Forest Biometry
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Lecture – 34
Volume Table

[FL], today we will have a look at Volume Tables.

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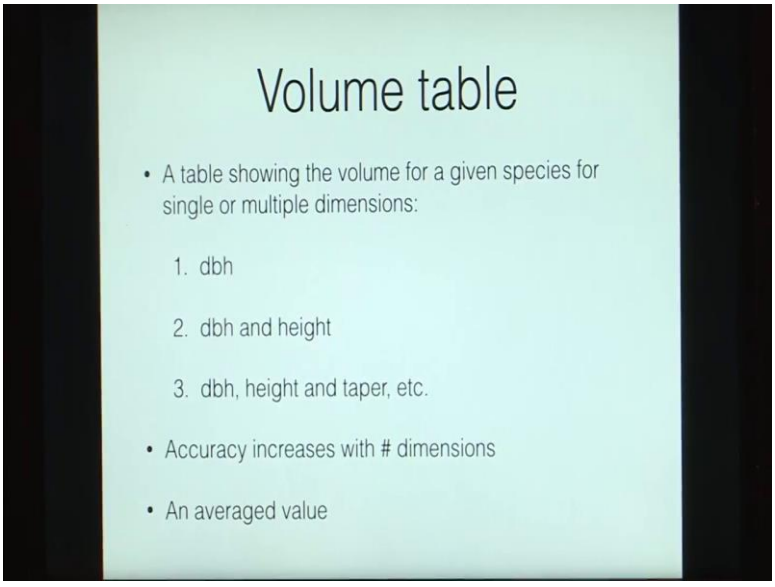

So, coming to the slides what is the volume table? A volume table is a table that shows volume for given species for single or multiple dimensions and those dimensions can be the diameter at breast height, dbh and height, dbh height and taper or any other parameters.

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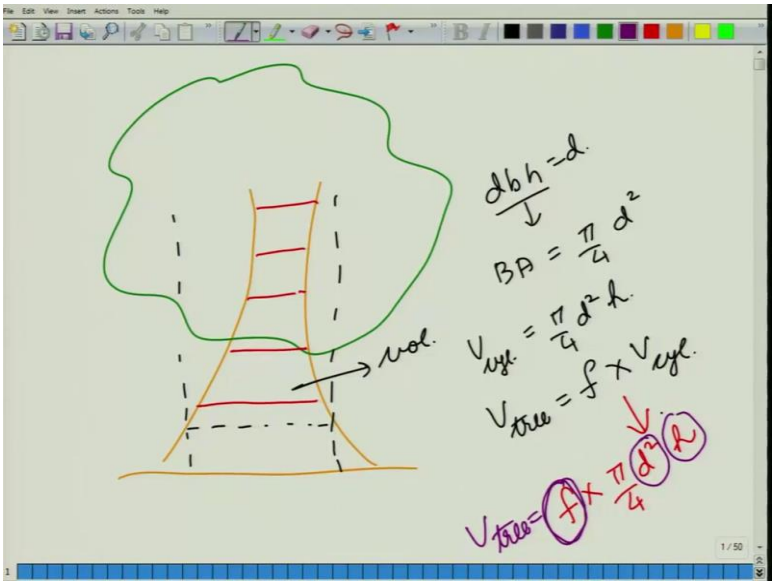

So, essentially as we have seen in this course if you have a tree and you are interested in knowing the volume. So, we know how to measure the dbh if we know the dbh then we can find out the basal area that is given by pi by 4 into d square if dbh is written as d. What is the volume of the cylinder? That will have a basal area equal to that of the tree and height that is equal to that of the tree the volume of the cylinder will be given by pi by 4 d square into h where h is the height of the tree and the volume of the tree is given by form factor multiplied by the volume of the cylinder. So, this is something that we have already seen in this course and there are a number of methods of finding out the volume of the tree, so for instance we could divide our tree into a number of sections and then measure the volume of each section or rather calculate the volume of each section by taking its diameters at the 2 ends or say its centre diameter and the height of the section or the length of the log and we can total up all those volumes to gives us the volume of the tree.

Now if we wrote this equation it becomes f into pi by 4 d square h. So, what all things do we require to find out the volume of the tree we need to know the f, f is the form factor that is given by the taper of the tree. So, for instance if this tree had a bole that was completely cylindrical its form factor would be one if it is a bole was in the form of a cone then the form factor is 1 by 3. So, depending on its taper we will have a value of f. We also require the value of d which is the diameter at the breast height and we also need to know the height of the tree.

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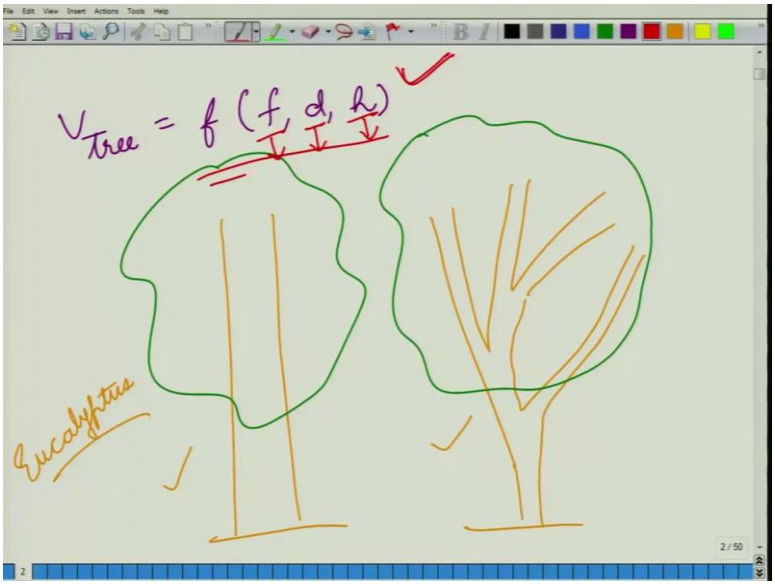

So, essentially we can say that the volume of the tree is a function of the form factor the diameter and the height. So, if we know this function completely then if we knew the form factor the diameter and the height then we would be able to know the volume of the tree. However, when you go into the field situations when you look at a number of trees, so all those trees will be having different diameters different heights and maybe even different tapers. So, for instance we have already seen in this course that you can have a eucalyptus tree that has a very cylindrical bole or you could have another eucalyptus tree that is extremely branchy. So, it has a number of fogs. So, these 2 trees can be the trees of the same species say in the case of eucalyptus.

And what would determine whether your tree has this shape or whether it has a fog shape? Well we have looked at (Refer Time: 04:05) theory and we know that if our tree is right in the centre of a forest and it is not suffering a huge amount of wind pressures to (Refer Time: 04:15) on its sides. So, in that case it will have a roughly cylindrical bole whereas, if you have an isolated tree and that is suffering a huge amount of wind forces then it will go on accumulating mass at the bottom to give it a taper. Also when you put your tree in isolation and it is suffering a huge amount of wind forces it might acquire the shape of a fork or maybe this forking shape came out because of some interactions between this tree and its environment. So, maybe there was some insect attack or maybe some disease that led to any epicormic growth. So, all the trees in your forest stand will be different. So, if you wanted to find out the volume of your trees using this formula

you will have to measure the form factor for every tree, the diameter for every tree and the height for every tree.

Now, is there any way of simplifying this? So, why do we want to go for a simplification we want to have a simplification because measurement of all these things for every tree becomes very tedious and at the same time we do not want a very high level of accuracy and precision in this case because wood is not a very expensive material. So, for instance if your tree were made out of gold. So, you would want to know every single milligram of the tree and you would want to calculate it completely exactly, but in the case of a tree whose price maybe say around 30,000 rupees or even say 15,000 rupees per cubic meter whether it is 1 cubic meter or whether it is 0.15 cubic meter it is not very life and death situation. So, you can have some amount of flexibility when you are measuring these values.

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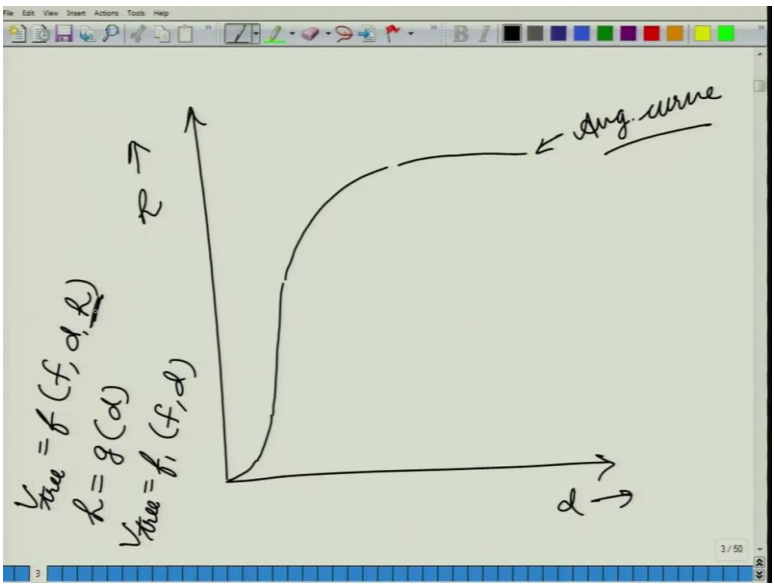

So, if you go back to this equation is there any way of simplifying it? So, for instance, if we took a tree and if suppose we measured its diameter and its height how would that grow like. So, in the beginning this tree might give a small increase in height then it might grow exponentially in height and then this height might even flatten out. So, for instance if you go into a very dense forest then your trees might not be showing any further growth in height even though its diameter is increasing. So, if we knew this if we were able to find out an average curve that gives us heights for different diameters. So, in

the equation your volume of the tree is a function of form factor, the diameter and the height we could replace this height with some other function of the diameter. So, that would become h is equal to some other function of the diameter.

So, in that case your volume of the tree will become some other function of the form factor and the diameter because you are now considering the height as a function of the diameter.

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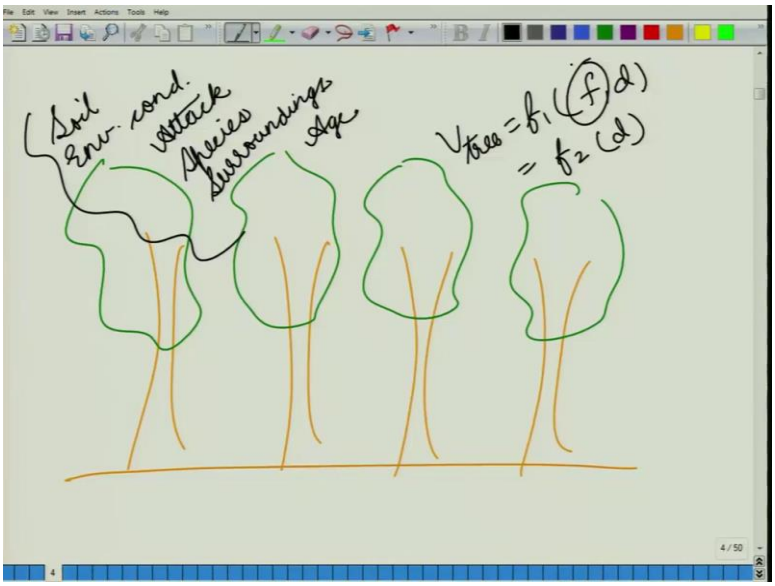

Now at the same time when you go inside a forest, so if we are not considering the edge effect, suppose we have a number of trees in the forest. So, if you consider one location then there might not be a very great difference in the form factors of all these trees because essentially if all these trees have been subjected to the same soil to the same environmental conditions; maybe to the same levels of attacks by say pest or insects or diseases. If all these trees are of the same species and they are all having the same surroundings and probably the same age. So, in that case there might not be a very huge difference in the form factors of all these different trees. So, when we write that the volume of the tree is an function of the form factor and the diameter. So, for a given locality for a very small area we could even say that the volume of this tree is some other function of just the diameter itself.

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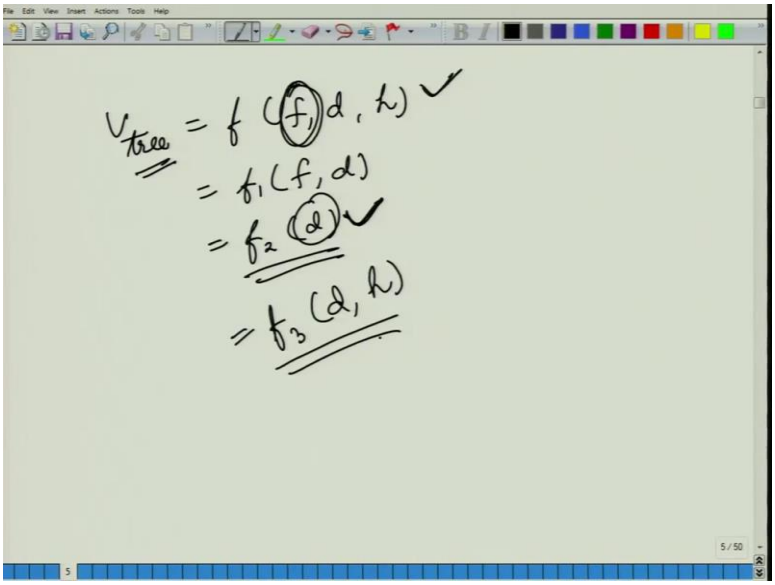

So what we have here is that the volume of the tree is a function of form factor, diameter and height or some other function of just the form factor and the diameter or some other function of just the diameter. So, we can simplify these equations, but when we do this then we will be reducing the amount of accuracy that we have. So, this equation is the most accurate equation and this equation is the least accurate equation. So, depending on what we want to do with our trees we might be good with a less accurate equation as well.

So, now, coming back to the slides, so it says that the volume table can give you the volume in terms of just the diameter at breast height, so coming to the tablet this would be the equation. So, it is giving you the volume of the tree just as a function of the diameter. Now back to the slides or it could give you.

So, you can even write it as another function that is just based on the diameter and the height because you could say that for any site f would be a constant if we are considering a very small locality. So, for instance here we said that when all these conditions are the same then we can say that f is constant for all these trees. So, we can even remove the f and just write it as a function of diameter and height. So, moving back to the slides now. So, here it says that it can give it to you in the function of just the diameter and the height or the diameter height and taper or any n number of factors. So, accuracy increases with the increase in the number of dimensions.

So, for instance if you measure it just with the dbh it is the least accurate and if you measure the diameter, height, taper and maybe some other factors as well it might the accuracy will increase. Now in the case of a volume table the volumes that we are getting on this table are average values. So, they might not correspond to each and every tree, but they are averaged out value because we want a quick estimation. So, for instance if you are in a forest and you wanted to have n a very accurate and precise measure, in that case you will chop down your trees, you will cut them into sections and maybe measure each and every section and then sum up those volumes to get the exact volume of very tree, but if you wanted to have a quick computation you could take an averaged out value.

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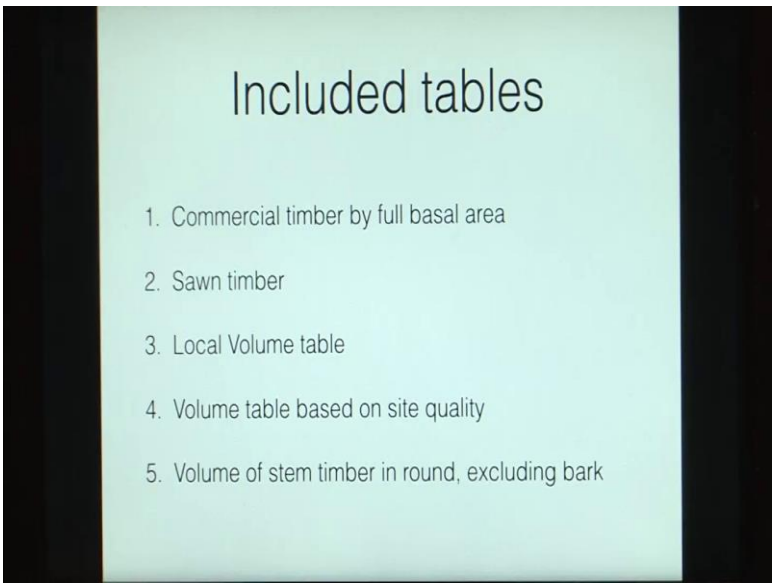

So, coming back to the slides, when we talk about volume tables you can have different kinds of volume tables. So, some of those are given on this slide. So, you could have a volume table for the commercial timber by full basal area. So, here what you are considering is commercial timber. Commercial timber is the timber that you are extracting out of the forest to be used commercially. You could even have another table for sawn timber.

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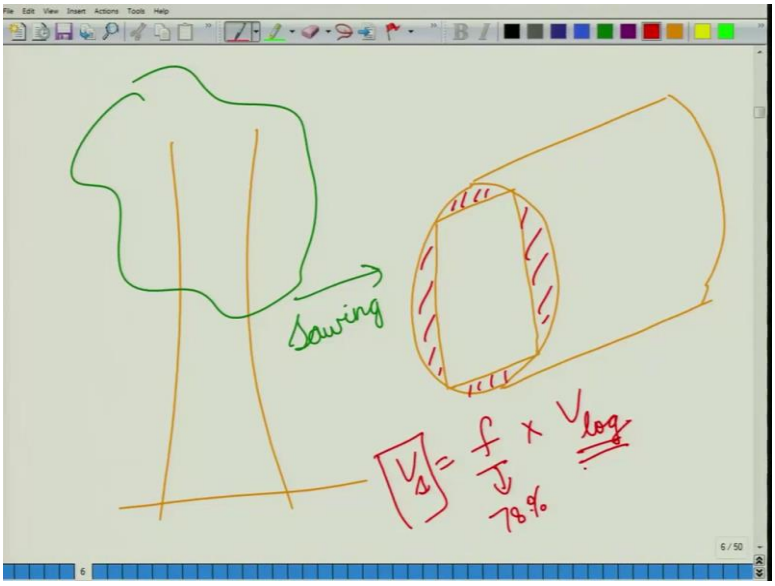

So, for instance when you have a tree and when you are putting it through the sawing operations then as we have seen before in the cross section because we want to have sheets of the log. So, in that case we might be losing out on the d's as we have seen in the quarter girth form you know, we will be extruding these. So, we can either calculate the whole volume and then find out the volume of the sawn timber to be some factor f the volume of the log. So, and in the case of the quarter girth formula we calculated this f to be 78 percent approximately. So, we can either write it as a fraction of the volume of the log or we can directly multiply all the values of volume of the log with this factor and directly note down the volumes of the sawn timber.

So, coming back to the slides. So, this is what it says that you can even have a table for a sawn timber. You can even have a local volume table. Now what is a local volume table? A local volume table gives you the values for a given locality it is not a generalized value that you can use everywhere, but say if you want to consider the forests of say Dehradun then maybe a very small area. So, for instance a forest of (Refer Time: 13:21) might be having very similar values. So, you can derive a local volume table for that.

Now coming to the slides you can even have volume tables based on site quality. So, site quality tells you how fertile a site is, you can have the volume of stem timber in round excluding bark, you can find out the volumes including the bark or excluding the bark.

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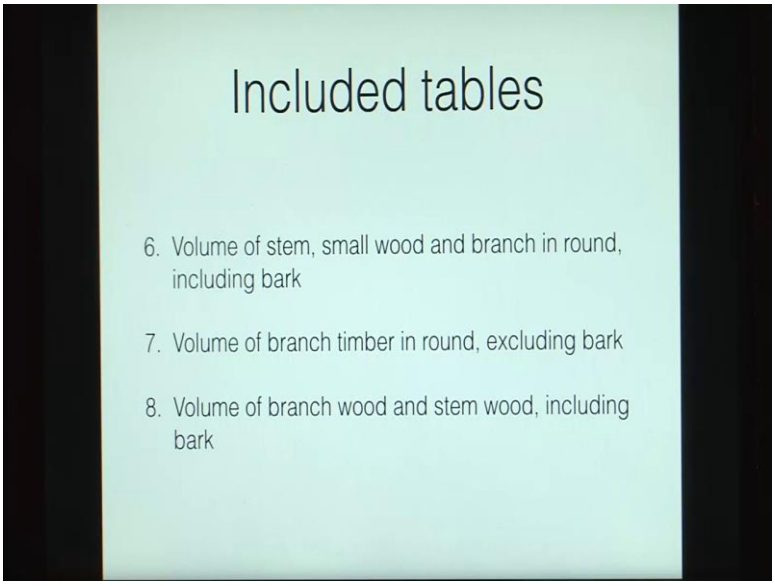

So, there it was excluding the bark now you can have volume of the stem small wood and branch.

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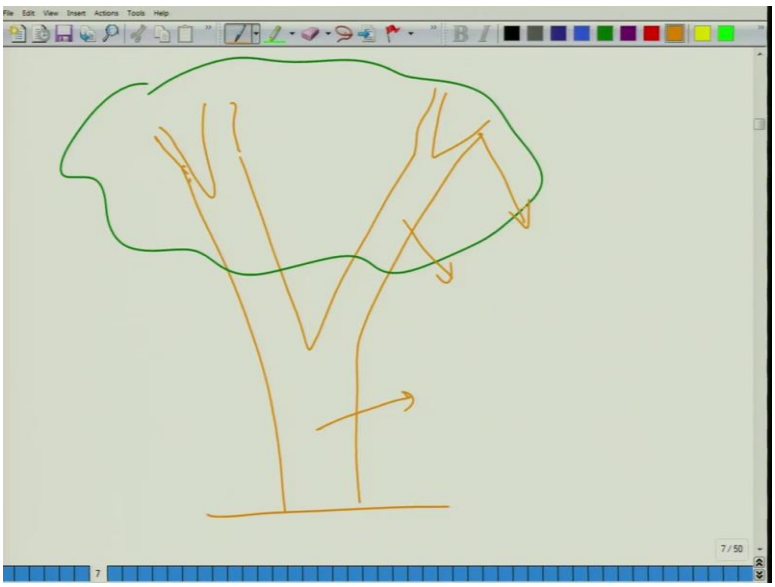

So, in this case when we are considering a tree, in this tree we can find out the volume of the main stem or we can find out the volume of the branches or the volumes of even the even smaller branches, which is what it says in the slide volume of the stem small wood and branch in round including the bark. So, when we are saying in round it is not a sawn volume or you can find out the volume of branch timber in round excluding the bark. So,

in this case we are just considering what volume we can extract out of the branches. So, maybe they could be used as fuel wood. So, depending on your applications you can have different kinds of tables or you can even have volume of branch wood and stem wood including the bark because even if there is bark you can burn it, so that is good in terms of your fuel value, or you can have volume of commercial timber in round volume of sawn timber or you can even have a table for the deductions for bark where you can make if you have the other values.

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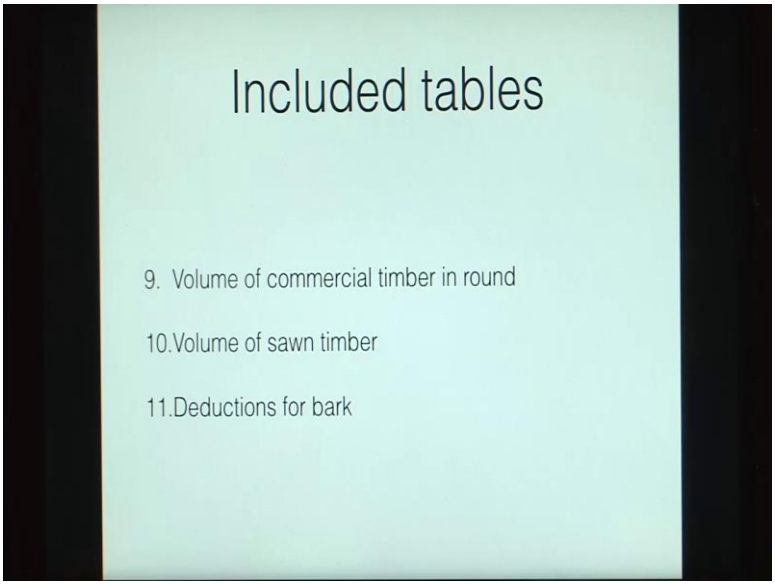

So, essentially we can have different kinds of volume tables and if we looked at a table of the volumes, so this is a book that tells the growth and yield data for forest tree species of the plains of India.

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So, this book is colloquially called as the volume table book or the yield table book.

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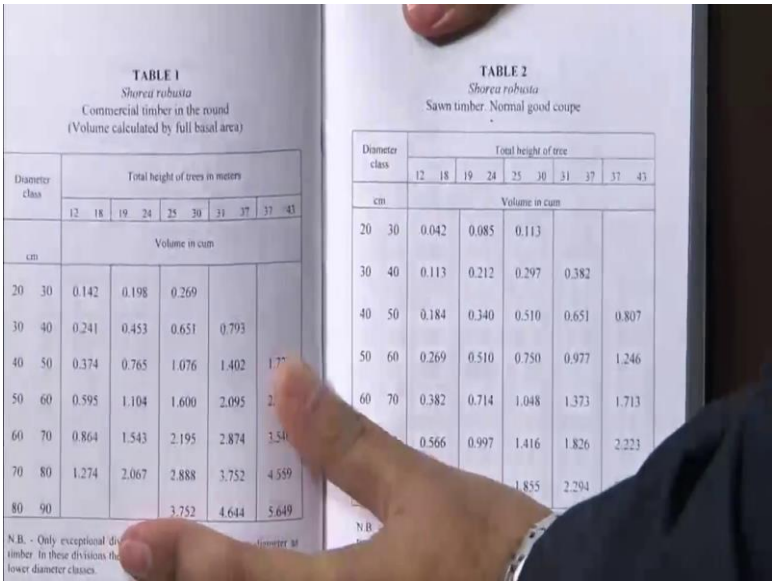

So, if we look at one particular species say the species called Shorea Robusta which is sal. So, if we look at the volumes of sal. So, this table gives us the commercial timber in the round and the volume is calculated by the full basal area. So, if you looked at this table here it shows us different diameter classes in centimeters. So, this is 20 to 30 centimeter dia class, 30 to 40, 40 to 50 and so on and then on this side we have the height of the tree in meters. So, you can have.

12 meter height tree, 18 meters height tree, 19 to 24 meters, 25 to 30 meters and so on. So, for each of these categories for say this diameter class 30 to 40 if you have a tree that is in this height class of 19 to 24 the volume in cubic meters is 0.453. So, all these things have already been calculated for you and you would just need to match the columns and the rows to get the values. So, this is one table that gives us for Shorea Robusta the commercial timber in the round. Now this is another table that gives us for Shorea Robusta it gives us the sawn timber in a normal good coupe. So, it is saying that it is a normal coupe. So, coupe is an area in which you are performing felling operations you are extracting that timber out of it. So, it is a normally good coupe for that coupe. If you want to find out how much is the volume of the sawn timber that you will be extract that you can extract from a tree of this diameter class and this height class then you can get it from here. So, for instance for the same dia class and the height class 30 to 40 and 19 to 24 it says 0.212. Now earlier we had the value of 0.453 and this one says 0.212. So, which tells us that roughly we will be able to extract half of the volume in the sawing operations.

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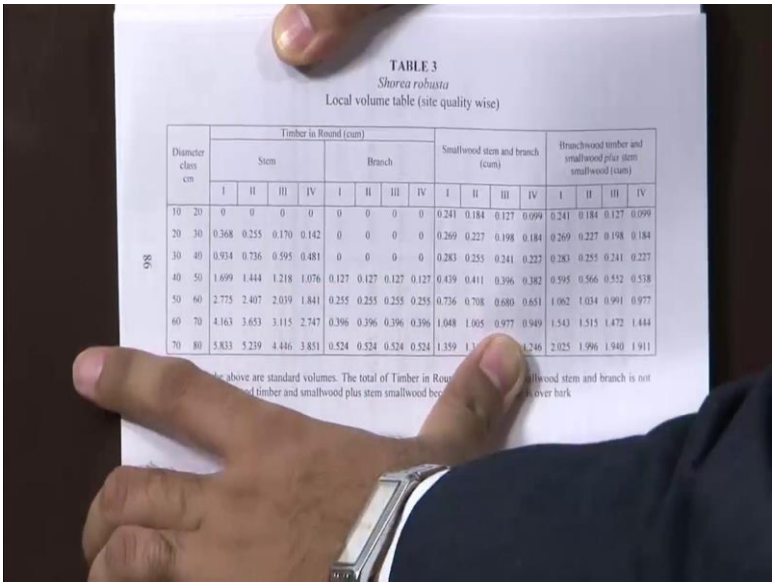

So, let us look at another table now, now this table shows us for Shorea Robusta this is a local volume table that is site quality wise. So, here as well we have in this diameter class. So, we are only measuring the diameter and we are measuring the site quality. So, site 1 is the best site, 2 is a little worse than that 3 is a little more worse and 4 is the worst or the least fertile soil. So, if we just are measuring this diameter class values. So, for say

30 to 40 you can have different volumes in a full grown tree. So, this is a local volume table.

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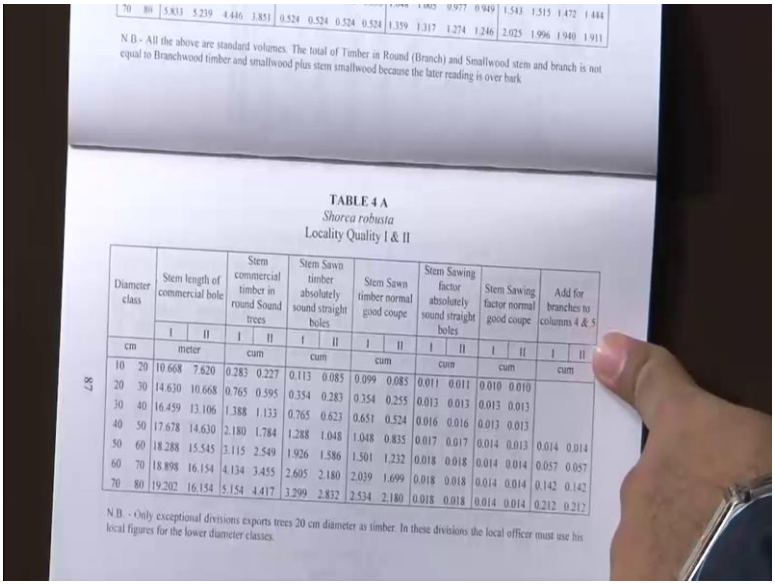

70 80 5.833 5.239 4.446 3.851 0.524 0.524 0.524 0.524 1.359 1.317 1.274 1.246 2.025 1.996 1.940 1.911

N.B.- All the above are standard volumes. The total of Timber in Round (Branch) and Smallwood stem and branch is not equal to Branchwood timber and smallwood plus stem smallwood because the later reading is over bark

TABLE 4 A

Shorea robusta

Locality Quality I & II

Diameter class		Stem length of commercial bole		Stem commercial timber in round Sound trees		Stem Sawn timber absolutely sound straight boles		Stem Sawn timber normal good coupe		Stem Sawing factor absolutely sound straight boles		Stem Sawing factor normal good coupe		Add for branches to columns 4 & 5	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II
cm		meter		cum		cum		cum		cum		cum		cum	
10	20	10.668	7.620	0.283	0.227	0.113	0.085	0.099	0.085	0.011	0.011	0.010	0.010		
20	30	14.630	10.668	0.765	0.595	0.354	0.283	0.354	0.255	0.013	0.013	0.013	0.013		
30	40	16.459	13.106	1.388	1.133	0.765	0.623	0.651	0.524	0.016	0.016	0.013	0.013		
40	50	17.678	14.630	2.180	1.784	1.288	1.048	1.048	0.835	0.017	0.017	0.014	0.013	0.014	0.014
50	60	18.288	15.545	3.115	2.549	1.926	1.586	1.501	1.232	0.018	0.018	0.014	0.014	0.057	0.057
60	70	18.898	16.154	4.134	3.455	2.605	2.180	2.039	1.699	0.018	0.018	0.014	0.014	0.142	0.142
70	80	19.202	16.154	5.154	4.417	3.299	2.832	2.534	2.180	0.018	0.018	0.014	0.014	0.212	0.212

N.B. - Only exceptional divisions exports trees 20 cm diameter as timber. In these divisions the local officer must use his local figures for the lower diameter classes.

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You can have also another kind of a table that gives you the values only for the locality or the site quality 1 and 2. So, this one gives you that for this diameter class if you wanted to look at the stem length of the commercial bole then in the sight one, if we considered this 30 to 40 centimeter diameter class in the case of a site 1 quality area the stem length of the commercial bole will be 16.46 meters, but in the case of site 2 it will reduce from 16.5 approximately to 13.1. So, the length of your commercial bole will reduce. So, essentially it tells you how much is the length of your commercial bole. So, that is the point till which you will perform your cutting operations it will also give you the stem commercial and in round.

So, this was in meters you can even have the volume values in cubic meters, then you can have the sawn timber that is an absolutely sound straight bole. So, these are different qualities of wood. So, it can give it to you in the terms of its volume you can even have this stem sawn timber in the normal good coupe in cubic meters, stem sawing factor and the addition for branches. So, that is a volume that you are going to add to number 4 and 5 volumes. So, this is another local quality volume table another table.

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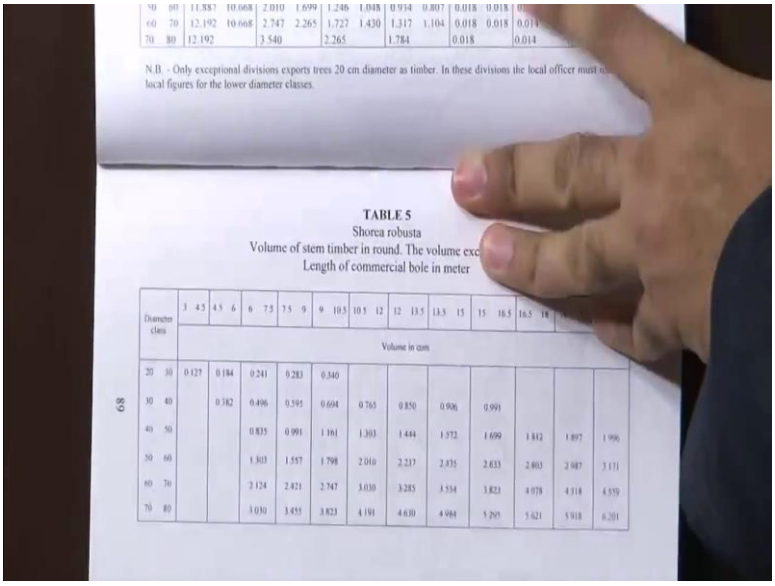

Thus table 5 it gives you the volume of stem timber in round excluding the bark. So, all these tables are arranged in a similar fashion. So, you have your length of the commercial bole or the height of the tree in this first row and here you will have the diameter classes and for all of these you can you will be able to measure the volumes here in the table.

So, now, coming back to the slides if we now looked at the types of volume tables. So, here we had a different volume tables, but how do we classify them.

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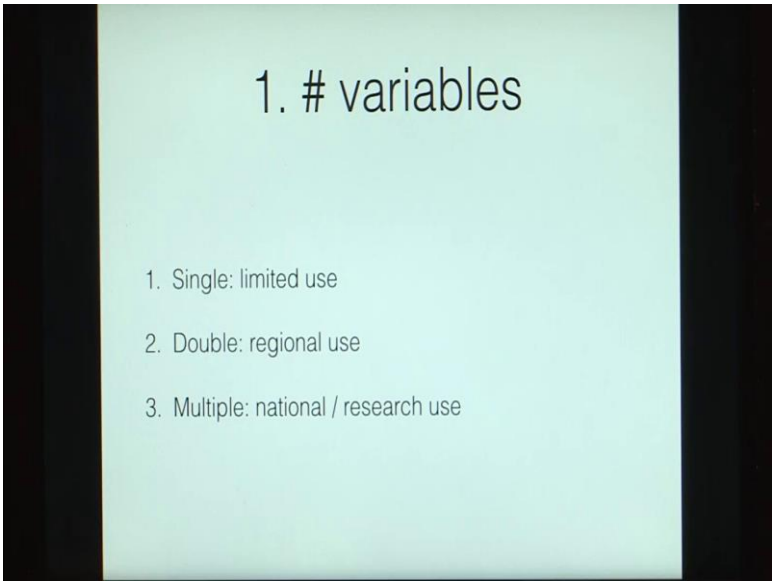

So, if we looked at the classification of volume tables the first classification is based on the number of variables that you have. So, for instance a single variable say your diameter at breast height it will have limited use, if you have 2 variables say diameter and height or diameter and the form factor or form factor and height it will have a bit more usage. If you had multiple number of variables the diameter the height the form factor the site quality and so on. Then it might have much more usage especially in the case of research.

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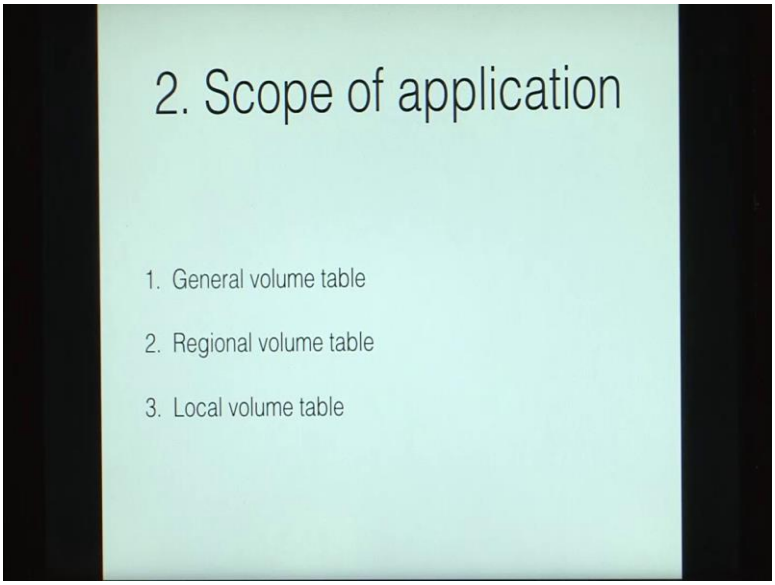

As per the scope of application you can have a general volume table a local volume table or a regional volume table this general volume table is the most generalized table. So, it will have all your variables and it will be a giving you all sorts of values, you can use your general volume table to derive a regional volume table or a local volume table.

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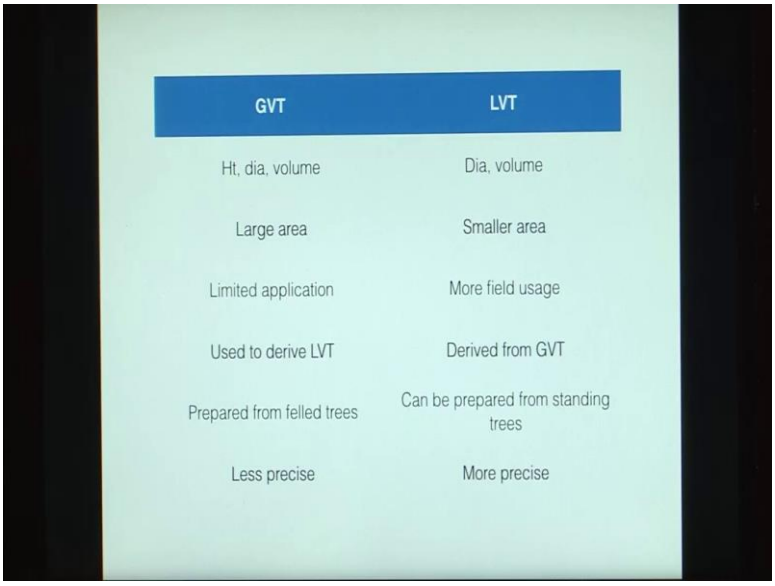

So, if you looked at the differences between these between your general volume table and the local volume table here are the differences. So, the general volume table gives you 3 quantities. So, it will have height diameter and the volume whereas, a local volume table will only give you diameter and volumes corresponding to those diameters because we are considering that for this localized region the height is a function of diameter and that has already been put into the volume values. So, your general volume table can be used for larger areas whereas, local volume table as its name suggest it can only be used for a small localized area.

The general volume table has a limited application it is very useful in the case of research purposes, but because if you want to use your general volume table you have to measure these 2 values height and diameter to get the volume, it has limited application in the field situations. Whereas, a local volume table because it in this case you only have to measure one value of diameter. So, it has more field usage the general volume table is used to derive the local volume table and the local volume table is derived from.

The general volume table your general volume table is prepared from felled trees because in this case once you have cut your trees you measure all the variables that you can find out then measure the volume with all the sections to get your general volume table, but because your local volume table is derived from the general volume table it can be prepared from standing trees as well because you only need to measure the diameters

and you can always get the volume from your general volume table considering the heights. So, it can be prepared from standing trees and the general volume table. Now general volume table is less precise for your field applications, whereas, a local volume table is much more precise.

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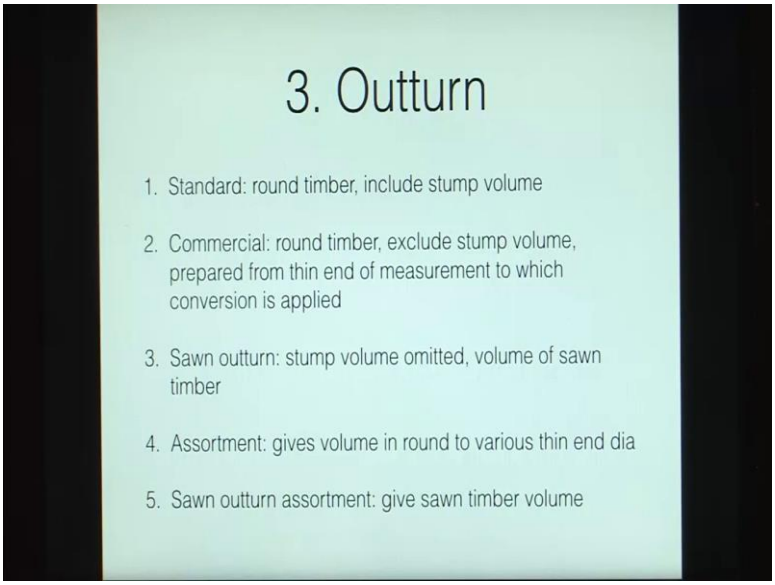

So, that was another way of classification another classification or the third classification is on the basis of the outturn. So, outturn tells you what are you trying to measure or what are you trying to get out of your volume table. So, you can your outturn could be the standard round timber the commercial round timber the sawn outturn assortment or so on. So, that is what we already saw in the case of the book. So, how do we prepare these volume tables?

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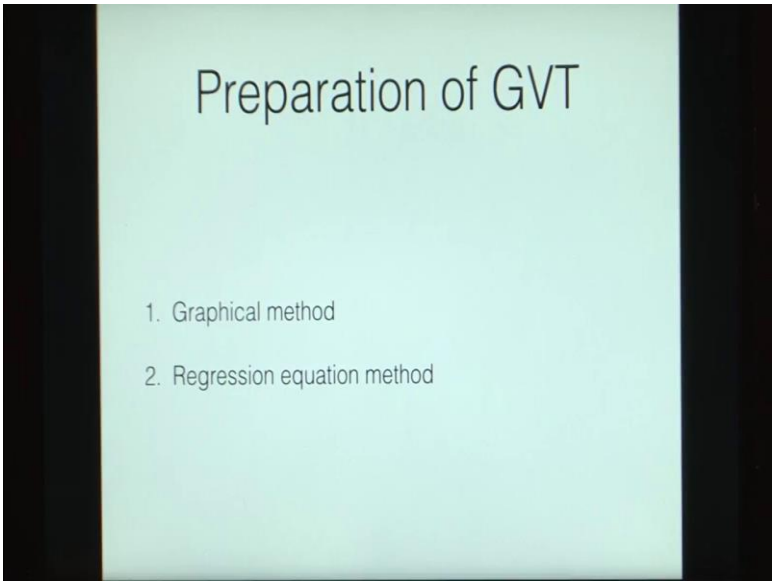

So, there are 2 methods of preparation of volume tables one is called the graphical method and the second is called the regression equation method. So, when we are trying to prepare our volume tables we are trying to get the volumes in a tabular form such that if we know the measurements of 1 parameter or 2 parameters or 3 parameters we should be able to get the volumes. So, in the case of general volume table we will be measuring the diameters the heights and the volumes and then use them in a tabular fashion. So, this table can be generated either by the graphical method or the regression equation method.

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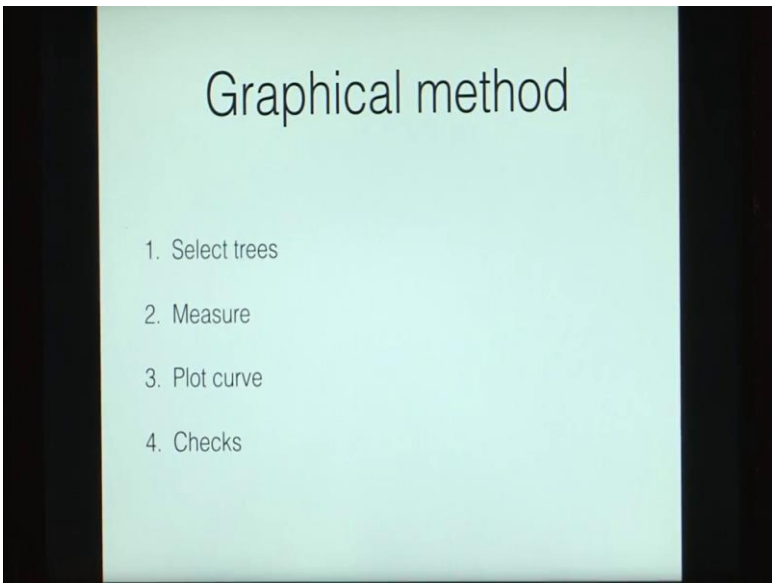

So, what do we do? In the case of the graphical method we start by selecting the trees so we cannot put each and every tree we need to find out the generalized trees. So, we will come to it in greater details later. So, once we have selected those trees and we have filled those trees then we are going to take measurements of those trees then plot the curves use a number of checks and balances and then get a table out of it. So, let us look at these steps one by one.

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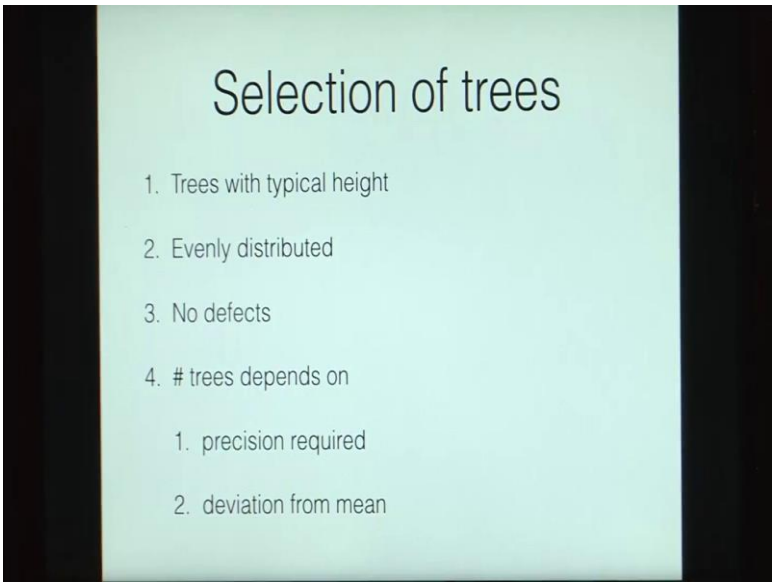

So, when we talk about the selection of trees we need trees with a typical height.

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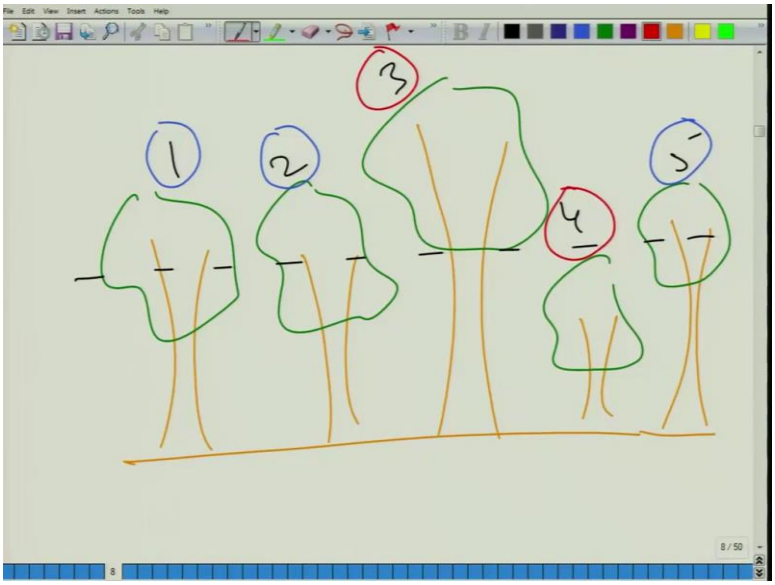

So, for instance if in your forest you have these trees say one more tree and so here you have these trees of the same species in the same forest. So, what is the typical height we can say that these. So, if we write it as 1 2 3 4 and 5. So, we have 5 trees here. So, if we figured out the average height of the typical height it would be somewhere like this. So, we can say that tree number 1 and tree number 2 and tree number 5 are the typical trees whereas, this tree number 3 will not be selected for making our volume table because it has a greater height the tree number 4 will also not be selected because it has a very small height. So, our trees have to be typical in height.

So, coming back to the slides. So, trees with typical height they need to be evenly distributed. Why evenly distributed? Because suppose your trees were very close together, here we have let us have these trees are very close together. So, they are forming one (Refer Time: 26:17) if we measure these trees, these will not be able to give us the values that we find in a typical forest.

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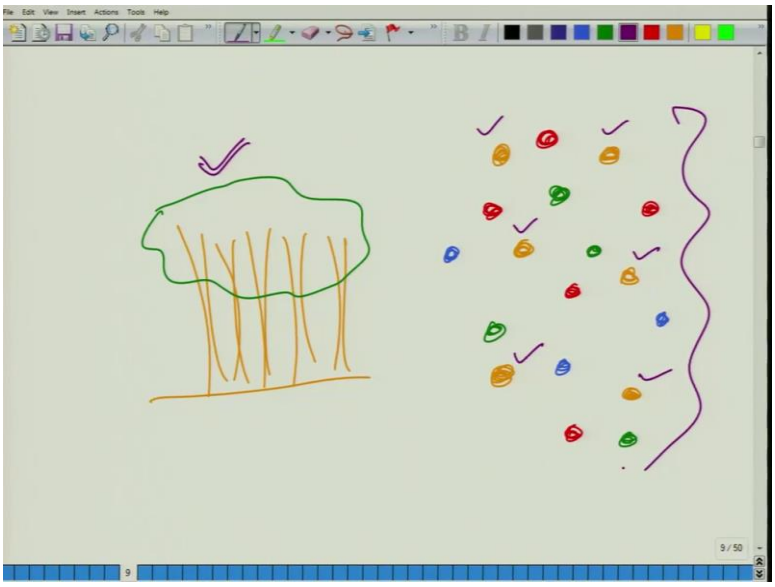

So, consider a forest in which you have mixed species. So, when we talk about mixed species then we might have our trees separated from each other. So, this is one is species this is another species this is our third species say this is our 4th species. So, if we look at trees of one kind suppose this tree, here we have these trees that are separated from each other. So, if we took trees that are very closely distributed together then these values

might not be representative of the field situations which is why we go for evenly distributed trees.

So, coming back to the slides. So, we need evenly distributed trees these trees should not be having any sort of defect. So, for instance if you have selected those trees that were infested by insects or say they were disease trees or say they had a huge amount of forking. So, these trees are not the representative trees of the trees in the in a forest stand now in the case of a volume table remember that we are trying to get the averaged out values and averages are very much affected by the outliers. So, for instance if you had values say 15 16 15 16 15 16 and if say one value was 200. So, your average will be very much moved by the extreme values, which is why we want trees that are very typical. So, there will be perfect trees of a typical height that are spaced in a typical fashion. So, we are going to use the measurements of those trees only to derive our general volume table.

So, coming back to the slides. So, how many trees are we going to select? So, this selection of the number of trees will depend on the precision that is required. So, precision that is required. So, if you want more precision you will go for more number of trees and it will also depend on the deviation from the mean. So, for instance if your values are very spread apart, which is why we talked about the measures of central tendency and dispersion.

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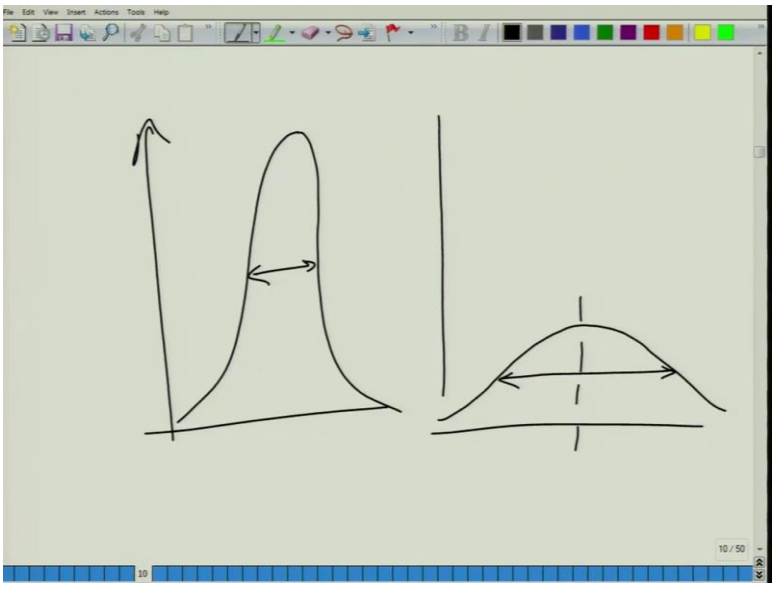

So, for instance if you have a distribution that goes like this. So, just measuring these few number of trees will be able to get all sorts of variations that are typically found in the population, but on the other hand suppose we had a distribution like this, because here we have a huge amount of deviation from the mean so we will require more number of measurements or more number of trees that need to be selected.

So, once we have selected those trees. So, coming back to the slides now. So, once we have selected these typical trees, we are next going to plot our values.

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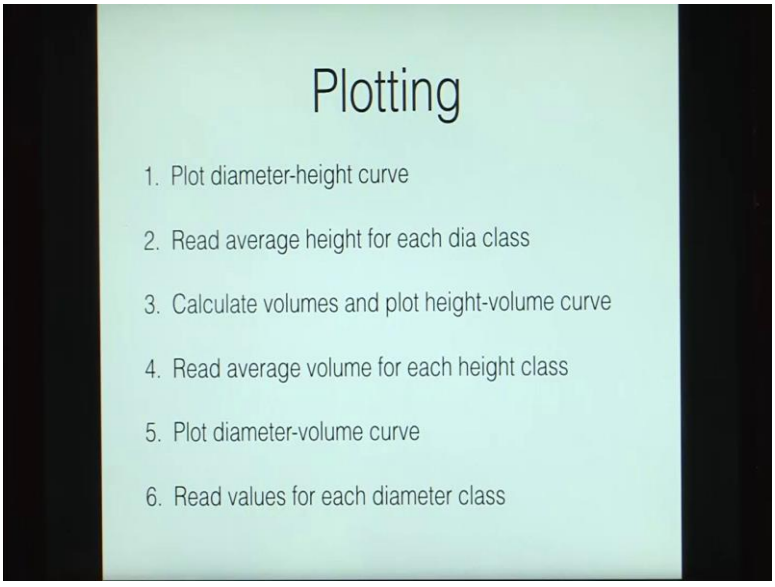

So, we will measure the diameters we will measure the heights and then we will plot a diameter versus height curve.

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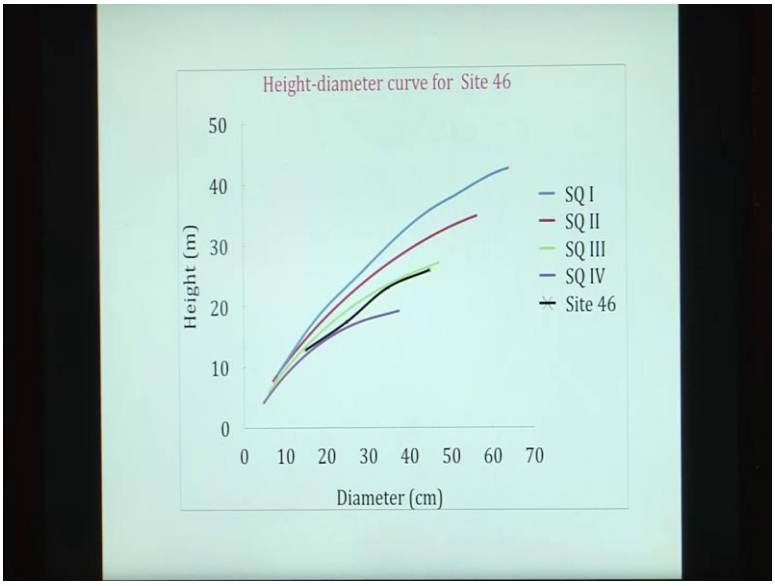

So, now this curve is here we have plotted some typical values for the case of sal. So, for different site qualities 1 2 3 and 4, as you can see if you consider any particular diameters say 40 centimeters diameter. So, site quality 4 will give you a height that is around 33 meters whereas, site quality one will give you a very small height and these are the most typical values and these are the values that we calculated from the field.

So, once you have got your values you are going to plot these curves next after you have your diameter you will read the average height for each diameter class coming back to these curves. When we talk about a diameter class what would be the height of your tree that has this diameter class of 20 to 30. So, you will figure out that height from the curve to get a typical height for each diameter class.

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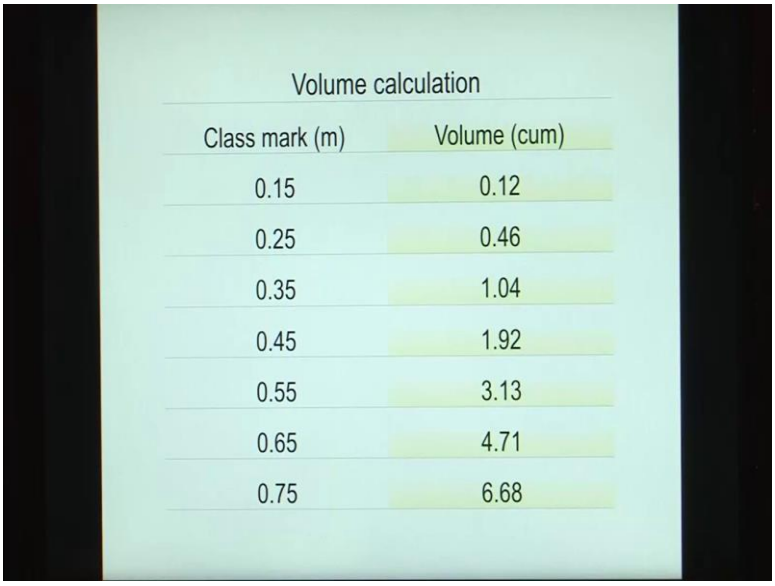

Then you are going to calculate the volumes and plot the height versus volume curve. So, in this case for each class we can calculate the volume. So, if we have the class mark and if we know the form factors if we know the heights we can find out the volumes. Once we have calculated the volumes we can plot the height versus volume curve.

Now we are trying to get the most typical values. So, which is why we plotted the height versus volume curve and then we read the average volume for each height class. So, we know the average height for each diameter class we know the average volume for each height class. So, next we are going to plot the diameter versus volume curve, so, here is one diameter versus volume curve. So, the volume goes on increasing at a slow rate in the beginning and then it is going to increase exponentially. So, this is the diameter versus volume curve.

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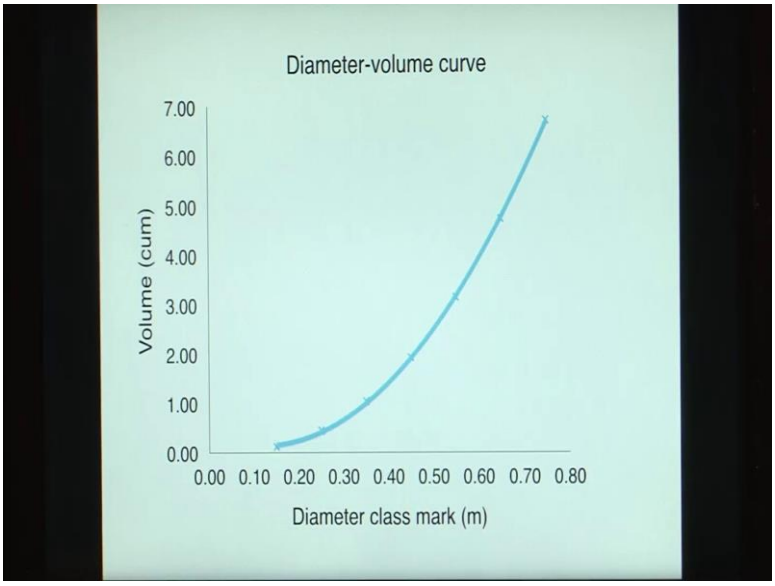

Once we have done that we are going to read the values for each diameter class. So, now, we know the typical heights for each diameter, we know the typical volumes for each height we know the typical volumes for each diameter class. So, we can use all these values now to get our general volume table.

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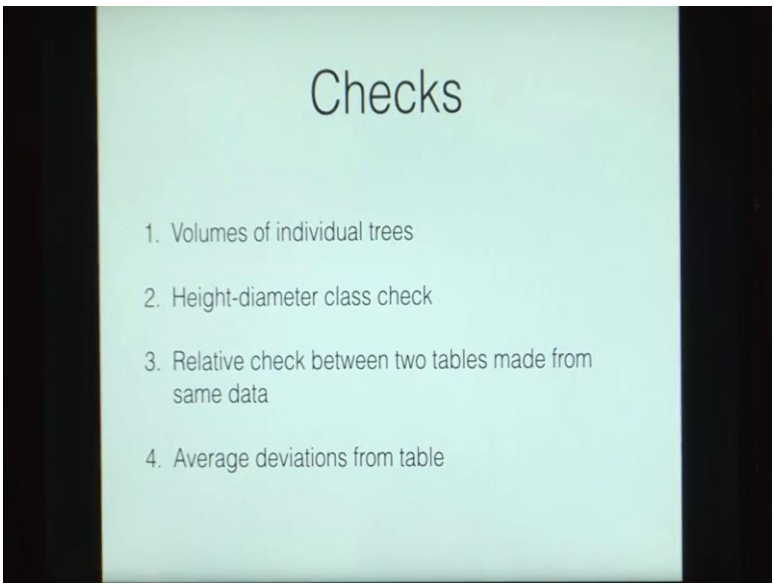

Now when we are preparing a general volume table we need to take care of a number of checks and balances. So, for instance the volumes of the individual trees should not deviate by a large amount. So, if we have selected our typical trees, in that case the

volumes of the individual trees will not vary a lot from each other then we can go for a height and diameter class check. So, for instance once we have plotted that curve for typical heights for each diameter class we can measure the heights of the individual tree and then check them against this curve whether our plot is correct or not. We can even have a relative check between 2 tables made from the same data.

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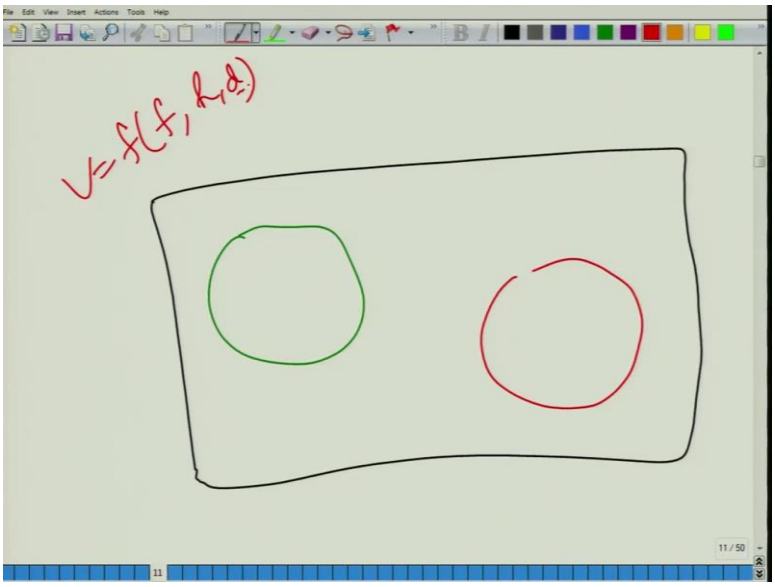

So, once you have calculated a huge amount of data. For instance if you had a large sized forest, if this is your forest area and we are getting one volume table from trees that have been extracted from this side and another table from this side. So, both these volume tables should give us values that are close together. If we have a huge amount of deviation then maybe we have not selected our typical trees or maybe there has been some sort of calculation mistake.

So, coming back to the slides we also need to check the average deviations from the table. So, deviations for each tree from the final table will also be checked. So, that is the first way of calculating a general volume table. Now remember your general volume table was giving you the volume as a function of the form factor height diameter and maybe some other variables.

Another method in which that we can use to find out our general volume table is called the regression equation method.

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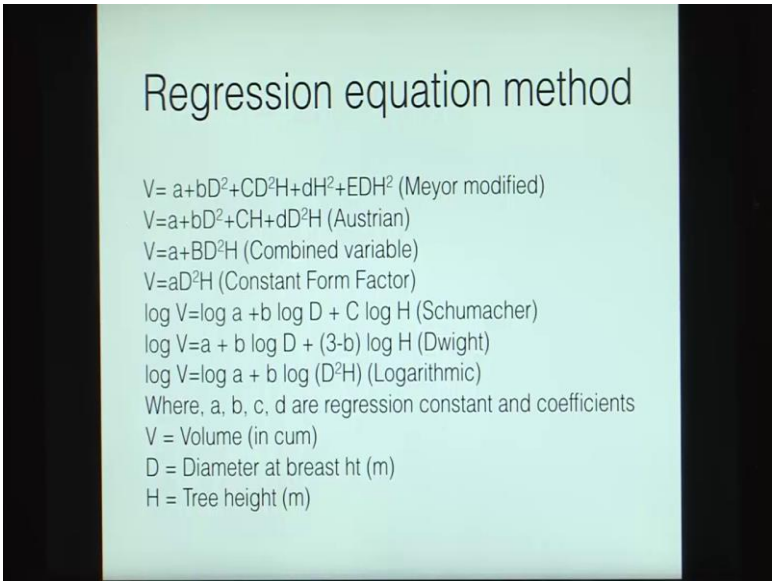

So, in the case of a regression equation method. So, suppose we are using 2 variables the diameter and the height. So, we can write these general formulae. So, like volume is a constant plus another constant multiplied by d square now by d square because in the case of volume we will have say pi d square h by 4. So, in your volume based always going to vary as variable of d square plus another constant multiplied by d square multiplied by height plus say another constant multiplied by h square plus say another constant multiplied by diameter into height square. So, you can write any sorts of regression equations. So, these are generalized equations and then we are going to try and fit our calculated values from the selected tree to our regression equation to get the all these constants and once we have figured out those constants then we can derive a volume table using these.

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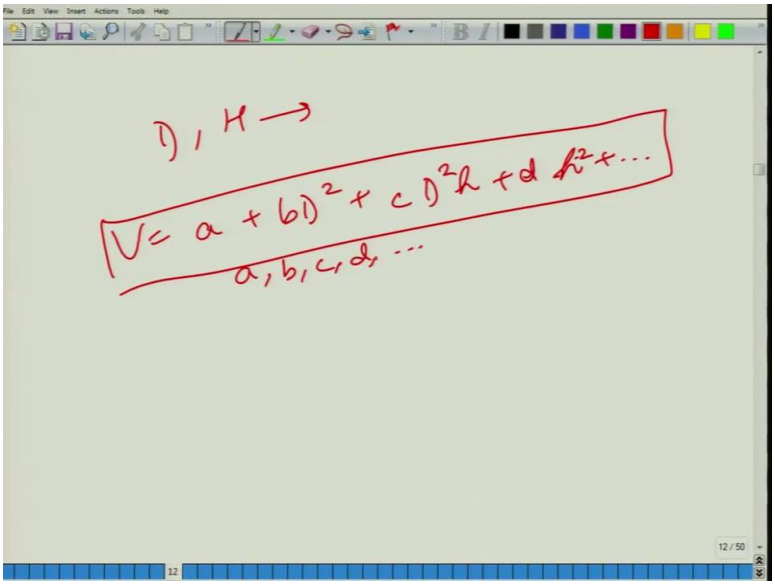

So, we will have our diameter height and if we know our equation. So, the equation suppose it is a plus b d square plus c d square h plus let us call it capital D to differentiate it from our constant value into h square plus whatever. So, if we are able to calculate our constants a b c d and so on. So, then we can use this equation with all these constants pertain to derive a general volume table for each diameter and the height. So, that was about the general volume tables. How about the local volume tables?

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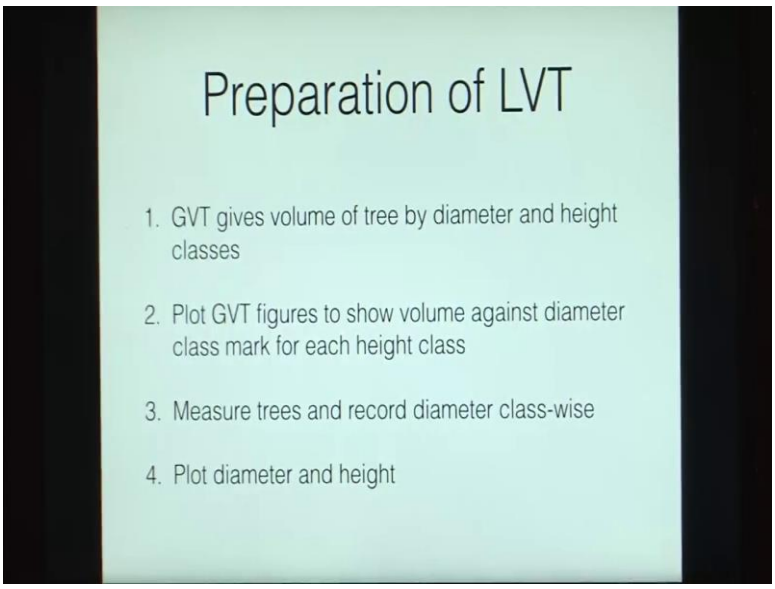

So, remember that a local volume table is derived from a general volume table. So, our general volume table gives us the volume of the tree by diameter and height classes. Now when we want to get our local volume tables we need our volume in terms of the diameter only. So, we can plot our general volume table figures to show volume against your diameter class mark for each height class. So, what we are trying to do here is suppose we plot our values of the volume versus each dia class, suppose here are our dia classes. So, we are writing it against the class marks. So, suppose it is 15 25 35 45 55 and so on in centimeters.

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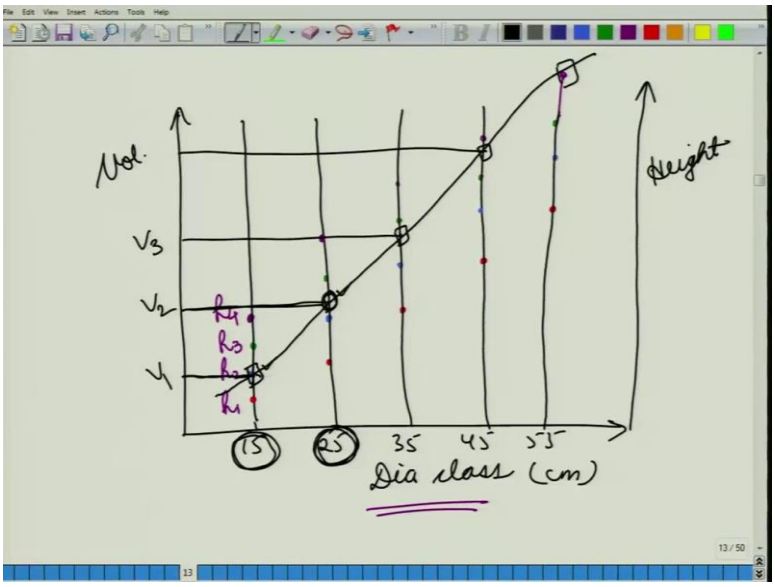

So, if we with our general volume tables we will have that for a 15 centimeter diameter we can have a volume say V 1 for a particular height one then this for height 2 this is a value for height 3 and this is a value for height 4. So, this is height 4 height 3 height 2 and height 1. So, similarly we can find out these values for each of the different diameter classes. So, here we are marking our the volumes for each diameter class for different heights. So, this is what we will get from the gvd. So, coming back to the slides, we are plotting our gvd figures to show the volume against the diameter class mark for each height class.

Next we will measure our trees and record diameter class wise their values to plot diameter versus height. So, now, coming back to this to the tablet. So, what we are doing

now is that for our particular location. We are measuring the diameters and we are measuring the heights.

So, suppose we get the heights like this. So, let us write it as square. So, suppose these are the heights that we get. So, these are the heights that we have measured from our locality. So, coming back to the slides, now, we are plotting the diameter versus height curve. So, what we are doing is coming back to the tablet now. So, this was volume and here we have the height. So, for this dia class we have this height, for this dia class we have this height and so on. So, coming back to the slides.

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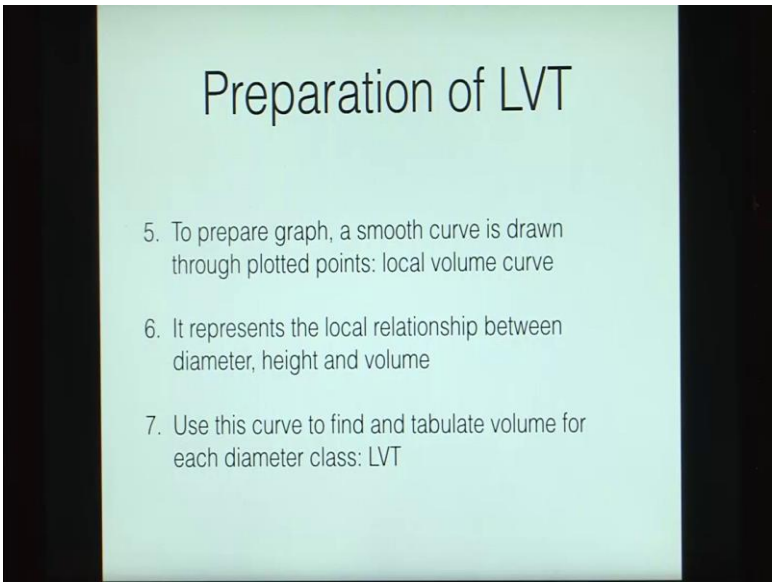

Next we do to prepare the graph a smooth curve is drawn through the plotted points which gives us a local volume curve. So, what we are doing is coming back to the tablet. Now we are drawing a smooth curve from all these values of heights once we do that we get a local volume curve because for this diameter this would be the height and this would be the volume. So, this is the first volume for this diameter class this is the height and this is the volume V 2.

Similarly here we have another volume V 3 here we have another volume V 4 and so on. So, this curve is called the local volume curve. So, coming back to the slides now, once we have drawn the local volume curve it represents the local relationship between diameter height and volume because we have drawn you are in the tablet we have coming back to the tablet. So, here we have drawn the diameter class versus volume and

the height. So, we have drawn all these 3 values together. And we have derived our curve the smooth curve. So, coming back to the slides.

Next we use this curve to find and tabulate the volumes for each diameter class and once you do that we get the local volume table.

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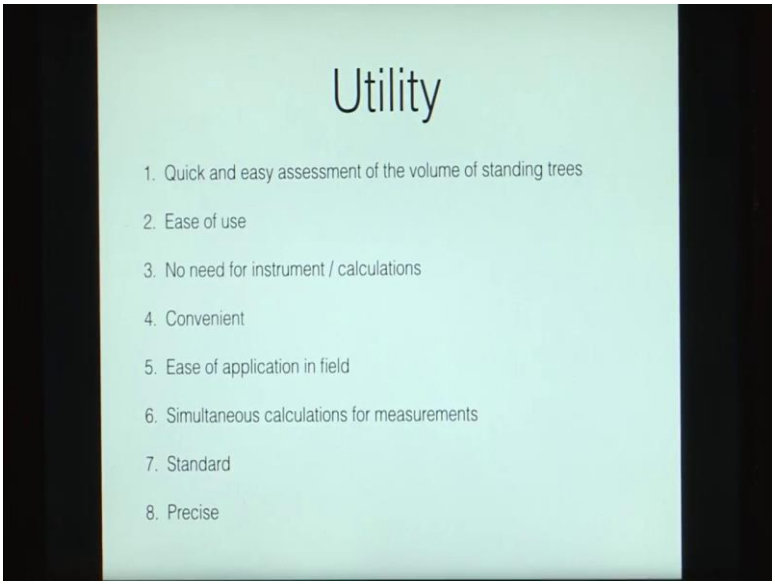

So, what is the utility of these volume tables one they give us a quick way of accessing the volume of the standing trees, they are easy to use there is no need for any other instruments or calculations, they are convenient to use, they have an ease of application in the field they permit us simultaneous calculations for measurements. So, for instance in the case of a log if you measured its diameter you will, diameter and the length you will directly be able to get the volume. So, we can directly write the volume values as such in our records they are standard and precise ways of getting the values, but at the same time they also have a few limitations.

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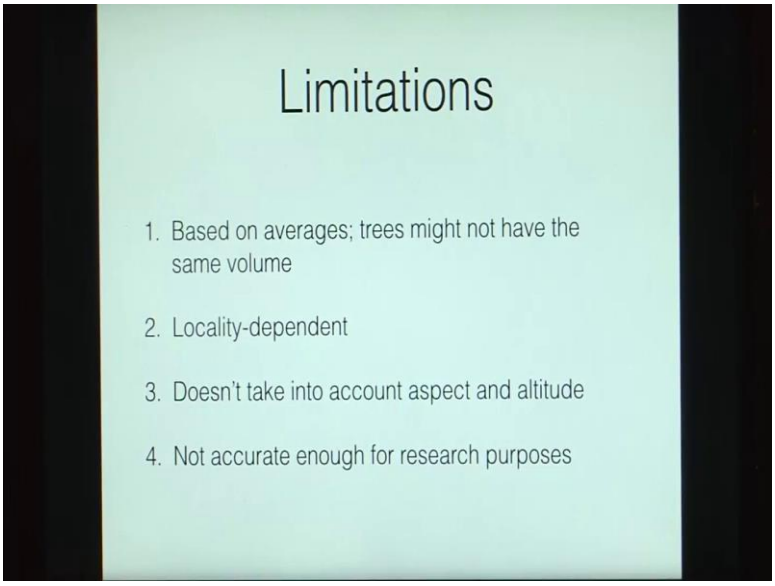

They are based on averages and your trees might not have the same volume as the average volume, they might be dependent on the locality. So, if you have say a local volume table for Kanpur you might not be able to use it in Dehradun for instance because your local volume tables will be locality dependent. They do not take into account aspect and altitude.

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So, for instance if we considered a hill and suppose this is towards the South and this is towards the North. So, in the case of India which is line in the northern hemisphere the

sun is always towards the South. So, what it does is that this portion receives the sunlight whereas, the other portion is hidden from sunlight for the most part.

How does that matter? Because this site is receiving sunlight, here the temperatures will be higher the humidity will be lower whereas, on the other side you will have reduced temperatures and higher humidities. So, essentially a tree that is growing here might appear very different from a tree that is growing here, but our volume tables the generalized volume tables or the local volume tables are not taking care of this value of the aspect. So, this is what we call as the aspect of our site.

At the same time our local volume tables or the general volume tables do not also take care of the altitude. So, in the case of altitude our tree growing here might be very different from a tree growing, here might be very different from a tree growing here because as we are going up in the height the temperature is reducing. At the same time the amount of wind pressures that these trees will face might also vary according to the height. So, our volume tables are not taking care of the aspect of the site and also the altitude of the site. So, in certain applications this might become a limitation.

So, coming back to the slide, they are not accurate enough for research purposes because remember we have only taken our typical trees and taken out averaged out values. So, they might not be accurate enough for research purposes. So, these are some limitations of the general and the local volume tables. But that being said they play a very important role in the case of field forestry because they permit us to get some computational values quickly and with ease without the need of many instruments. So, that is all for volume tables.

Thank you for your attention [FL].