Forest Biometry
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Lecture – 38
Site Quality

[FL]. Today we shall discuss a topic known as Site Quality.

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So, what is a forest site?

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By a site we mean an area pluses environment. So, the area plus the environment will give us the type and quality of vegetation. So, the type of vegetation might be very different. So, for instances in the case of hilly areas you might be having coniferous forest, in the case of planes you might be having broad leaved forest. So, the type of vegetation will vary, and also the quality of vegetation as data mined by its diameter its height its volume and by a number of other factors.

So, area plus environment gives you the type and quality of vegetation. So, what are the factors that affect your site?

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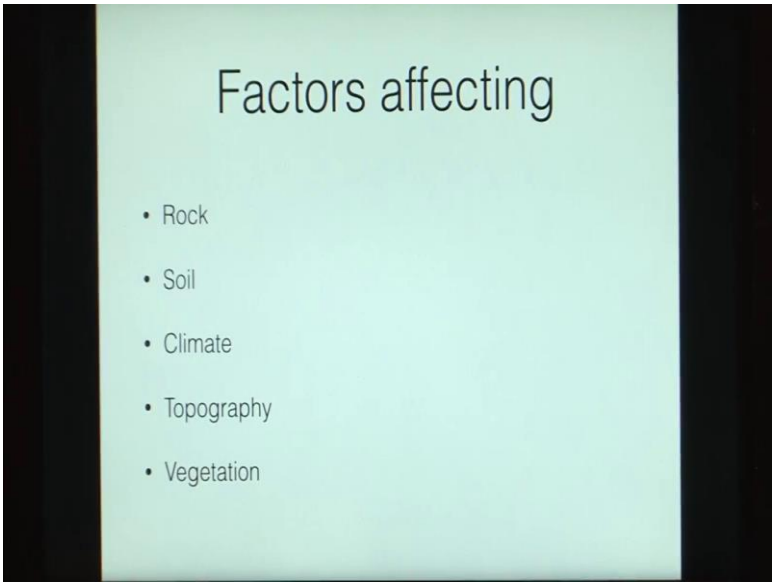

You can have the factors including rock. So, for instance this soil that is generated out of your ignitions rocks is going to be very different from the soil that is generated out of say sedimentary rocks. So, the rock is a factor that affects the site soil also varies climate also varies as does topography and vegetation. So, for instance let us consider two sites.

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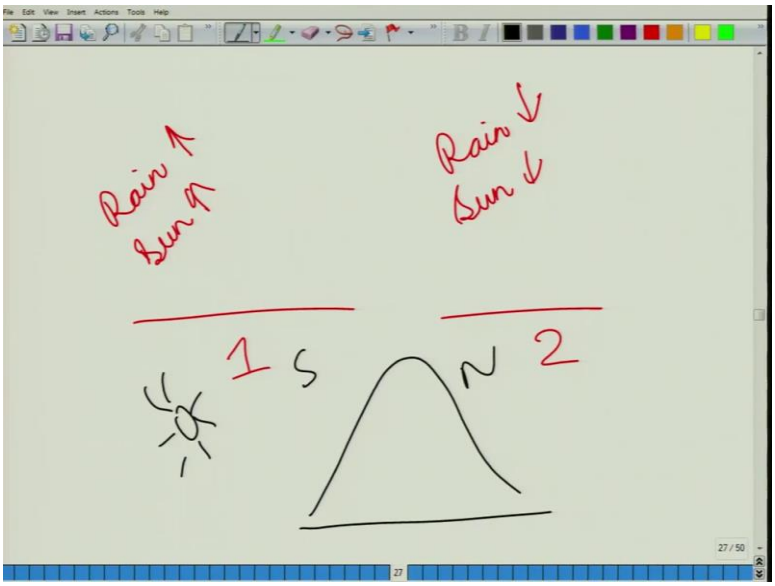

So, you have site 1 and you have site 2. Now in site 1 suppose you have more amount of rain and then site 2 you have a less amount of rain. So, will that change the quality and the type of vegetation that you have there, yes because if you have a very parch region

then you might be having 0 fights in those regions say cactus is or say a agava or euphorbia whereas, in areas where you have lots of rains you might be having a mixed forest or even in ever green forests. So, you will be seeing large sized trees in those areas.

Similarly, if you have two sites, that are having very same soil very same amount of rain, but suppose one site receives lot of sun whereas, the other site receives a very less amount of sun. So, for instance these are two sites on two different sites or aspects of a hill. So, in the case of a hill, suppose this is the southern side. So, southern site will be having more amount of sun as compared to the northern side. So, will that affect the your type and quality of vegetation? Yes because in the southern facing aspects you will be having more amount of sunlight. So, more amount of photo synthesis, but at the same time you might be having more amount of heat and less amount of moisture because it leads to a greater amount of evaporation.

So, all these factors, coming back to the slides all these factors rock soil climate topography, vegetation, a vegetation is also a very important factor that can affect your site quality. So, for instance if you have a region if you have two regions that have the same rocky terrain the same climate the same topography, but one site has say some grasses and the other site is completely devoid of vegetation, its completely barren. So, will that affect the kind of vegetation that will eventually grow in that area? Yes because in the case of grasses they will be having roots, they will be penetrating your rocks they will be converting it into soil, and releasing the nutrients that are trapped inside.

So, all these factors affect the quality of the site. So, how do we define a site quality?

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We define it like this; it is the relative productive capacity of a site relative productive capacity. So, productive capacity tells you how much amount of biomass is being generated by this by that site and it is in terms of a relative measure. So, for instance you can say that site A is of a better quality as compared to site B. So, it is in relation to something else. So, when you have something in a relative sense you can also convert it in to an absolute sense by giving it some values.

Now, site productivity, we are talking about the relative productive capacity. So, the site productivity depends on two things, site quality and the management input. So, for instance if you have two sites of the same site quality, your and if the management inputs are different. So, they will be giving you different site productivities. So, when we talk about this equation site productivity is equal to plus management.

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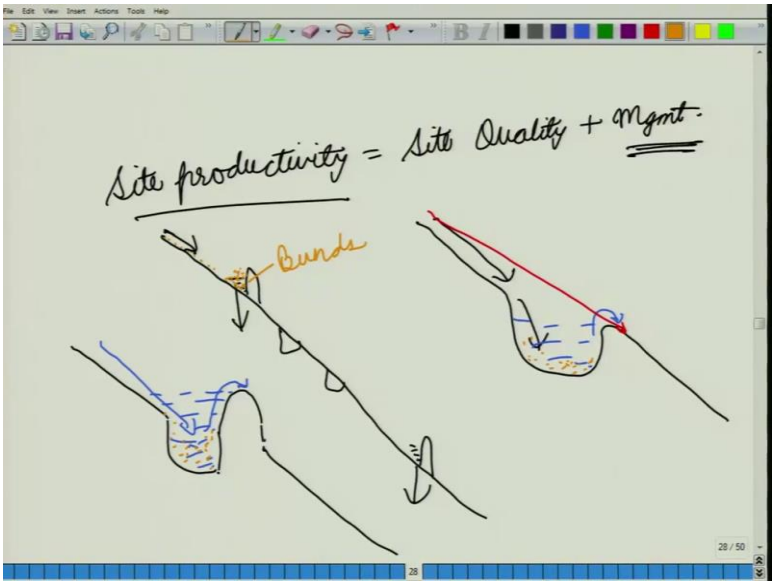

So, if you want to figure out the site quality of two sites, you can use site productivity if you keep the management operations constant.

So, whether management your site quality will determine the site productivity. So, what are the kinds of management inputs that you can in give to a site.

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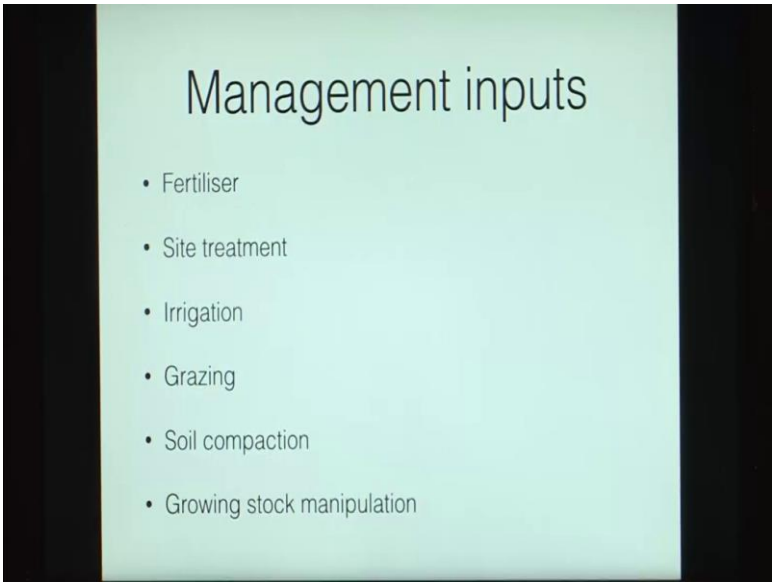

So, here are these you can apply fertilizers. So, if you apply fertilizer the amount of productivity from that site will increase, you can have some other sorts of site treatment.

So, for instance you can say plough particular piece of land. So, that kind of a site treatment will also increase the productivity, you can put on irrigation or for instance in the same soil you can put on say check dams or say contour trenches. So, if you put up check dam or a contour trench, what it does is suppose this is your slope and if you have put up some bunds like this. So, what will happen is, the water that was flowing through will get accumulated at these points and will then later be seep down.

So, when that happens the water table of this area will slowly increase, at the same time any amount of soil that is coming here with this water flow, will also be accumulated here. So, essentially the amount of soil erosion will reduce. So, this is one kind of a site treatment, that we normally use in the case of forestry to increase the productivity of a site. So, these bunds in the place of bunds you could also go for contour trenches. So, in the case of trenches and place of putting it upside, you will have it like this. So, for the same region you could develop say trenches that are parallel to the contours and perpendicular to the slope.

So, when you do that, when you have a when you have this sort of a structure then any water that comes here will get accumulated at this location and similarly, all the soil that was here will get accumulated here. So, you are not and when this water goes out again the speed will be much less as the water that would have directly moved from this point to this point. So, essentially when you are reducing the speed of water, you are allowing the water to seep inside the soil and you are also protecting all the soil and all the the nutrients from erosion.

So, you can have contour trenches, contour gulleys bunts or you can have a combination of these. So, a combination will go like this. So, you will have a gulley like structure and any soil that you had remove from that gulley, is put on the upper side. So, in this case any water that is going down will be accumulated here and at the same time it will have to overcome this structure to move down. So, essentially the water level here will go to this level and also all the soil that was there will get accumulated here and you will not allow it to go across. So, any loss due to erosion will also be checked.

So, contour gulleys contour trenches bunds and so on are examples of site treatment. So, coming back to the slide you can also have artificial irrigation. So, artificially and irrigation is it is not that common in the case of forestry, but we do have artificial

irrigation in the case of nurseries. You can also have a control over grazing. So, for instance if in a piece of land, you had small saplings.

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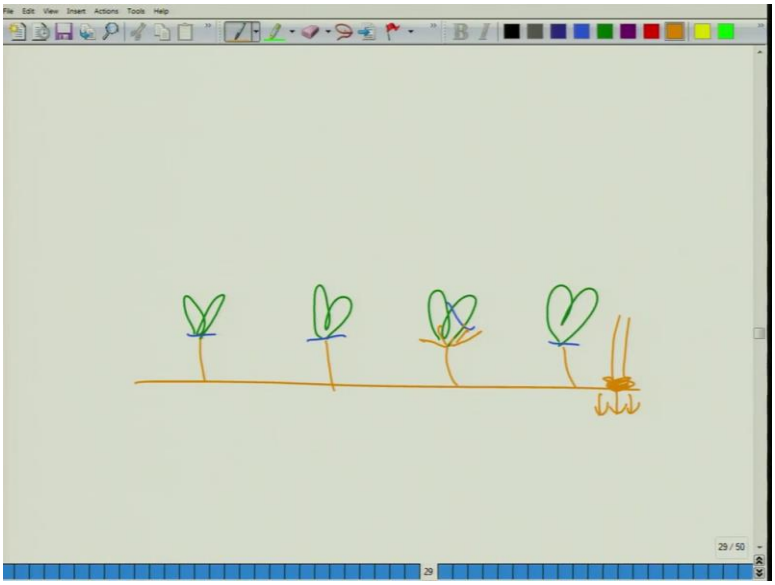

So, what does grazing do? If an animal comes here and say enables of the top portions, in that case. So, your animal is eating away the leaves of the plants, in that case not only does this plant not have any appreciable amount of photosynthesis, because some amount of photosynthesis will might go on in this stem, but because it will not have an appreciable amount of photosynthesis. So, it will not be able to put on more biomass or more growth.

So, grazing is something that is very harmful to your stacks, and also if your plants have being grazed at an early stage. So, may be later on they might be giving out branches in the form of a number of fox. So, you might. So, in this case the new branches that will come out might come out like this, and your tree in place of becoming a tree will develop a bushy structure. So, that will also affect your overall site quality, grazing also leads to soil compaction. So, because your animals been if you see the whose of the animals, they exert quite a huge amount of pressure on your land. So, all these soil gets compacted.

So, when your when your soil is compacted in that situation if any seed falls on the bare ground, it will not be able to germinate properly, it will not its is newly developed radical will not be able to go inside your soil and develop in to a root system. So, the amount of compaction can also lead to a change in the site quality or the site productivity. So,

coming to this slide you can also have growing stock manipulation. So, when we talk about a growing stock manipulation, what we mean is that you can see in the case of a forest where you have your trees that are very close together.

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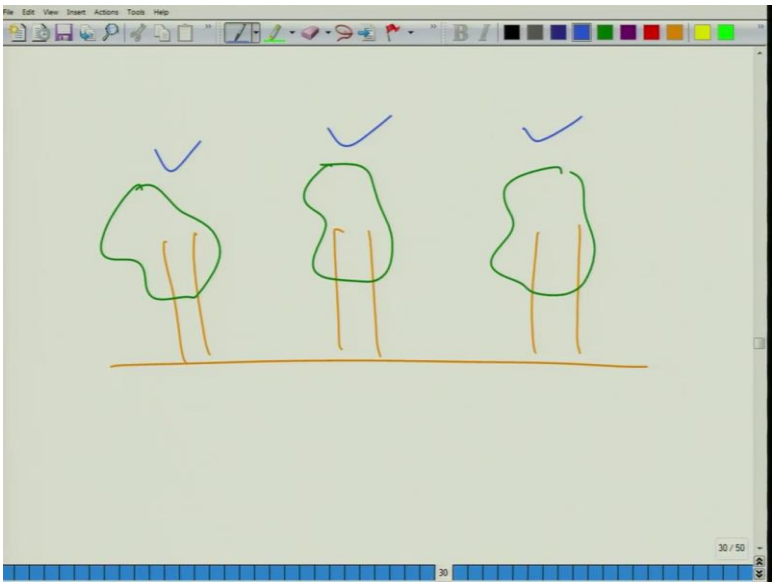

So, in this case you are having a huge amount of competition. So, in the case of agrowing stock manipulation, you might remove certain trees in other thinning operation and when you do that. So, this is stand looks very much dense and very much in competition. So, if you remove a few trees. So, in that case the amount of competition reduces and these trees that are left now, will be able to put on more growth both in its in their height and also sideways. So, the amount of biomass that will be there in the forest in a later stage will be greater. So, this is also another sort of management input. So, coming back to the slides, how do we measure the site quality?

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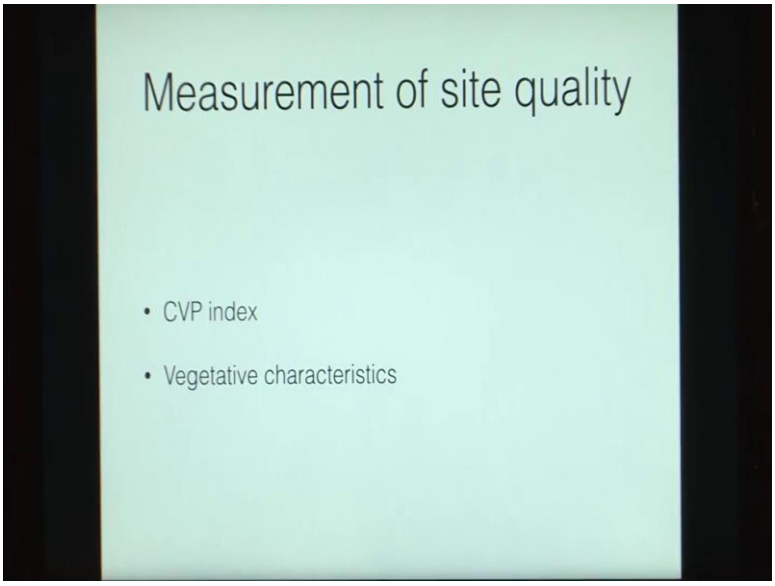

So, now, in the case of site quality, we are using the equation site productivity is equal to site quality plus management and now we are interested in finding out the site quality itself. So, this site quality can be figure out in a number of ways, two of the most common of ones are the CVP index and the vegetative characteristics. So, let us look at the CVP index.

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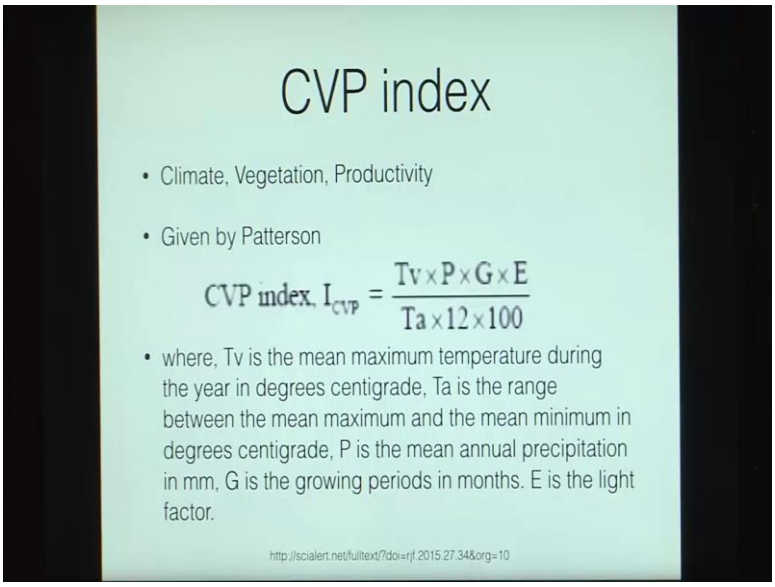

CVP index in is an index that was given by patterson and CVP stands for climate vegetation and productivity.

So, if we look at this equation for CVP index the index CVP is given by TV upon T a multiplied by P multiplied by G by 12 multiplied by E by 100. So, you can write it like this.

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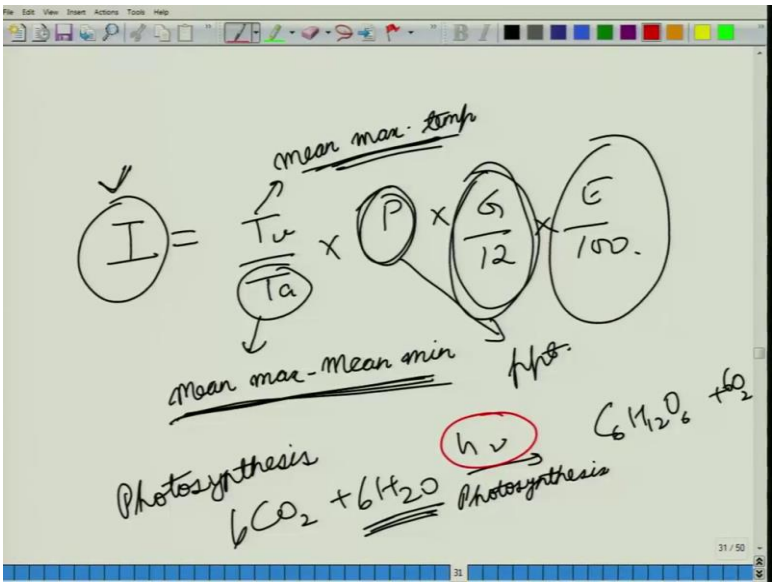

So, the index I is given by T v upon T a multiplied by P multiplied by G by 12 multiplied by E by 100. Now in this equation T v is the mean maximum temperature during the year T a is the range between the maximum temperature and the minimum temperature.

So, it is the mean maximum minus the mean minimum. So, how does this affect your site quality? If you increase the mean maximum temperature, if your region is having a higher temperature it will also say that it will also mean that the enzymatic reactions in the plants will be faster, because when you heat up your ambience and plants are not able to regulate their own temperatures. So, their temperature is the same as that of the ambience.

So, when the ambience temperature increases the enzymatic activity increases. So, by increasing the mean maximum temperature, you can increase the amount of productivity that is there you also have the mean maximum minus the mean minimum. So, if this this value reduces. So, for example, if your trees throughout the year are having are experiencing the same climate or the same temperatures.

So, in those situations they will not be facing huge amounts of stress, because it is all an equilibrium condition whereas, in cases where your high your maximum temperatures are very high and the minimum temperatures are very low. So, in that case your plants have to prepare for these adaptations to high temperatures and the low temperatures they will they will be experiencing huge amounts of stress and there will be putting huge amount of resources to overcome the these stresses.

So, if we look at this equation the mean maximum minus the mean minimum comes in to the denominator. Now P is the amount precipitation that you have. So, it is the mean annual precipitation in millimeters. So, if you increase the amount of P. So, your area is receiving more amount of rains. So, when it has more amount of rain it means that your plants are having are not facing any dearth of water, and water is a is an ingredient in the reaction of photosynthesis.

So, in which case you have Co2 plus H2o in the presence of h nu and in the process of photosynthesis gives you and when you be balance it this is the equation that we have already seen. So, if your area I getting huge large amounts of water so the productivity of the site will be greater. Now water is not only required for the case of photosynthesis, but it also plays a number of other roles. So, for instance the any amount of minerals that you are trees get out of the soil come in the form of dissolved solutions in which your minerals are dissolved in water.

So, water is also important for your plants to get minerals, water is also important if your plants have to maintain that their temperatures. So, when water is released through the process of transpiration, it cools down the surroundings. So, the amount of precipitation will also increase the productive. Now G by 12, G refers to the growing season in months. So, G by 12 is the growing period in year; so for instance if the growing season is say 3 months. So, in that case your G by 12 value will become 1 by 4.

So, only in one fourth of the year are your plants able to grow wheres if your G is 6 months your G by 12 becomes half. So, your plants in place of growing for only 25 percent of the time are able to grow all throughout the year. So, this is what your G by 12 value gives you. The last term is E by 100, now E is the light factor. So, in the equation we had h nu h nu refers to light. So, E by 100 gives you a light factor or in certain cases it is also referred to by your potential evapotranspiration.

So, coming back to the slides the CVP index measures your productivity in terms of the climate and the vegetation. So, this is one way in which you can find out the site quality in an absolute term.

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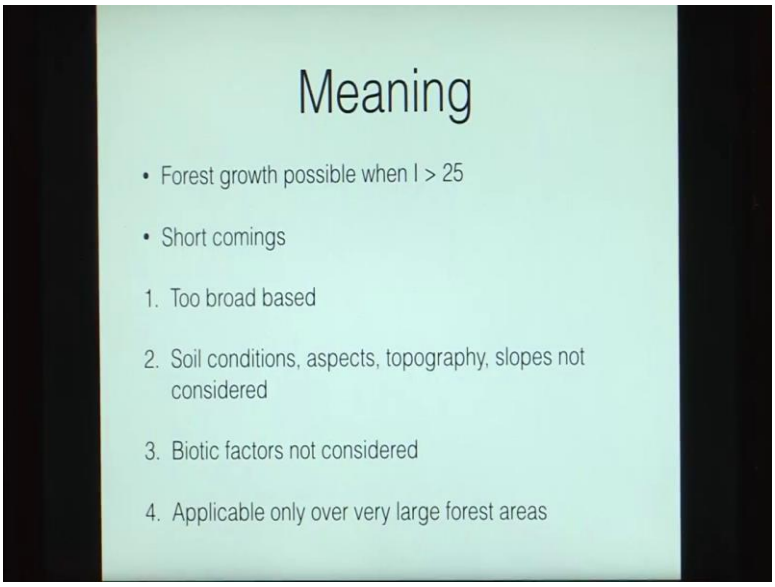

So, what does it mean, what does it mean by your different values of I? So, forest growth is possible only when I is greater than 25 in areas where I is less than 25 you might have you might be having say deserts or maybe it is a permafrost, but your forest growth will not be possible then what are the short comings of using the CVP index? One it is very broad based. So, essentially whether you are having a value of I is equal to 25 or a value of I is equal to 30, it is difficult to decide what kind of growth your land will be experiencing just by using the CVP index.

At the same time it does not consider a number of other factors such as soil conditions aspect topography slope and so on. So, here you are not considering the amount of fertility that your soil is having, whether it is or an northern or an southern aspect, the topography or the elevation and the slopes, these kind of factors are not being considered that also does not consider the biotic factors that are there. So, for instance if your area is experiencing huge amount of grazing pressure or a biotic pressure or if people are going into your forest and chopping the down your trees, then the net amount of productive that you will find in that peace of forest later on will be less, but this factor is not being considered in this CVP index. Also it is applicable only over very large forest areas.

So, for instance if you consider because it is considering those values like precipitation. So, this is a climatic variable not a whether variable. So, it is applicable only in very large area.

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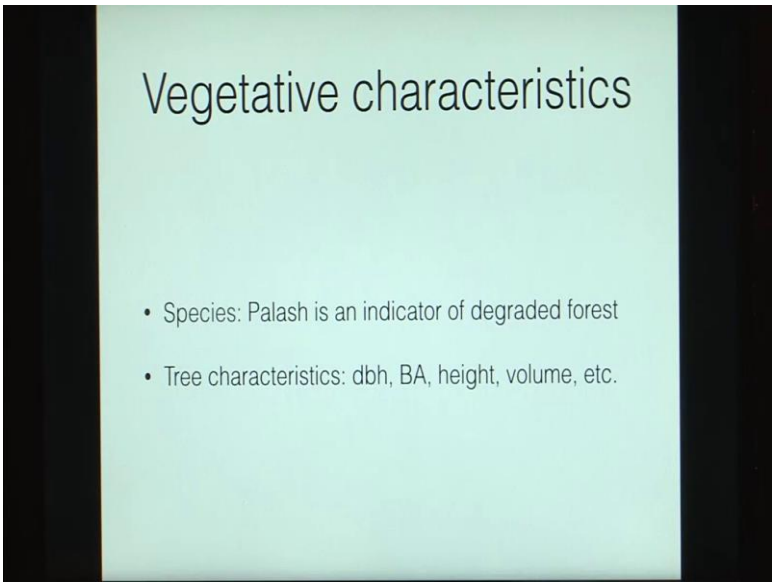

The second way in which we can measure the site quality is by utilizing the vegetative characteristics.

So, vegetative characteristics reverse to the kind of a species that we have in an area and the characteristics of the tress that are there in the area. So, for instance this tree called Palash or dark is an indicator of a degraded forest. So, if you have a forest that is very less green forest. So, you might not see very large number of Palash trees, but if your forest is in a very degraded area it is not having good amounts of fertility, the growth is very difficult or say it is experiencing huge amount of grazing or biotic pressure. So, you might be saying a number of palash trees in that area.

So, the species of trees that are found in an area can give us an indication of the site quality of the area. At the same time if you have two sides that have the same species, then the parameters of those species might give you an indication of the site quality of the area.

So, for instance if you have two patches of forest say of Sal trees Shorea robusta, and in one forest you have trees that are very lean and thin and those trees are having a very

stunted growth, and they are of the same age as compared to another patch that has very large diameters trees that are putting up very huge appreciable growth and they are growing to very large heights. So, we can say that the forest in which we are seeing these larger trees has may be some better amount of site quality as compared to another area, that has a very lean thin and less volume trees.

So, coming back to the slides, we can see a number of tree characteristics to measure these vegetative characteristics, such as diameter at breast height the basal area the heights the volume and so on.

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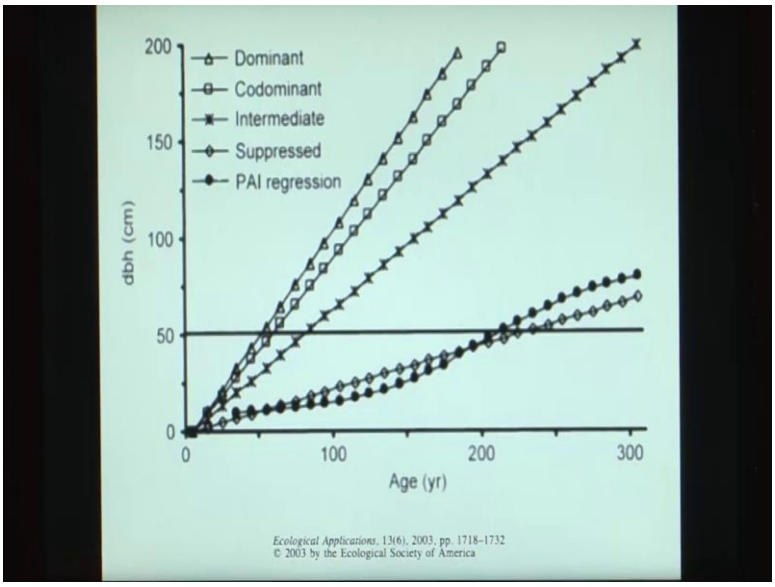

So even inside a first if we look at the diameter at breast height, as it varies with the age. So, here we can see that in the case of a dominant forest of a dominate tree. So, a dominant tree is one which is on top of the canopy, and it is receiving sufficient amounts of sunlight.

So, in suppose this period of 100 years it is putting up a diameter of around greater than a 100 value whereas, a codominant tree is receiving a lesser amount of diameter growth; similarly if we look at these suppress trees. So, this is these diamond shaped figures are the suppressed trees. So, if we compare a dominant tree which is putting up 100 plus centimeters of diameter, as compare to that this tree will only be putting up say 30 to 40 centimeters of diameter.

So, in this case we are varying just one factor and that is the amount of sunlight that a tree is receiving. What if we and even in the case of this one factor we can see that these two trees are putting a very different figures of diameter growth, what if we considered a number of other factors. Like the site fertility the site of the amount of precipitation that your site had or the amount of biotic pressure that your site had so, in that case will be able to get a very good estimate of the site quality just by looking at the diameter growth.

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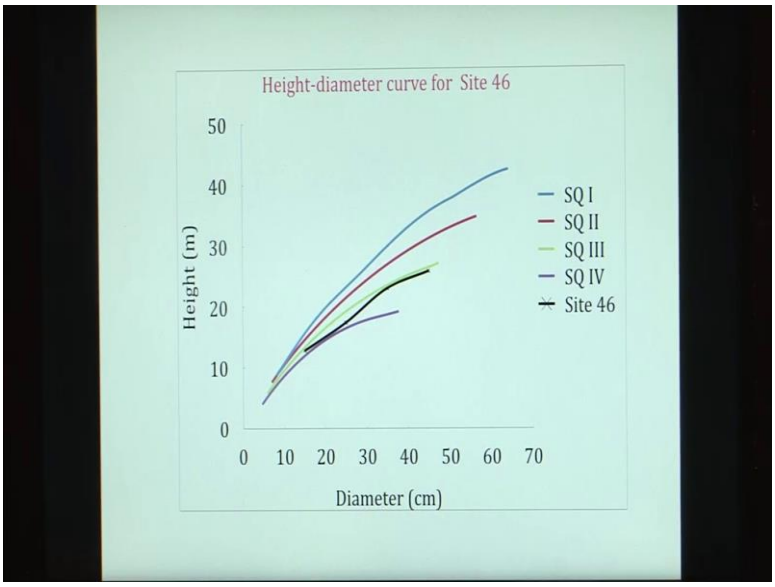

However the most common way in which we figure out the site is by using the height growth. So, for instance here in this sal forest we are plotting up the diameter versus the height and we are using these are some standard site qualities. So, as you can see in the case of your site quality one forest your tree is go to a height of around 14 meters, in the case of site quality 2 forest they grow to a height of say around 32 meters. In the case of site quality 4 they can only put up a height of around 15 meters. So, here the difference is much more pronounced.

So, in all these diameter classes your trees will grow to a certain height and then this curve will start to flatten out. So, how do we do a field estimation of the site quality?

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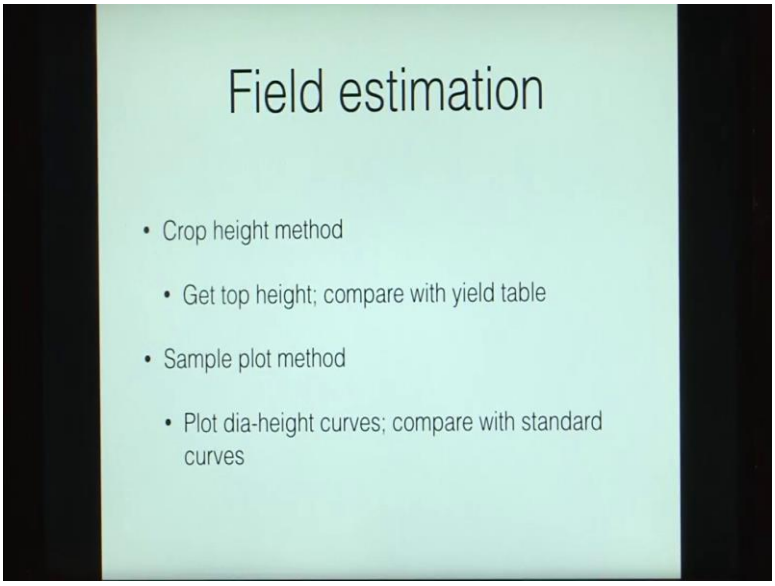

So, we have two ways of doing it, one is called the crop height method and the second one is called the sample plot method. So, in the case of the crop height method we get the top height and compare it with the yield table. So, when we see the top height what is the height of the top few percentage of trees in a forest; is what we are trying to figure out and then we can use our yield tables to get the top height.

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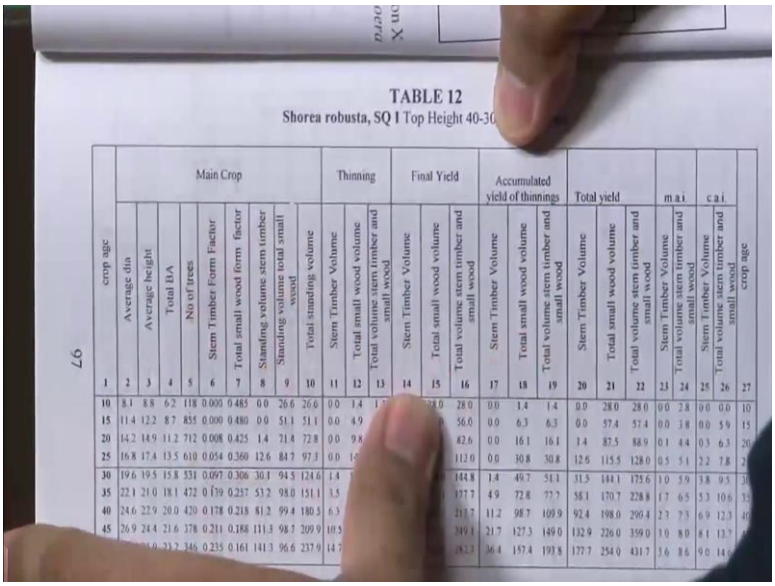

So, for instance if you look that this table. So, now, let us look at this table for site quality one. So, it defines the site quality one as a forest that is having a top height of 40

meters to30 meters. So, we write it in descending order. So, any tree that any forest that has a height of greater than 30 meters at 8years of age will be put into the site quality 1.

So, now here in this column we are seeing the crop age the average diameter and the average height.

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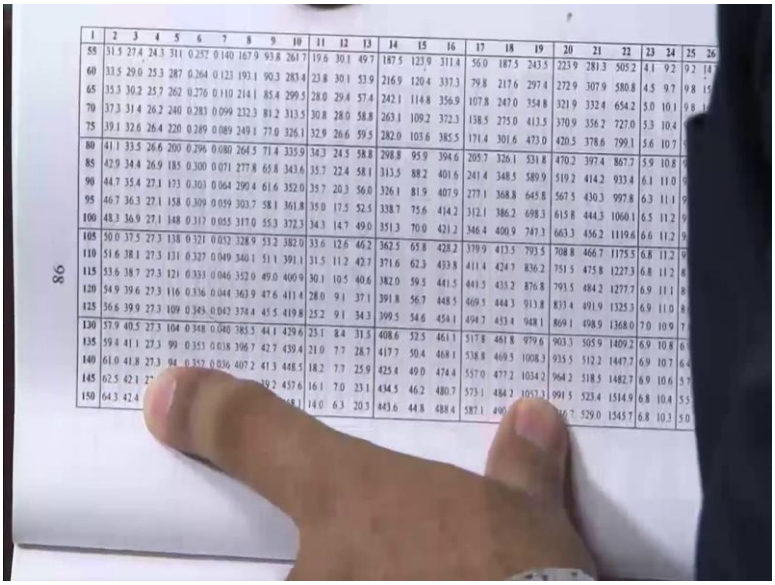

So, if we see as the height as the age increases the height of the trees also increase and it goes to. So, for instance here at an age of 150 years, the tree will be having a height of 42.4 meters, at an age of 80 years it has a height of 33.5 meters. So, any forest in which your trees are having a height that is greater than this height or where its stop height is between 30 to 40 meters will be called a site quality one forest.

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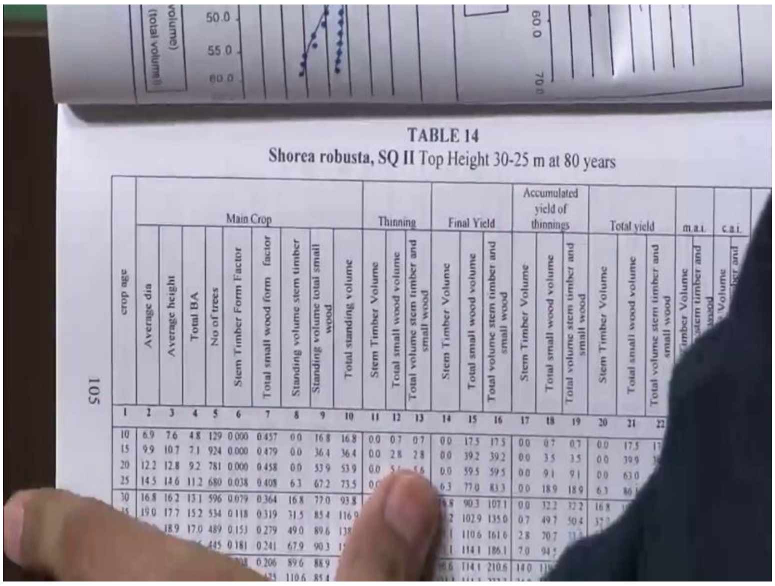

On the other hand we defined a site quality 2 forest as one having a top height of 30 to 25 meters at eight years of age. So, if we look at this yield table

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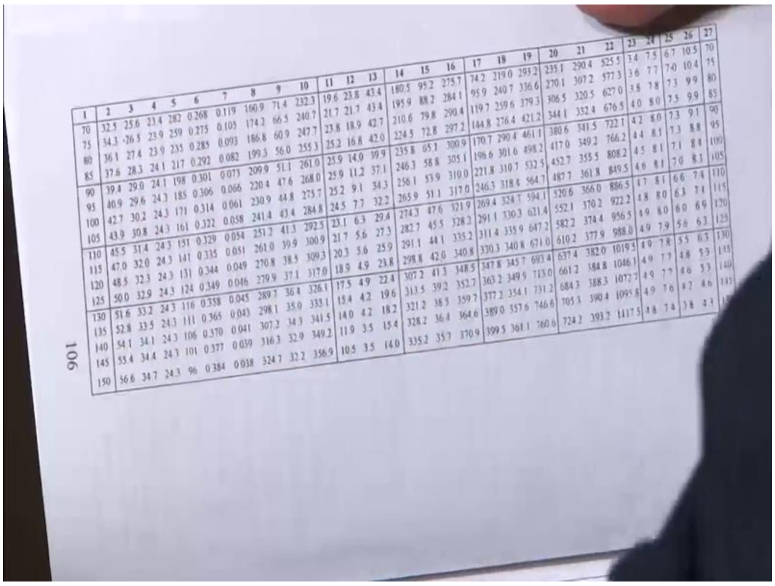

At 80 years of age, this forest has a height of 27.4 meters. So, that is the average height.

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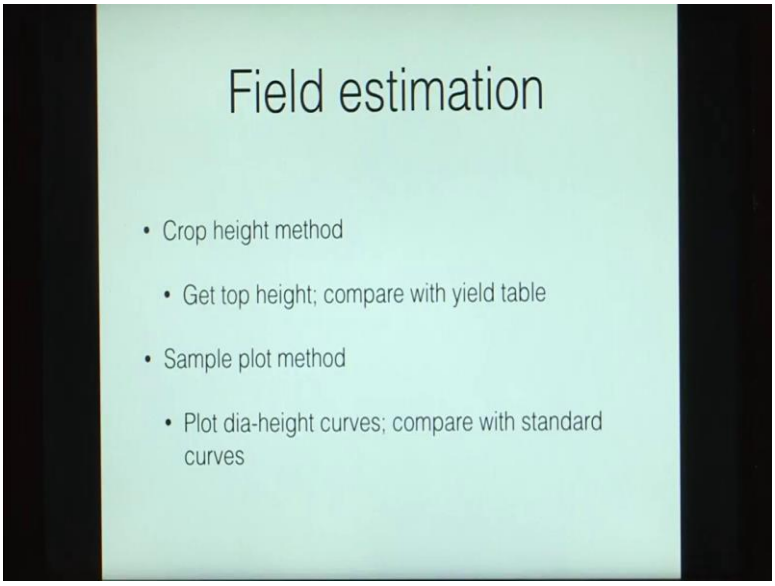

The top height might be a bit greater than that. So, just by looking at the top heights of your forest you can figure out this height quality; however, figuring out your site quality might be a bit difficult because all your tress it is difficult to get the age of the trees. So, another way in which we figure out the site quality is called the sample plot method, which you can see on your screens now.

So, in this case we plot the diameter versus height curves and compare them with the standard curves. So, if you look at this figure again, here we have plotted the sample curves for all these fourth a site qualities 1 2 3 and 4. Now in this case when we are getting our measurements from the field, we can see that even though we are not seeing the our top heights, we can see that this curve of diameter versus height very much matches the site quality three curve. So, we can say that our forest here in this case have a site quality of 3. So, just by taking the diameter and height values we can get the site quality, if you plot our diameter versus height curves.

So, today we talked about site quality what do we mean by site quality, how do we measure site quality in terms of CVP index and in terms of these graphical ways of measuring the heights, and we also saw that we can to get our site quality for a particular region, the most standard way is to plot diameter versus height curve and plot this standard site quality values, and then compare or field curve with those of the standard site quality curves. So, that is all for today.

Thank you for your attention. [FL].