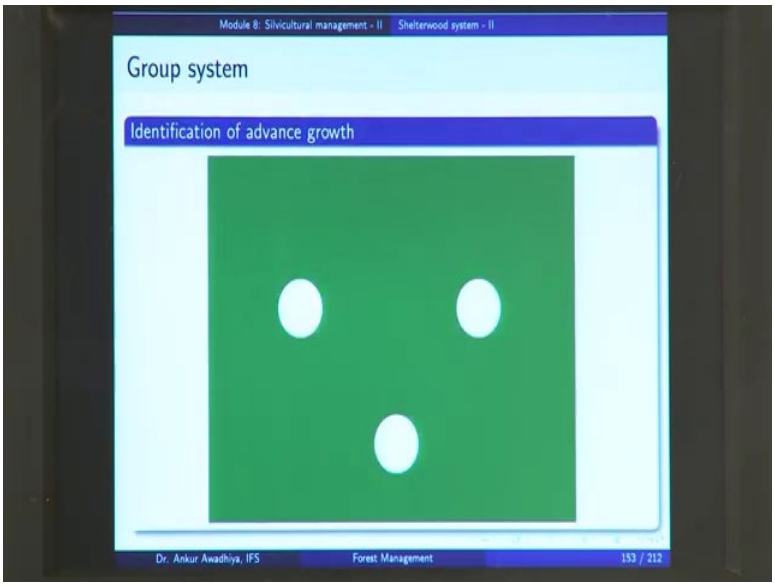

So, the group system begins with the identification of advanced growth. So, suppose this is your complete forest and there are these three locations; because this is an irregular forest. So, here you are saying that in these locations you are having trees that are of a larger age group. So, for instance, you have these 90 to 120 years age trees in these areas.

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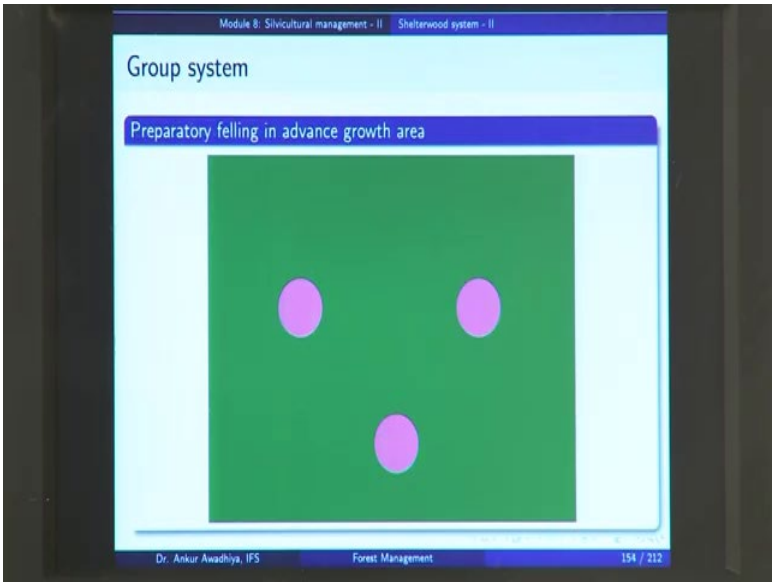

So, you do the preparatory felling in this area; in these areas that are showing the advance growth. So, for the next 30 years, you are doing the preparatory felling in these areas and the other areas you are not touching whatsoever.

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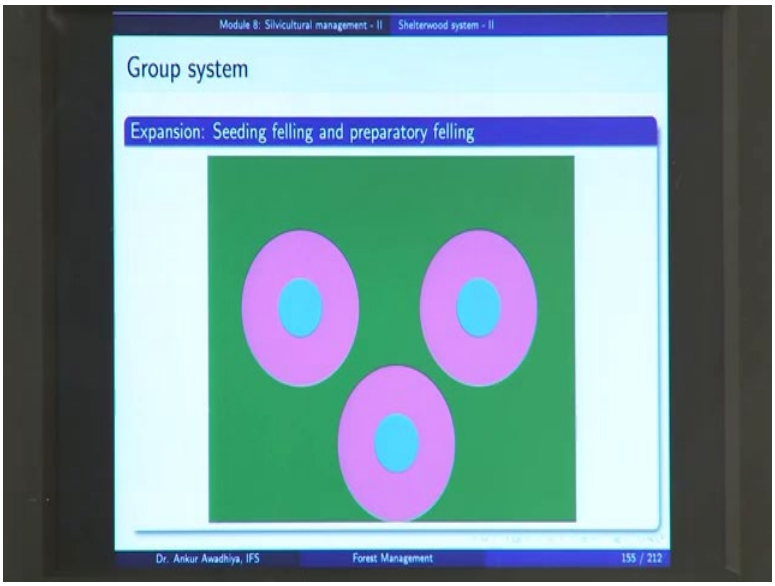

Now, at the end of your 30 years, what you do is that you do the seeding felling in these areas. And in the surrounding areas, you move in a centrifugal pattern and you do the preparatory felling in the surrounding areas.

So, what you have done now is that, those areas that were having the advance growth, you did the preparatory felling, and then in the next cycle, you did they see the seeding felling. And in the surrounding areas, now, you have done the preparatory felling. Now, here again, you will choose these surrounding areas, looking at the age distribution of trees; and so, these will not be concentric circles, but then the shape might differ. So, suppose in this area, you have more number of trees. So, it will look like this. But you are expanding it centrifugally.

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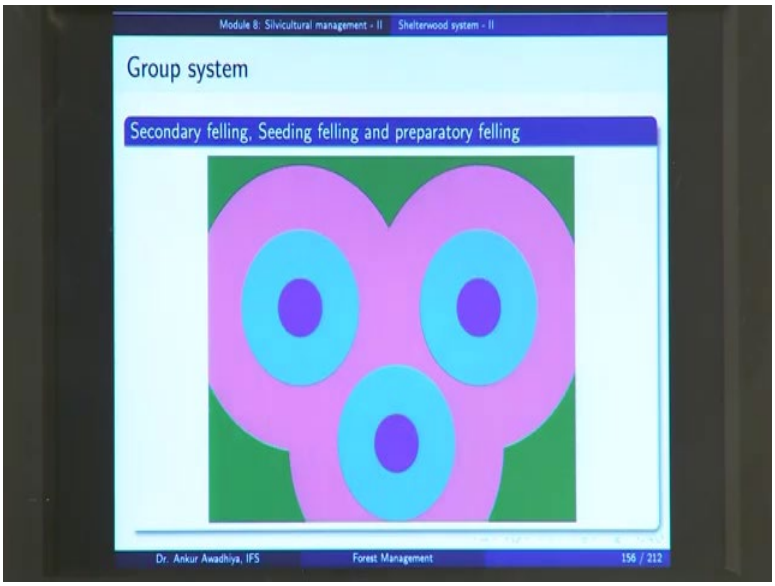

So, once you have done the seeding and the preparatory felling, next you are doing the secondary felling. So, the these areas that initially showed the advanced growth. Now, they have moved to secondary felling; these areas have now moved to the seeding felling and the surrounding areas have moved into the preparatory felling phase.

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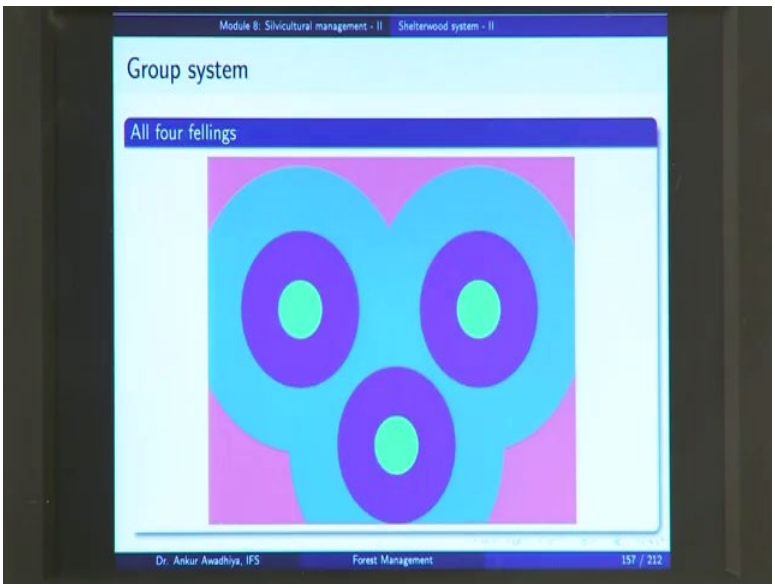

And then, you do the final felling in these areas.

So, now at the end of your cycle, what you have is that in these three areas that had an advanced regeneration at the end of your of all your operations, you still have advanced

regeneration in these areas. So, in this way, the structure or the special structure of the forest is maintained. So, in these areas, you have all the four fellings that have been done. In these areas, you have had three fellings. In these areas, you have had two fellings, and in this pink area, you have had only one felling.

And, this cycle would then continue because these areas where you had had your final fellings. Now, with the advanced regeneration in the next cycle, you will again do the preparatory felling in these areas. These areas where you were having the secondary felling, you will do the final fellings here; these areas with the seeding fellings, you will do the secondary fellings. And, this these pink areas we had, you did the preparatory felling, would now move into the seeding felling.

So, till perpetuity, we can maintain the spatial structure of this forest while extracting timber out of it and by ensuring that there is adequate amount of regeneration through the shelter wood system.

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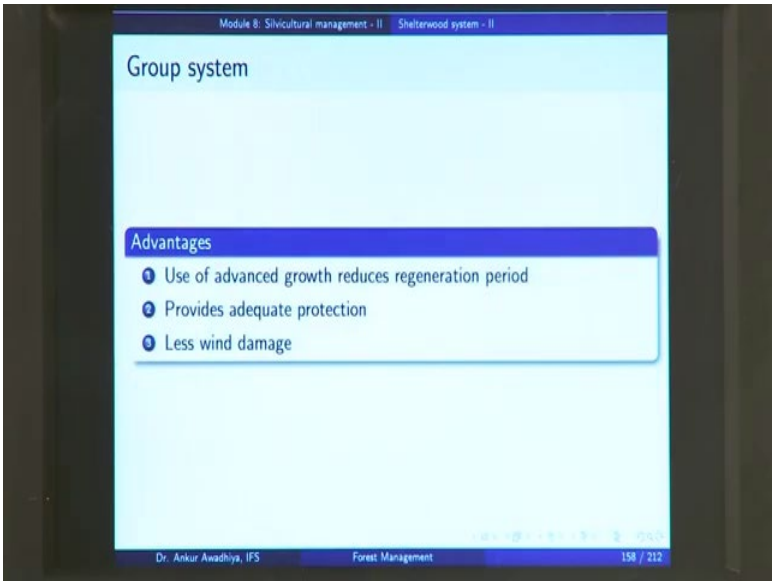

So, the group system provides a number of advantages that you begin with the use of advanced growth areas. So, because you are using the advanced growth areas, the regeneration period is now less, because you did your preparatory felling in those areas that were that were already showing some amount of advanced growth.

So, there are some seedlings; there are some junk plants that have already established and so, the so, the total amount of time that you would we would to require to regenerate any periodic block would be considerably less than if you began with those areas that did not have any advanced regeneration.

Then, it provides adequate protection to the young crop because you are leaving trees to act as shelter trees. Then, there is also less wind damage, less wind damage because in these cases you are moving at centrifugally. So, there will be a wind damage only in the outer areas. But the inner areas, we will not see any wind damage. So, there is less wind damage in the group system.

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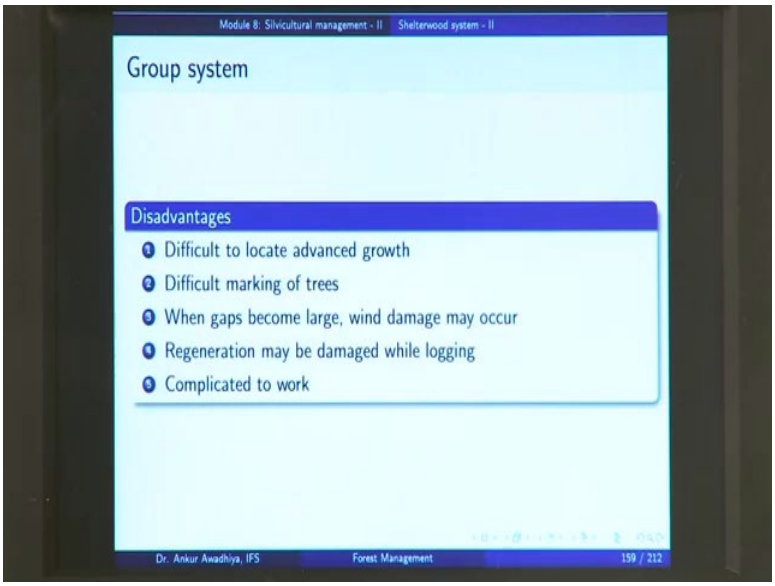

However, you also have certain disadvantages of the system. It is difficult to locate the advanced growth because you have to move through the whole of your forest area, and you have to mark all those areas that are having the advanced growth, because you will begin your system by looking at the advanced growth. So, in the beginning, you have to survey the whole area, and that at times, it becomes difficult especially if your area is having a high density of trees.

Then, the marking of trees is difficult because each and every time you have to go to all these different areas of the forest, and there you have to mark the trees that are to be felled in different fellings. So, because you have to traverse the whole of the forest again and again; so, it becomes a bit difficult. When gaps become large, wind damage may

occur. So, even though we said that there is less amount of wind damage in these central areas, but then if these areas are large in size, then there is a possibility that you might have a wind damage.

So, suppose you have a forest in which there is a large huge patch that was showing an advanced regeneration, and you cleared up that patch. So, there might be some amount of wind damage that occurs in that area. Then, regeneration may be damaged while logging why because in all of these stages you are moving through the whole of the forest. So, even when you are you have done all the four fellings, you have to go to the central area; you have to go to this area, you have to go to this area, you have to go to this area.

So, everywhere you are doing these fellings and once you have done the felling to extract the logs, to extract the timber, you might have to drag them out, or even to do the feelings you might have to take heavy machinery inside. To move the logs, you might require to take the heavy trucks inside. So, every time you are having a young regeneration, and all the time you are entering into this forest with your equipment, with people, with the machines, and all of and in all of these instances, there is a damage to the young crop or to the regeneration.

So, regeneration may be damaged while working. And, the fourth difficulty is that it is complicated to work because there are a number of things that you need to keep in mind; you have to survey the area again and again; you have to mark these trees again and again; you have to perform your operations in a way that you minimize the amount of damage to the young crop.

So, all of these required training; all of these require skills; and, all of these require more amount of money and time that needs to be invested. So, which is why the group shelter wood system did not attain that amount of popularity that it could, because unlike in a clear felling system where things are very simple, here though you have to visit all the areas of the forest at all times. And, you have to impart a lot of skill to the people.

So, these are the disadvantages - difficult to locate the advanced growth, difficult marking of trees, when gaps become large wind damage may occur, regeneration may be damaged while logging and it is complicated to work with.

So, in this lecture, we looked at the intricacies of the shelter wood system. So, we looked at what are the periodic blocks. We looked at what is a rotation period, what is a regeneration period, how do we get to the number of periodic blocks. So, the number of periodic blocks is the rotation is divided by the regeneration age. Regeneration age is that is the time that your forest takes to become regenerated, to become established, with the next generation. Rotation age is the age of maturity at which you consider that your wood is now ready to be filled; ready to be harvested or extracted.

So, rotation period divided by the regeneration period gives you the number of periodic blocks. Now, we remark the periodic blocks is periodic block 1, 2, 3 and 4 where periodic block 1 is the periodic block where you do your regeneration operations. So, suppose you have a rotation age of 120 years and it takes roughly 30 years for your crop to become regenerated, then you will have 4 periodic blocks. In which case. you will have PB 1, 2, 3, 4; PB 1 will be the area where you will do the regeneration. So, you will cut the trees you will harvest the old trees and you will also establish the younger generation.

Now once you have done this these operations in 30 years. So, at the end of 30 years your PB 1 will now become PB 4, because it will be worked again after 90 more years. Then, your PB 2 which was having the crop of 60 to 90 years of age.

In these 30 years now, the 60 year tree has become a 90 year old tree. The 90 year old tree has become a 120 old tree. So, that has now become PB 1. So, it moves in the opposite sequence. So, from PB 1 you get to PB 4; from PB 4 you get to PB 3 into PB 2. And then, it again becomes PB 1. Then, we looked at the group shelter wood system which was given by Karl Gayer. The biggest advantage is that you retain the spatial structure of the forest.

So, you begin by looking at those areas that have an advanced regeneration; you begin your preparatory felling in those areas that have this advanced regeneration. And then, you move centrifugally around these areas. So, in the central areas where you were having the advanced regeneration, you do the preparatory felling, followed by the seeding felling, followed by the secondary felling, followed by the final felling. And once you are done with your final felling, it will again be having such amount of advanced regeneration that you will again do the preparatory felling in those areas.

So, because it moves centrifugally around these advanced regeneration areas, so, at the end of all your operations, you still have a forest that maintains its irregular structure. And by irregular structure, we mean that the trees of different age classes do not occupy equal areas of the land. So, there might be situation in which your advanced regeneration is in say only 10 percent of the forest; so, at the end of all your operations, your advanced regeneration will again be only in 10 percent of the forest.

So, you maintain the spatial structure of these forests. Then, we looked at the advantages and the disadvantages of these systems. The advantages are mainly that your trees have adequate amount of protection, there is less amount of wind damage. But then, the major disadvantage is that this system is a lot more complicated than say a clear felling system. And so, you have to impart large amount of training skill, equipment to the people who are working your forests. And, the second major disadvantage is that you have to work in every area of the forest again and again.

So, whenever you are doing your extract; your harvesting operations; your timber extraction, you are also damaging the young crop, because of which the system did not attain a huge amount of popularity. And then, in certain areas, if you say have an advanced regeneration in suppose 70 percent of the area; so, when you create these huge gaps in 70 percent of your area, then there is a huge possibility that you will have wind damage in that area.

So, because in this system you do not have 4 periodic blocks that occupy equal areas of land. So, there is a big possibility that sometime in the whole of the operation, there will be time, in which you will be clearing a large area of the forest. And, in that case, you will be exposing your trees to wind damage, and also to desiccation, or drying up, or to frost. So, these are the advantages and disadvantages of the group shelter wood system. So, that is all for today.

Thank you for your attention [FL].