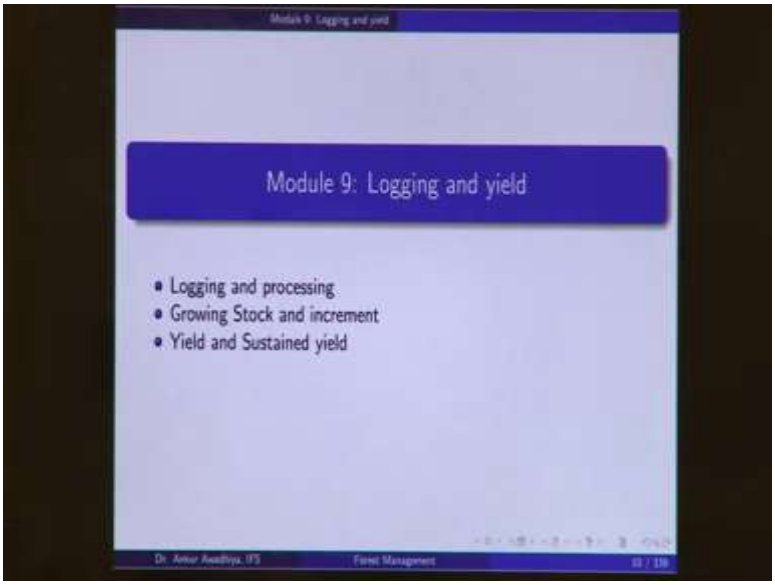
Forests and Their Management
Dr. Ankur Awadhiya
Department of Biotechnology
Indian Institute of Technology, Kanpur

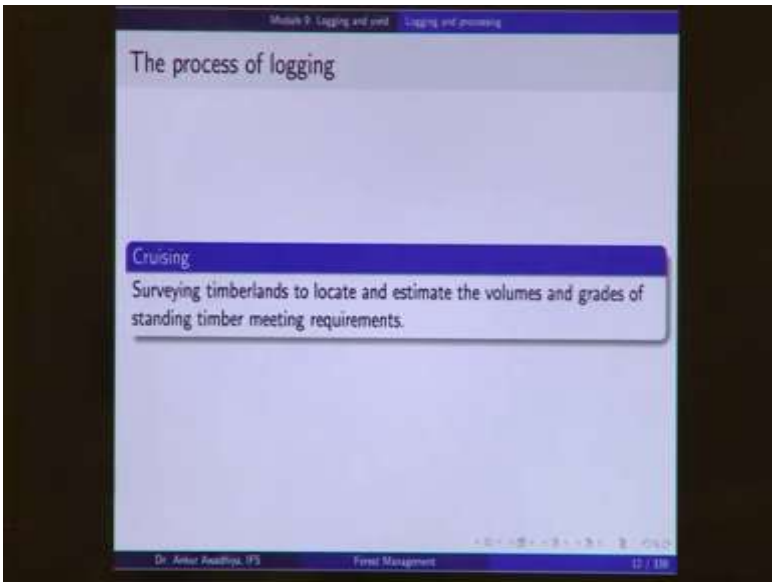
Module - 12
Revision
Lecture - 36
Revision (Part 3)

(Refer Slide Time: 00:16)



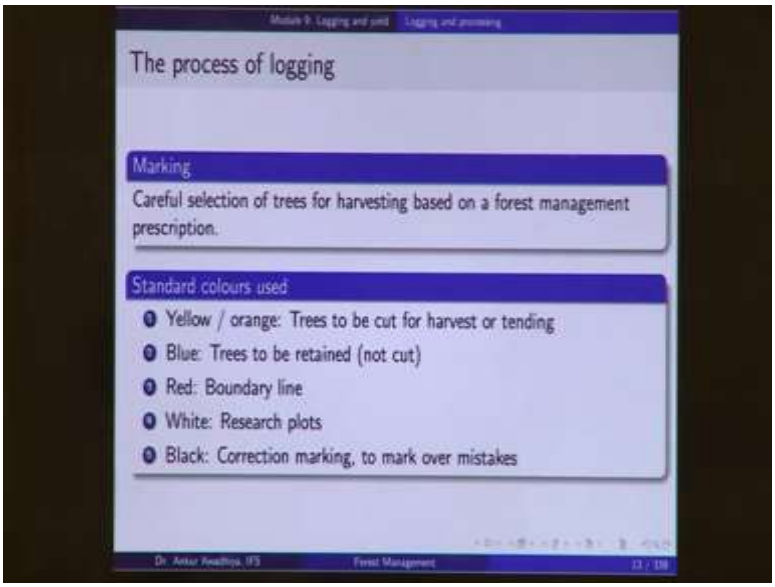
[FL] We move forward with our Revision module. So, in module 9, we looked at logging and yield, logging and processing, growing stock and increment, and yield and sustained yield.

(Refer Slide Time: 00:25)



Now, logging; the process of logging or cutting trees and harvesting trees begins with this stage of cruising, in which the timber lands are surveyed to locate and estimate the volume and grade of standing timber that meets the requirements.

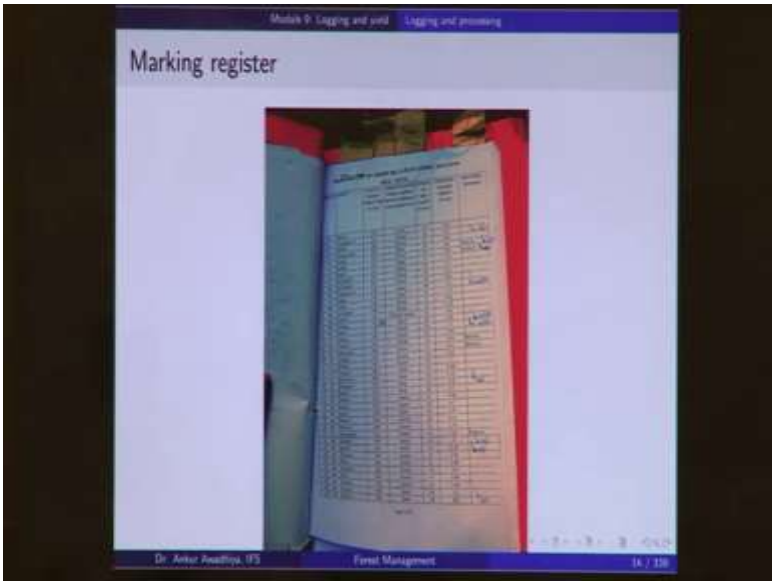
(Refer Slide Time: 00:38)



This is followed by marking which is a selection of trees for harvesting; based on forest management prescription, standard colours are used. And, typically, yellow or orange means that a tree has to be cut for harvest, blue means that it has to be retained.

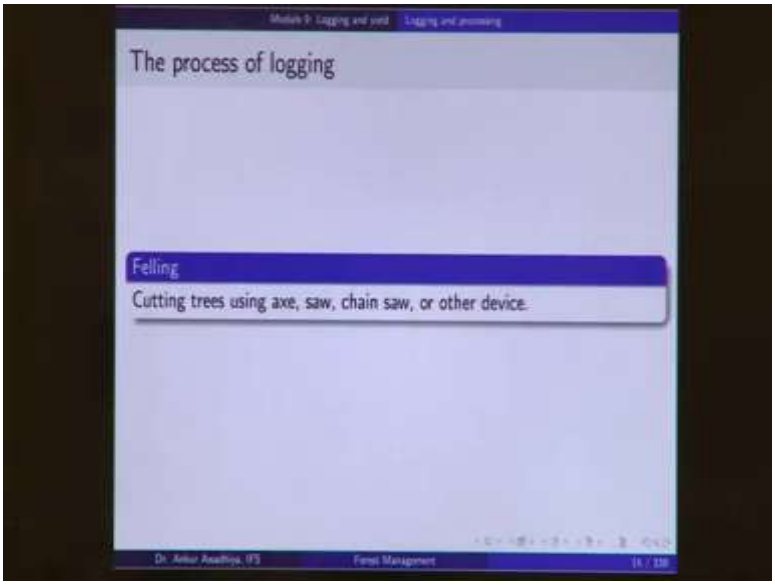
Typically, we use blue for trees that are very close to a river, red is boundary line, white is research plot and black is a correction marking to mark over the mistakes.

(Refer Slide Time: 01:07)



So, during marking, we make an enumeration register followed by a marking register. The enumeration register tells us what each tree is, how does it look like, what are its characteristics. And then, the marking register makes use of the enumeration register to specify which trees are to be felled, and how do these trees look like, what is their species, what is their diameter, what is the height, what is the condition and so on.

(Refer Slide Time: 01:37)

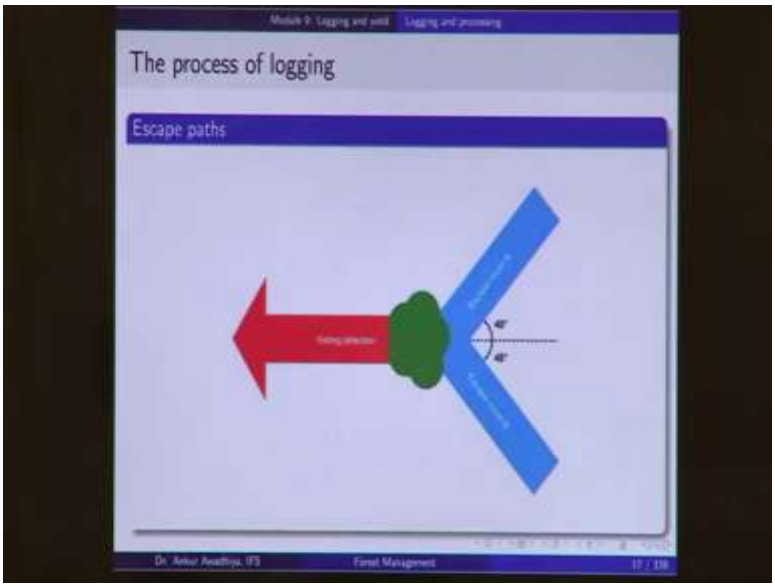


Then, felling is done and using axe, saw, chain saw, or other devices.

(Refer Slide Time: 01:43)

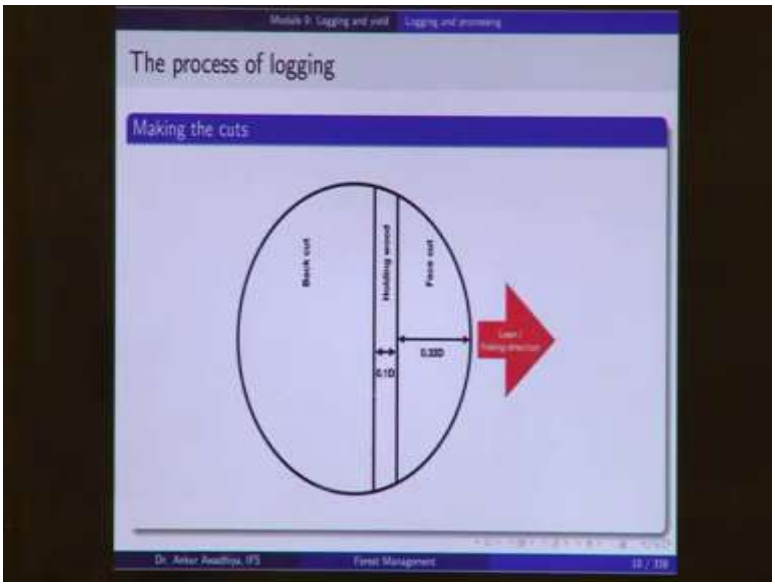
The most important factor is safety on the floor and especially, the distances that need to be maintained from different equipment and also from the falling tree.

(Refer Slide Time: 01:53)



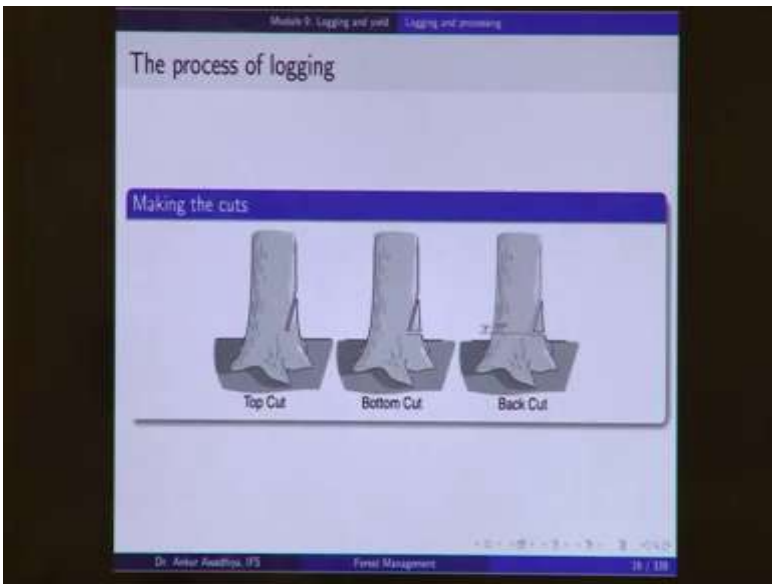
So, we decide on the escape paths, which are typically 45 degrees to the back of the felling; we decide on 2 escape paths for every tree.

(Refer Slide Time: 02:03)



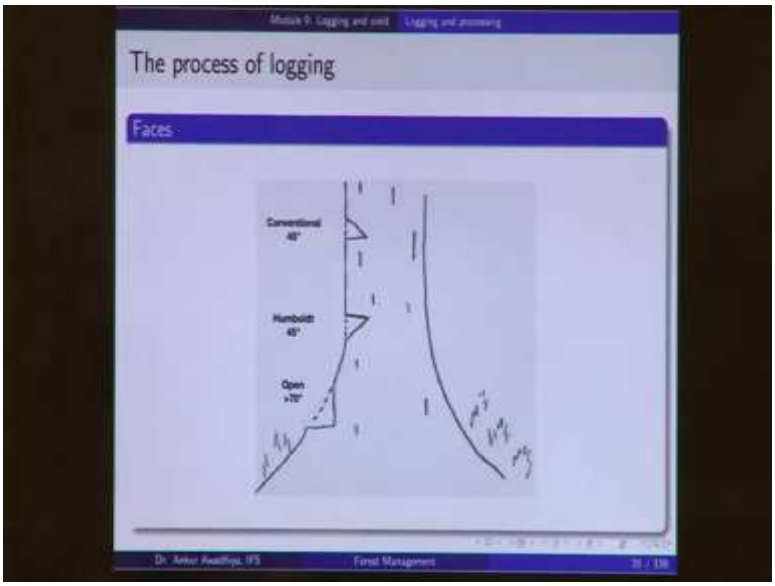
Now, in the process of logging, we make the cuts. So, there are different cuts; you have the face cut, on the front which comprises of the top cut, and the bottom cut, and followed by a back cut, and the portion that remains in between is known as the holding wood which also acts as hinge.

(Refer Slide Time: 02:23)



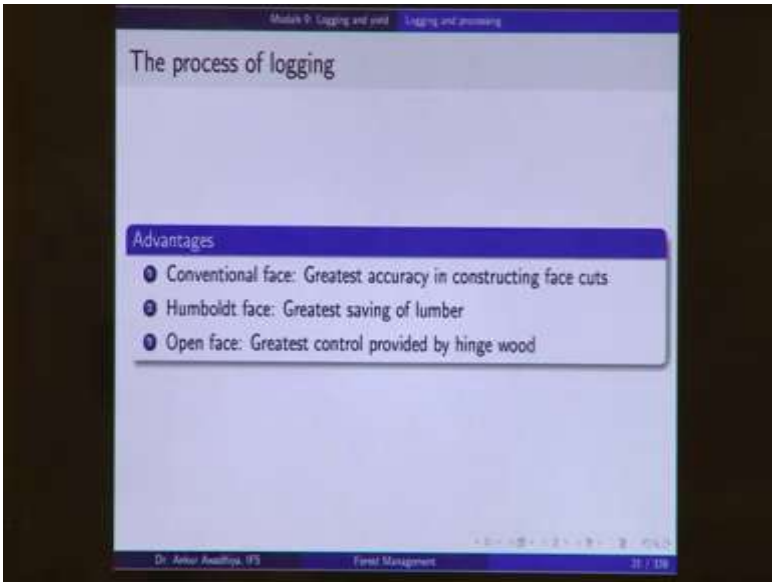
So, this is how the cuts are made. You make the top cut, then bottom cut, followed by the back cut.

(Refer Slide Time: 02:29)



Now, conventionally, 3 faces are generally used. The first one is a conventional face where the top cut is at 45 degrees, the bottom cut is parallel to the ground, the Humboldt cut has a top cut which is parallel to the ground, and a bottom cut which is downwards and there is also an open cut where the angle is greater than 70 degrees.

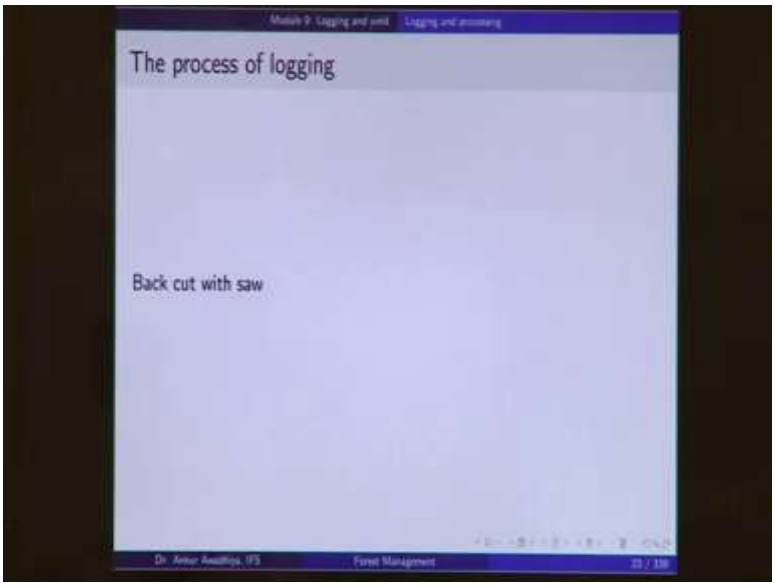
(Refer Slide Time: 02:51)



And, all these 3 faces have different advantages. The conventional face has the greatest accuracy in constructing the face cuts, Humboldt face has the greatest saving of timber, and open face provides the greatest control by the hinge wood.

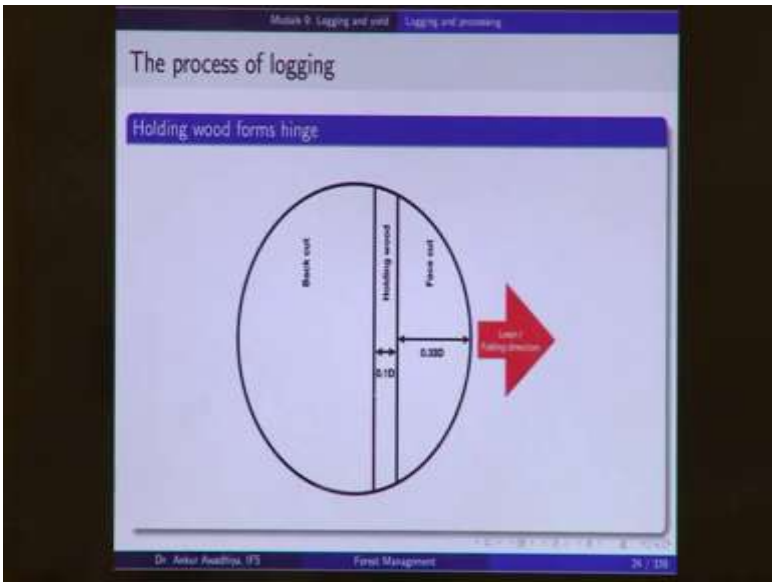
(Refer Slide Time: 03:04)

(Refer Slide Time: 03:07)



So, this is how a front cut is being made.

(Refer Slide Time: 03:09)



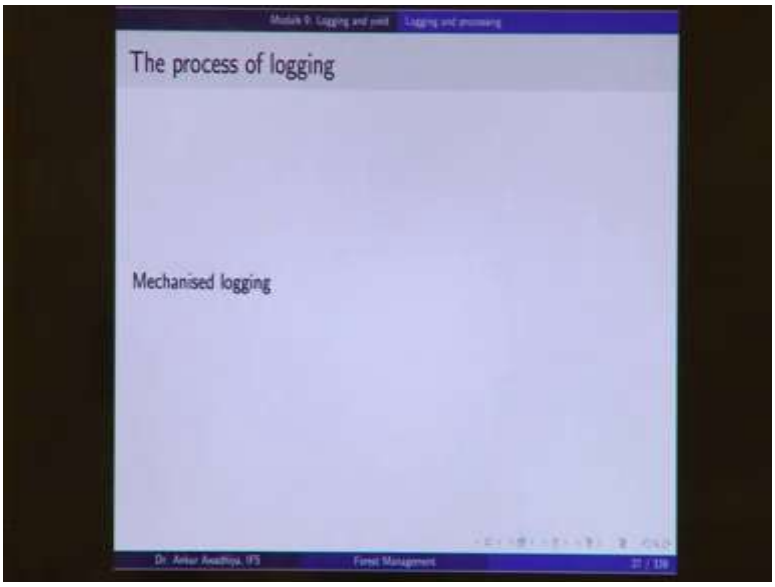
Back cut made with a saw and the portion that remains makes up for a hinge.

(Refer Slide Time: 03:12)

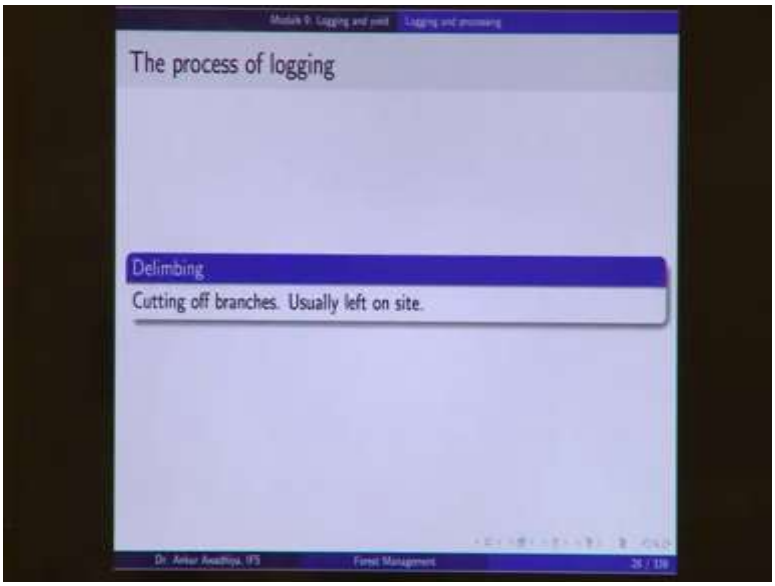
(Refer Slide Time: 03:19)

So, this is how a stump looks like. Then, you have the felled logs.

(Refer Slide Time: 03:22)

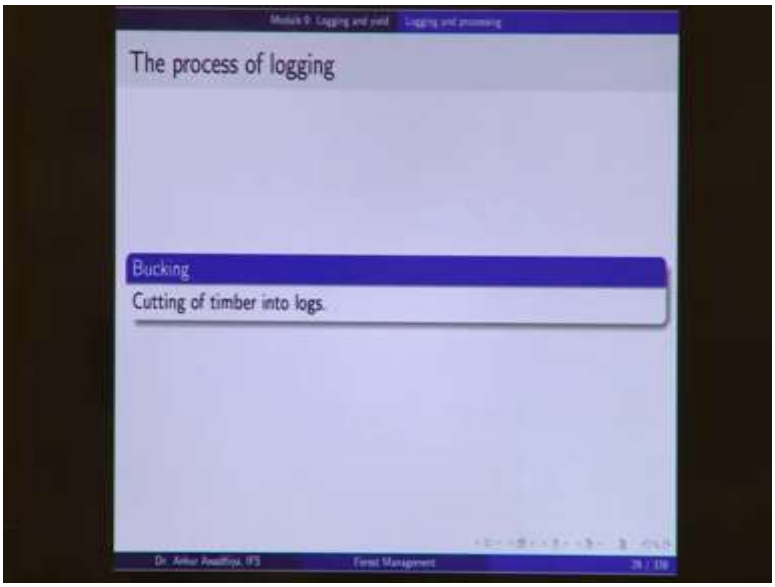


(Refer Slide Time: 03:23)



Then, these felled logs are delimbed. So, delimbing is the process of cutting off the branches. Generally, these branches are left on the site so as to protect the regeneration and also to act as food for the herbivores.

(Refer Slide Time: 03:43)



But, in our country, because of a dearth of timber, we generally these branches are also taken out.

(Refer Slide Time: 03:46)

Then, bucking is the process of cutting the timber to size.

(Refer Slide Time: 03:48)

Then, hammer marks are put on this on these timber blocks.

(Refer Slide Time: 03:52)

(Refer Slide Time: 03:57)

And then, these timber is skidded from the logging area to the landing area, typically using elephants or tractors or labour, and then on the landing site, these timber are arranged in the form of stacks.

(Refer Slide Time: 03:59)

(Refer Slide Time: 04:01)

(Refer Slide Time: 04:02)

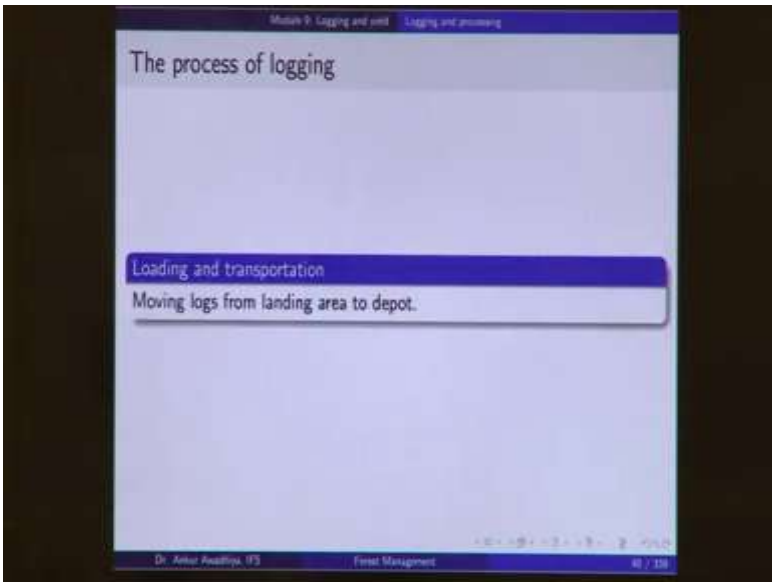
(Refer Slide Time: 04:09)

(Refer Slide Time: 04:10)

(Refer Slide Time: 04:12)

So, this is how stacks look like; and these stacks are also known as thappis, and in the we also maintain register for a thappi.

(Refer Slide Time: 04:20)



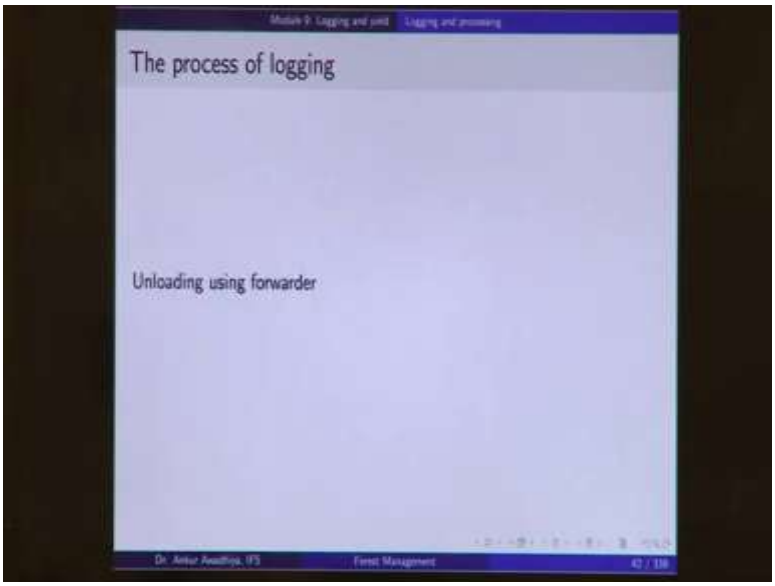
And then, there is loading and transportation in which the logs are moved from the landing area to a depot.

(Refer Slide Time: 04:26)

This loading can be done using a crane ,or through using a forwarder; is a machine in which you have a truck and a crane together.

(Refer Slide Time: 04:29)

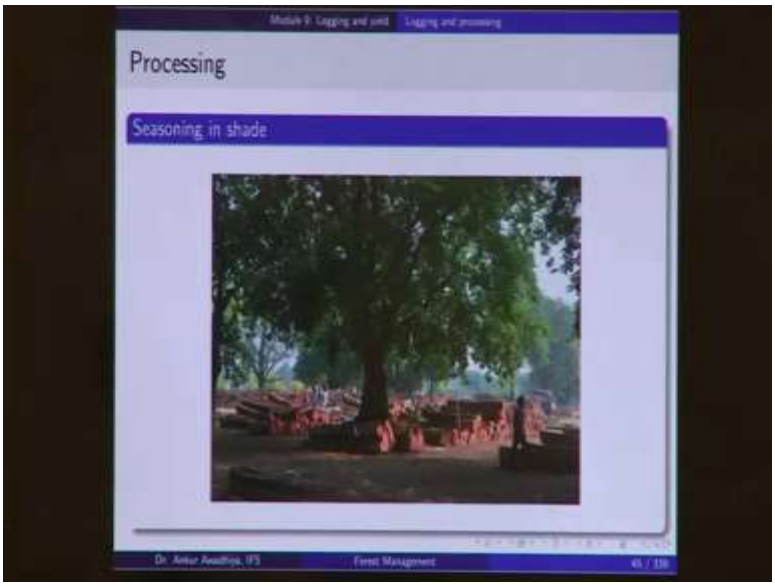
(Refer Slide Time: 04:37)



(Refer Slide Time: 04:38)

Then, it is unloaded in a depot.

(Refer Slide Time: 04:40)



(Refer Slide Time: 04:54)

And, in the depot, the typical processes are seasoning in which is a process in which the amount of moisture in the wood is reduced slowly so as to avoid any deformities. Then, grading is done in which timber of similar size and shape and condition is put together. And then, the graded lots are made; they are again marked with paint.

(Refer Slide Time: 05:03)

(Refer Slide Time: 05:04)

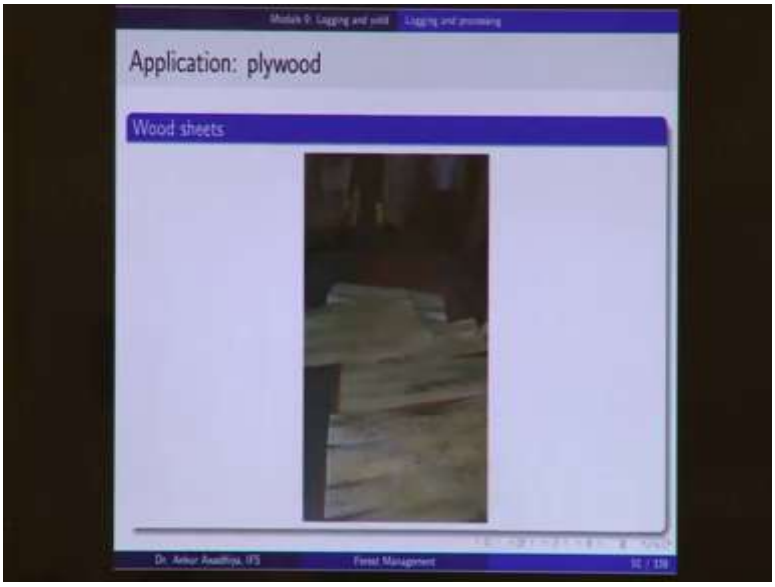
(Refer Slide Time: 05:06)

And then, they are put up for auction.

(Refer Slide Time: 05:09)

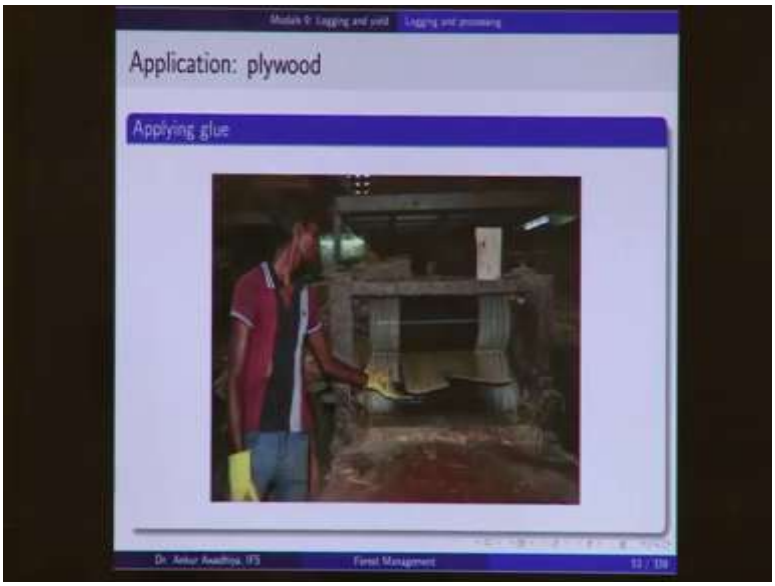
Now, people can use the this wood directly to make furnitures or other stuffs, or they can convert it into plywood and generally soft wood is used to make plywoods. In the process of making plywood, first of all the the timber is converted into thin sheets like shavings and then these sheets are glued together using a press.

(Refer Slide Time: 05:26)

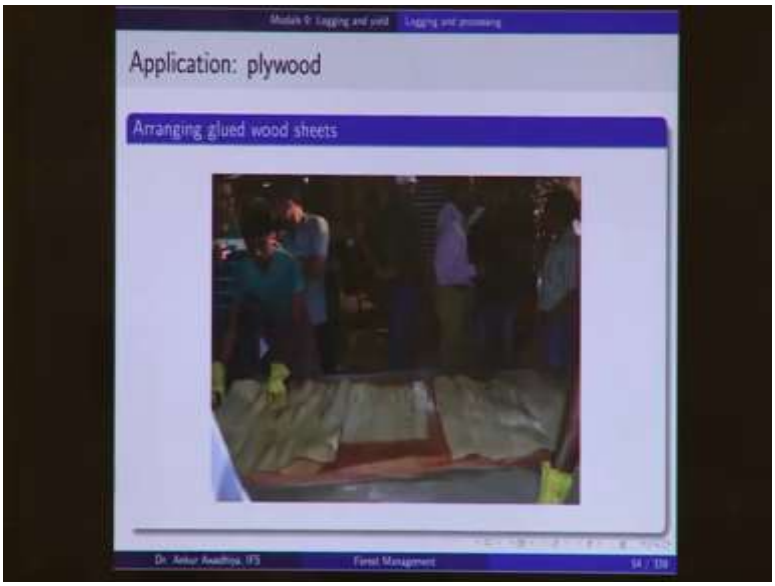


(Refer Slide Time: 05:29)

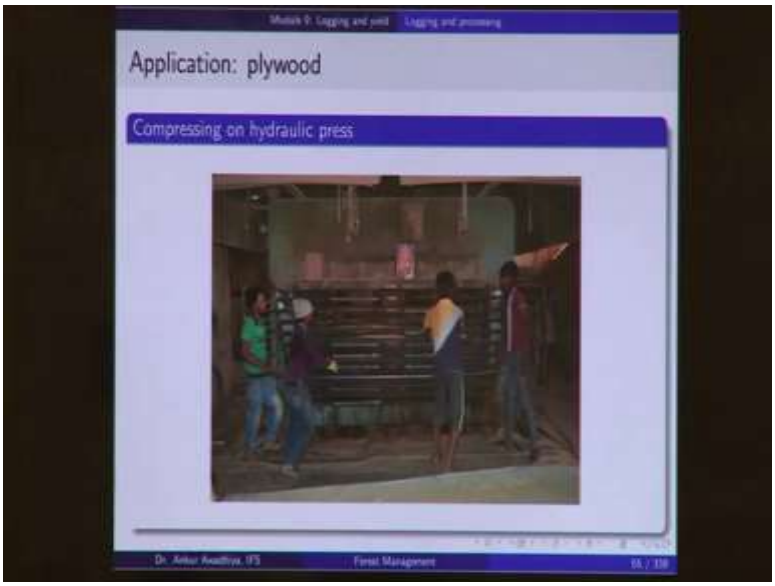
(Refer Slide Time: 05:30)



(Refer Slide Time: 05:31)



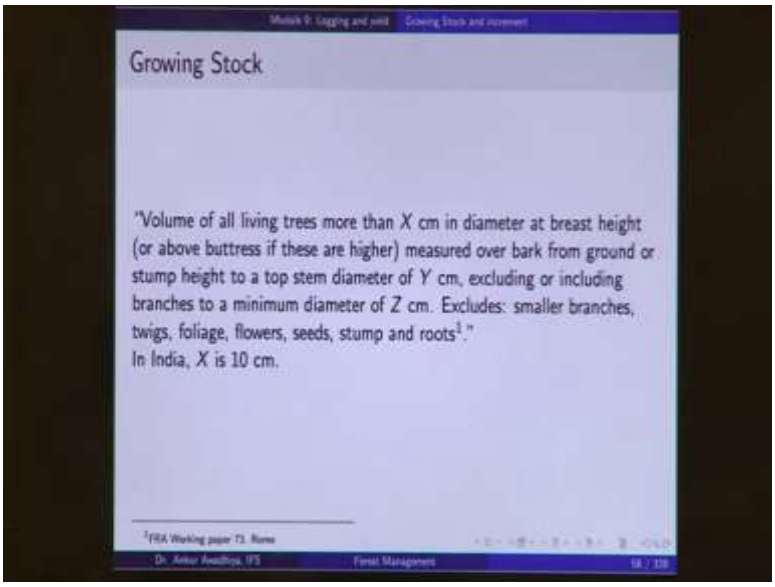
(Refer Slide Time: 05:32)



(Refer Slide Time: 05:33)

In the next lecture, we looked at growing stock in increment.

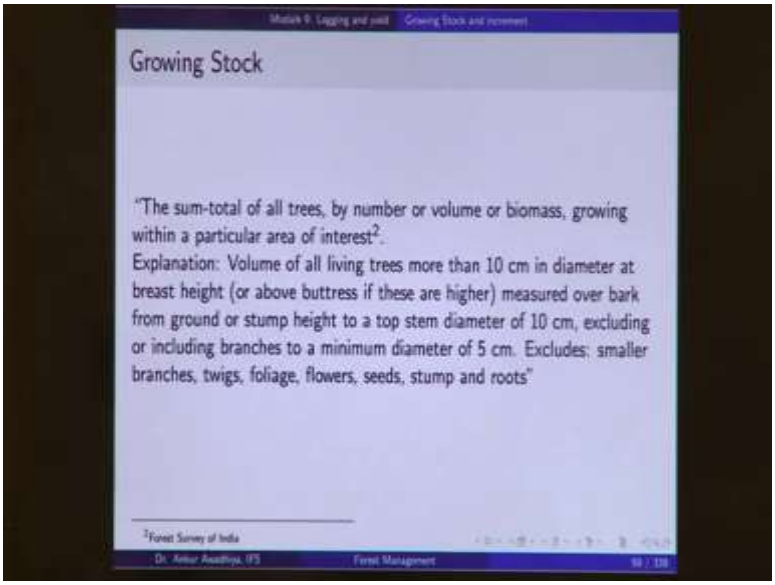
(Refer Slide Time: 05:36)



Growing stock is defined as volume of all living trees more than X centimeter in diameter at breast height or above buttress if these are higher, measured over bark from the ground or stump height to a top stem diameter of Y centimeter, excluding or including branches to a minimum diameter of Z centimetres. And, it excludes small branches, twigs, foliage, flowers, seeds, stump and roots. So, essentially growing stock is the volume of all the timber of all the trees put together, and because very small timber is

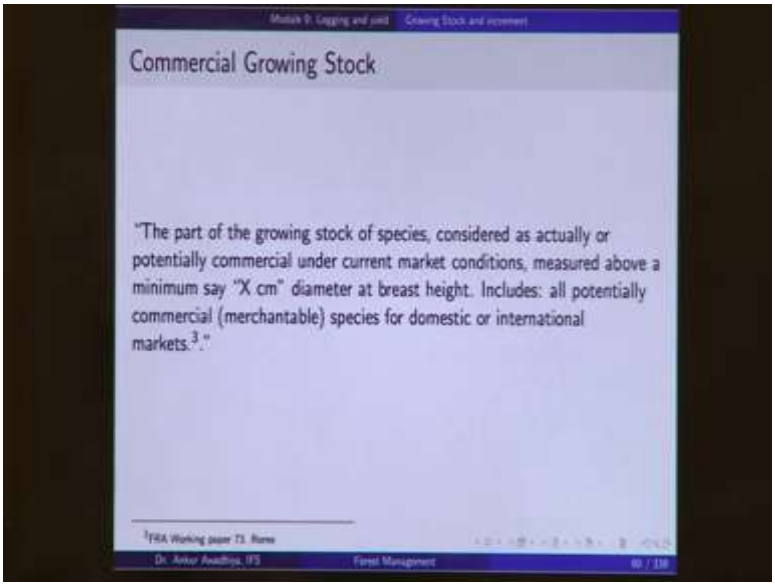
difficult to measure; so, we typically remove very small timber from these calculations. And, in India, X is taken to be 10 centimeters.

(Refer Slide Time: 06:23)



So, it is the sum total of all trees by number or volume or biomass growing within a particular area of interest.

(Refer Slide Time: 06:31)

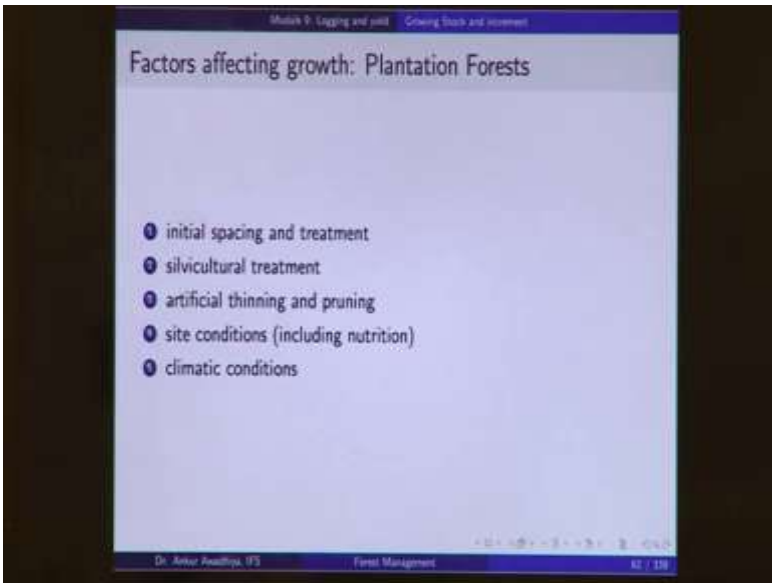


Now, we also define a commercial growing stock which is the part of the growing stock of species, considered as actually or potentially commercial under current market conditions, measured above a minimum say “X centimeter” diameter at breast height.

(Refer Slide Time: 06:45)

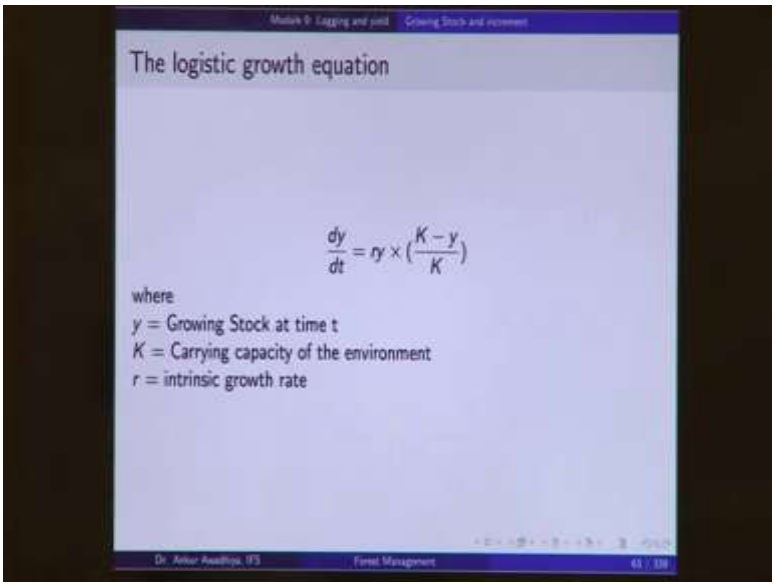
Now, there are different factors that affect growth in natural forest: regeneration, spatial distribution, silvicultural treatment, artificial thinning, site conditions, climatic conditions.

(Refer Slide Time: 06:57)



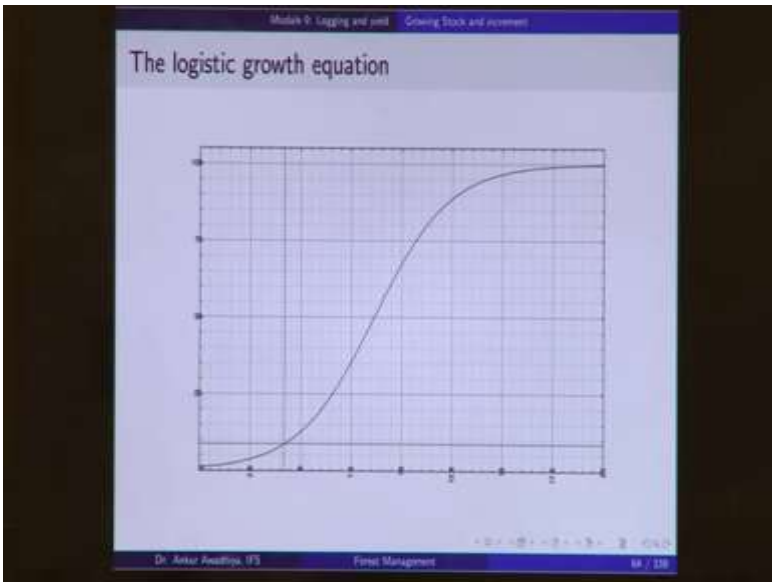
And similarly, in the case of plantation forests, these are the factors that influence growth, initial spacing and treatment, silvicultural treatment, artificial thinning and pruning, site conditions including nutrition and climatic conditions.

(Refer Slide Time: 07:12)



Next, we look at the logistic growth equation.

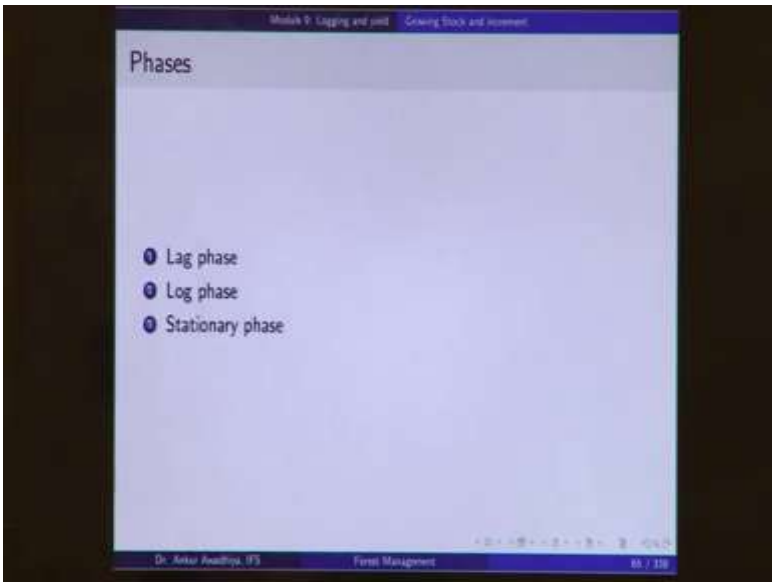
(Refer Slide Time: 07:16)



Which is the equation for the S shaped sigmoidal curve, and this tells us that the change in the growing stock which is dy by dt is equal to r, which is the intrinsic growth rate, multiplied by the growing stock at that particular point of time, multiplied by K minus y divided by K, where K is the carrying capacity of the environment.

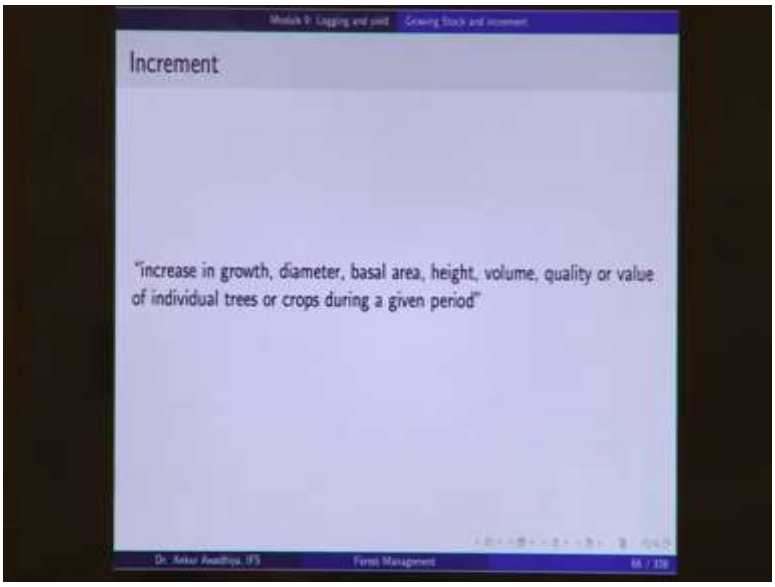
Now, if we look at this curve, there are 3 phases: this is the lag phase where the growth is very slow, this is height, and then you have the phase of stagnation or stability.

(Refer Slide Time: 07:50)



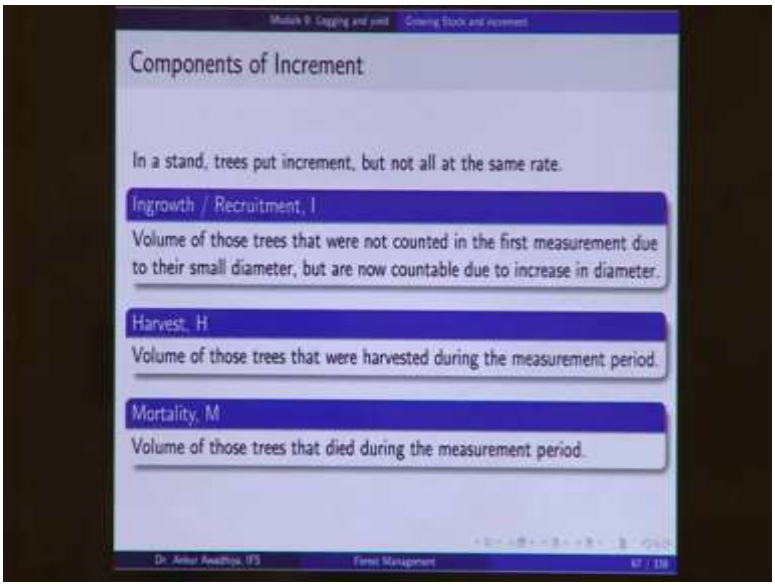
So, we have the lag phase, log phase and the stationary phase.

(Refer Slide Time: 07:54)



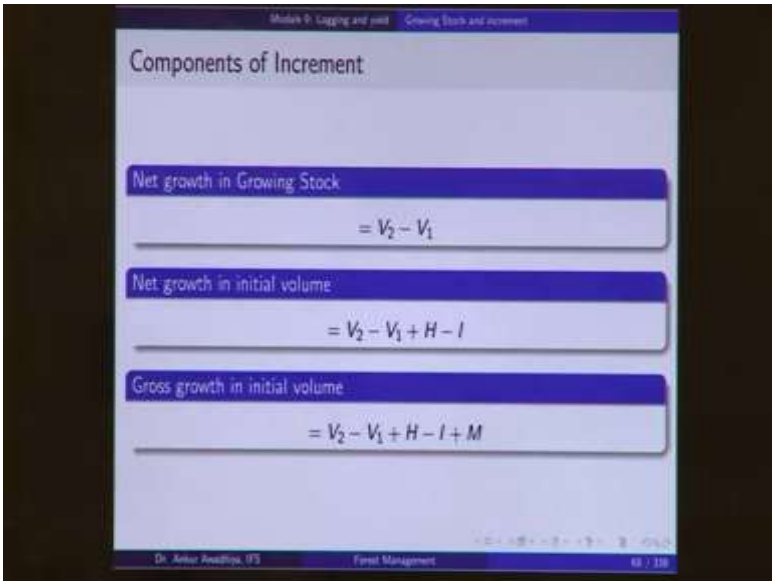
Now, increment is defined as an increase in diameter, growth, basal area, height volume, quality or value of individual trees or crops during a given period. So, increment is what is changing, what is the increase.

(Refer Slide Time: 08:07)



And, in a stand, trees put increment, but not all at the same time. And so, we define different components of increment. So, in growth or recruitment is the volume of those trees that were not counted in the first measurement due to their small diameter, but are now countable due to the increase in diameter. Harvest is the volume of those trees that were harvested during the measurement period; mortality is the volume of those trees that died during the measurement period.

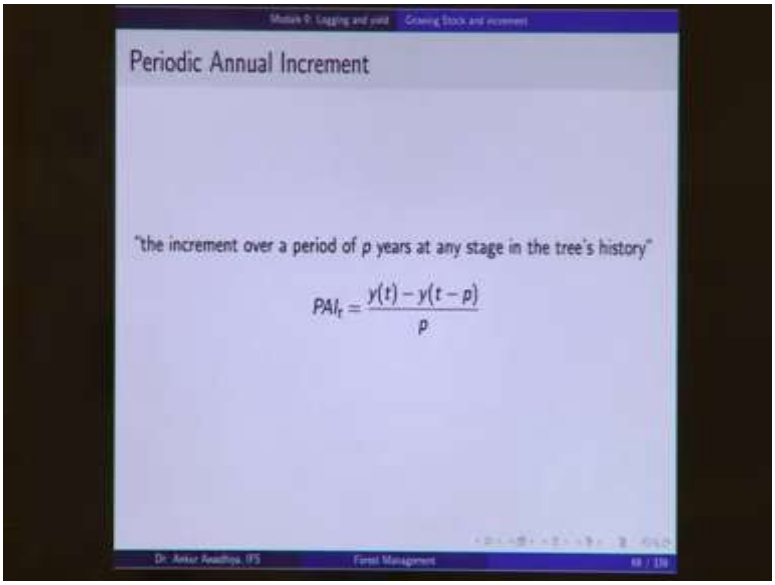
(Refer Slide Time: 08:35)



And then, we can define the net growth in growing stock as V 2 minus V 1 that is the change in the growing stock in the two measurement periods; so, V 2 minus V 1.

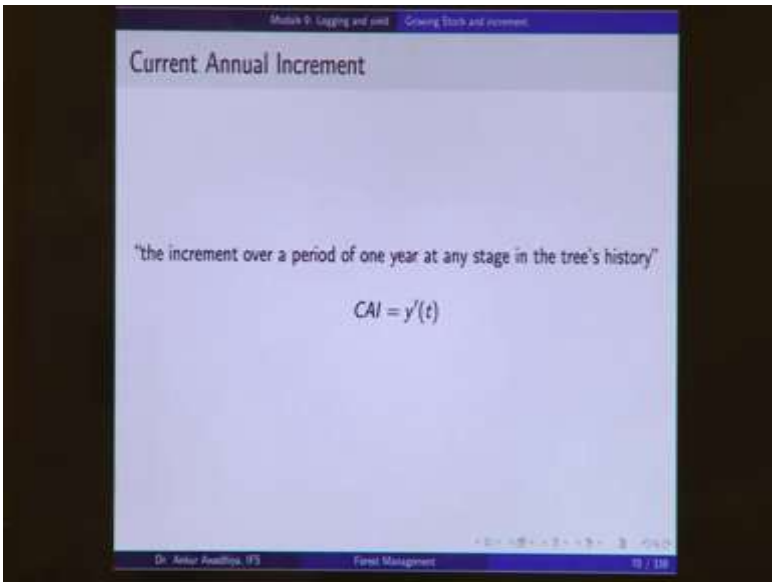
The net growth in initial volume is V 2 minus V 1 plus H, which is the trees that were harvested, minus I, which is the trees that were recruited in this period. And, gross growth in the initial volume is given as V 2 minus V 1 plus H minus I plus M.

(Refer Slide Time: 09:10)



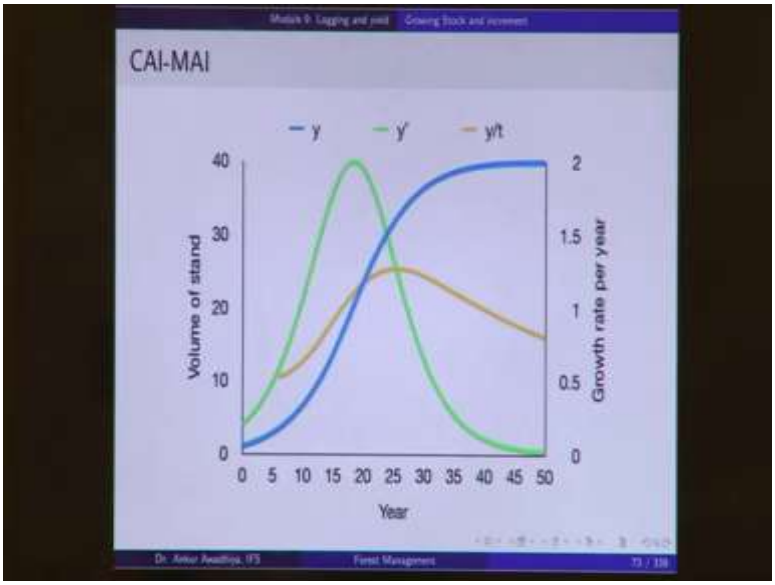
Then, we define periodic annual increment as the increment over a period of P years at any stage in a tree's history. So, it is PAI is the growing stock at time t minus growing stock at a time t minus p divided by P. So, this is the average rate of increment over a specific period.

(Refer Slide Time: 09:36)



If this specific period is made to be 1 year, then we call it a current annual increment which is the increment over a period of 1 year, at any stage in the tree's history.

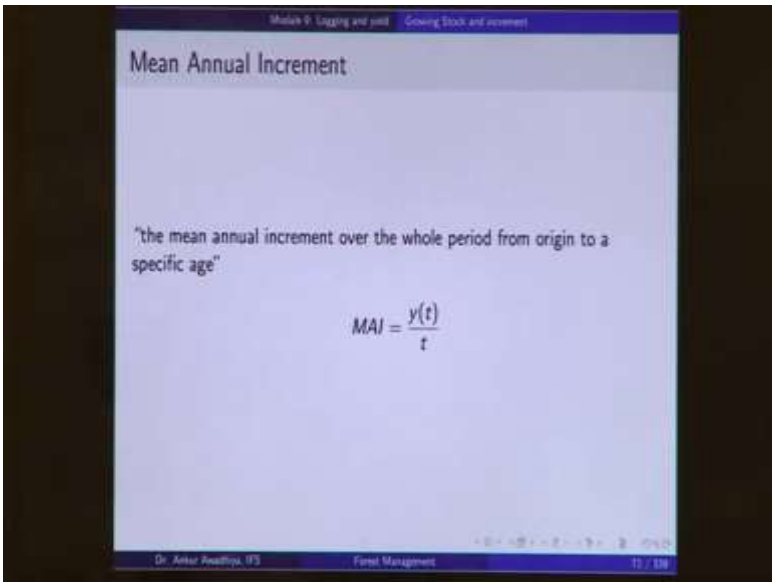
(Refer Slide Time: 09:46)



So, if we looked at the logistic growth equation, the CAI will be given as the differential of this curve or y prime t.

So, here, you have the logistic growth equation, this one is y prime. Now, y prime is essentially the slope of this curve. So, in this portion, it will be very less; in this portion it will be very less; in this portion it will be maximum, which is what we are seeing here.

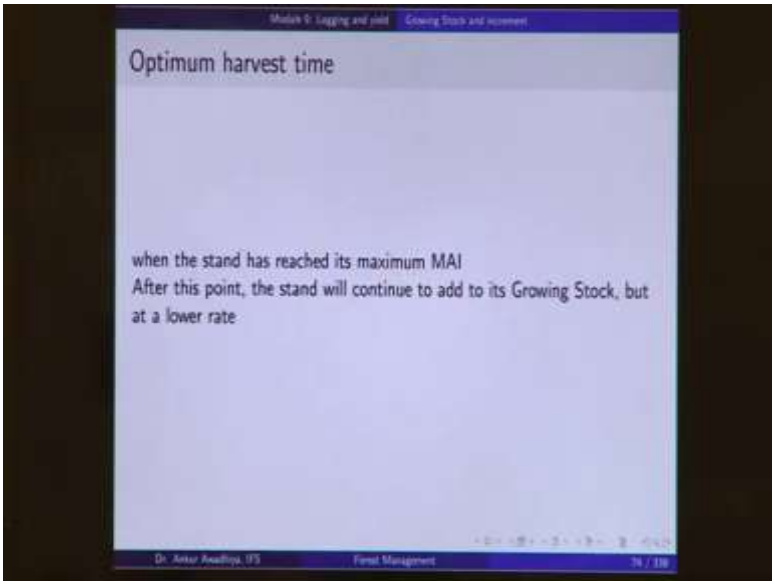
(Refer Slide Time: 10:13)



We also defined mean annual increment which is the increment over the whole period from origin to a specific age. So, mean annual increment is given by the growing stock at time t divided by t, which is what we are seeing here by this yellow curve.

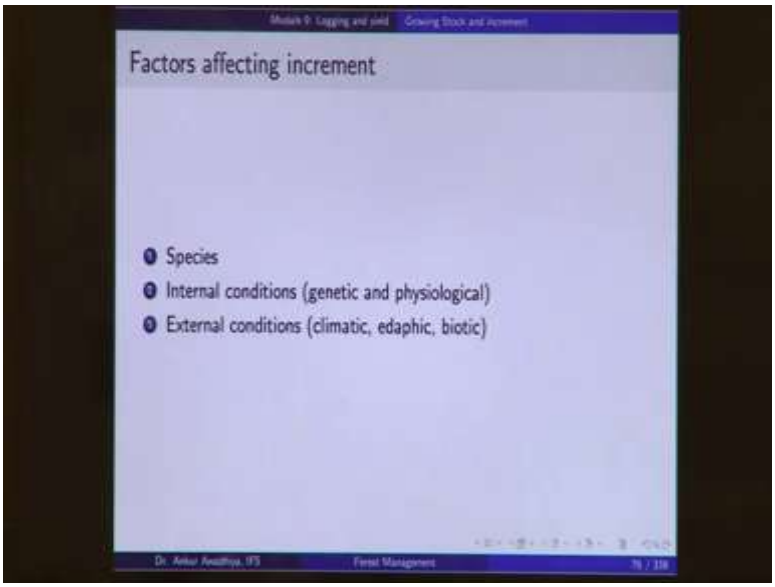
Now, the CAI is maximum at the point of inflection, and the MAI is maximum at the point where CAI and MAI are cutting each other.

(Refer Slide Time: 10:43)



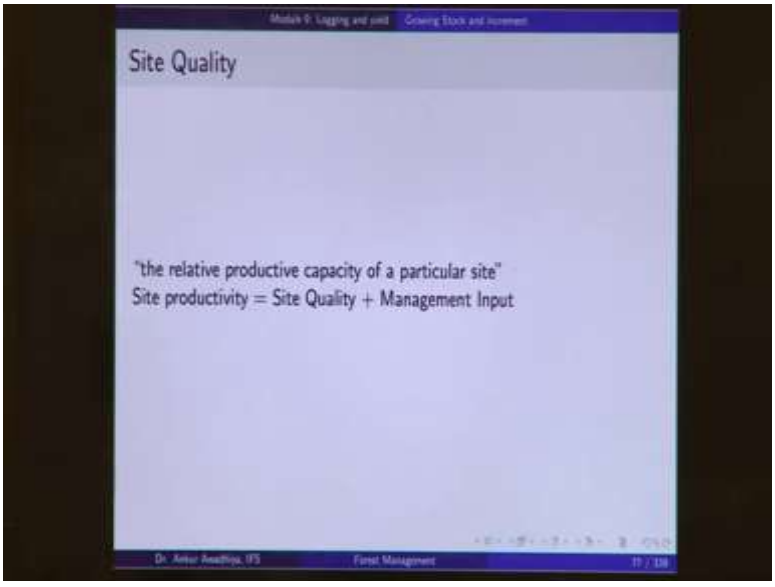
And, the this point of cutting also gives us the optimum harvest time, this is the time when the stand has reached its maximum mean annual increment, after this point the stand will continue to add it to its growing stock, but at a lower rate.

(Refer Slide Time: 10:58)



Now, what are the factors affecting increment? These are species, internal conditions: both genetic and physiological, and external conditions: climatic, edaphic and biotic.

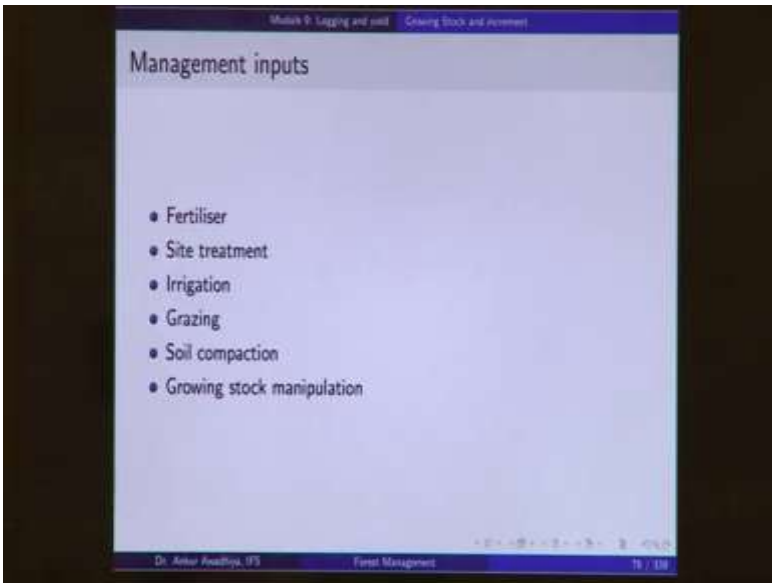
(Refer Slide Time: 11:08)



Site quality is defined as the relative productive capacity of a particular site. The relative productive capacity not the absolute productive capacity, because the at the absolute

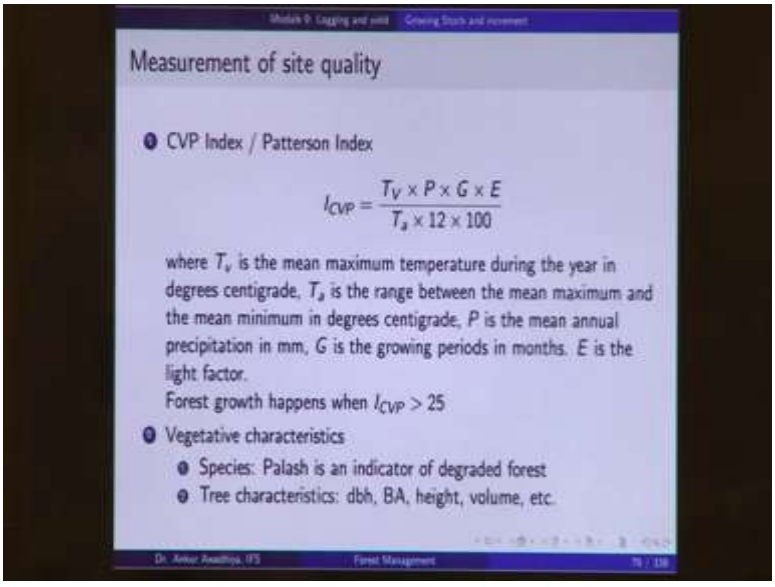
productive capacity is given by a combination of site quality plus the management inputs. So, site quality ask the question, if you are not doing any management input to the site, what is the amount of growing stock or increment that this site can support?

(Refer Slide Time: 11:39)



Now, what are the management inputs? They are fertilizer, site treatment, irrigation, grazing, control over soil, compaction and growing stock manipulation.

(Refer Slide Time: 11:48)

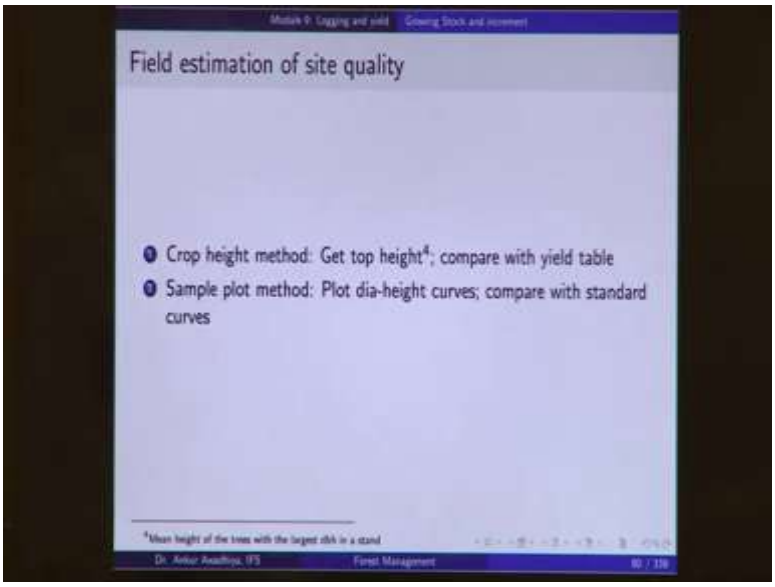


Now, the measurement of site quality is done in through various methods. The first one is the CVP index or the Patterson index; this is the formula TV into P into G into E

divided by T a into 12 into 1000 and forest growth happens only when I is greater than 25. The other option is that of looking at the vegetative characteristics. So, you actually look at what plants are growing in that area.

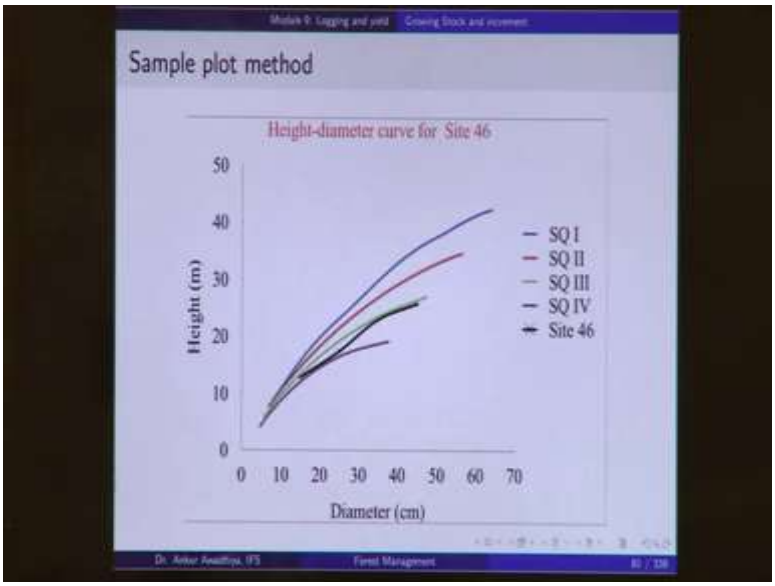
So, you can look at the species such as, if you see that Palash is there in in an area; then Palash is an indicator of a degraded forest or it tells you that the site quality is not that high, and you can also look at tree characteristics, that is you can look at what is the size of the trees that are actually growing there. If they have a large DBH, if they have good basal area, if they have good height, good volume, then it will tell us that the site quality is good.

(Refer Slide Time: 12:42)



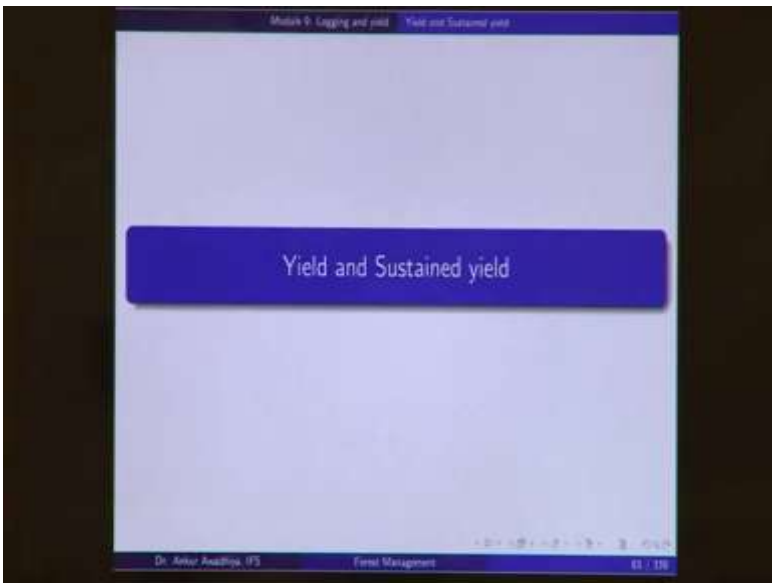
Now, field estimation of site quality is done through 2 methods: crop height method and the sample plot method. Now, in the crop height method, you get the top height and compare it with the yield table, which will give you the top heights for different site qualities. Now, top height is not the height of the tallest trees; it is the mean height of trees with the largest DBH in a stand. This; the second method; is the sample plot method in which case we plot the diameter height curves and then compare them with the standards.

(Refer Slide Time: 13:13)

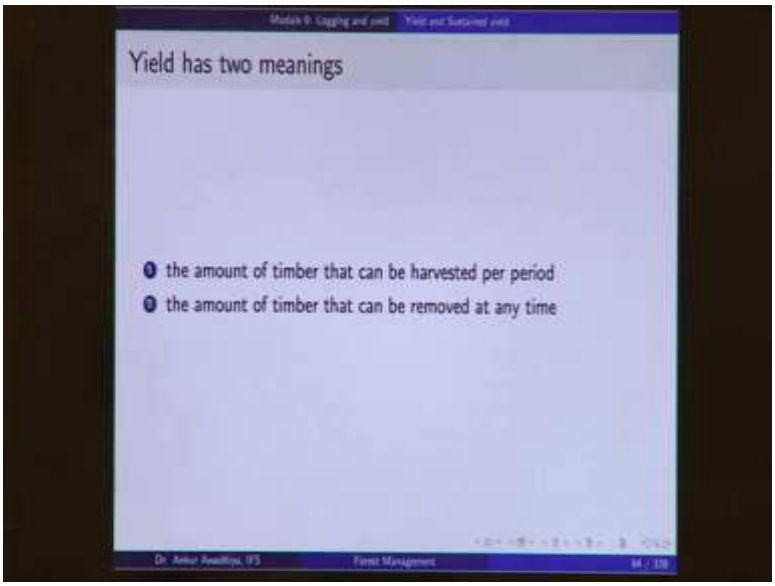


So, here we are seeing that there are these 4 different standards 1, 2, 3, 4 and, this is the actual field situation. So, we can say that this one is very close to site quality 3.

(Refer Slide Time: 13:30)

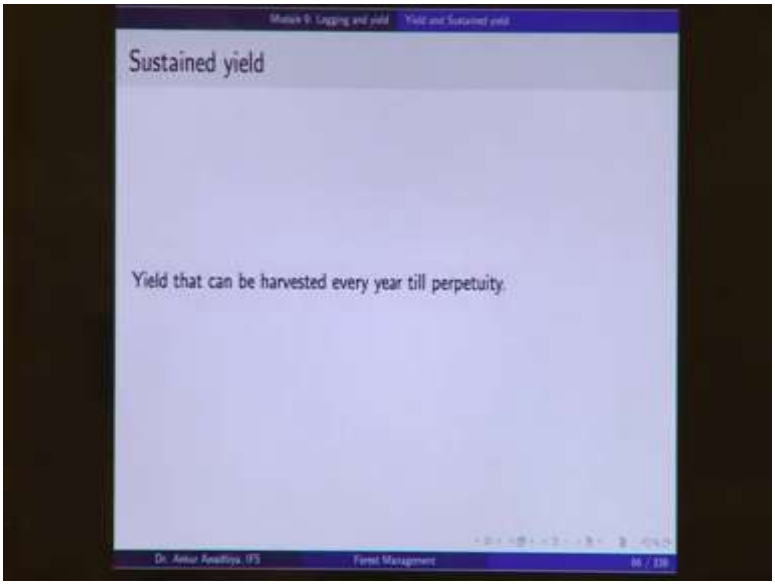


(Refer Slide Time: 13:34)



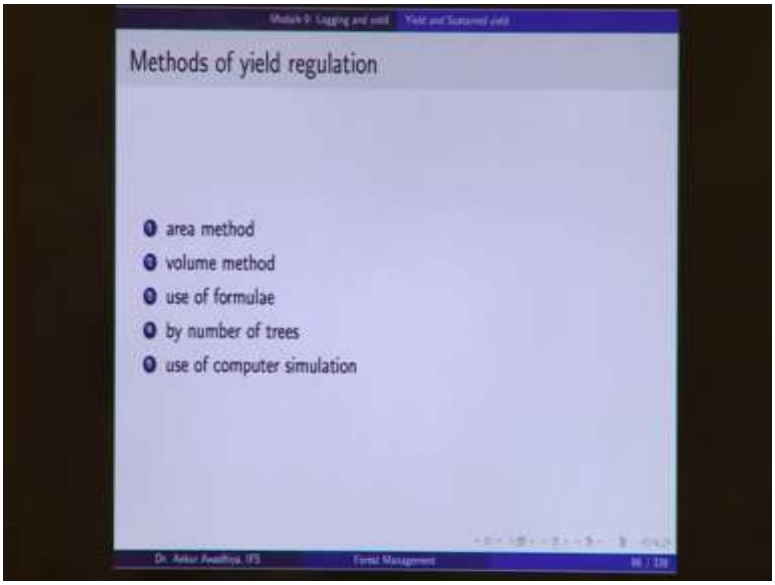
Next, we looked at yield and sustained yield. Yield has got two meanings: the amount of timber that can be harvested per period, which is typically taken to be 1 year. So, the amount of timber that you can harvest every year. Or, the second meaning is the amount of timber that can be removed at any time. We just asking the question that, if you look at a snapshot of the forest, what is the total inventory of growing stock that is available that can be removed..

(Refer Slide Time: 13:58)



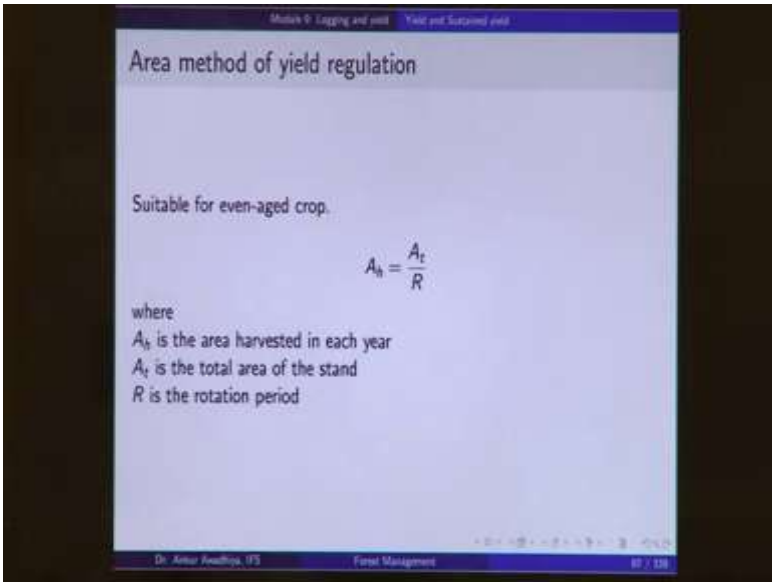
But typically, we go with sustained yield which is yield that can be harvested every year till perpetuity.

(Refer Slide Time: 14:04)



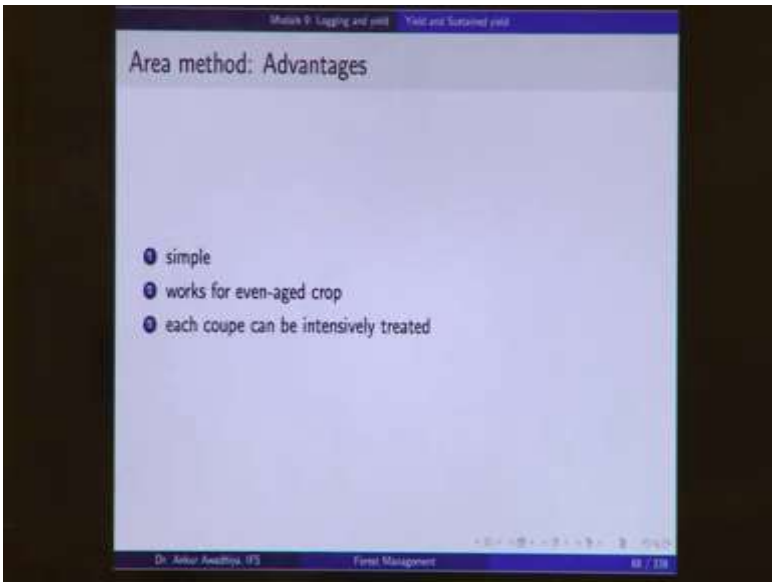
Now, to find out these yields or to compute these yields, we have different methods. The easiest one is the area method.

(Refer Slide Time: 14:13)



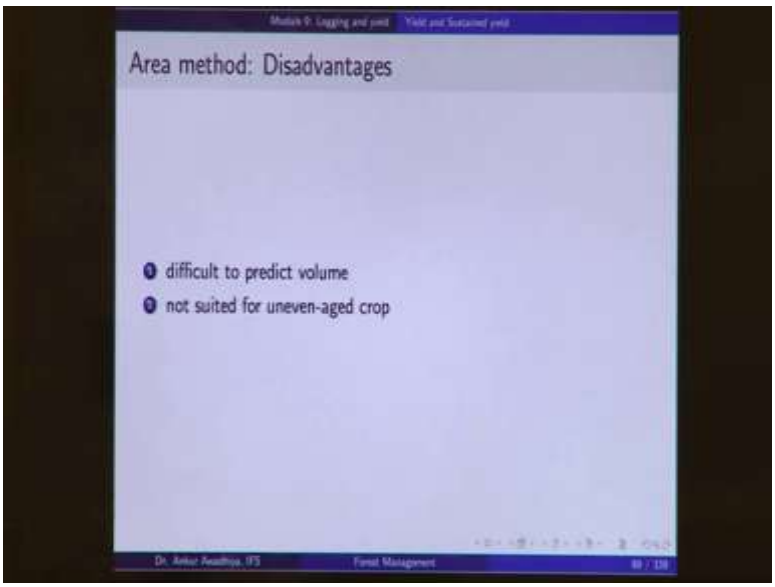
Now, in the area method, we say that for an even-aged crop the area that should be processed every year is equal to the total area divided by the rotation period.

(Refer Slide Time: 14:25)



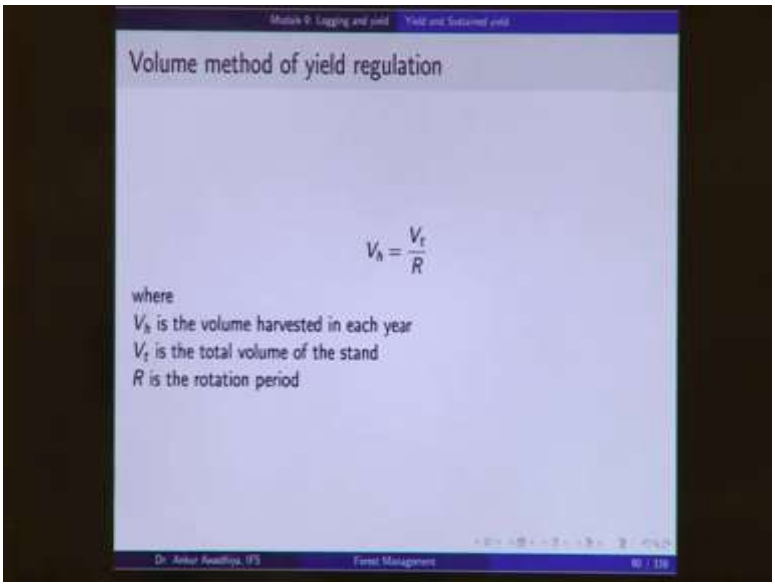
So, this is a very simple method. It works for even-aged crop; each coupe can be intensively treated.

(Refer Slide Time: 14:30)



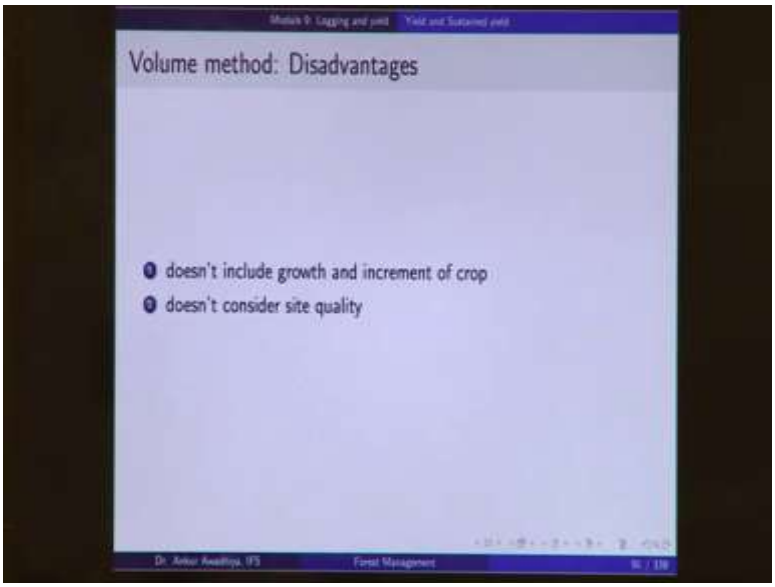
However, it is difficult to predict volume. So, you cannot tell what is the amount of timber that you will be extracting every year, what is the value that you will be generating every year, it's difficult to tell, and it is not suited for uneven-aged crops.

(Refer Slide Time: 14:45)



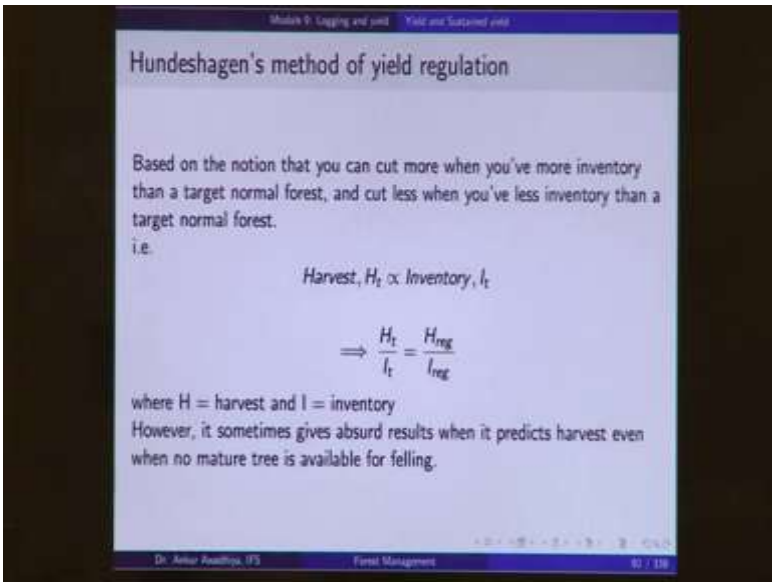
The second method is the volume method; it is a slight modification of the area method. So, the volume that can be extracted every year or the volume that can be harvested is equal to the total volume divided by the rotation period.

(Refer Slide Time: 14:59)



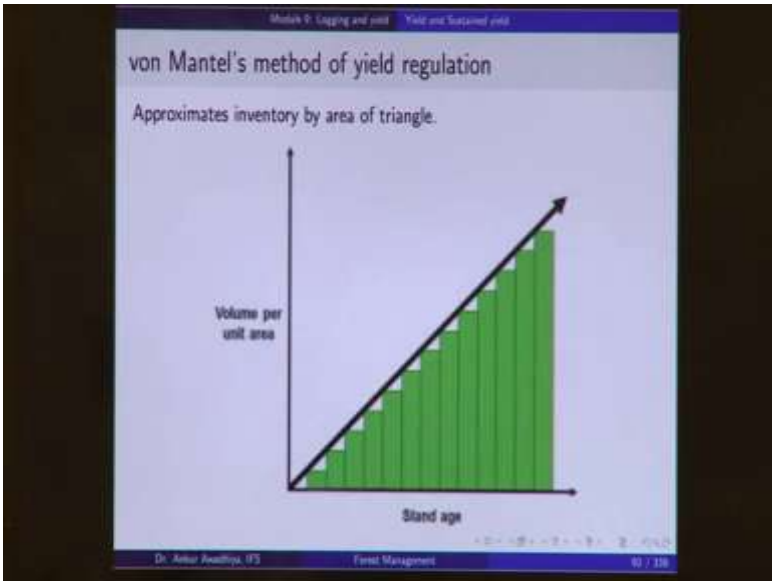
The disadvantages are that it does not include growth and increment of the crop and it does not consider the site quality.

(Refer Slide Time: 15:06)

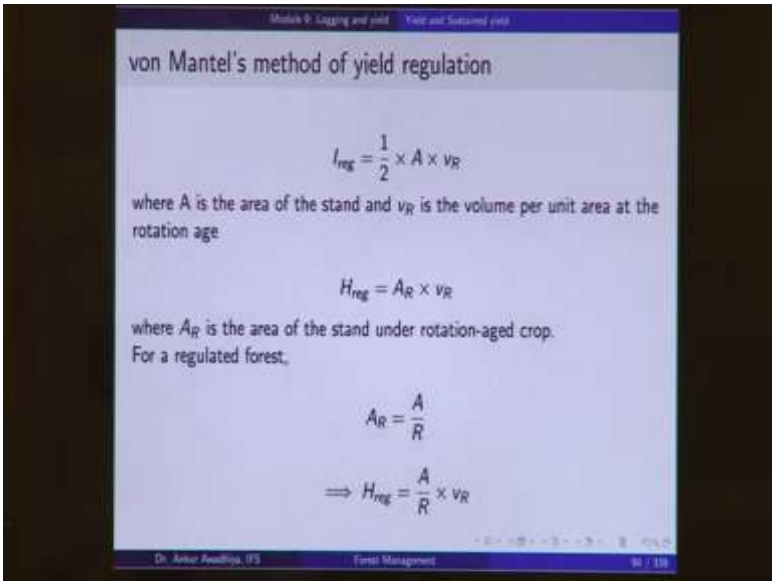


And, the next method is the Hundeshagen's method of yield regulation, which essentially says that, if you have more inventory, if you have more crop, then you can extract more. If you have less crop, you can extract less. So, essentially, harvest is proportional to the inventory or H by I is a constant. However, even in this case, there is an issue because in the case of very young crops; this will continue to give us some value of harvest, even though there is no tree that is mature enough for harvesting.

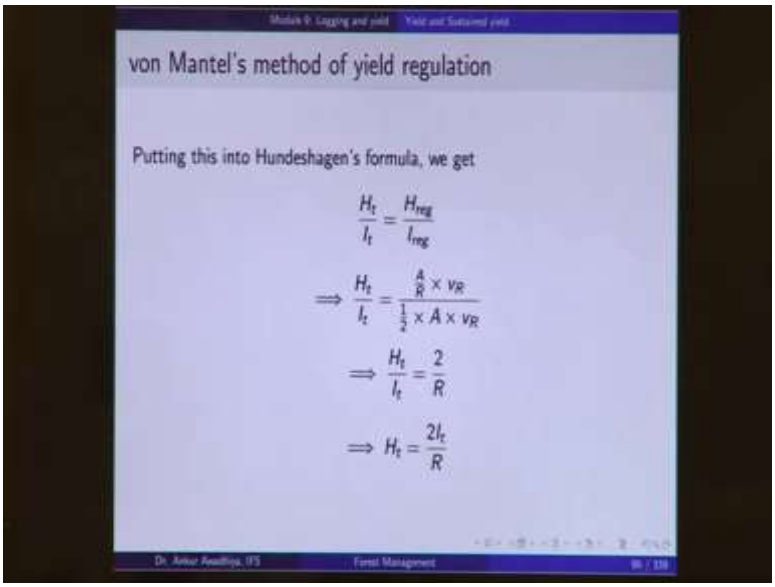
(Refer Slide Time: 15:38)



(Refer Slide Time: 15:44)

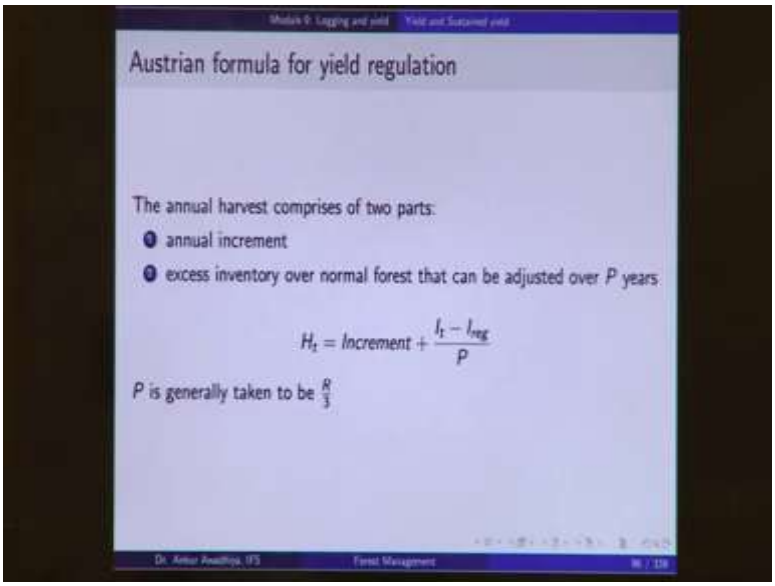


(Refer Slide Time: 15:46)



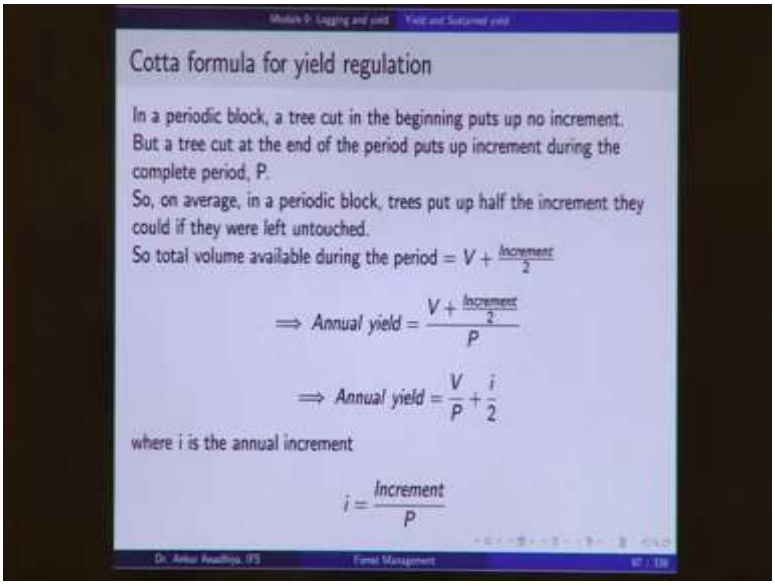
Now, one very commonly used method is the von Mantel's method, which approximates inventory by the area of a triangle, and it tells us that the volume that can be extracted every year is equal to 2 times of the inventory, divided by R or 2 times the growing stock divided by R. So, as against the volume method, which told us that the amount extracted is growing stock divided by R, this one says that you can extract 2 times of that because the growing stock is not a stationary thing; it is also putting up increment. So, this is an improvement over the volume method.

(Refer Slide Time: 16:13)



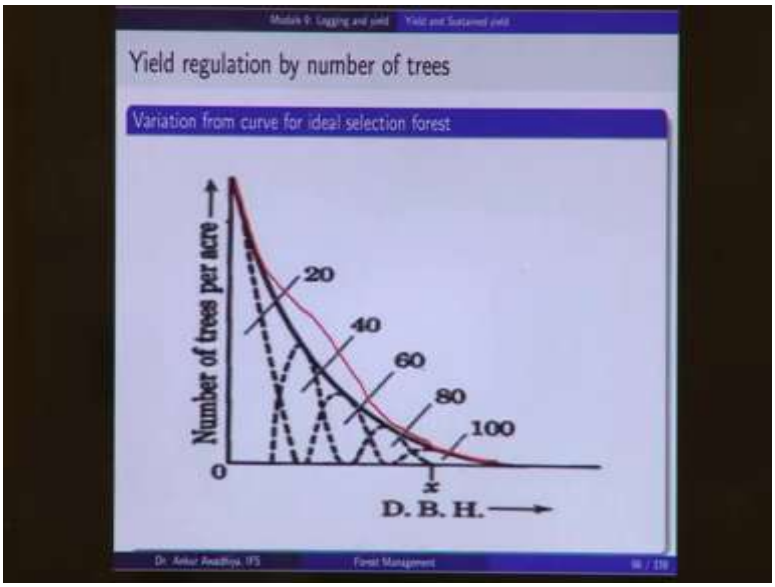
Then, we also have the Austrian formula which says that you can extract the annual increment, but then you also have to consider the excess inventory over the normal forest that needs to be adjusted and this adjustment can be done over a period of say P years. In which case, you will say that the amount extracted every year is increment plus I t minus I of a regular or a normal forest divided by P. P is generally taken to be one-third of the rotation period.

(Refer Slide Time: 16:43)



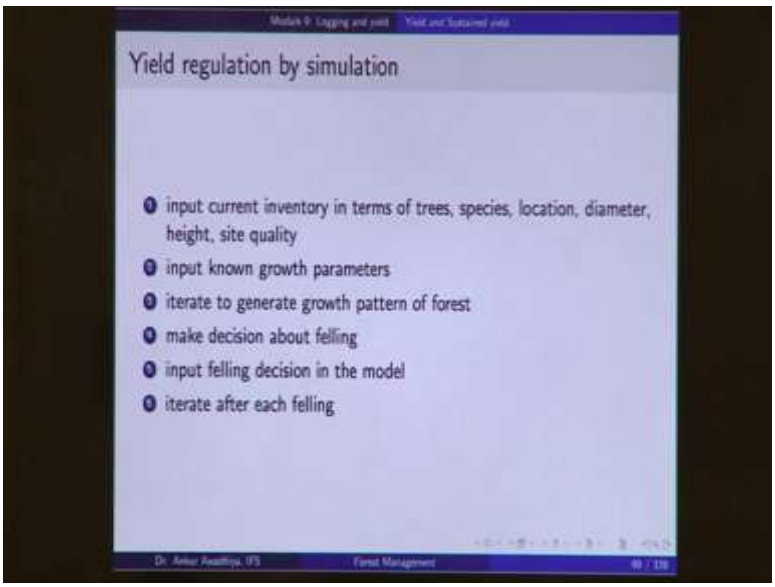
Next, we have the Cotta's formula. And, Cotta formula says that the volume that the annual yield is equal to the volume or the growing stock divided by the number of years in the periodic block plus i by 2, where i is the annual increment.

(Refer Slide Time: 17:04)



Then, the next method is yield regulation by the number of trees; in which case, we plot the curve for a normal forest, we plot the actual field situations. And, there in the ND curve; we can see that for each and every time interclasses, how many trees can be extracted to bring our forests close to the normal forest.

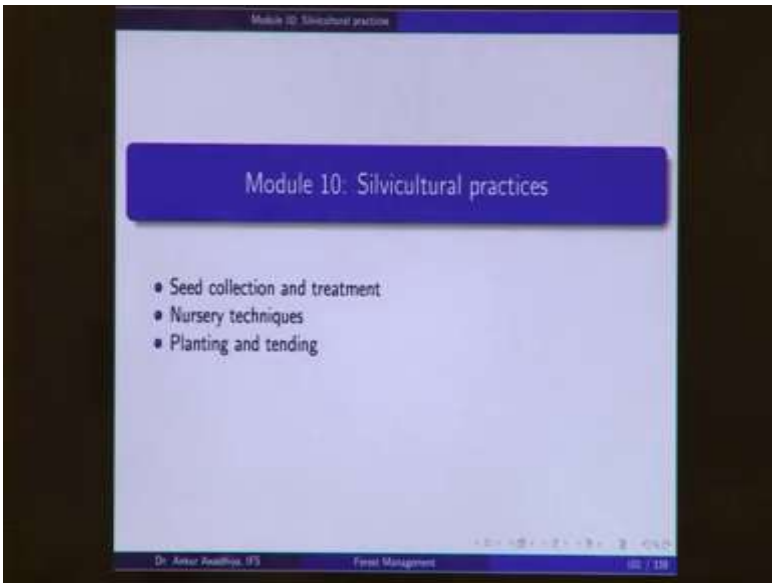
(Refer Slide Time: 17:24)



And finally, we have yield regulation by simulation through computers; in which case, we input the current inventory, we input growth parameters, we iterate it to get or to generate a growth pattern of the forest, make decisions about felling, input the felling decision to the model, and then iterate it once again. And, this process will go on again and again.

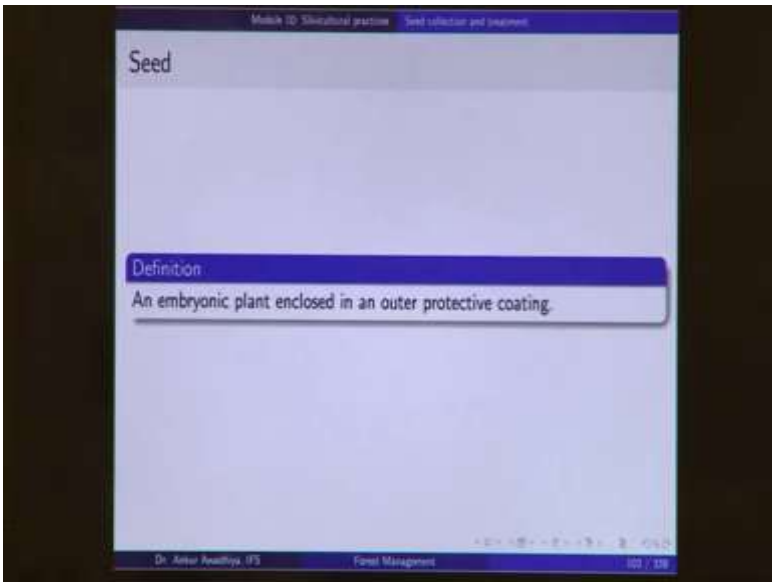
So, after this iteration, you will again make a decision about felling and put the felling decision, iterate. Then, again make a decision about felling, and put the felling decision, iterate and this process will go on and on.

(Refer Slide Time: 17:55)



Then, in module 10, we looked at silvicultural practices; that is seed collection and treatment, nursery techniques, planting and tending.

(Refer Slide Time: 18:04)

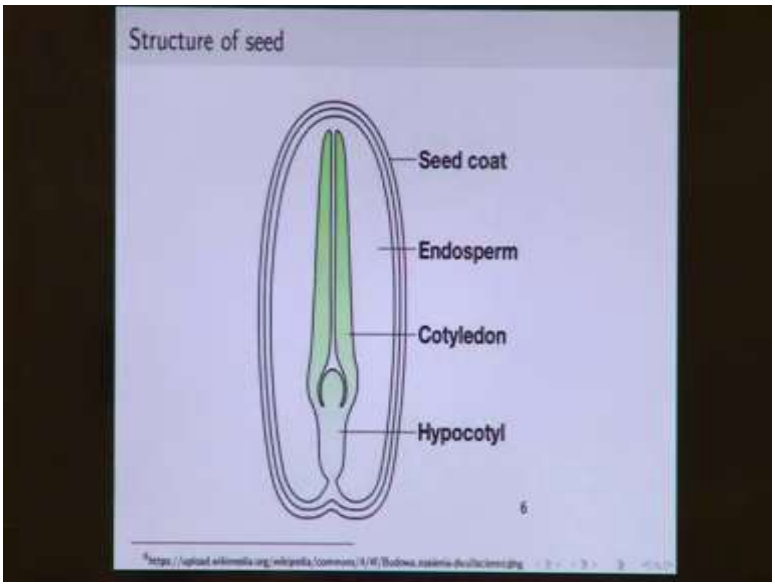


In seed collection, we defined seed as an embryonic plant that is enclosed in an outer protective coating.

(Refer Slide Time: 18:09)

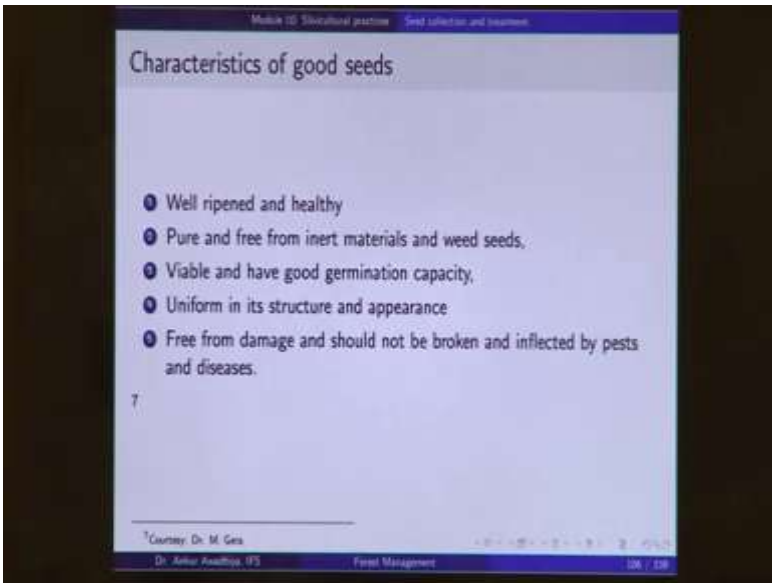
This is how seeds look like.

(Refer Slide Time: 18:11)



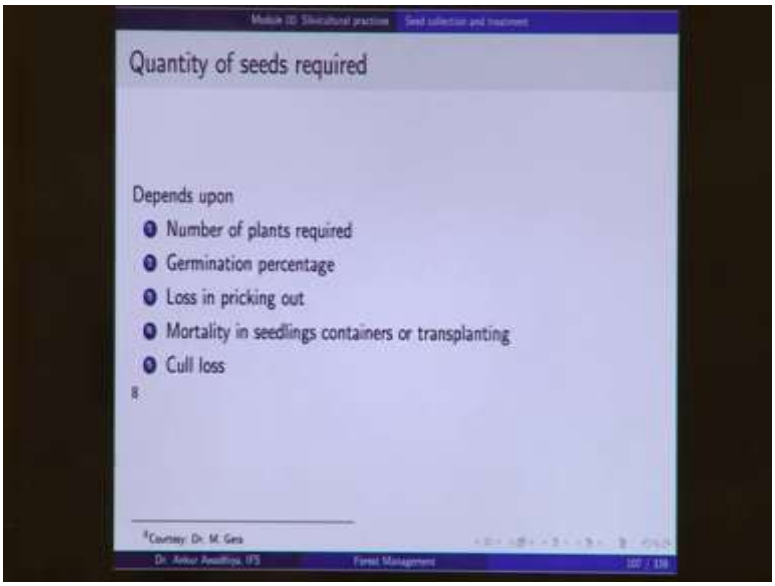
So, you have an outer protective coating in the form of a seed coat, and you have the embryonic plant, which is shown as the cotyledons, which are the leaves and the hypocotyl, and there is endosperm, which provides food to this embryo.

(Refer Slide Time: 18:26)



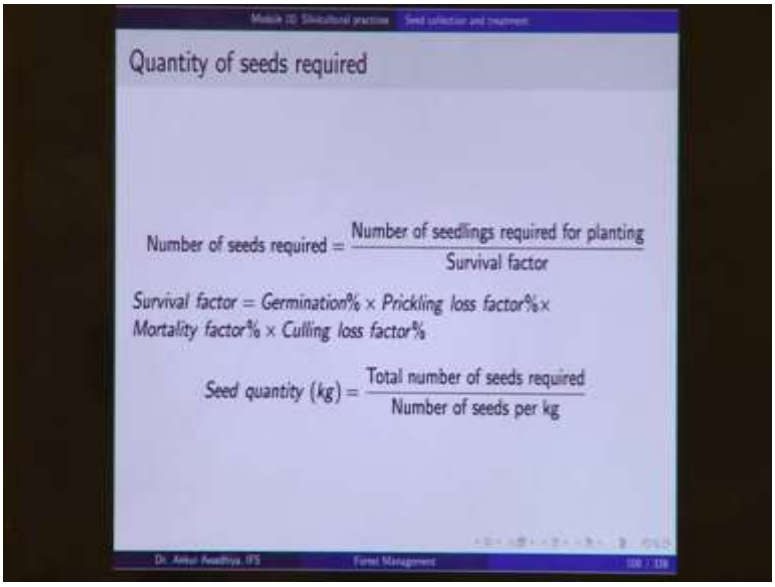
Now, we define good seeds; good seeds are well ripened and healthy. They are pure and free from inert materials and weed seeds, viable and have good germination capacity, uniform in their structure and appearance, free from damage and should not be broken and infected by pests and diseases.

(Refer Slide Time: 18:44)



Now, the quantity of seeds that you need for your operations depends on the number of plants that are required; including the amount that you will require to casualty, plus the germination percentage, plus it depends on the loss in picking out, mortality in seedling containers or transplanting and the culling loss.

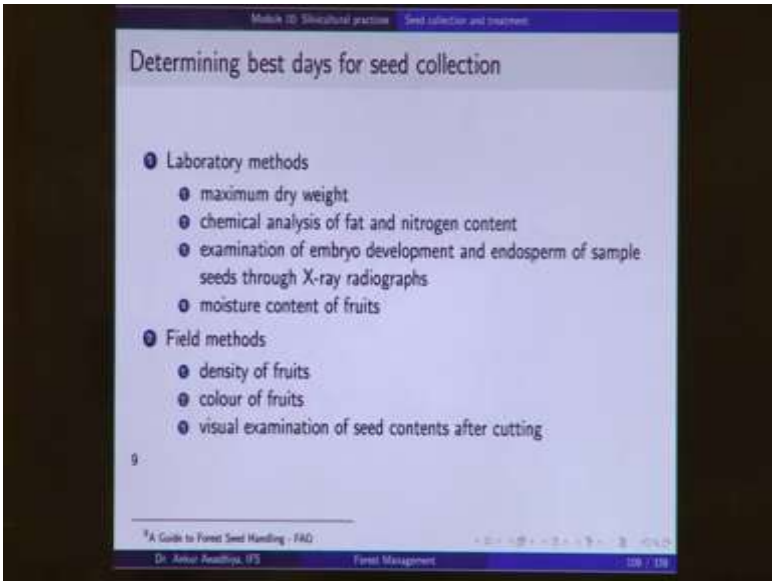
(Refer Slide Time: 19:05)



And, the total quantity of seeds required is given by the number of seedlings that are required for planting, divided by the survival factor; where survival factor is given as germination percentage, multiplied by prickling loss factor percentage, multiplied by

mortality factor, multiplied by culling loss factor. And, total quantity of seeds that is required is given by total number of seeds divided by number of seeds per kg.

(Refer Slide Time: 19:29)

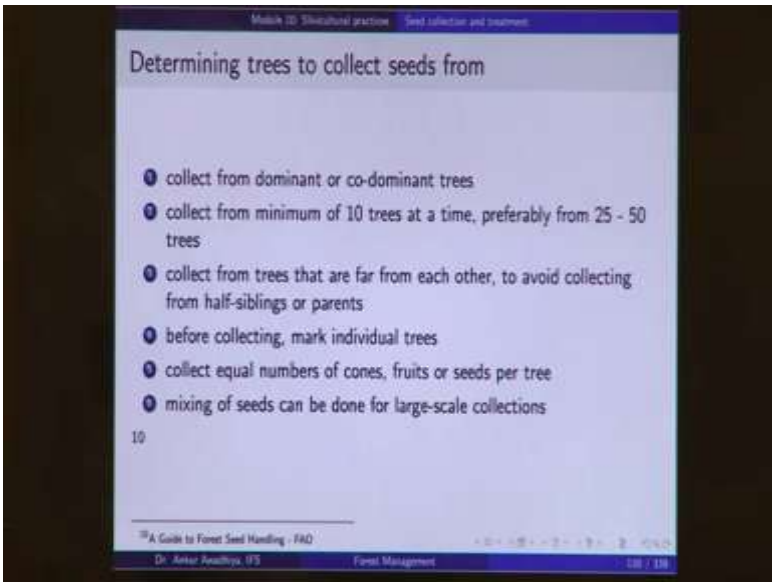


Now, when we are doing a seed collection, we need to determine the best days for seed collection. Typically, seeds are collected in the seed years when the plants have a very large production of seeds. But even in the seed year, which is the particular day when you should be doing the collection, is determined by either laboratory methods or field methods.

Now, laboratory methods include maximum dry weight, chemical analysis of fat and nitrogen content, examination of embryo development and endosperm of sample seeds through X-ray radiographs; typically, by soaking of the seeds in barium chloride solution, which makes it opaque to the X-rays. And, barium chloride is only able to enter it into the non-living portions, it does not enter into the living portions.

So, you can very easily if you see the embryonic development. Or, you can look at the moisture content of the fruits. The field method includes density of fruits, colour of fruits and visual examination of seed contents after cutting.

(Refer Slide Time: 20:30)

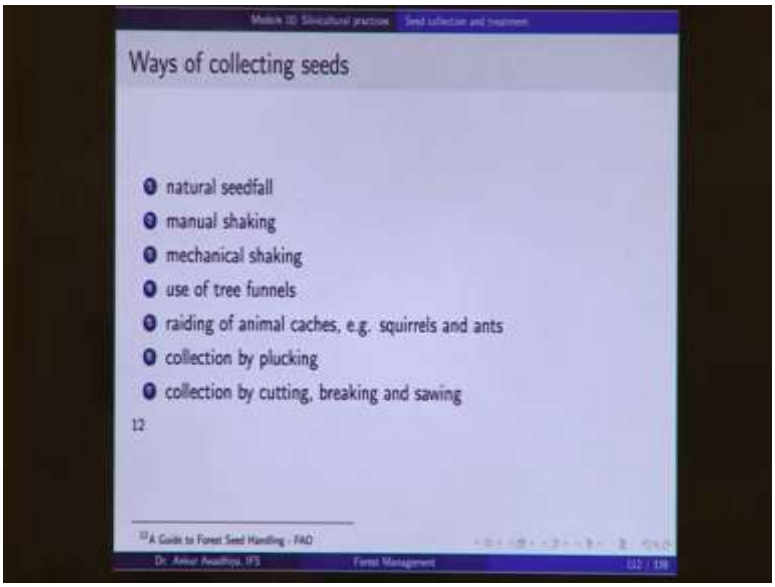


We also determine the best trees to collect the seeds from, and these are generally dominant or co-dominant trees; you collect from a minimum of 10 to 50 trees, collect from trees that are far from each other to avoid collecting from half siblings or parents. Before collecting, mark individual trees, collect equal number of cones, fruits or seeds per tree, mixing of trees make for large scale collections.

(Refer Slide Time: 20:56)

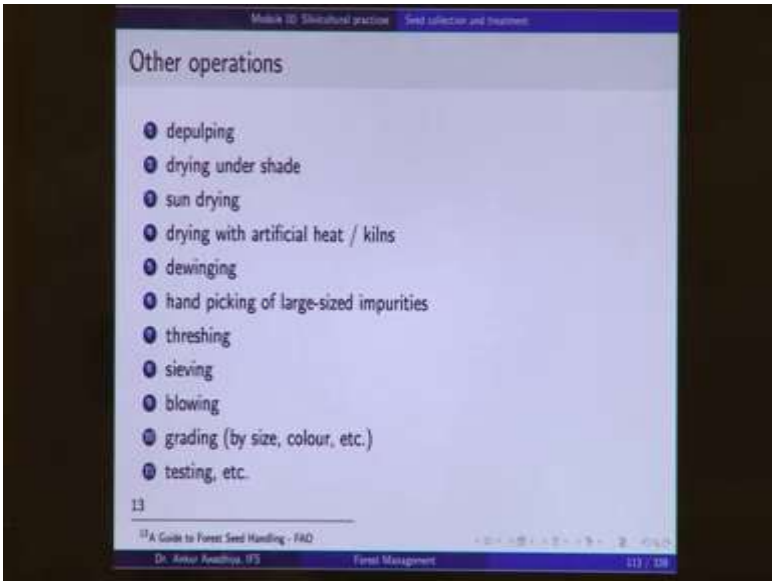
Now, for a proper seed collection, you need to organize collecting teams, transportation, equipment, records, permits and seed extraction, because as soon as you collect these seeds, they have to be processed.

(Refer Slide Time: 21:10)



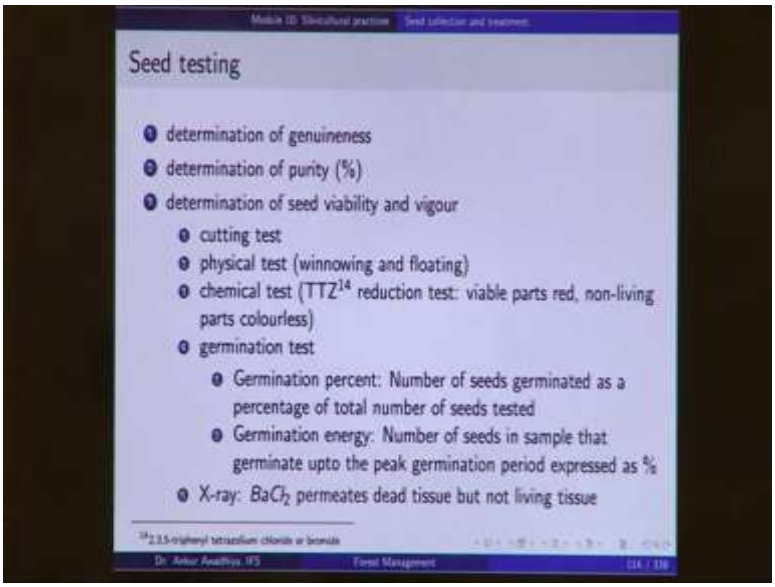
Now, ways of collecting seeds include natural seed fall, manual shaking, mechanical shaking, use of tree funnels, raiding of animal caches including squirrels and ants, collection by plucking and collection by cutting, breaking and sawing which is typically the last.

(Refer Slide Time: 21:28)



Other operations include depulping, where the pulp is removed; drying under the shade, sun drying, drying with artificial heat or kilns; dewinging of seeds; hand picking of large sized impurities, threshing, sieving, blowing, grading, testing and so on.

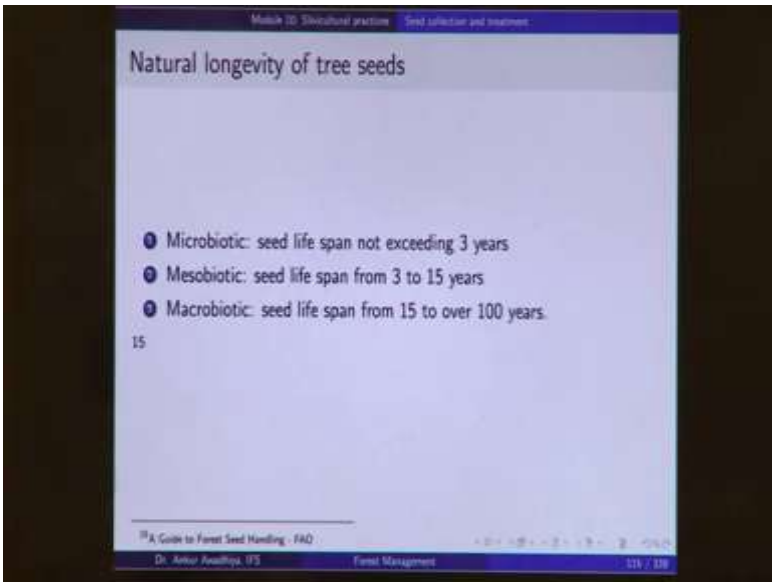
(Refer Slide Time: 21:46)



Now, seed testing; we require information about the determination of genuineness, determination of purity, determination of seed viability and vigour. Now, seed viability and vigour; the vigour is the rate at which these seeds will actually grow into plants. So, this these are determined by cutting test, physical test such as winnowing and floating, chemical tests such as TTZ or Triphenyl Tetrazolium Chloride or Bromide reduction test, the viable parts are stained in red, non-living parts become colourless.

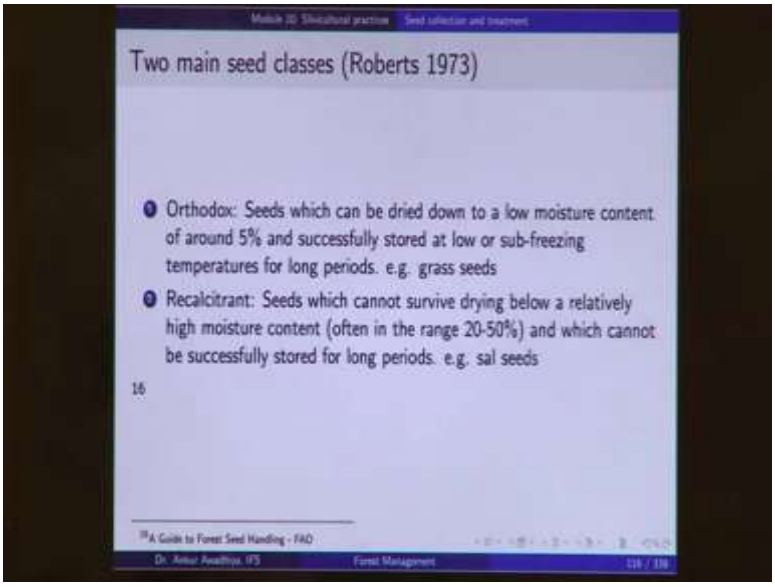
So, if you have a seed in which it looks colourless throughout, it means that it has already died, or we can look at germination tests in which the seeds are actually germinated. In which case, we look at 2 parameters; germination percentage which is the number of seeds that germinate as a percentage of the total number of seeds that were tested. And, the germination energy which is the number of seeds in the sample that germinate up to the peak - germination period expressed as a percentage, or you can look at X-ray radiograms where barium chloride is used which permeates the dead tissue, but not the living tissue.

(Refer Slide Time: 22:58)



Now, during storage, we need to look at the natural longevity of tree seeds. There are certain trees and where which are known as Microbiotic. Now in the case of Microbiotic plants, this the seed lifespan does not exceed 3 years, Macrobiotic seeds lasts for 15 to 100 years, Mesobiotic seeds lasts for 3 to 15 years.

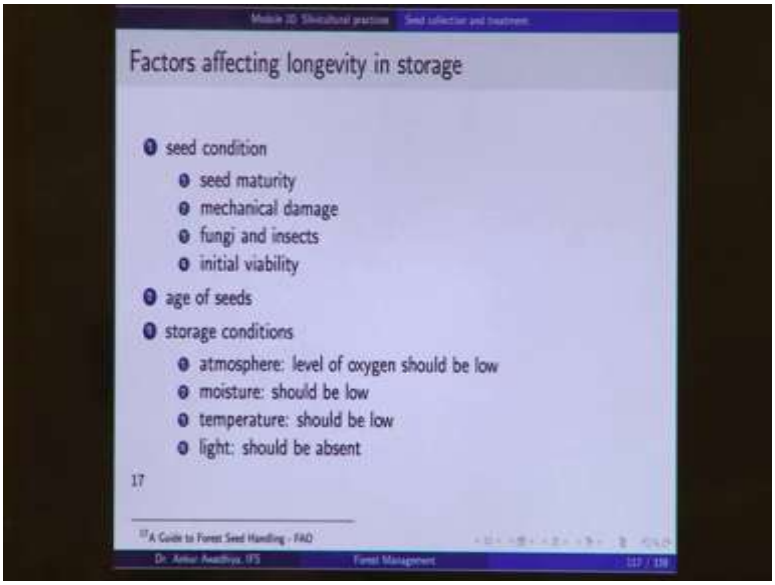
(Refer Slide Time: 23:21)



And, during storage, we classify seeds into 2 categories: orthodox and recalcitrant. Orthodox seeds are those seeds that can be dried down to a low moisture content of around 5 percent and successfully stored at low or sub-freezing temperatures for very

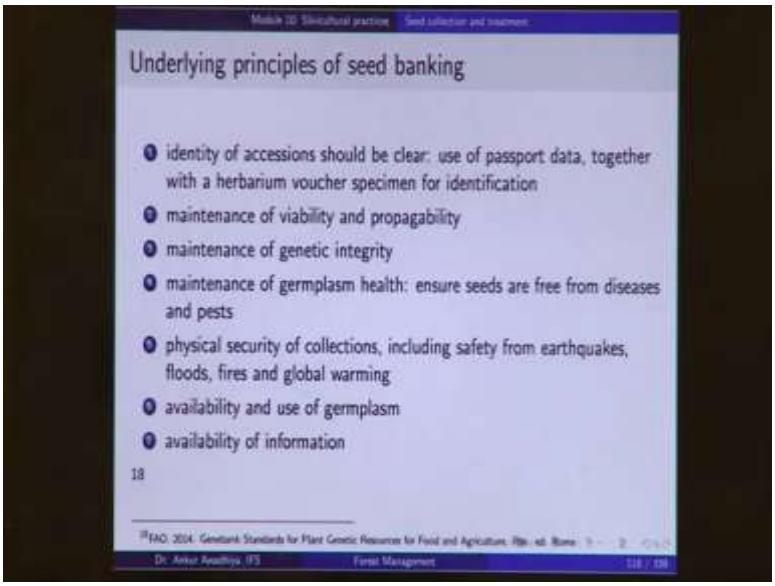
long periods; such as grass seeds. Whereas, recalcitrant seeds are those that cannot survive drying below relatively high moisture content, often in the range of 20 to 50 percent, and which cannot be successfully stored for long periods; examples sal seeds. So, it is difficult to store the recalcitrant seeds; it is easy to store the orthodox seeds after drying.

(Refer Slide Time: 24:02)



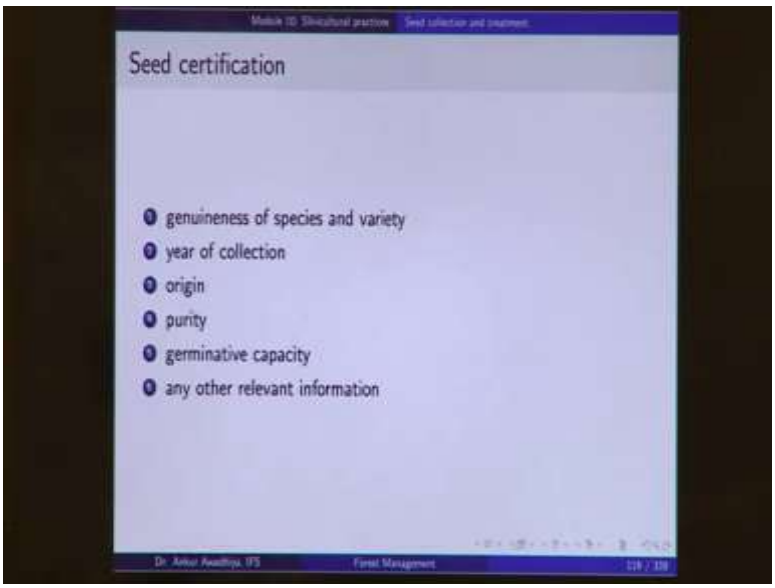
Now, there are a number of factors that affect the longevity in storage; the seed condition; including seed maturity, mechanical damage, fungi and insects, and the initial viability. The age of the seeds and the storage conditions; so, typically, the level of oxygen should be kept low, moisture should be kept low, temperature should be kept low and light should be absent.

(Refer Slide Time: 24:24)



Now, underlying principles of seed banking include identification of accession, maintenance of viability and propagability, which needs to be checked and tested again and again, maintenance of genetic integrity, maintenance of germplasm health, physical security of collections, availability and use of germplasm and availability of information.

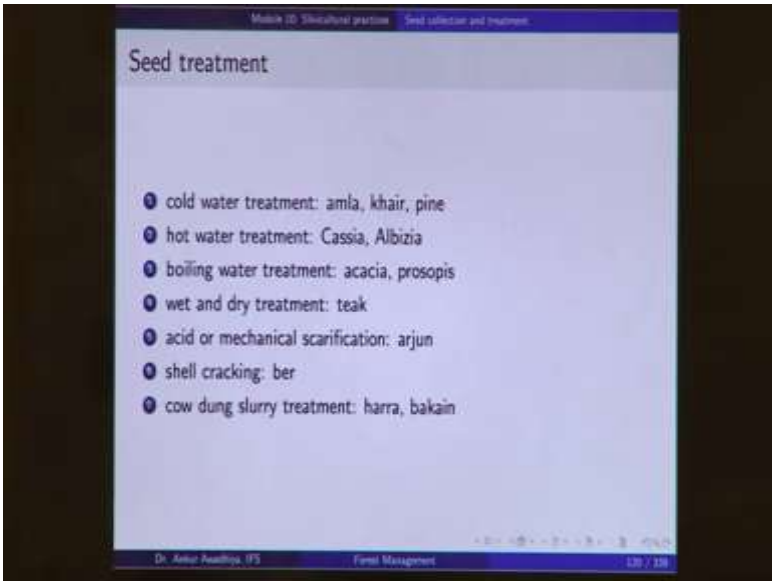
(Refer Slide Time: 24:45)



Now, these days, we also go for seed certification which tells us the genuineness of the species and the variety, the year of collection, the origin of these seeds, or the probe

enhancing of these seeds, the purity, the germinative capacity and any other relevant information.

(Refer Slide Time: 25:04)

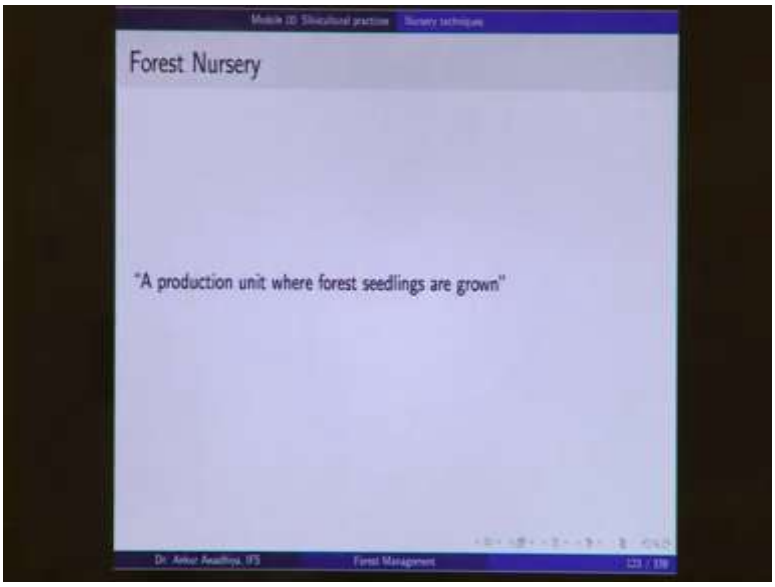


Now, before using we put the seeds through several treatments; including cold water treatment, hot water treatment, boiling water treatment, wet and dry treatment, acid or mechanical scarification, shell cracking or cow dung slurry treatment. So, different species of trees, the their seeds might require different treatments, in order to help them to germinate.

(Refer Slide Time: 25:29)

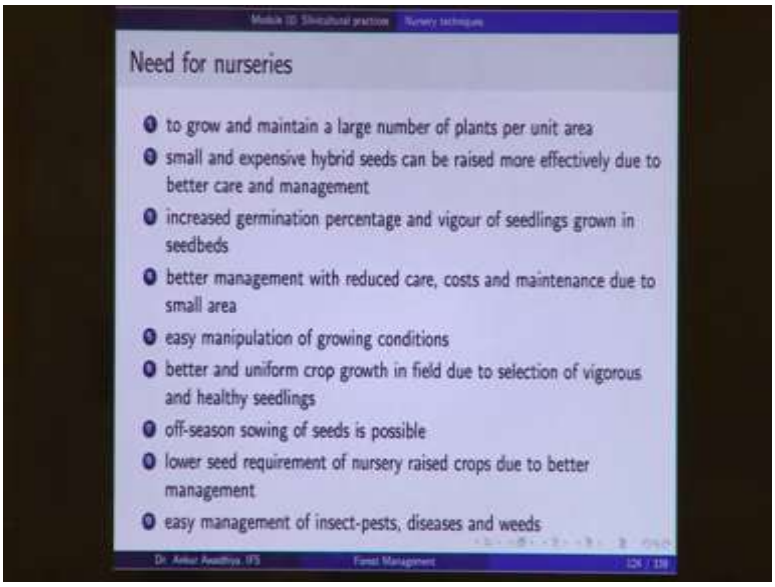
Next, we had a look at the nursery techniques.

(Refer Slide Time: 25:34)



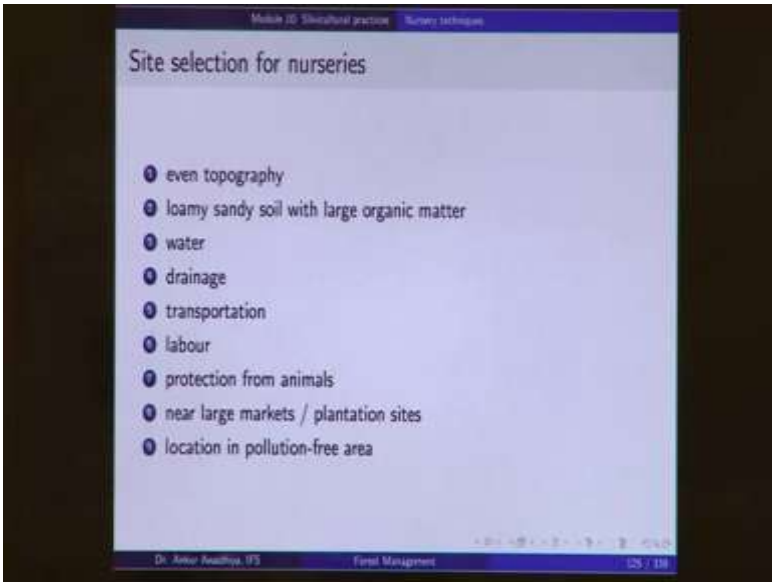
Forest nursery is a production unit where forest seedlings are grown. There is a big need to for these nurseries to grow and maintain a large number of plants per unit area. Small and expensive hybrid seeds can be raised more effectively due to better care and management in these nurseries. There is an increase germination percentage and vigour of seedlings grown in seed beds.

(Refer Slide Time: 25:39)



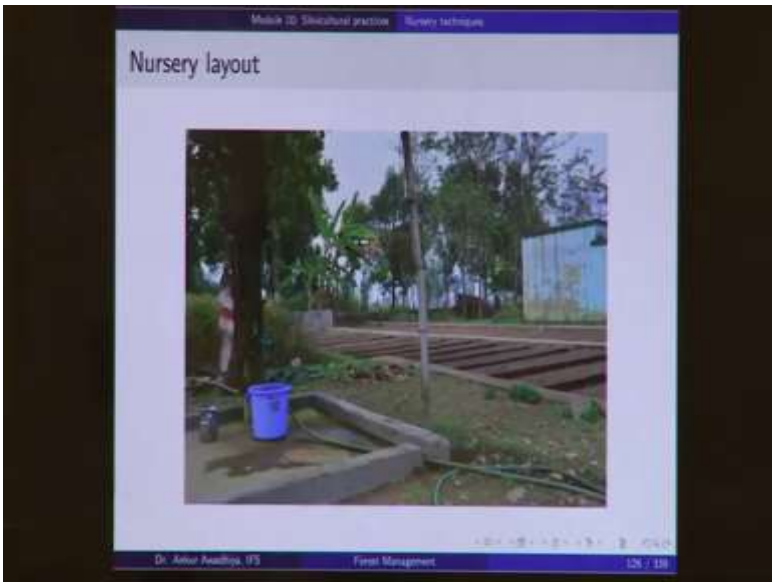
Better management with reduced care cost and maintenance due to small area, easy manipulation of growing conditions, better and uniform crop growth, off-season sowing of seeds, lower seed requirement and easy management. So, essentially, what we are saying is that, in the case of a nursery in a small area, you raise a large number of seeds and seedlings in a much-controlled environment, in which manipulations are much easier. So, effectively, this leads to the production of a large number of seedlings in less time, with less cost, with less efforts overall.

(Refer Slide Time: 26:31)



Where should a nursery be sited? So, it depends on the topography of the area; typically, it should be a flat topography with good soil, good water, good drainage, easier availability of transportation and labour, good protection from animals. It should be near large markets or plantation sites, so that the seedings can easily be transported. And, it should typically be located in a pollution free area, so that the plant leaves are not covered up with dust.

(Refer Slide Time: 26:58)



Now, this is a nursery layout. So typically, in a nursery you will be having the seed beds, you will be having certain storerooms, you will be having a source of water, you will be having certain trees to provide shading when required, you will be having roads, you will be having fencing.

(Refer Slide Time: 27:16)

(Refer Slide Time: 27:18)

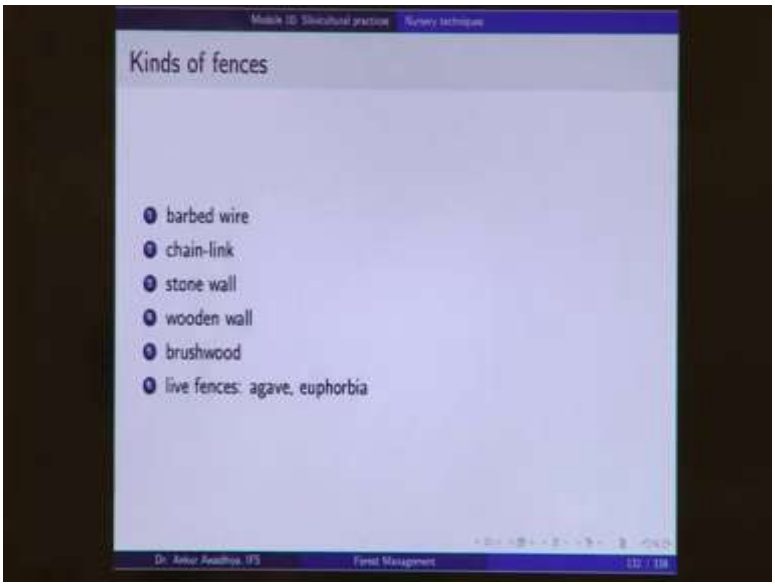
(Refer Slide Time: 27:20)

(Refer Slide Time: 27:22)

(Refer Slide Time: 27:23)

Now, a nursery fencing can be a barbed wire fencing; barbed wire fencing on wooden post, brushwood fencing, stone wall fencing, chain link fencing, life fencing and so on.

(Refer Slide Time: 27:25)

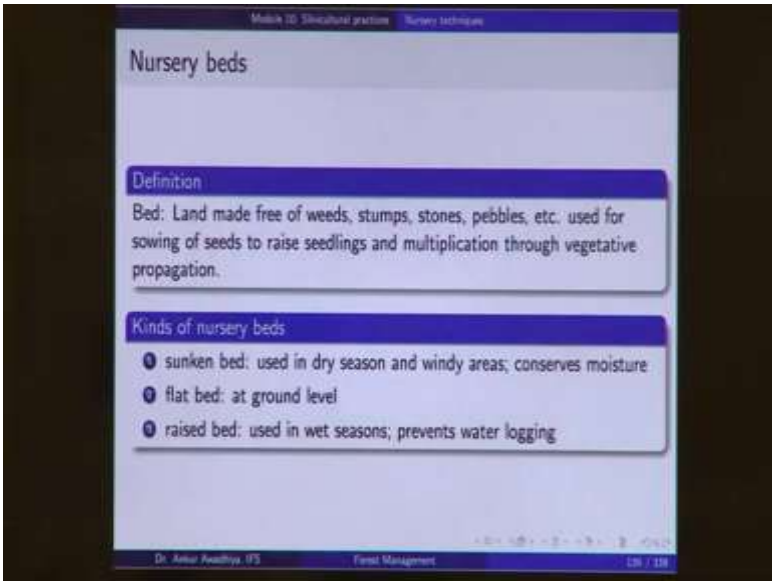


(Refer Slide Time: 27:29)

(Refer Slide Time: 27:32)

Now, a nursery is identified by the board, and these days at times the setting up and running of a nursery is also given to the Samitis.

(Refer Slide Time: 27:43)



Now, nurseries have nursery beds where a bed is defined as a land that is made free of weeds, stumps, stones, pebbles, etcetera; used for sowing of seeds to raise seedlings and multiplication through vegetative propagation. And, we have 3 different kinds of beds; we have a sunken bed which is used in dry season and windy areas because it conserves moisture, we have a raised bed which is used in wet seasons to prevent water logging,

and we have a flat-bed which is at the ground level and is that is used in average sorts of conditions.

(Refer Slide Time: 28:14)

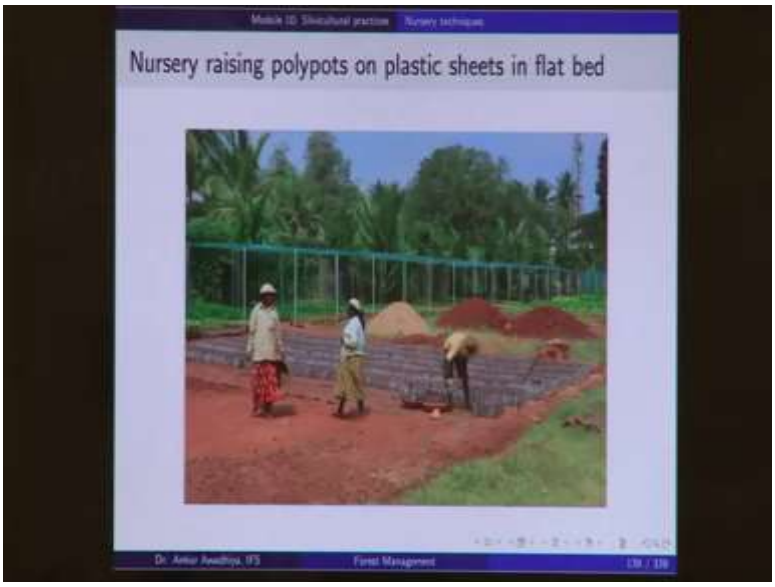
So, here we have raised beds.

(Refer Slide Time: 28:17)

(Refer Slide Time: 28:19)

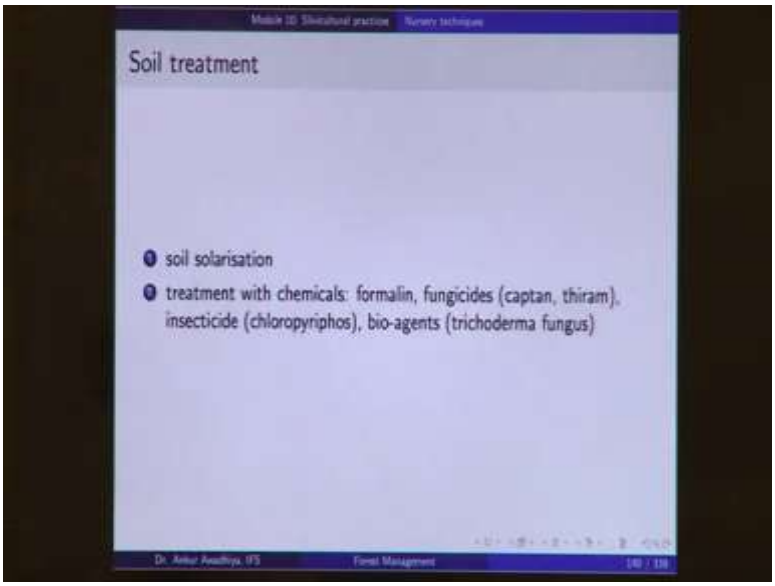
Sunken beds, the plants in the beds.

(Refer Slide Time: 28:21)



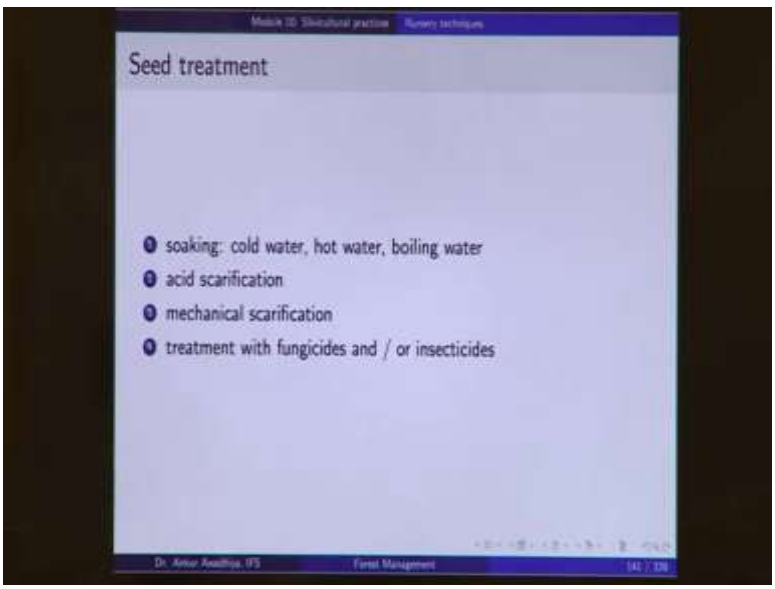
This is a nursery which is raising polypots on plastic sheets in a flat bed.

(Refer Slide Time: 28:27)



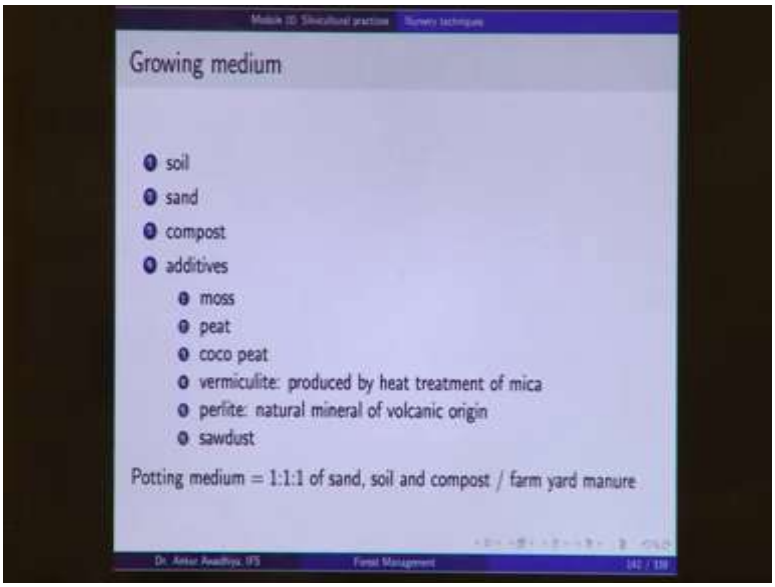
Now, before using the soil, it is put through certain treatments. So we do soil solarisation; in which case the soil is broken up, the lumps are broken up and then this soil is exposed to the sun, so that it becomes in dried up and also the pathogens die off, because of the because of drying and also the impact of the ultraviolet rays of the sun. In certain cases, treatment with chemicals may also be required; especially treatment with formalin fungicides, such as captan and thiram; insecticides such as chloropyriphos and bio-agents such as Trichoderma fungus, which is a symbiotic fungus which helps the plants.

(Refer Slide Time: 29:09)



Now seed treatment before sowing; we do a seed treatment through soaking, or is acid scarification, or mechanical scarification, and at times treatment with fungicides, and or insecticides may also be required.

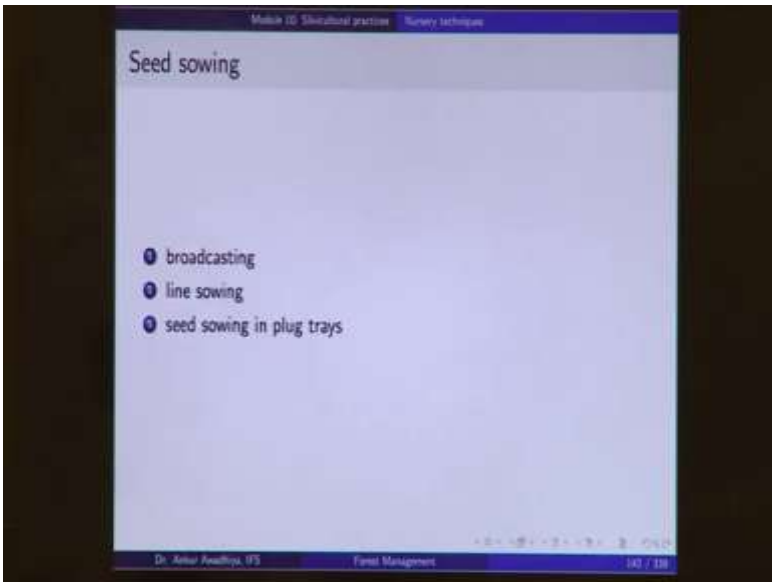
(Refer Slide Time: 29:25)



Next, we have the growing medium which is comprised of soil, sand compost and additives. Now, sand and compost are added to change the structure of the soil, to make it more permeable, and also to change the amount of nutrient availability in the soil.

Now, additives include moss, peat, coco peat, vermiculite, perlite, sawdust and so on. And, we also make a potting medium which is the one is to one is to one a mixture of sand, soil and compost or farm yard manure.

(Refer Slide Time: 30:00)



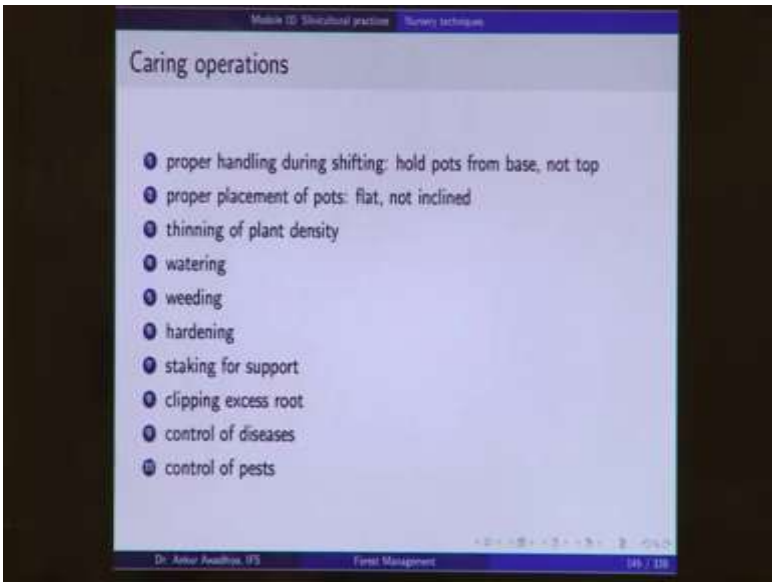
Now, seed sowing can be done through broadcasting, in which the seeds are just thrown over the soil, or we can go with line sowing, or seed sowing in plug trays.

(Refer Slide Time: 30:09)

So, this is a plug tray. The best thing about a plug tray is that, it is a standardized equipment or a standardized medium.

And so, it is very easy to automate the sowing of seeds through machines.

(Refer Slide Time: 30:24)



Now, a lot of caring needs to be done in nurseries; such as proper shift, proper handling during shifting, the pots should be held from the base not from the top, proper placement of pots, they should be flat, they should not be kept on an inclined because the roots are positively geo tropic. And, if the pots are kept at an at an inclined angle, then the plants will not be growing straight. So, they will be growing at an angle to the ground. We shall become deaf difficult for them when you have to plant them out in the field.

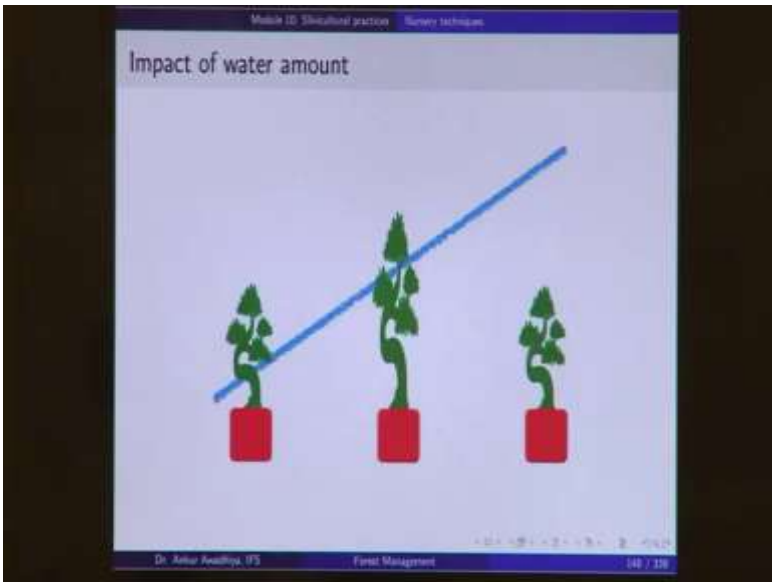
Then, thinning of plant density needs to be done from time to time to avoid whipping. Whipping is the process in which the plants grow very fast; they become very tall and because of because they are unable to grow in laterally. So, in this case, the plants just droop down, when you take them out. Then, watering needs to be done; weeding needs to be done; hardening of plants has to be done, in which case, you make the plant more resistant to the extreme situations outside. Then, staking for support is needed for certain plants, clipping of excess root, control of diseases and control of pests.

(Refer Slide Time: 31:38)

So, here we are seeing people who are caring for the plants.

(Refer Slide Time: 31:41)

(Refer Slide Time: 31:42)



The plants have to be watered in such a manner that the amount of water is neither too less nor is too high, because yeah in drought conditions, as well as in water logged conditions, the plants will not be able to show optimal growth.

(Refer Slide Time: 31:55)

Hardening is the process of acclimatisation of the plants to harsh field. And, in this case, the plants are being moved from an area of excessive or optimal care to an area of harsh conditions. And, typically, hardening is done by putting the plants under a green net.

So, from a very low amount of light, they will slowly and steadily they will be shifted to the very harsh 100 percent sunlight in dry conditions.

(Refer Slide Time: 32:24)

(Refer Slide Time: 32:25)

Weeding is regularly performed. Grading is performed in which the plants that are of similar growth characteristics and of similar size, they are graded together

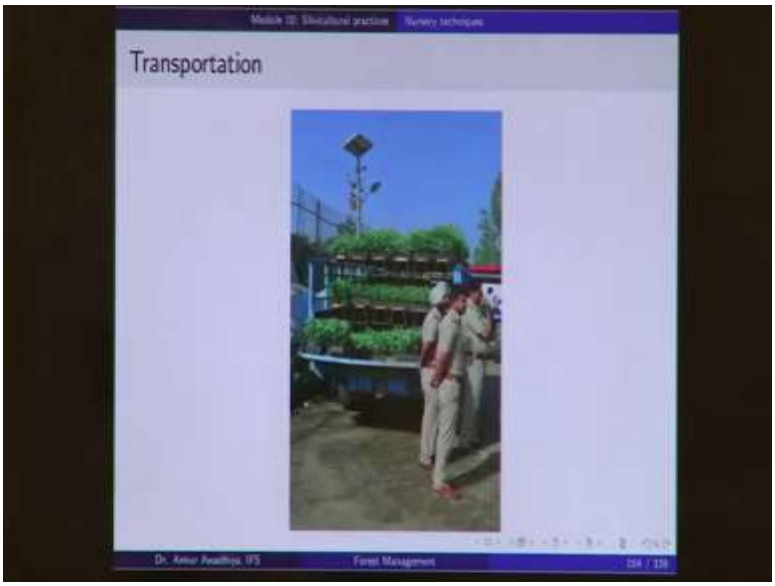
(Refer Slide Time: 32:36)

Here, we see plants that are ready for sale or usage.

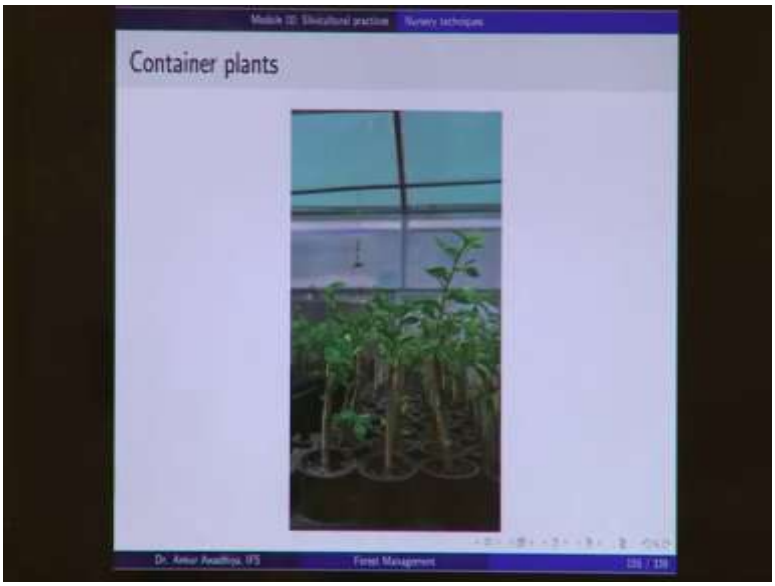
(Refer Slide Time: 32:28)

They are transported either in in small trucks or using tractors.

(Refer Slide Time: 32:43)



(Refer Slide Time: 32:43)



Plants are grown are these days also grown in containers.

(Refer Slide Time: 32:47)

(Refer Slide Time: 32:48)

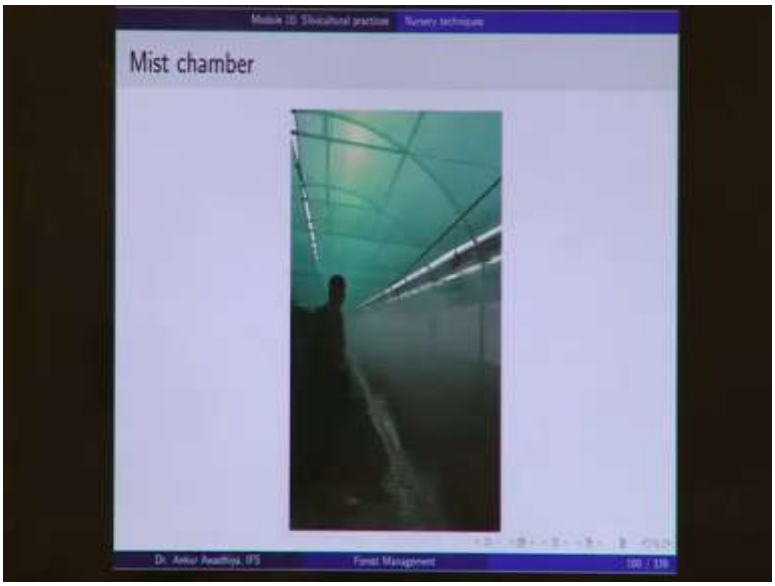
We also have this innovation that is known as the raised iron bed, in which case, we make use of an iron rods to raise up the bed, and we put containers and raise the crops there.

(Refer Slide Time: 33:00)

In certain nurseries, greenhouse is being used.

(Refer Slide Time: 33:04)

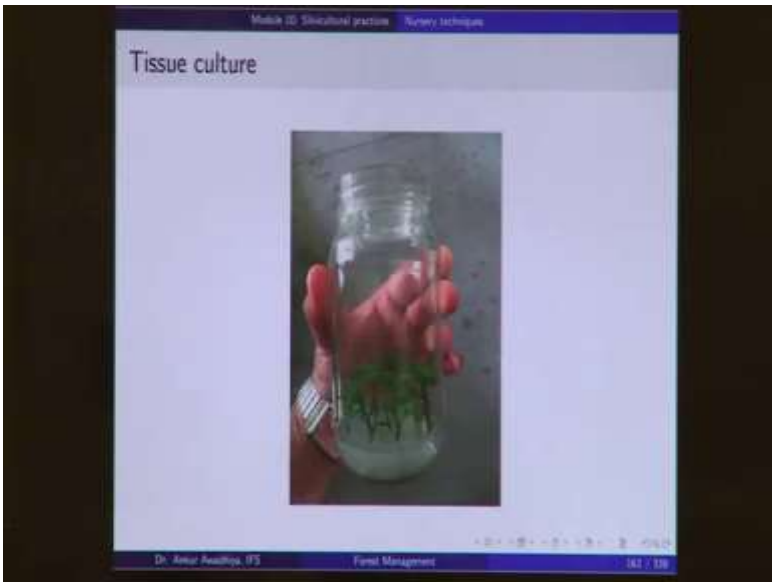
(Refer Slide Time: 33:05)



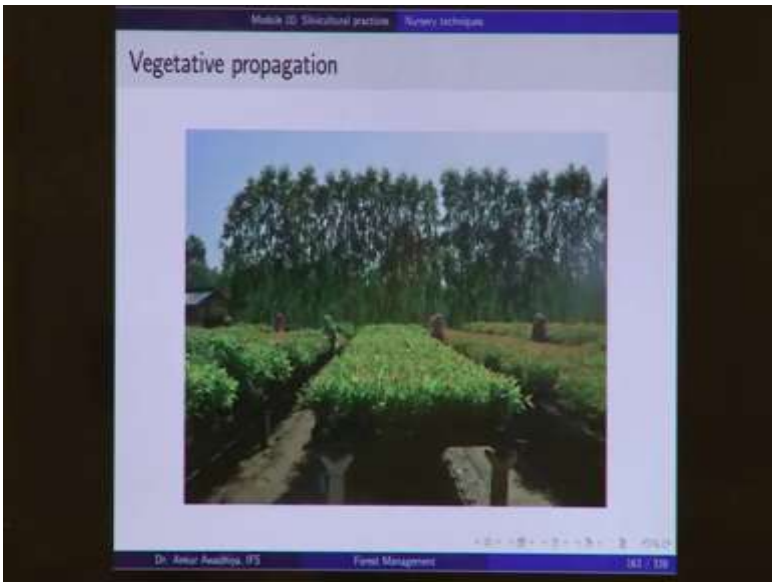
Mist chambers are being used and vegetative propagation.

(Refer Slide Time: 33:06)

(Refer Slide Time: 33:07)

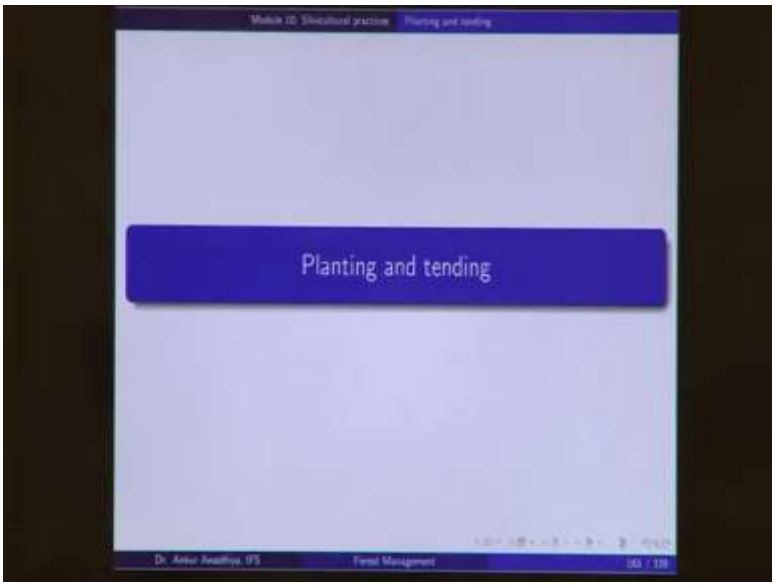


(Refer Slide Time: 33:09)



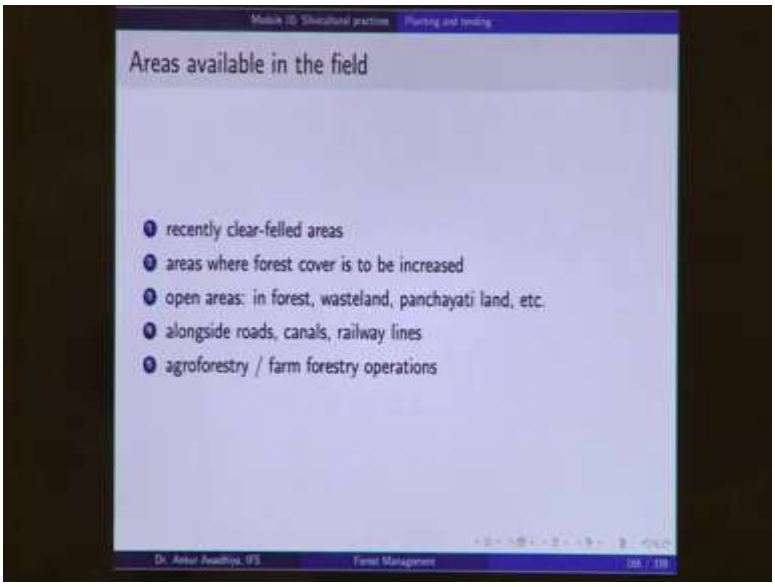
And, tissue culture are also being used in certain high tech nurseries.

(Refer Slide Time: 33:13)



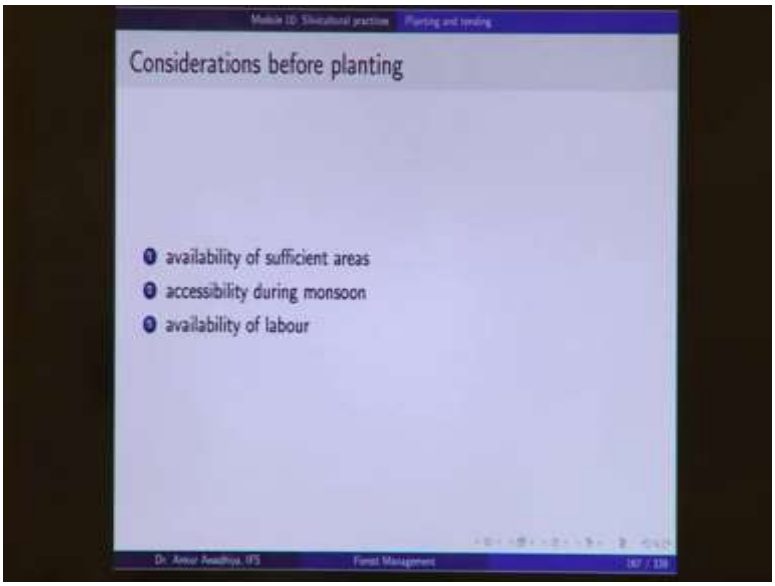
Next, we looked at planting and tending.

(Refer Slide Time: 33:15)



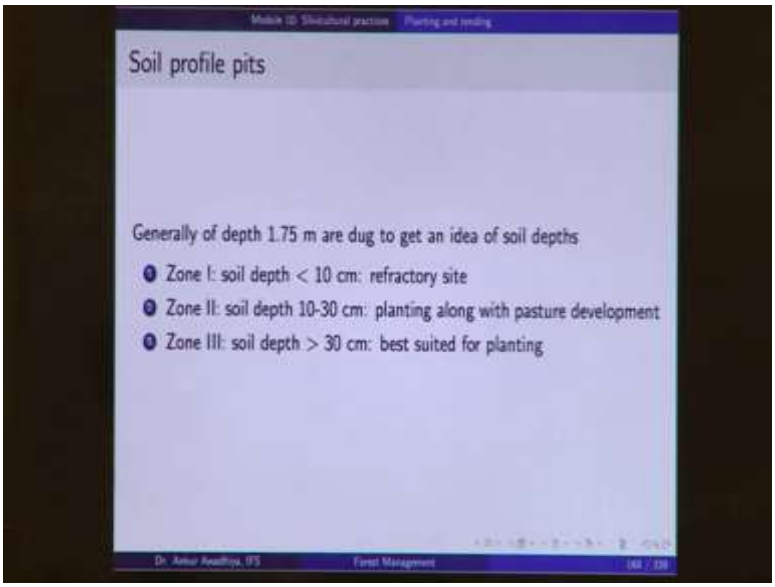
So, areas that are available in the field include recently clear-felled areas; areas where forests cover to be increased; open areas whether in forest or in wasteland or in panchayati land; alongside roads, canals, railway lines; and in agroforestry; and farm forestry operations.

(Refer Slide Time: 33:30)



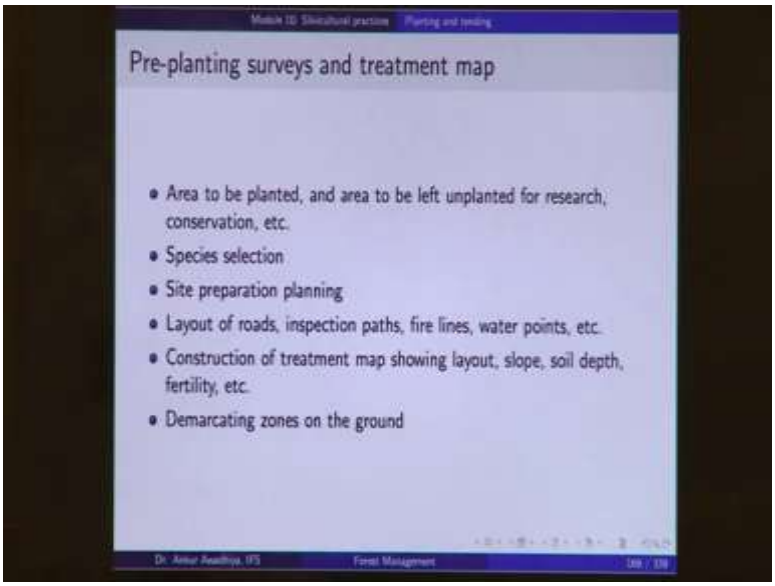
What are the considerations? They should be sufficient area available so that you can put up a sufficient amount of work. The area should be accessible during monsoons and labour should be easily available.

(Refer Slide Time: 33:42)



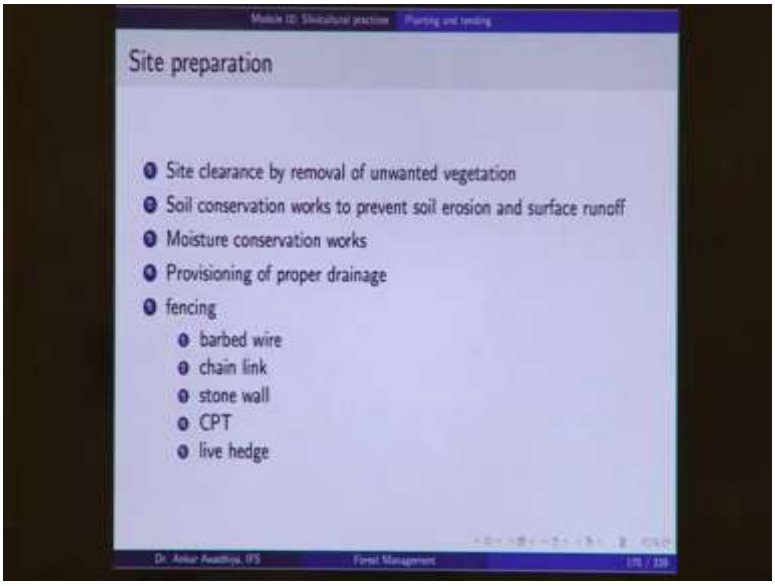
We begin by making soil profile pits, to debar, to classify soils into 3 zones: Zone 1 is a refractory site with very less soil depth; it is not suitable for planting trees, Zone 3 which has a soil depth of greater than 30 centimeters, is best suited for planting. And, Zone 2 with 10 to 30 centimeters of soil depth planting can be done.

(Refer Slide Time: 34:08)



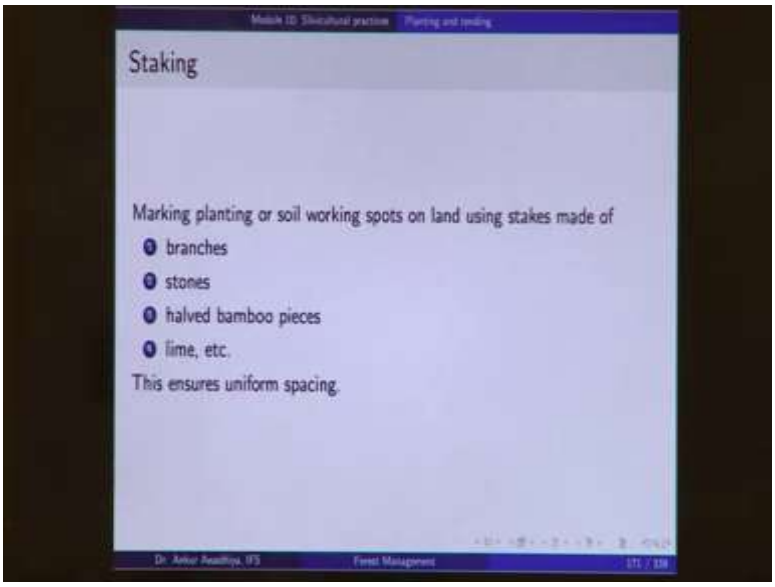
But it is done together with pasture development. And, before beginning to plant, we do a pre-planting survey and make a treatment map. So, areas to be planted, areas to be left unplanted will be marked on this map. There will be species selection, site preparation planning is done, layout of roads, inspection paths, fire lines, water points etcetera is made. Construction of treatment map is done which shows all of these different things layout, slope, soil depth, fertility and so on.

(Refer Slide Time: 34:41)



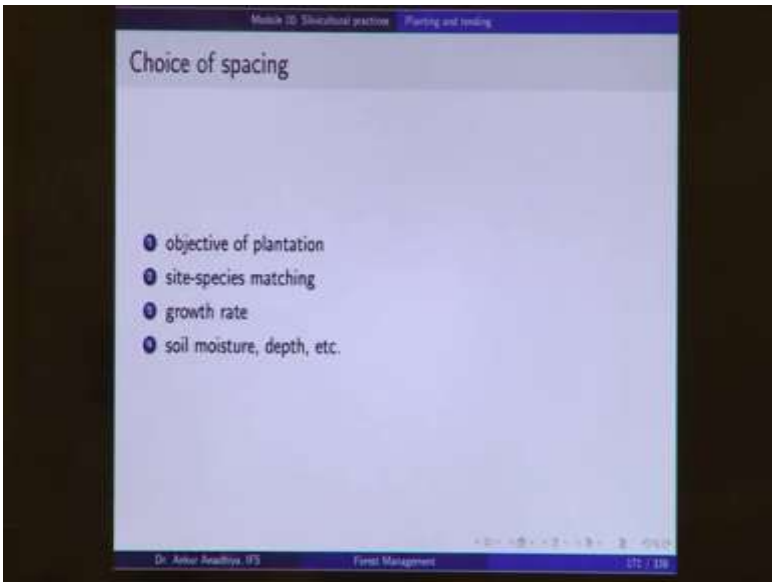
And, then these zones are demarcated on the ground. Then, site preparation is done by clearing of the site, the unwanted vegetation is removed, soil conservation works are done to prevent soil erosion and surface run off. Moisture conservation works are done, provisioning of proper drainage is done, and fencing is done through barbed wire fencing, chain link fencing, stone wall fencing, CPT which is a Cattle Proof Trench and also live hedging.

(Refer Slide Time: 35:05)



Next, we to ensure a uniform spacing. We do a staking operation where the planting and soil working spots are marked on the land using stakes that are made out of branches, bamboo pieces, stones, lime and so on.

(Refer Slide Time: 35:21)



The choice of the spacing depends on the objective of the plantation, the site and species matching, the growth rate that is expected and the soil moisture, depth and so on.

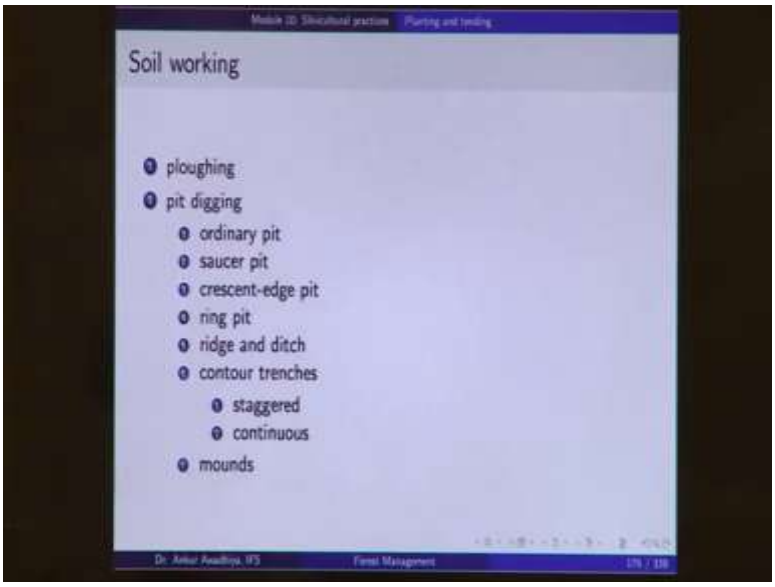
(Refer Slide Time: 35:33)

So, this is a person who is doing a staking.

(Refer Slide Time: 35:34)

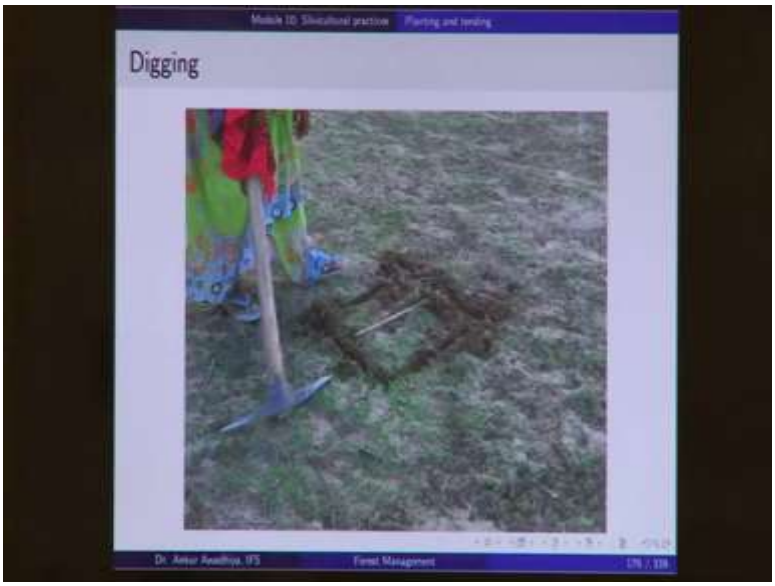
So, this point is marked on the ground and then the soil working needs to be done.

(Refer Slide Time: 35:37)



So, soil working includes ploughing of the whole area, or in strips or pit digging. So, we can make ordinary pit in normal areas, saucer pit in area that have less rainfall, crescent edge pits in areas with even less rainfall, ring pit in even more arid regions, or we can go with ridge and ditch in areas where the rainfall is unpredictable, or we can go with contour trenches, staggered trenches or continuous trenches, or we can go with mounds in waterlogged areas.

(Refer Slide Time: 36:14)



So, this is how the digging begins. So, here there is a stick that is telling us the size of the pit that will be dug.

(Refer Slide Time: 36:23)

(Refer Slide Time: 36:25)

And now, the digging process is beginning, and during the digging process, the topsoil is kept in a separate pile and the subsoil is kept in a different pile.

(Refer Slide Time: 36:34)

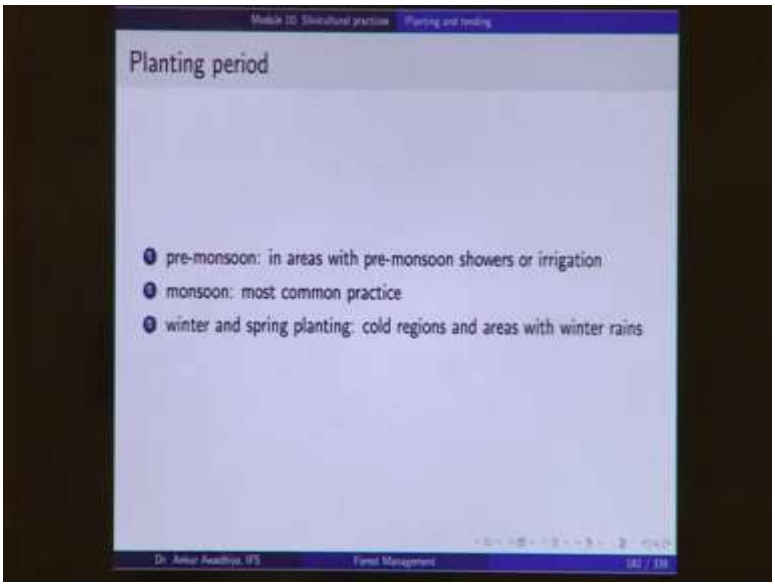
So, this is a pit that has been dug.

(Refer Slide Time: 36:37)

Measurements are taken to ensure that there is a good quality control.

(Refer Slide Time: 36:38)

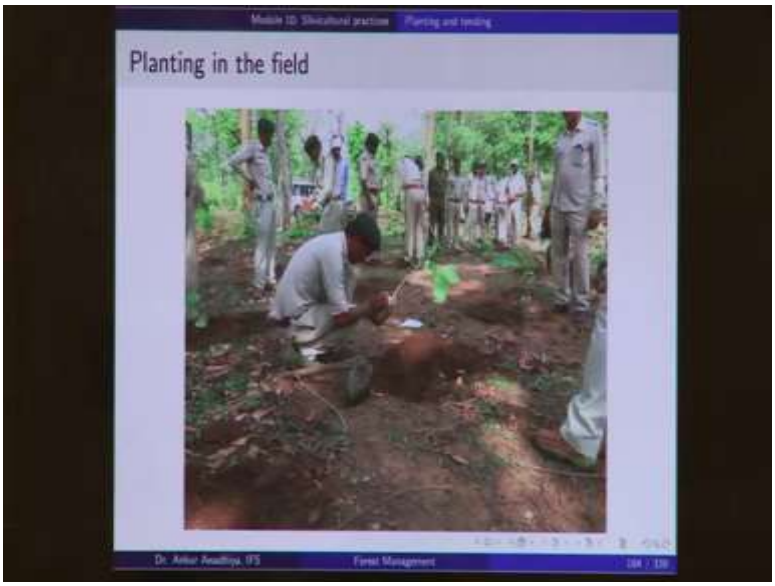
(Refer Slide Time: 36:40)



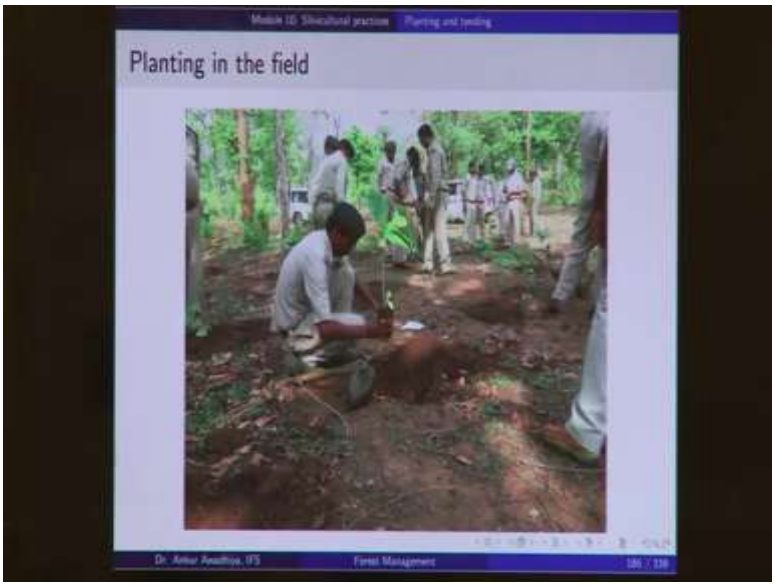
Now, planting can be done in 3 different periods. In most of the areas, we do planting in the monsoons. But in those areas where we get pre-monsoon showers or those areas where we have irrigation, we can extend the growing period by doing a pre-monsoon planting. And in those areas which are cold or receive winter rains, we can also do winter planting or even spring planting.

(Refer Slide Time: 37:05)

(Refer Slide Time: 37:06)

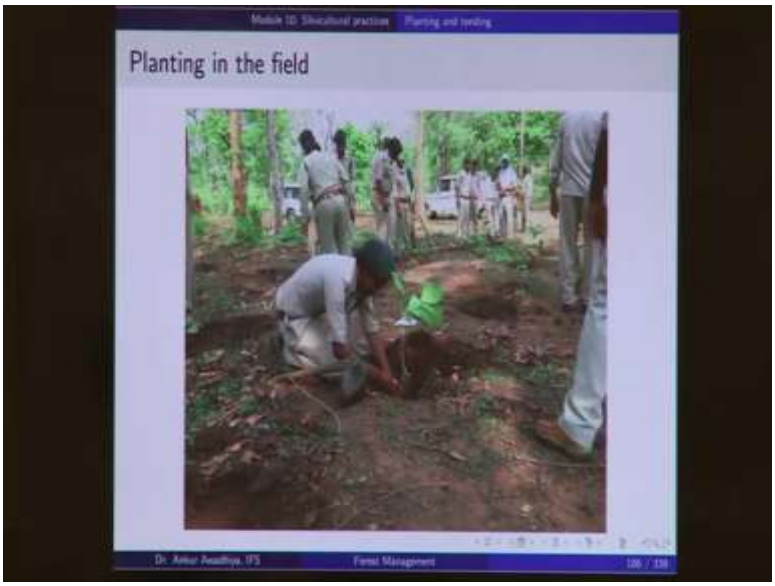


(Refer Slide Time: 37:09)



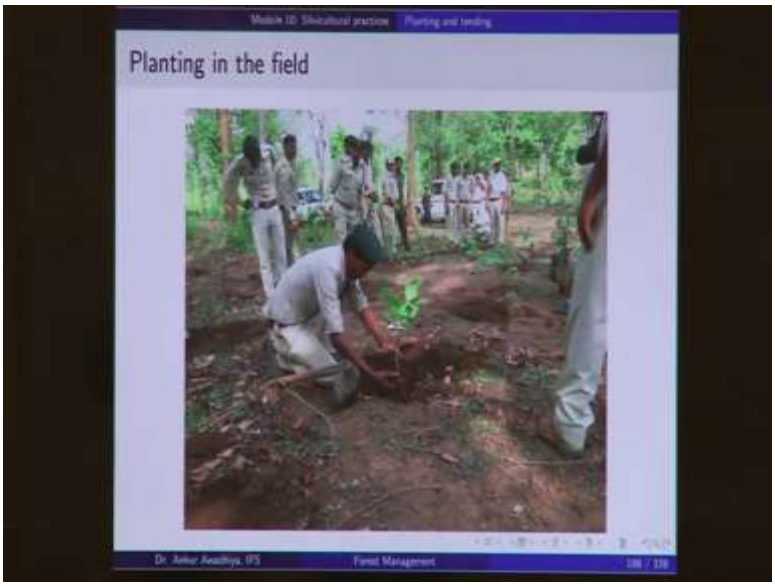
Now, planting in the field is done by removing the polythene cover, and then the plant along with the soil ball is placed inside.

(Refer Slide Time: 37:14)

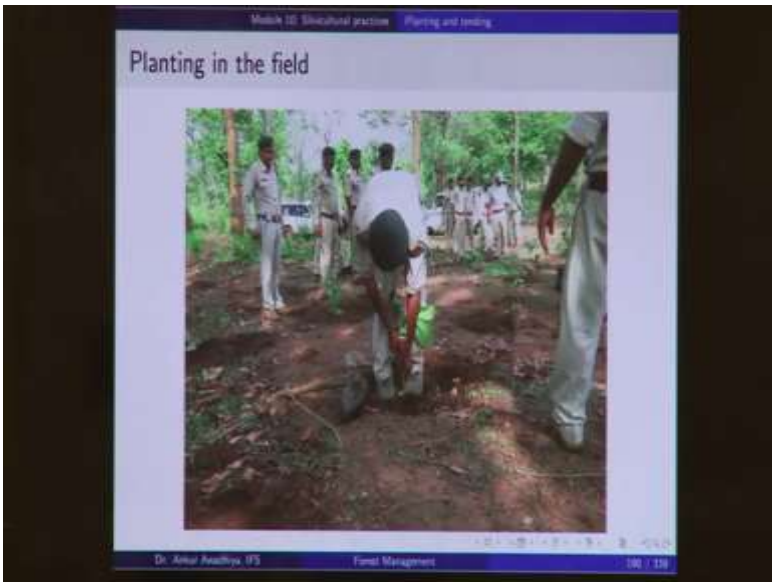


You need to ensure that the collar is at the same level as that of the ground.

(Refer Slide Time: 37:20)



(Refer Slide Time: 37:27)



Then, the soil is put back inside. Typically, the topsoil is put up first, followed by the subsoil.

(Refer Slide Time: 37:37)

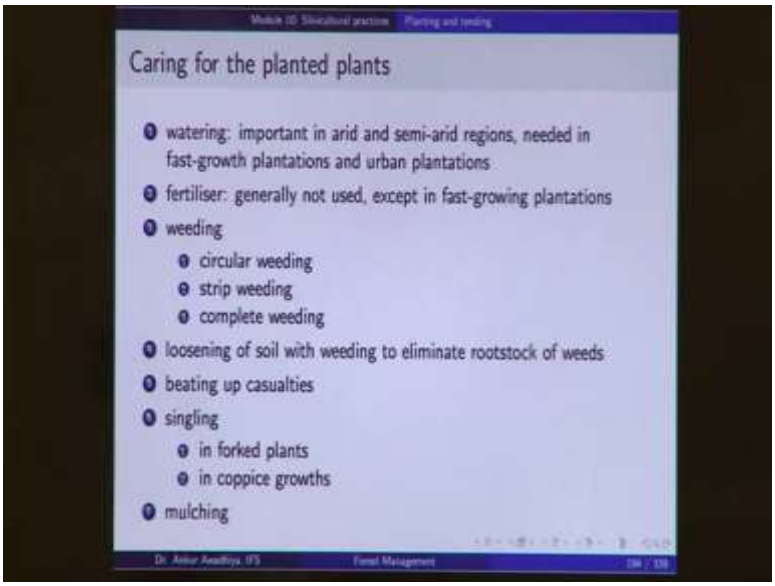
And then, this the soil is compacted by standing over it, and while taking care that you do not stand on top of the plant.

(Refer Slide Time: 37:38)

Typically, in the field situations, planting is done on a very large scale.

(Refer Slide Time: 37:41)

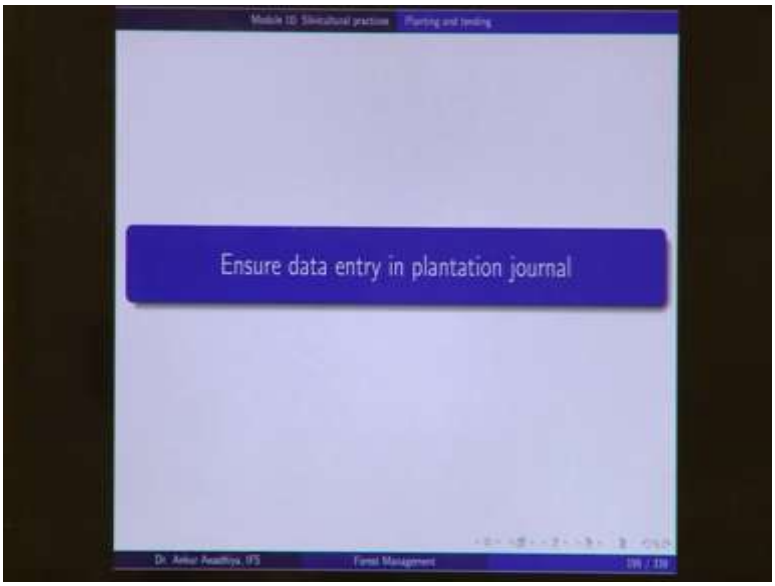
(Refer Slide Time: 37:42)



And then, once the planting is done, you need to tend for these plants; you need to care for these plants by watering them. It may be important in arid and semi-arid regions, and it is absolutely weeded in fast growing plantations and urban plantations. In certain cases, you might need fertilizers in especially in the case of fast-growing plants; otherwise, it is generally not needed. Weeding needs to be performed together with loosening of soil. Weeding can be done as complete weeding, strip weeding or circular weeding.

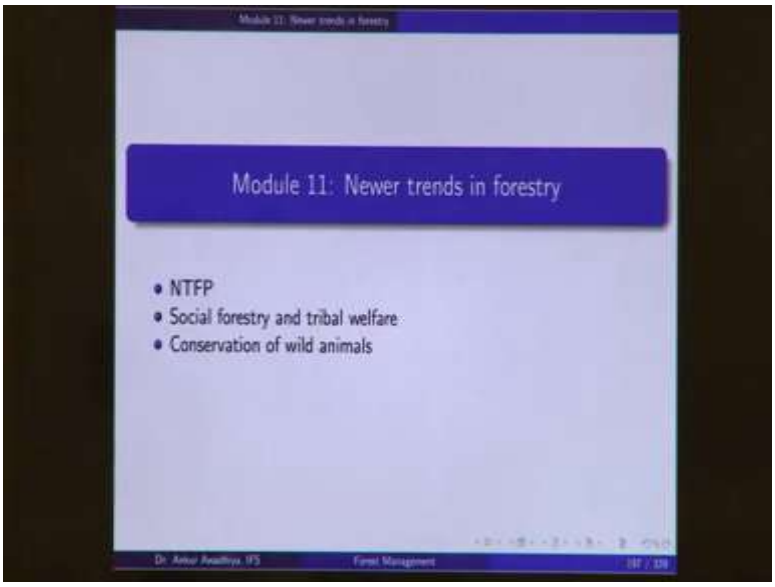
Then, beating up of casualties is done where the plants that have died are replaced. Singling operation is done for forked plants and in coppice growths and also mulching may be required.

(Refer Slide Time: 38:23)



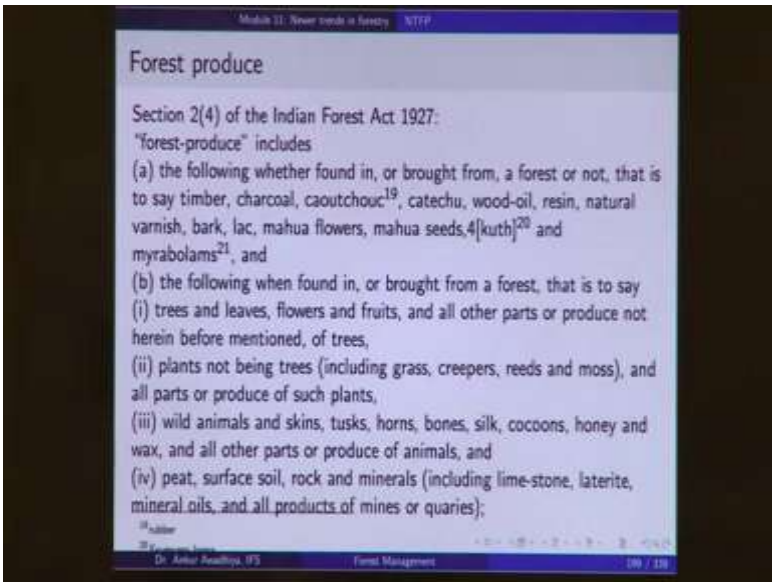
And at all stages, you ensure that data entry is done in the plantation journal.

(Refer Slide Time: 38:29)



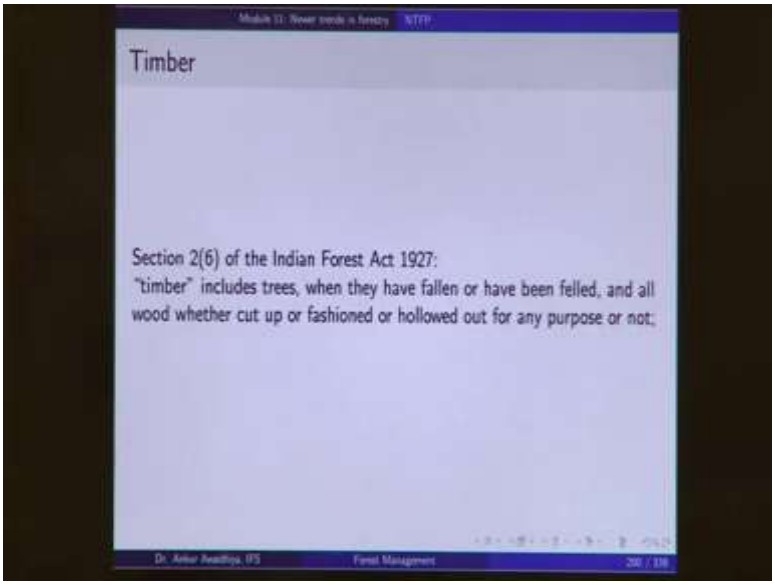
In the last module, we looked at newer trends in forestry; NTFP, social forestry, tribal welfare and conservation of wild animals

(Refer Slide Time: 38:39)

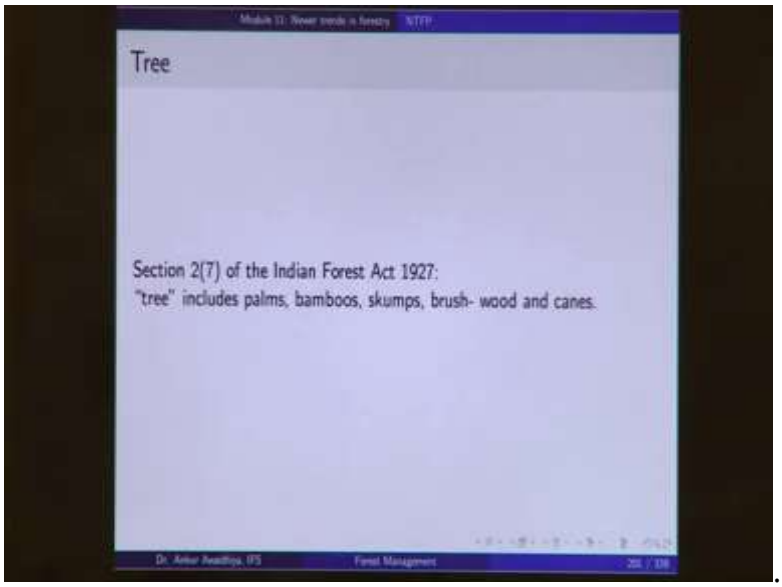


Now NTFP is non-timber forest produce. We have the definition of forest produce and definition of timber entry in the Indian Forest Act.

(Refer Slide Time: 38:44)

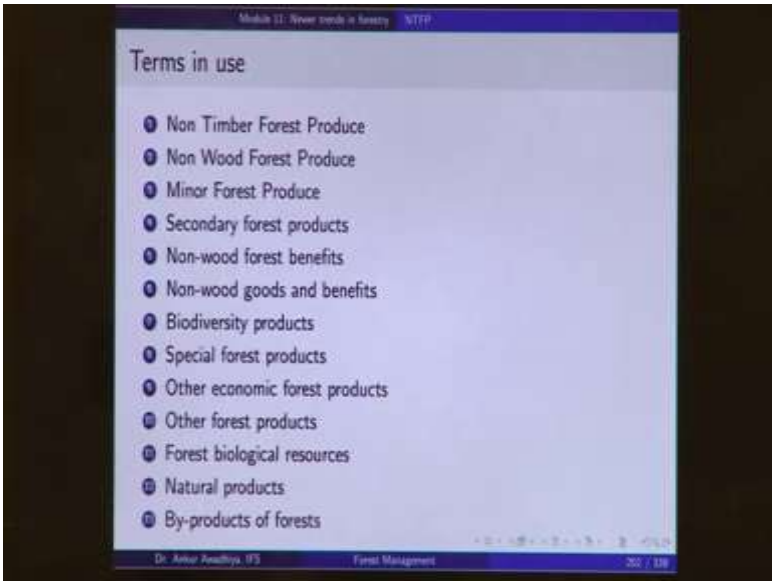


(Refer Slide Time: 38:45)



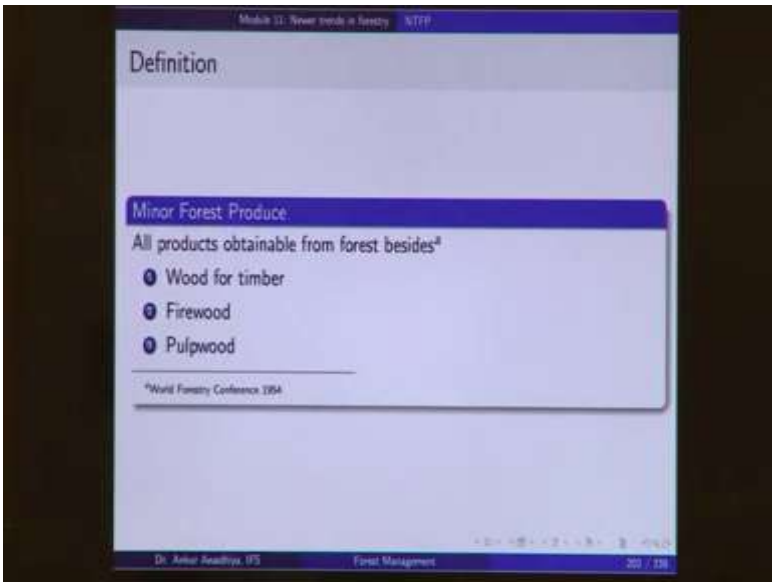
So, you take the definition of forest produce, subtract timber and you get the Non-Timber Forest Produce.

(Refer Slide Time: 38:55)



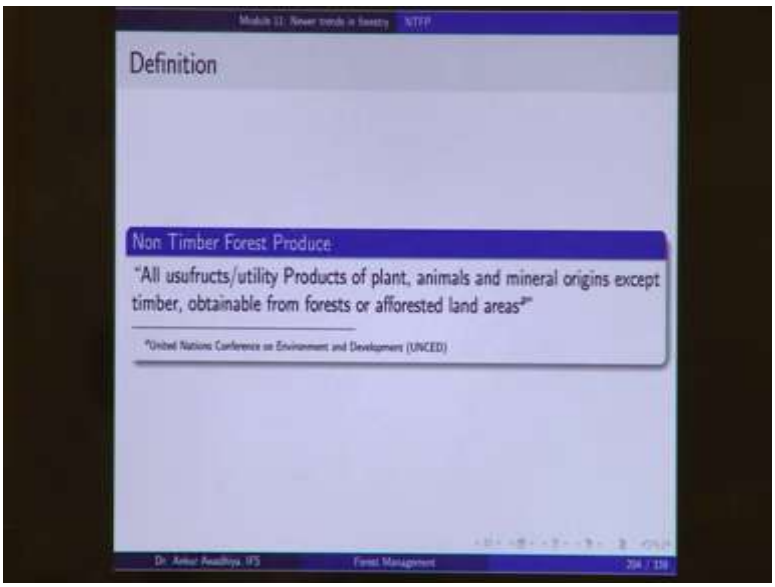
Now, typically, a number of other terms are also used such as Non-Wood Forest Produce, Minor Forest Produce, By-product of forest and so on.

(Refer Slide Time: 39:02)



Now, Minor Forest Produce is defined as all products that are obtainable from forest besides wood, firewood and pulpwood.

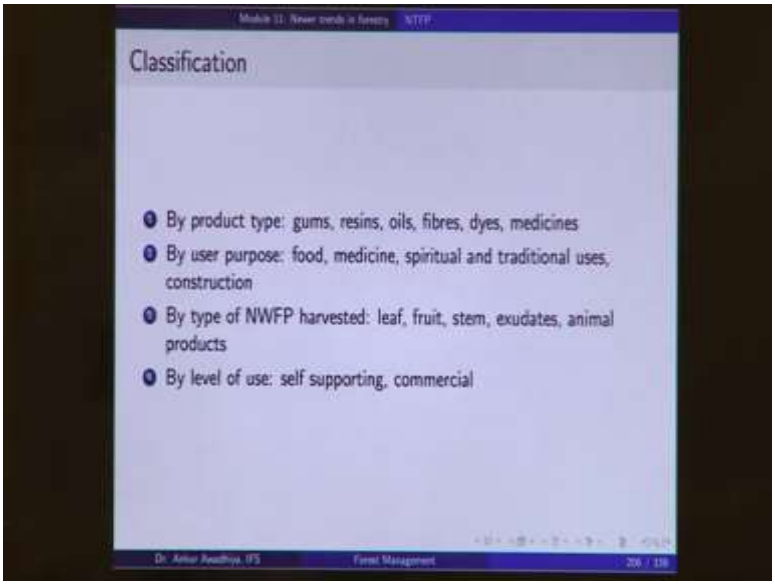
(Refer Slide Time: 39:11)



Non-Timber Forest Produce is also defined as all usufructs or utility products of plants, animals and mineral origins, except timber obtainable from forests or afforested land areas. Now in all these different definitions, they can be more exclusive or more inclusive.

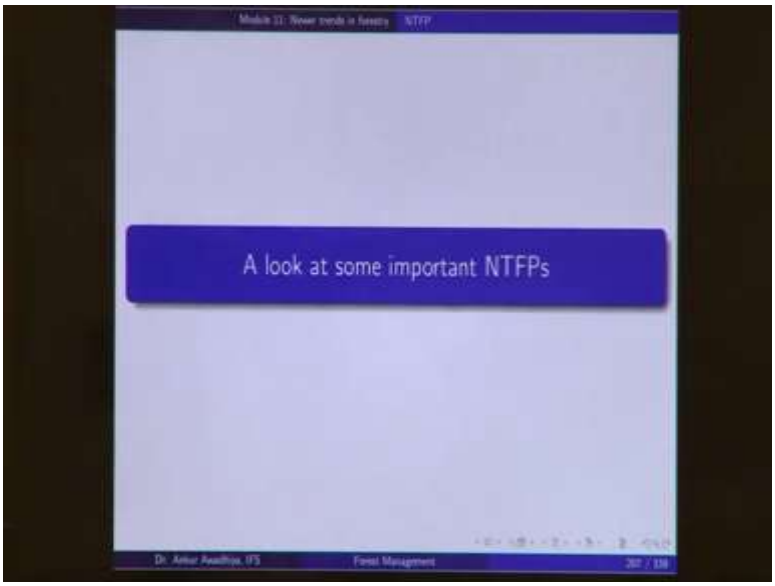
So, in certain definitions, we include not just forests, but also plantations; and in certain other definitions, we also include the trees outside forests. In certain definitions, we only look at the plant produce; in certain other definitions, we include animal produce and also the mineral produce. And in certain other definitions, we also include technological services.

(Refer Slide Time: 39:53)

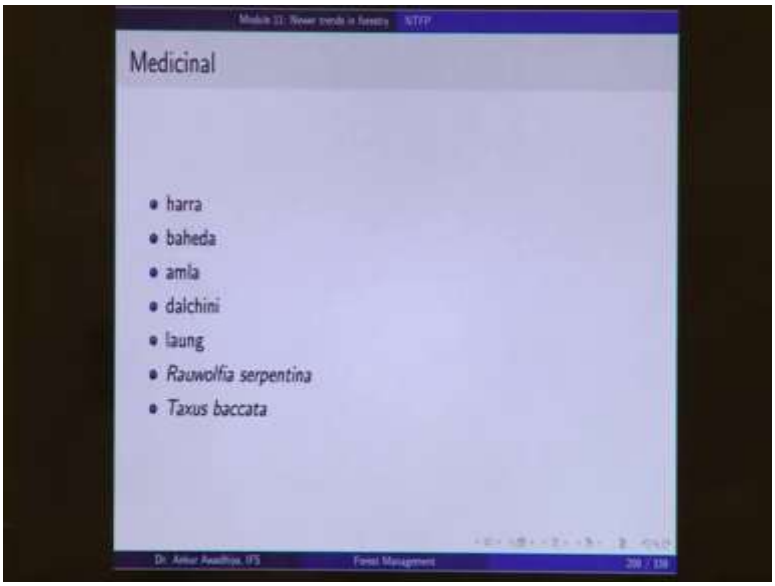


So, none of these definitions is perfect, but you get an idea. The classification of NTFP is done on the basis of the product: whether they are gums, resins, oils, fibres, dyes, medicines; by user purpose: food, medicine, spiritual and traditional uses, construction materials; by the type of NTFP that is harvested: leaf, fruit, stem, exudates, animal products; or by the level of use: whether it is being used in a self-supporting or sustainable manner or in a commercial manner.

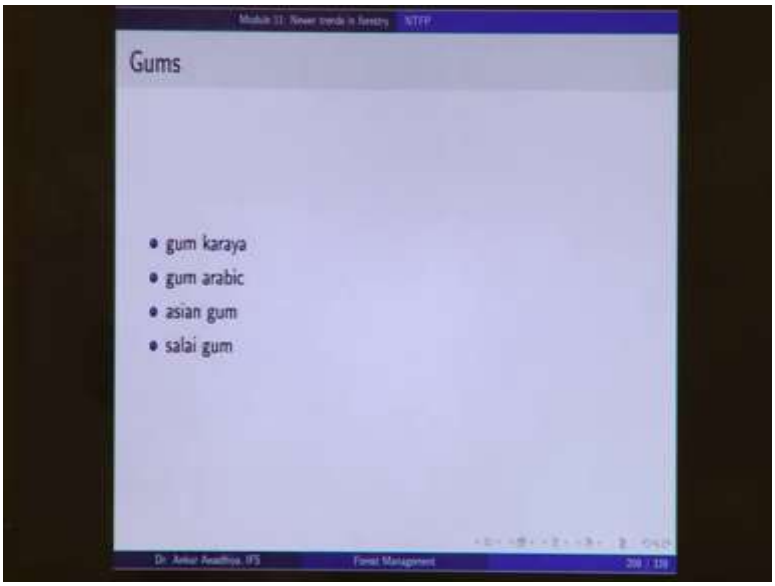
(Refer Slide Time: 40:22)



(Refer Slide Time: 40:24)

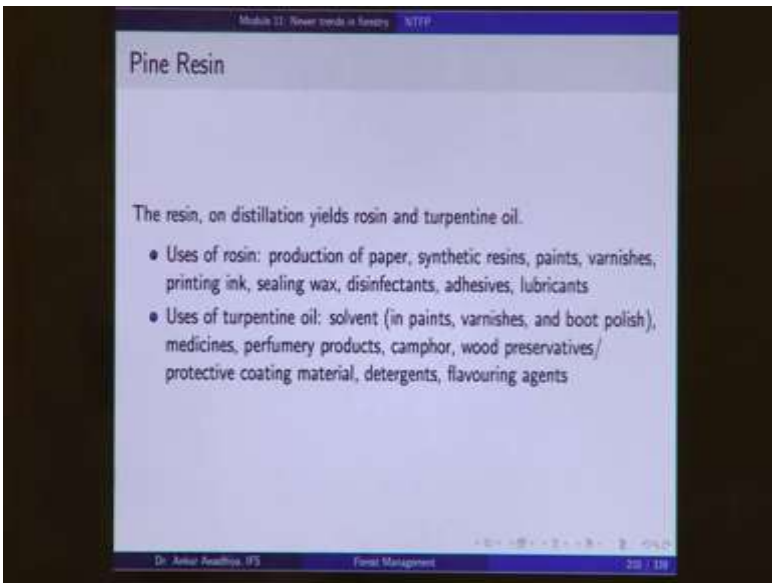


(Refer Slide Time: 40:27)



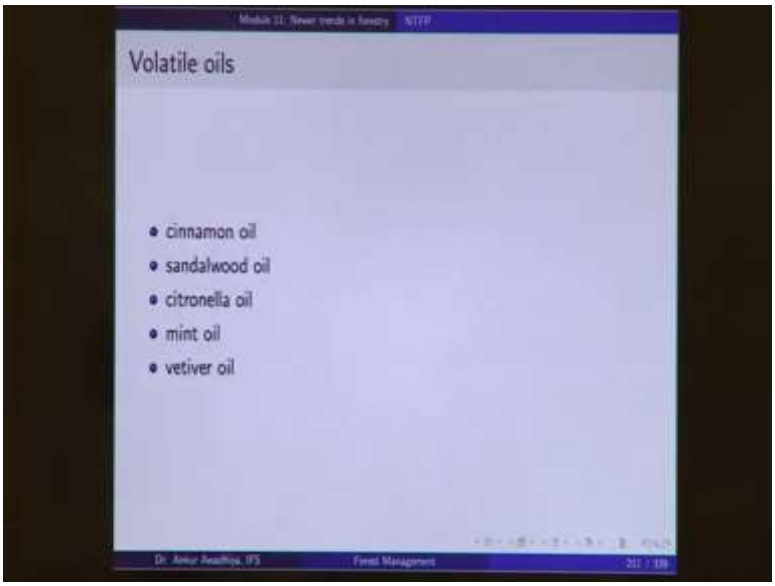
Next, we looked at some important in NTFPs including medicinal plants, gums, pine resin.

(Refer Slide Time: 40:28)

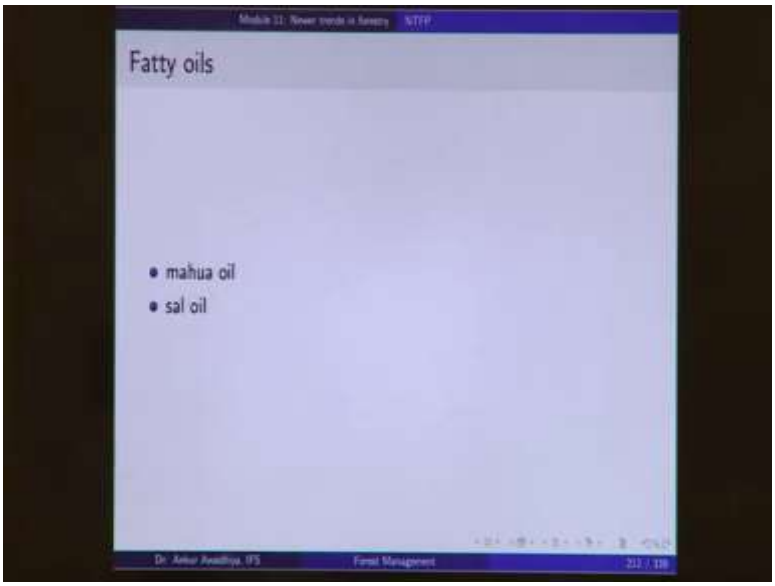


Now, resin on distillation gives you rosin and turpentine oil, both have different uses.

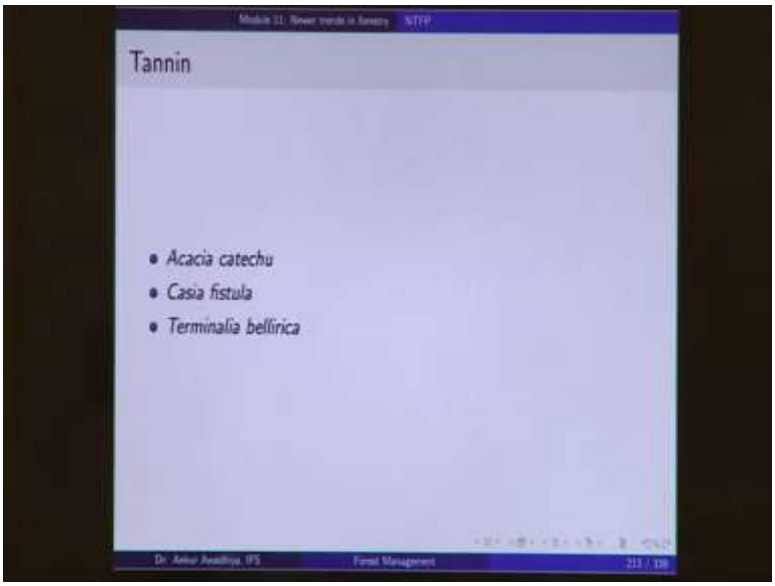
(Refer Slide Time: 40:35)



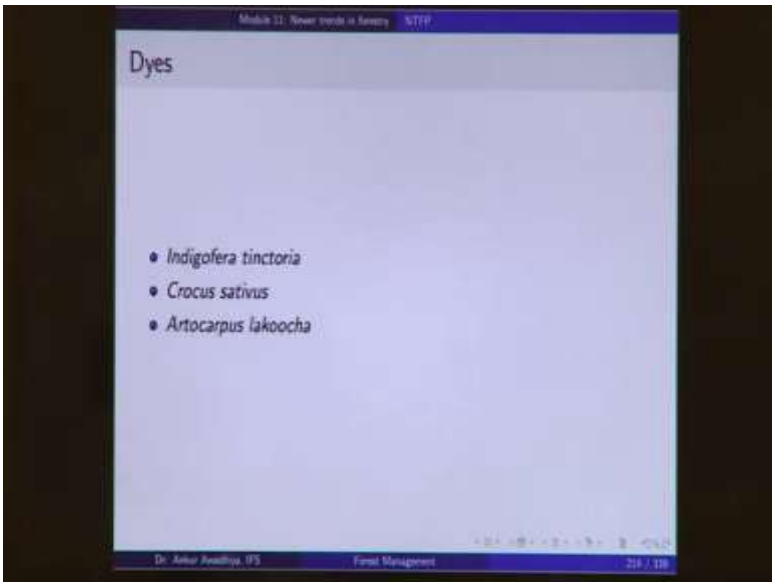
(Refer Slide Time: 40:37)



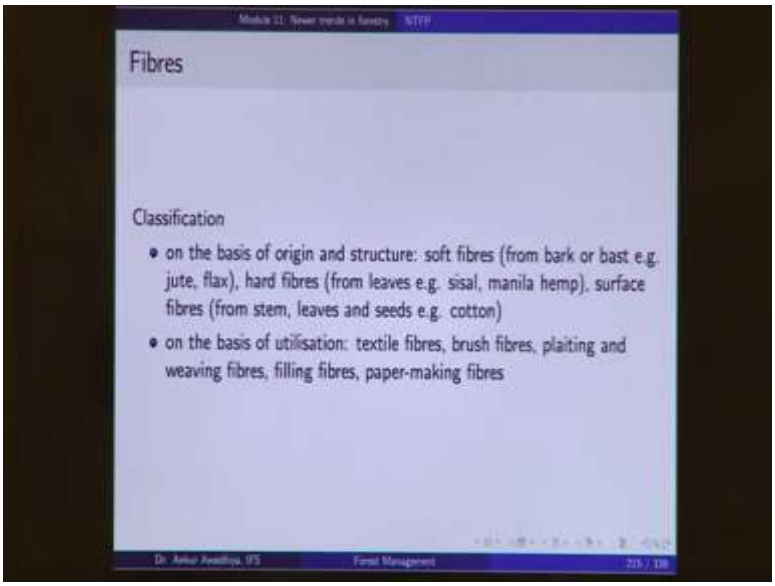
(Refer Slide Time: 40:39)



(Refer Slide Time: 40:40)

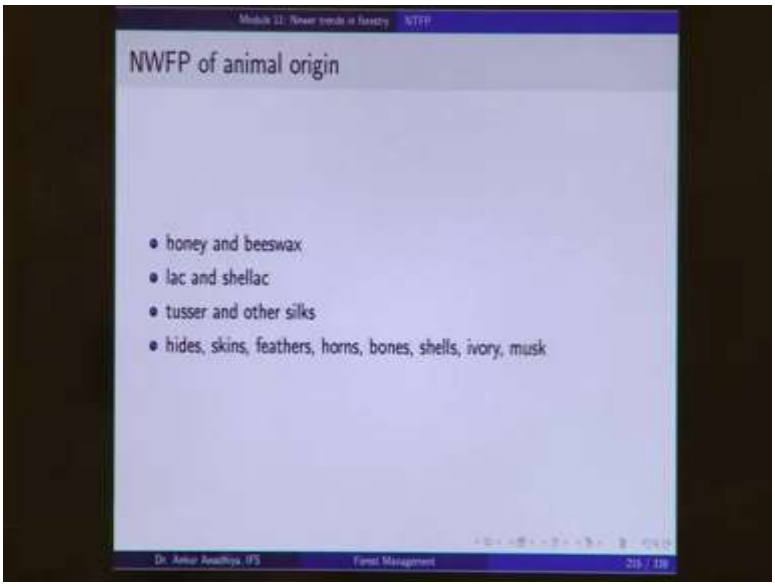


(Refer Slide Time: 40:41)



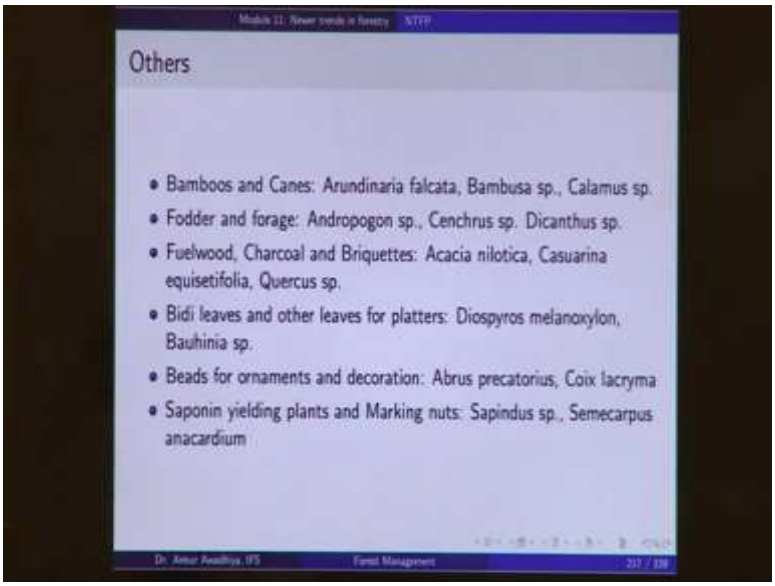
Volatile oils, fatty oils, tannins, dyes, fibres. we looked also at the classification of fibres.

(Refer Slide Time: 40:44)

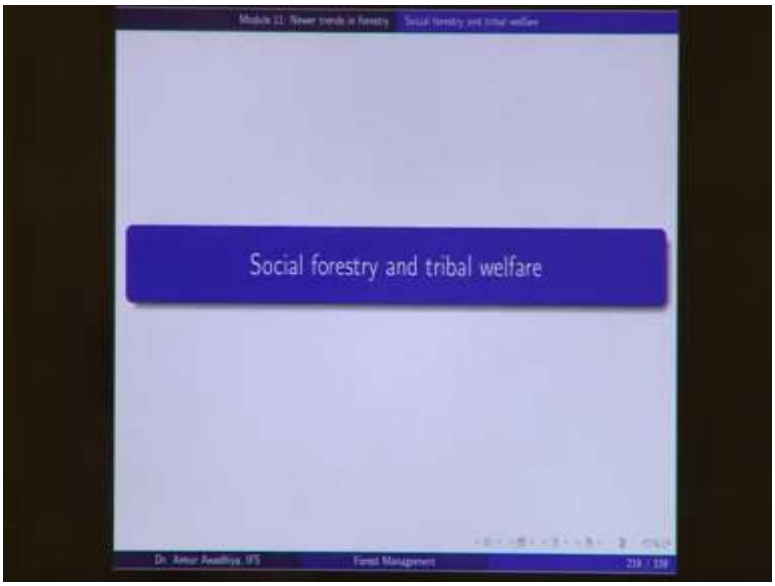


Non-Wood Forest Produce of animal origin, and also the other NTFPs.

(Refer Slide Time: 40:47)

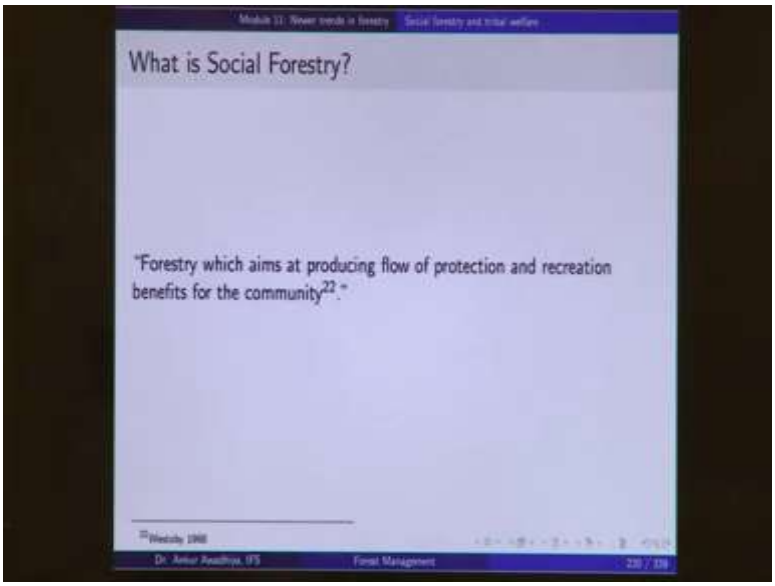


(Refer Slide Time: 40:50)



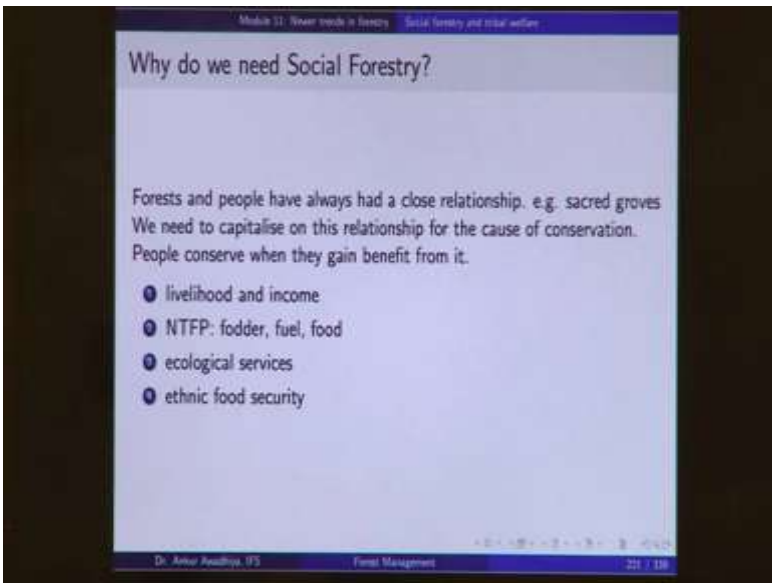
In the second lecture of this module, we looked at social forestry and tribal welfare.

(Refer Slide Time: 40:56)



Now, social forestry is defined as, forestry which aims at producing flow of protection and recreation benefits for the community.

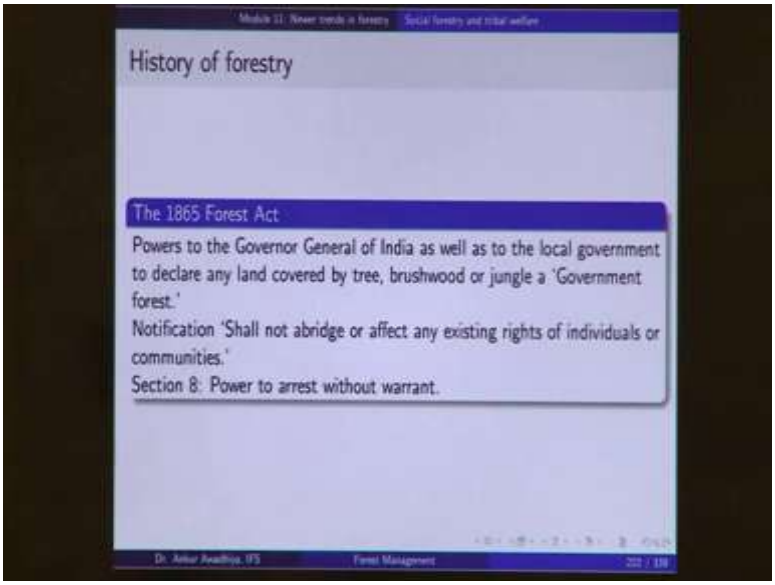
(Refer Slide Time: 41:11)



So, basically a social forestry says that, if you want to protect the forest, you can only do it then the local people are able to gain benefit from it. And historically, we have seen that people have had a close relationship with forest, and social forestry aims to encourage this relationship to inculcate a feeling of ownership of the people towards the forest, to ensure that the people are more and more inclined to conserve the forest. Now,

the benefits that are provided to the people are in the form of livelihood, income, NTFP, ecological services and ethnic food security.

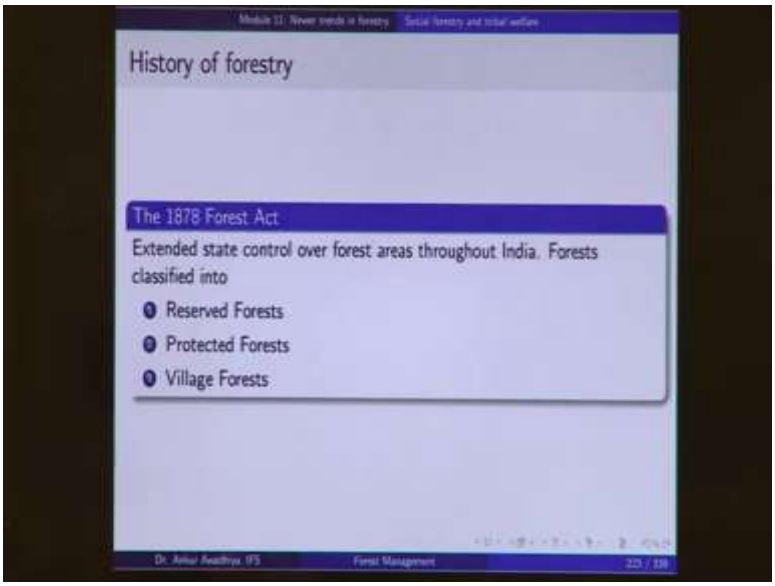
(Refer Slide Time: 41:45)



And then, we looked at a short history of forestry and why the social forestry was so important.

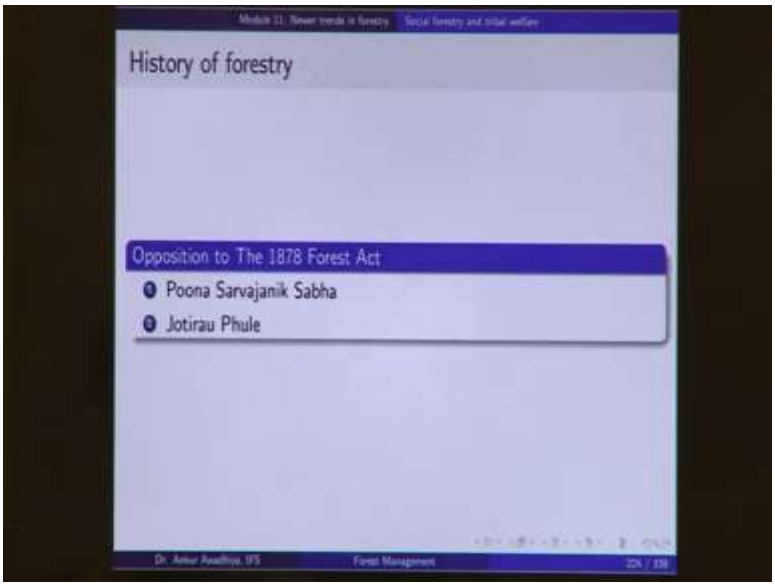
So, even though the 1865 Forest Act said that the notification will not shall not abridge or affect any existing rights of individuals or communities, but in those days, the field situation was not that good, people were largely illiterate, and they were not able to put forth their rights and their demands in a forceful manner. Now, because of which a lot of areas were converted into forest and people did not get to see lot of things.

(Refer Slide Time: 42:22)



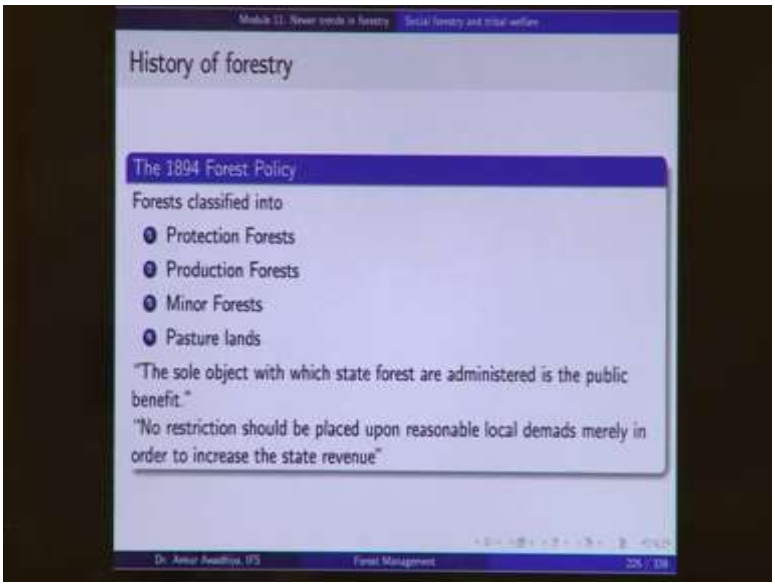
They were not able to exert their rights. Now, the 1878 Forest Act further extended it.

(Refer Slide Time: 42:28)



But then, there was in opposition to the 1878 Act by the Poona Sarvajanik Sabha and also Jotirau Phule.

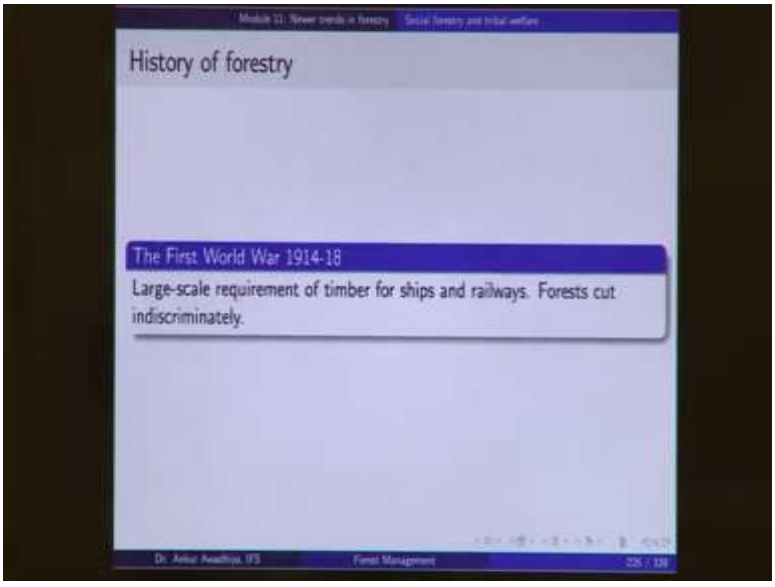
(Refer Slide Time: 42:35)



Now, the 1894 Forest Policy classified forests into 4 different categories, but it also wrote the sentence that the sole object with which state forests are administered is the public benefit, and no restriction should be placed upon reasonable local demands, merely in order to increase the state revenue.

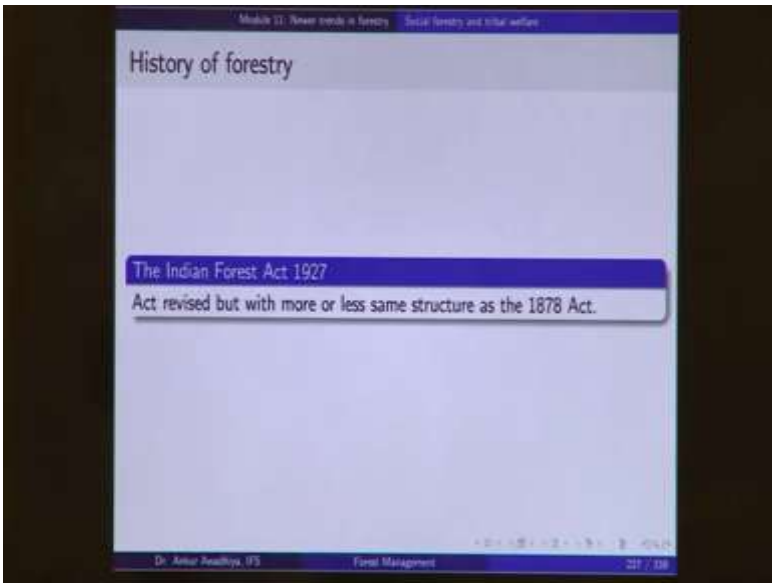
So, we are saying that even in the nineteenth century, we are shifting from the government utilisation of forests for revenue towards social forestry; that is, we are shifting towards the usage of forests for meeting of the local needs.

(Refer Slide Time: 43:11)

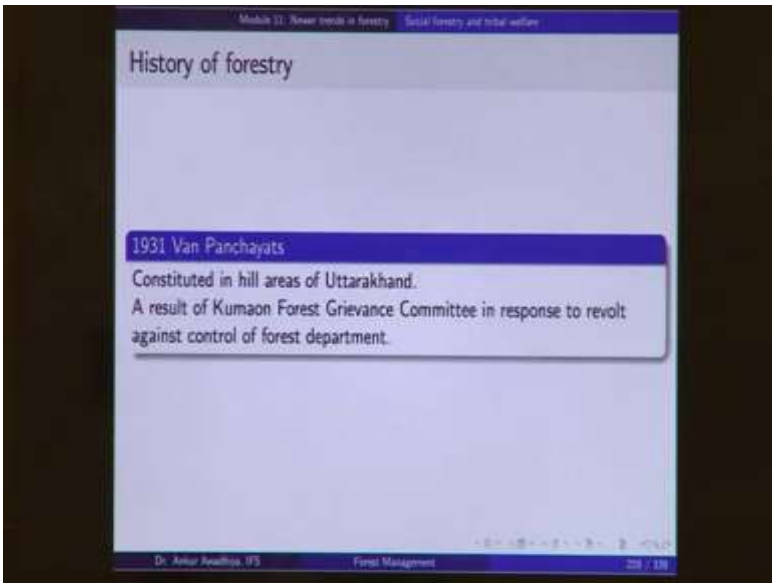


But then, we had the First World War where timber was extensively needed, and there was an indiscriminate cutting of forests. Followed by the Indian Forest Act which was revised act, but more or less the same structure was kept.

(Refer Slide Time: 43:20)



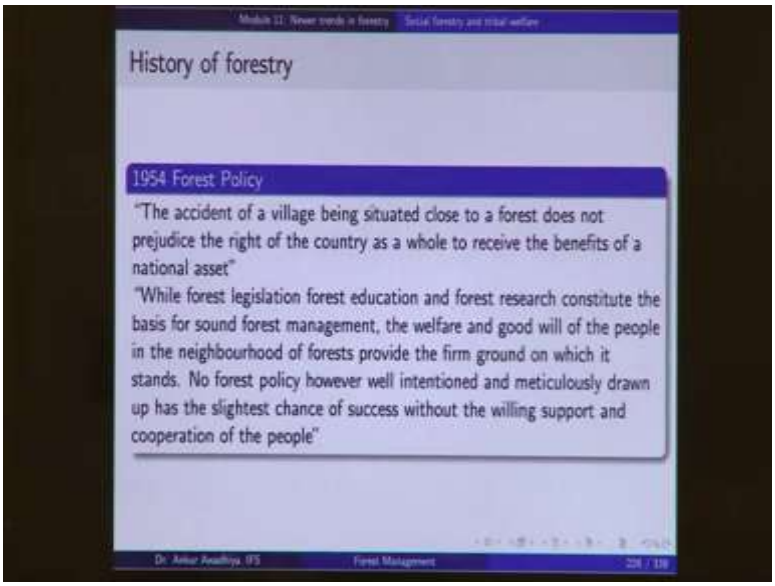
(Refer Slide Time: 43:26)



And then in 1931, we saw the beginning of the Van Panchayats.

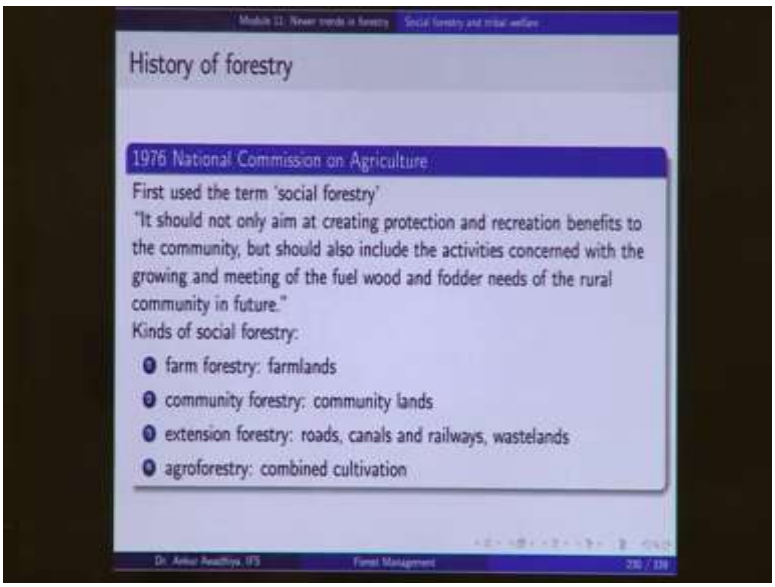
So, in the case of Van Panchayat, the Panchayat exerts its ownership on the forest and also it maintains and conserves the forest. So, it began in the hill districts of Uttarakhand.

(Refer Slide Time: 43:44)



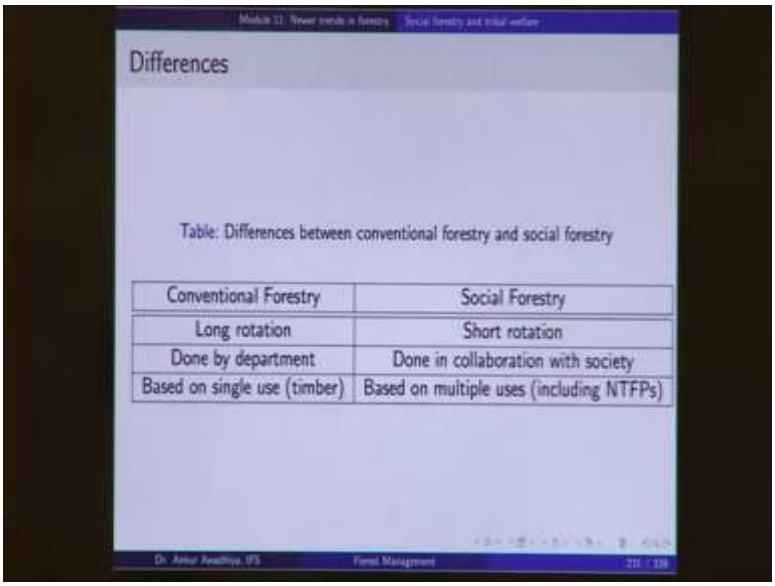
Then, in the 1954 Forest Policy, while forest legislation, forest education, and forest research constitute the basis for sound forest management, the welfare and goodwill of the people in the neighborhood; a forest provides the firm ground on which it stands. No forest policy; however, will intention and meticulously drawn up has the slightest chance of success without the willing support and cooperation of the people. So, with this 1954 Forest Policy, we said that social forestry is now an integral part, we need to look at it; without it, we will not be able to conserve the forest.

(Refer Slide Time: 44:19)



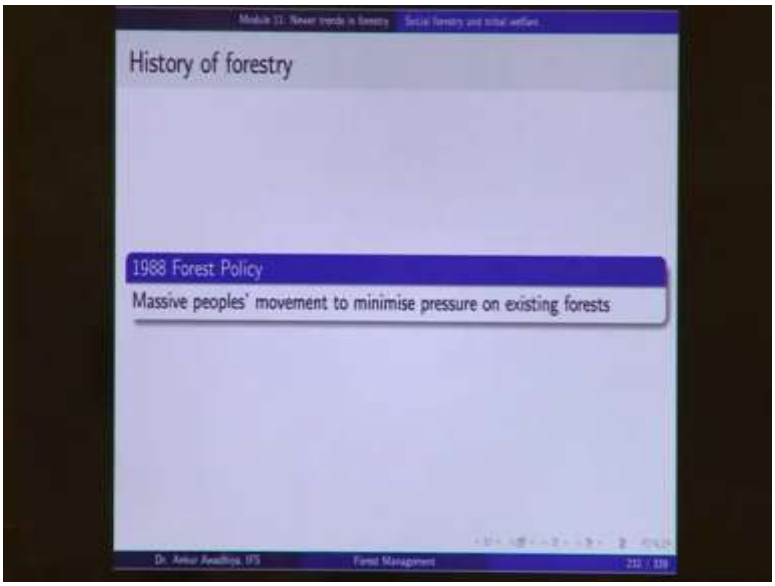
Then, came the 1976 National Commission on Agriculture which further elaborated on this concept, and it was the first to actually use the term social forestry, but it also expanded its definition. It said that there will be farm forestry, community forestry, extension forestry, and agroforestry.

(Refer Slide Time: 44:38)



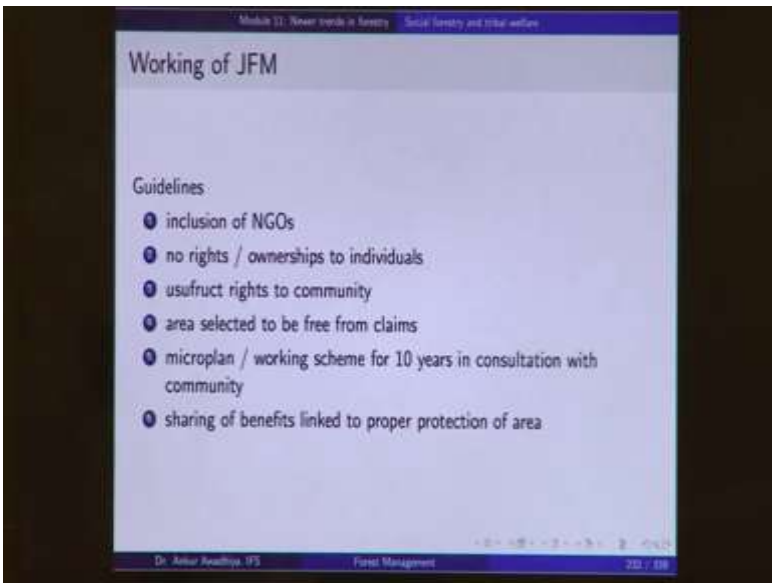
So, what are the differences between conventional forestry and social forestry? Conventional forestry is typically long rotation crops; social forestry short rotation crops. Conventional forestry is done by department, social forestry is done in collaboration with the society. Conventional forestry is based on a single use of forest for timber, whereas social forestry is based on multiple use of forest including NTFPs. And then, a water shed moment came in 1988 with the 1988 Forest Policy.

(Refer Slide Time: 44:03)



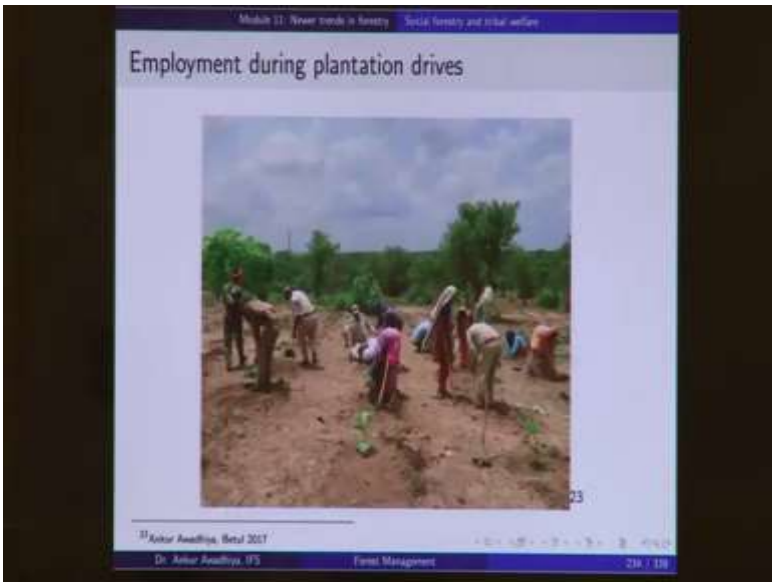
We said that massive peoples' movement is essential and will be done to minimize pressure on the existing forests.

(Refer Slide Time: 45:14)



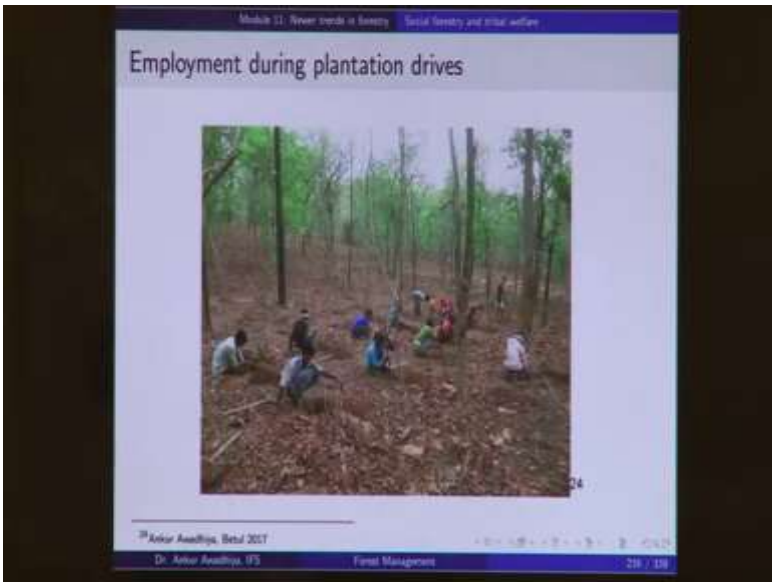
And so, we had the beginnings of the joint forest management in the nineteen eighties. So, this in this includes NGOs. And ,the individuals do not get rights, but the usufruct rights are given to the community; the area selected should be free from claims, microplans are made in consultation with the community, and sharing of benefits is linked to proper protection of the area.

(Refer Slide Time: 45:37)

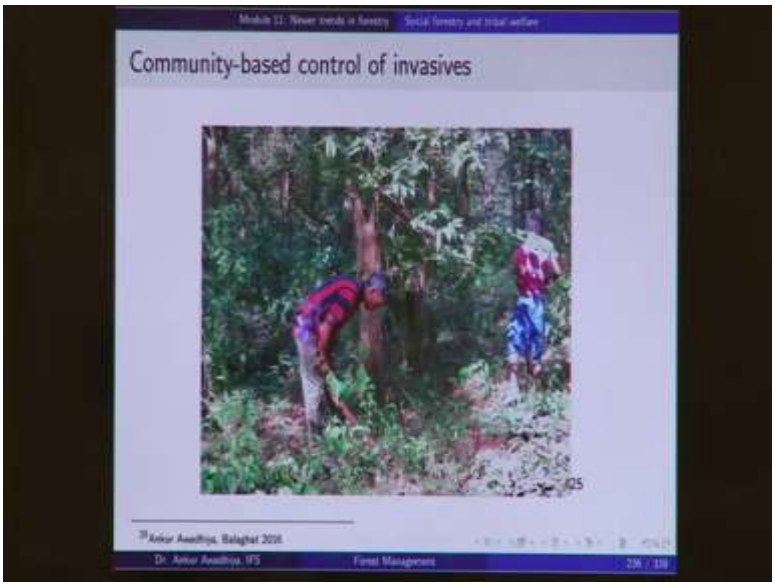


So, through joint forest management, people get employment.

(Refer Slide Time: 45:41)



(Refer Slide Time: 45:43)



(Refer Slide Time: 45:45)

In plantation: control of invasives, tendu patta is a big thing.

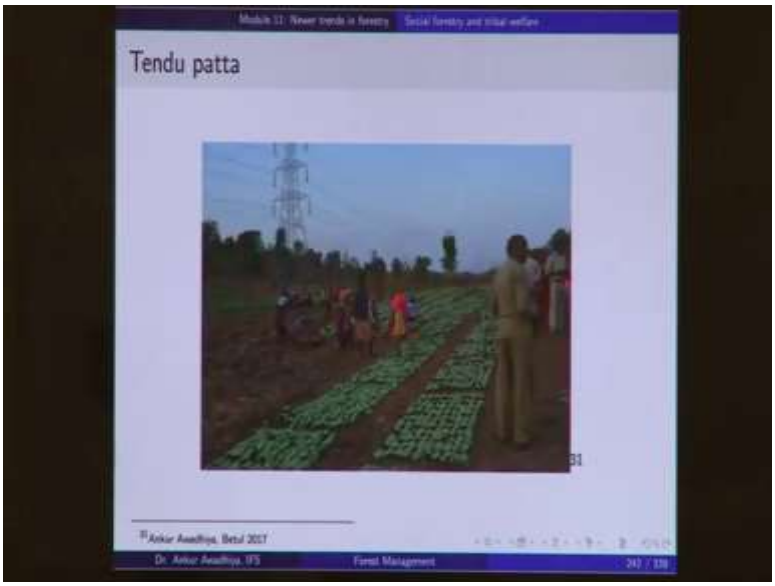
(Refer Slide Time: 45:47)

(Refer Slide Time: 45:48)

(Refer Slide Time: 45:49)

(Refer Slide Time: 45:51)

(Refer Slide Time: 45:52)



(Refer Slide Time: 45:53)

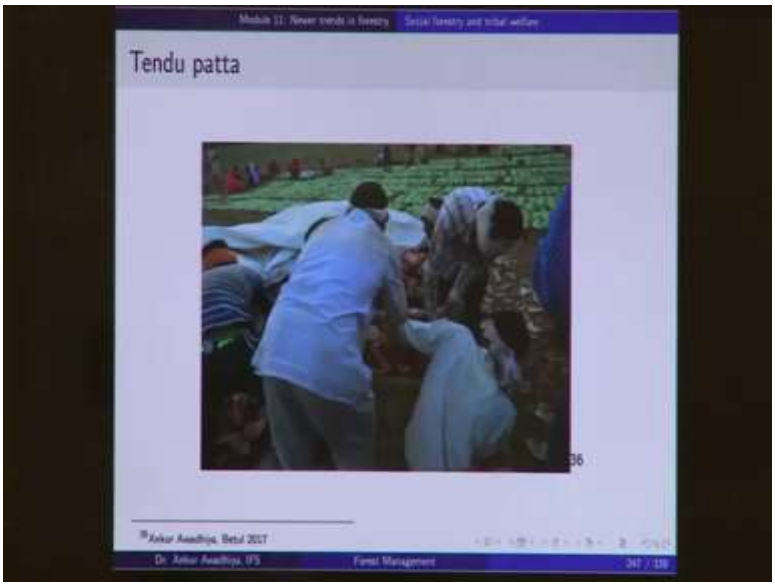
(Refer Slide Time: 45:54)

(Refer Slide Time: 44:45)

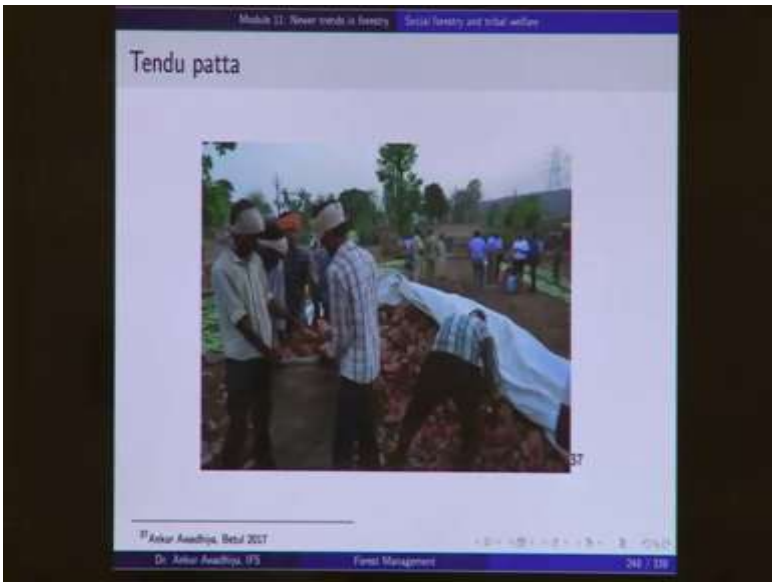
So, in tendu patta, the people and a lot of women specifically, they get sufficient amount, they get large amounts of money for the collection of tendu patta, and also through means of profit sharing mechanism.

(Refer Slide Time: 45:59)

(Refer Slide Time: 46:01)



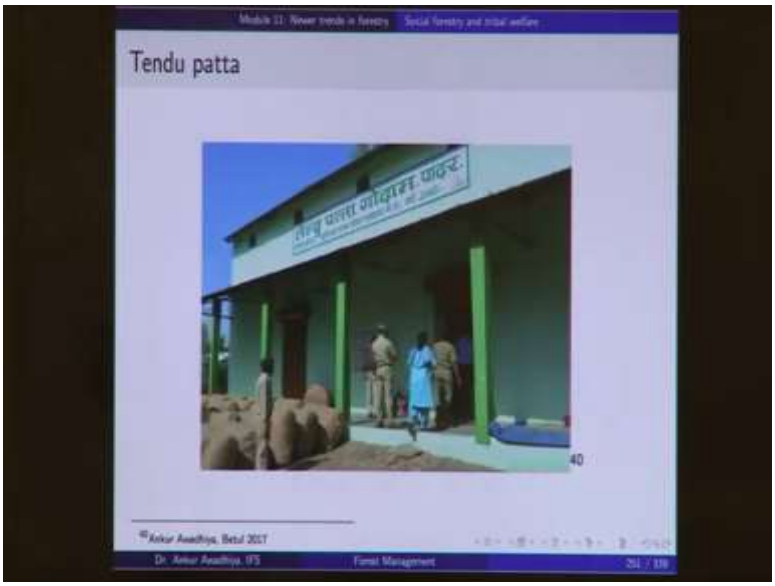
(Refer Slide Time: 46:02)



(Refer Slide Time: 46:03)

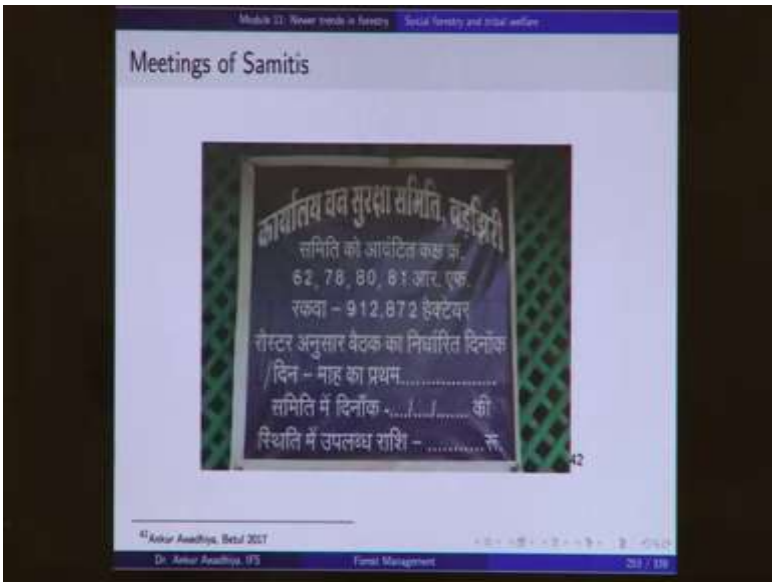
(Refer Slide Time: 46:04)

(Refer Slide Time: 46:05)



(Refer Slide Time: 46:06)

(Refer Slide Time: 46:07)



(Refer Slide Time: 46:08)

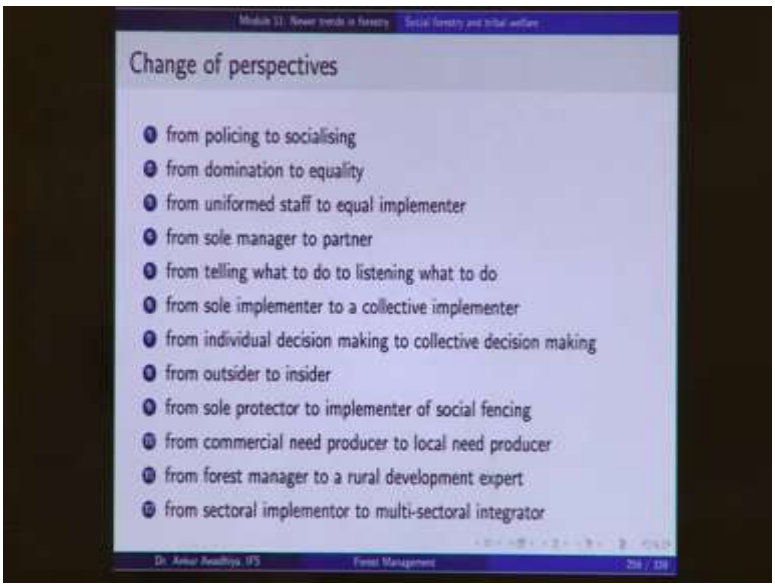
(Refer Slide Time: 46:09)

When this tendu patta is sold to outsiders, then in certain cases the Samitis are also setting up their own shops. They are also doing minor processing. They are also setting up their own nurseries.

(Refer Slide Time: 46:19)

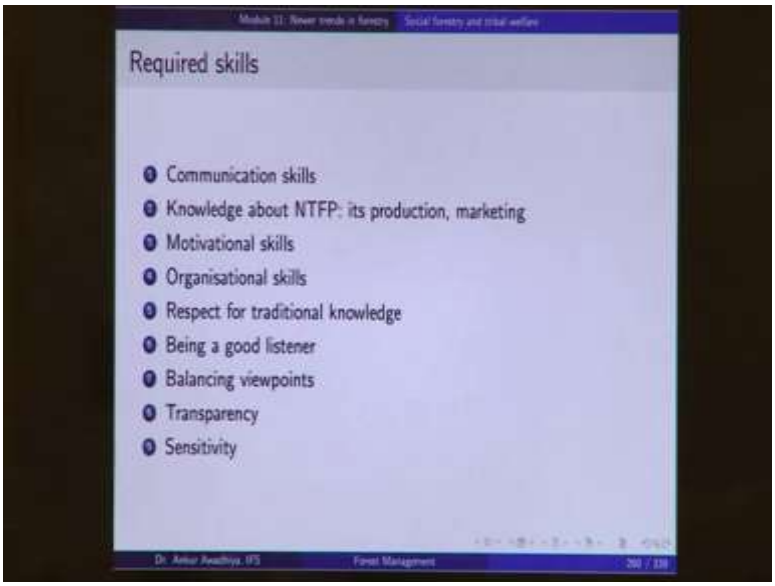
And, the department also facilitates the provisioning of medical services and other things.

(Refer Slide Time: 46:24)



So, social forestry is basically a change in perspective. So, the department is shifting from policing to socialising; from domination to equality; from uniformed staff to being an equal implementer; from telling what to do to listening what to do, and so on. So, basically social forestry is a new perspective.

(Refer Slide Time: 46:44)

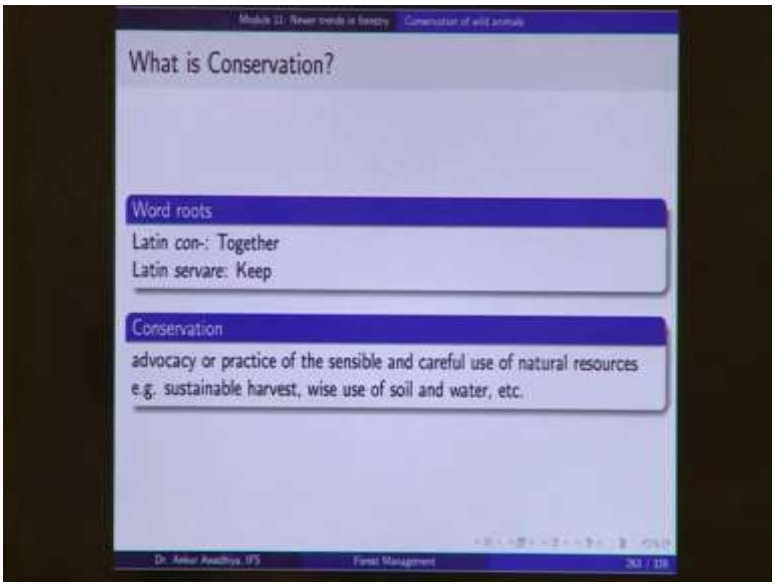


And, it also requires a number of new skills such as communication skills, knowledge about NTFP, motivational skills, organizational skills and so on.

(Refer Slide Time: 46:52)

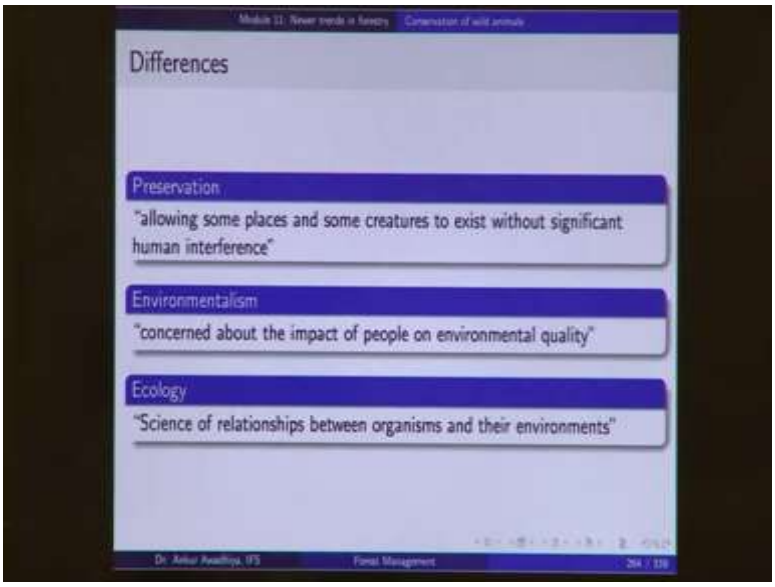
Now finally, we looked at the conservation of wild animals.

(Refer Slide Time: 46:56)

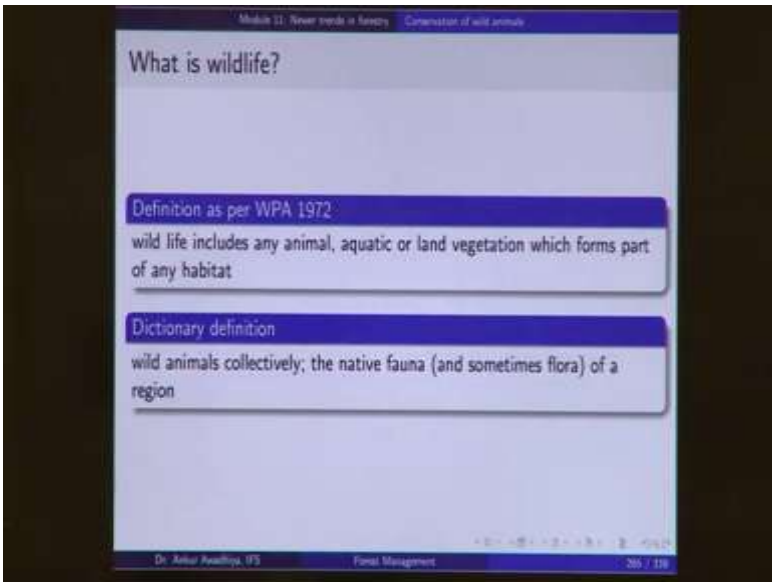


So, conservation comes from the word roots; ‘con’ and ‘servare,’ we just keep together.

(Refer Slide Time: 47:01)

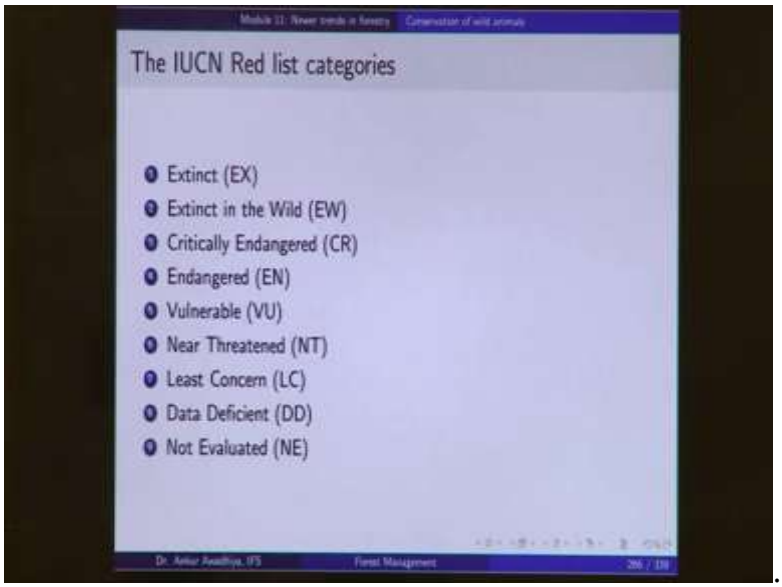


(Refer Slide Time: 47:05)



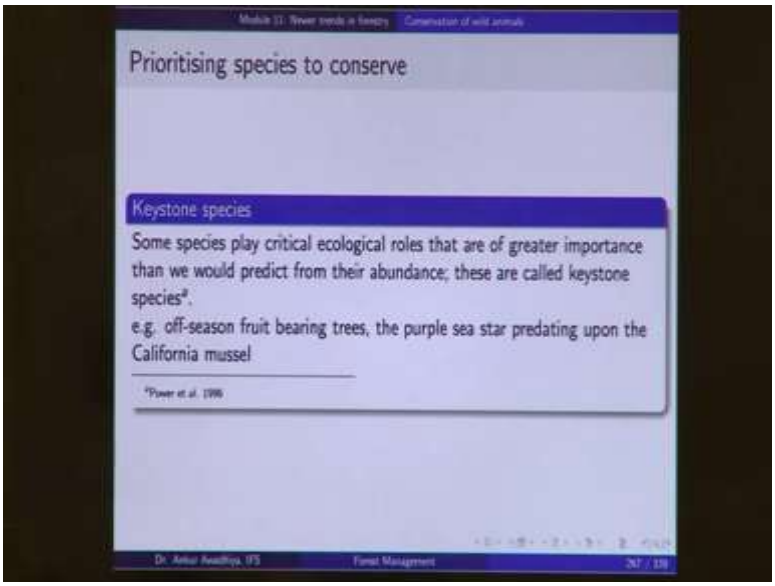
It is different from preservation, environmentalism and ecology. Wildlife is defined in the Wildlife Protection Act. It includes any animal; aquatic or land, vegetation which forms part of any habitat.

(Refer Slide Time: 47:17)



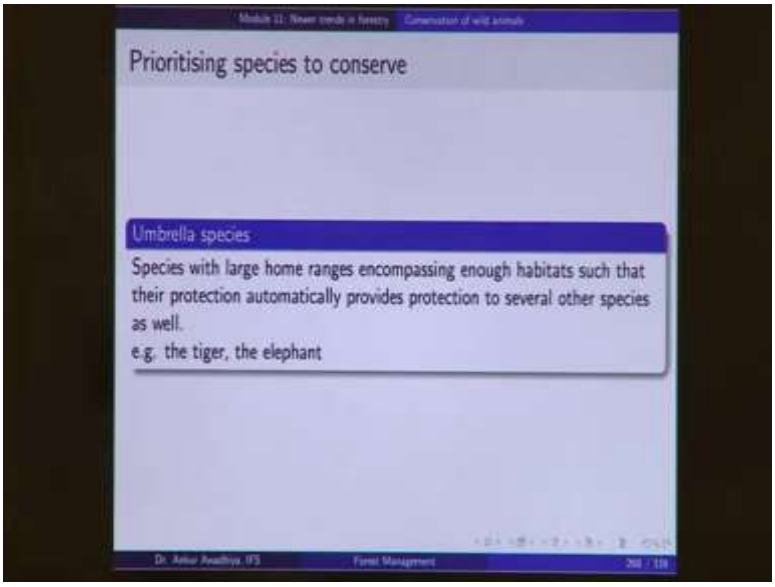
So, it is a pretty wide definition, and there are a number of species of animals that are in different levels of red list. So, there are certain animals that are already extinct, some are extinct in the wild, some are critically endangered, and we move down to endangered, vulnerable, near threatened, least concerned, these are data deficient and not evaluated.

(Refer Slide Time: 47:41)



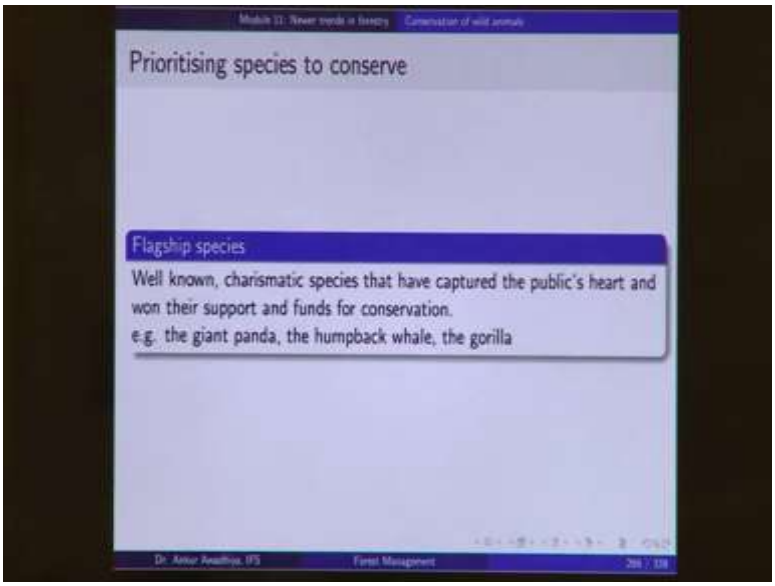
Now to conserve wildlife, we need to do a prioritization, because here again the needs are unlimited, but the resources are limited. So, there has to be a prioritization. So, for prioritization, we look at keystone species which play a much greater role in the functioning of the ecosystem, as compared to their numerical abundance.

(Refer Slide Time: 48:00)

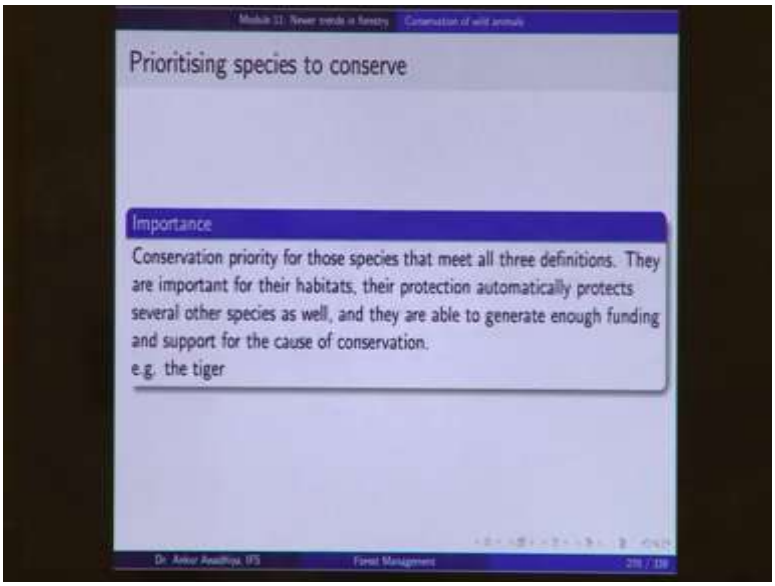


We look at umbrella species which require large home areas.

(Refer Slide Time: 48:04)



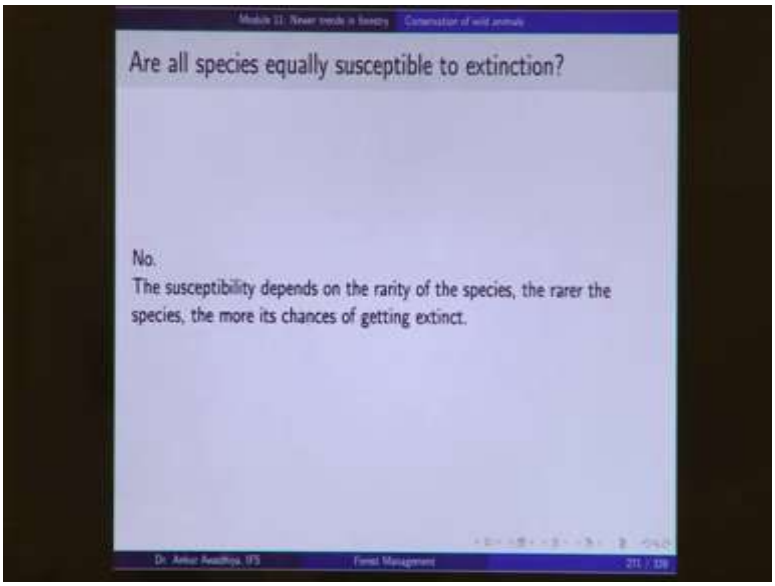
(Refer Slide Time: 48:07)



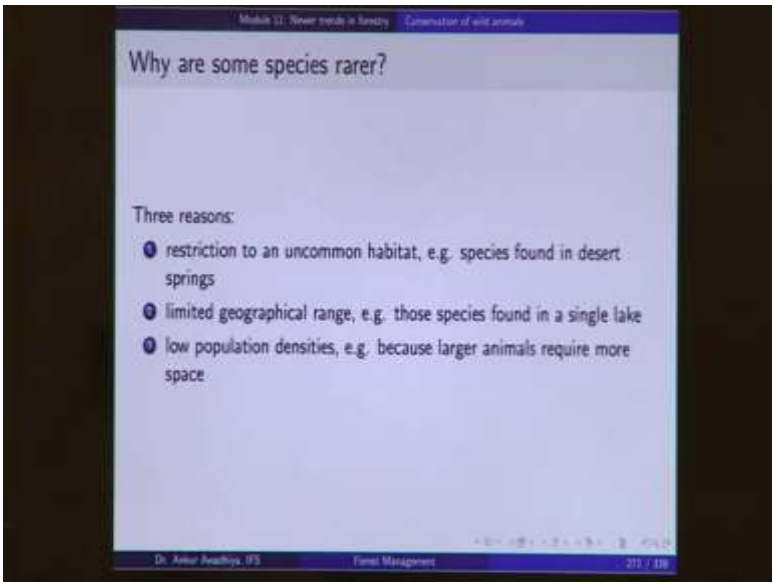
And, we look at flagship species that people actually love. And, we try to focus our conservation efforts towards those species that are one, or that have one or more of these characteristics, preferably all 3 of them.

So, for instance, tiger is a big thing in our country. Tiger; a lot of money and efforts are being put towards the conservation of tiger, because it is a keystone species, together with being a flagship species and an umbrella species. Now, we saw that all species are not equally susceptible to extinction; those species that are rare.

(Refer Slide Time: 48:37)

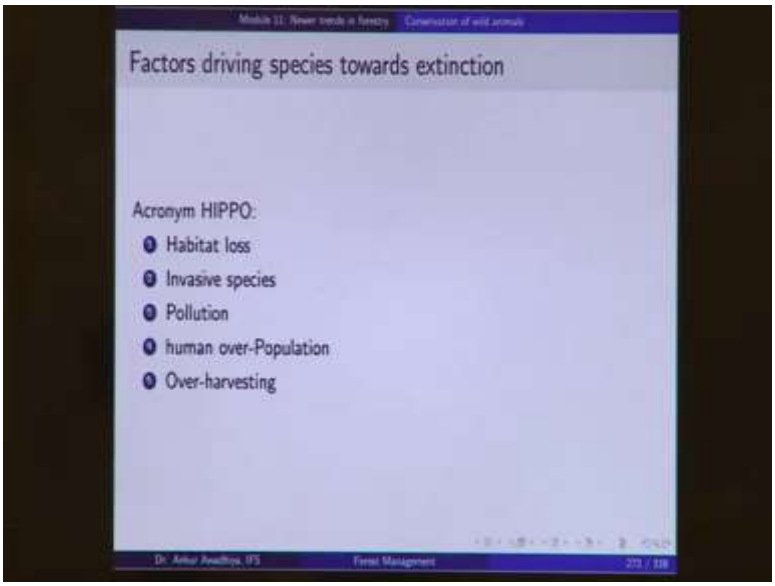


(Refer Slide Time: 48:42)



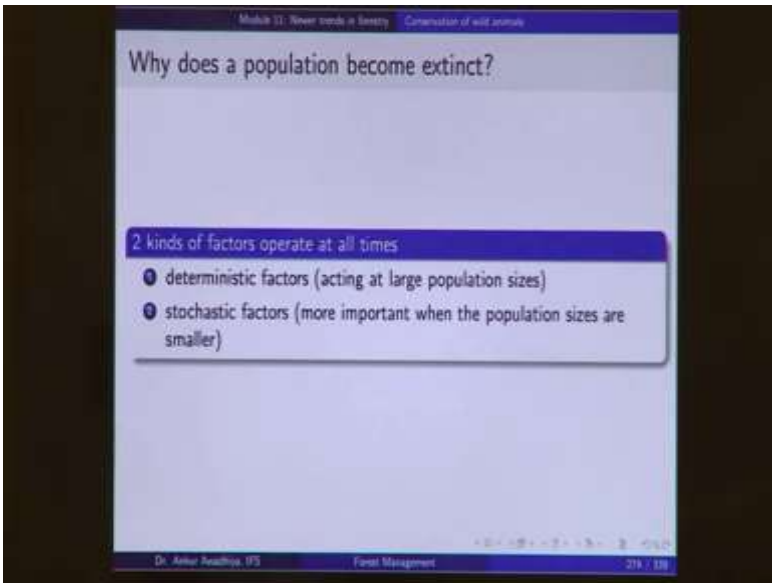
Typically, because they live in an uncommon habitat, have limited geographical range or have low population densities, they are rarer.

(Refer Slide Time: 48:50)



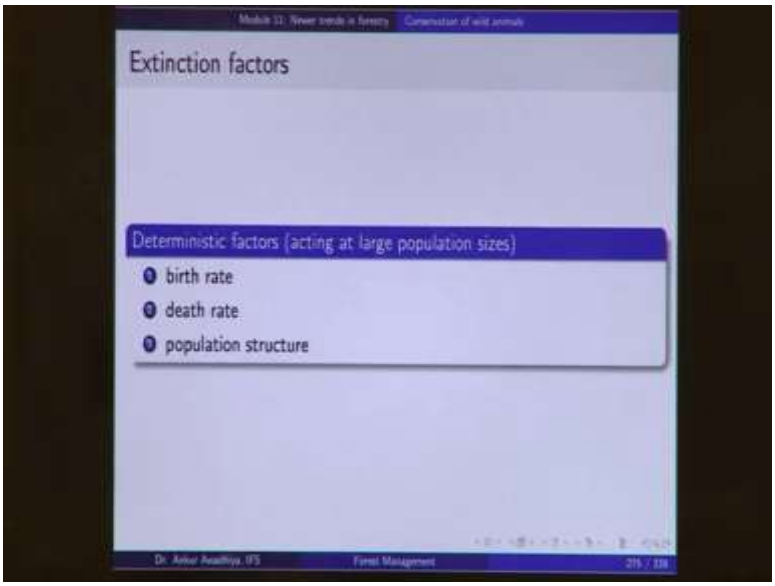
And, we looked at Hippo which is habitat loss, invasive species, population, and pollution, and overharvesting, which is driving a number of species towards the extinction.

(Refer Slide Time: 49:01)

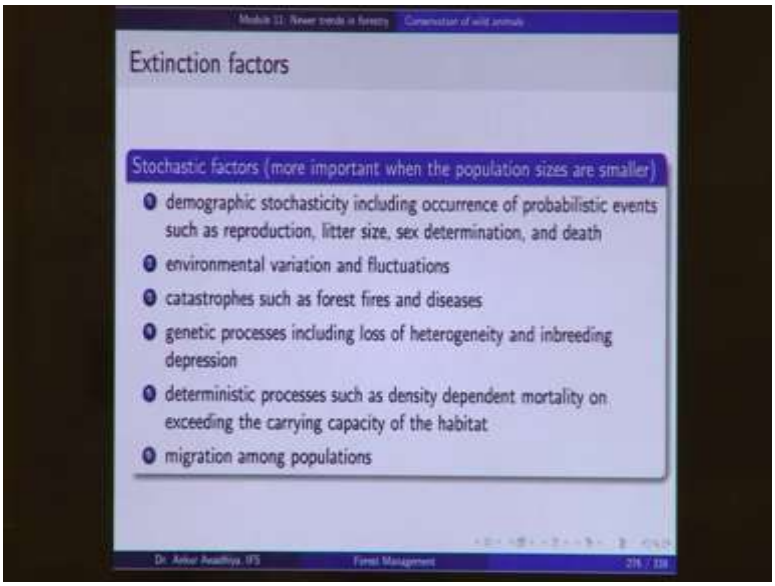


In extinction, 2 kinds of factors are operating: deterministic factors at large population sizes, and stochastic factors.

(Refer Slide Time: 49:10)

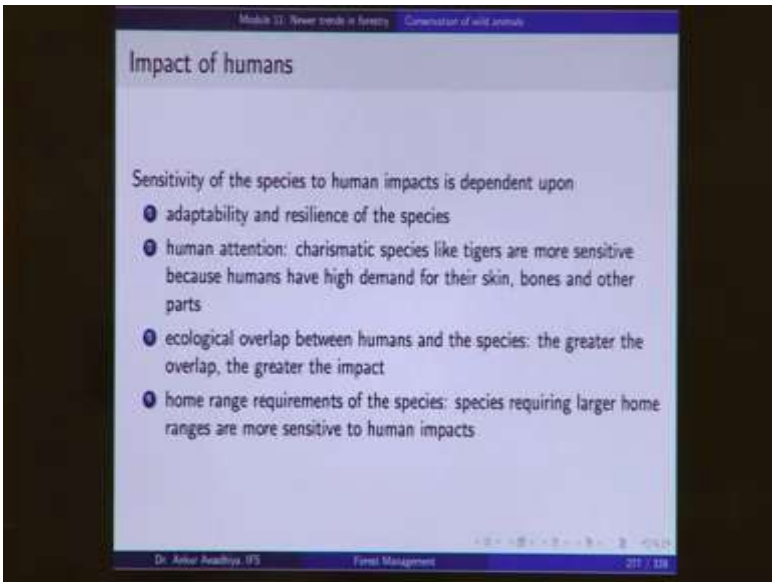


(Refer Slide Time: 49:11)

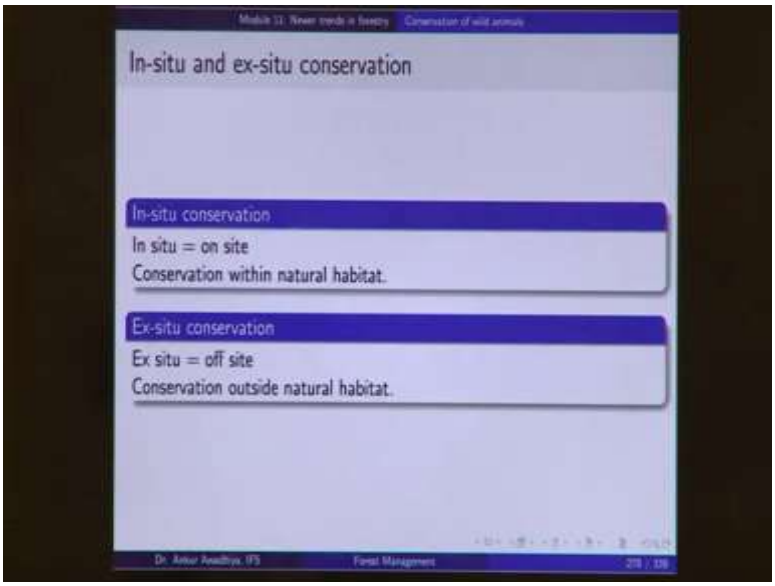


We looked at deterministic and stochastic factors and the impacts of humans.

(Refer Slide Time: 49:13)

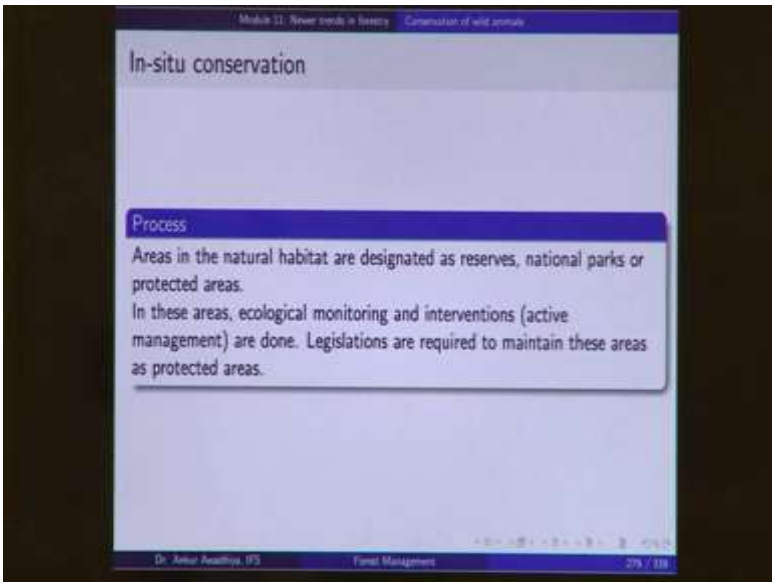


(Refer Slide Time: 49:15)



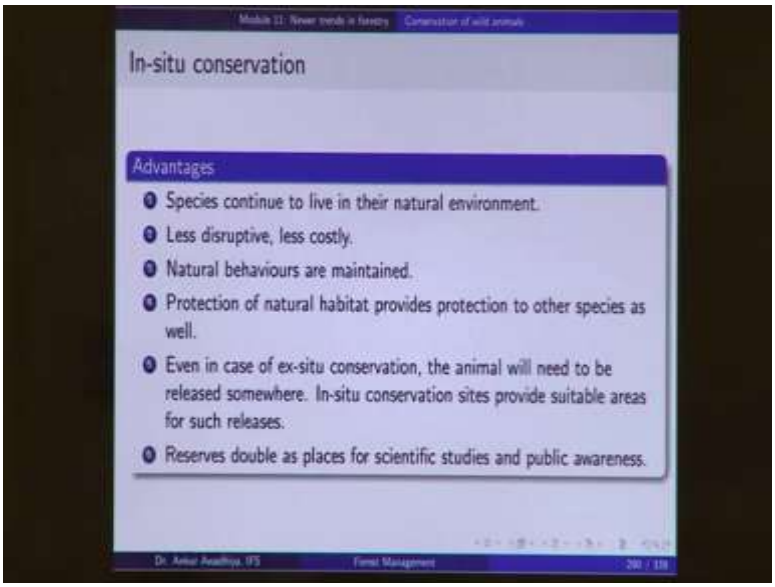
Now, in conservation, there are 2 different modes: one is in situ conservation which is on site, and the second is ex situ conservation which is off the site.

(Refer Slide Time: 49:24)



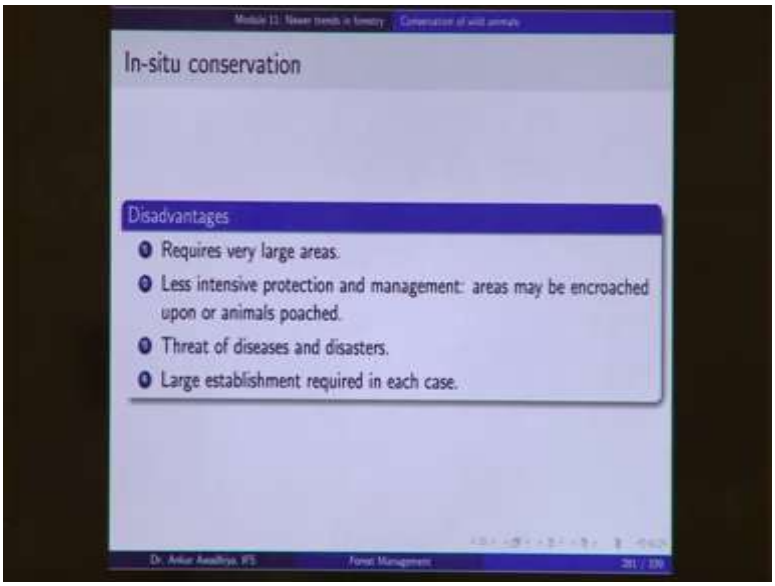
In the case of in situ conservation, we designate areas as reserves, national parks or protected areas. Ecological monitoring and interventions are done; legislations are required to maintain these areas as protected areas.

(Refer Slide Time: 49:38)

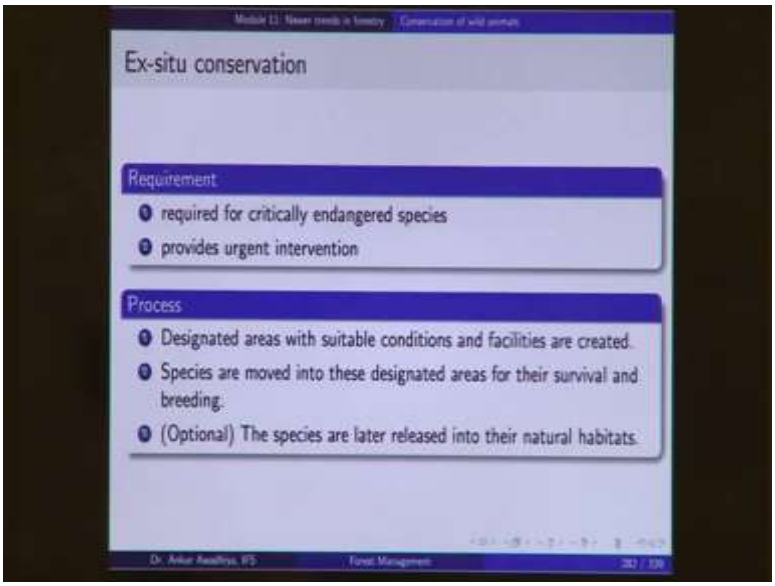


The benefit is that species continue to live. Next, we looked at advantages of in situ conservation, disadvantages. And, also ex situ conservation; advantages and the disadvantages.

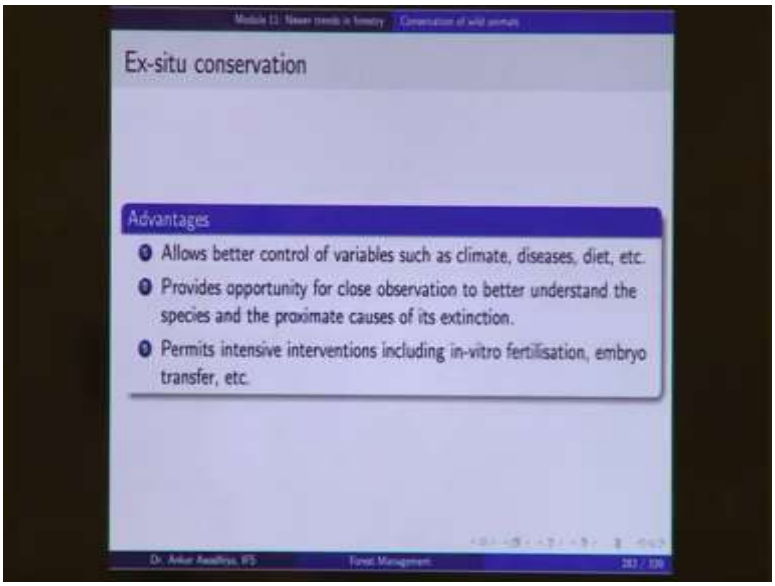
(Refer Slide Time: 49:44)



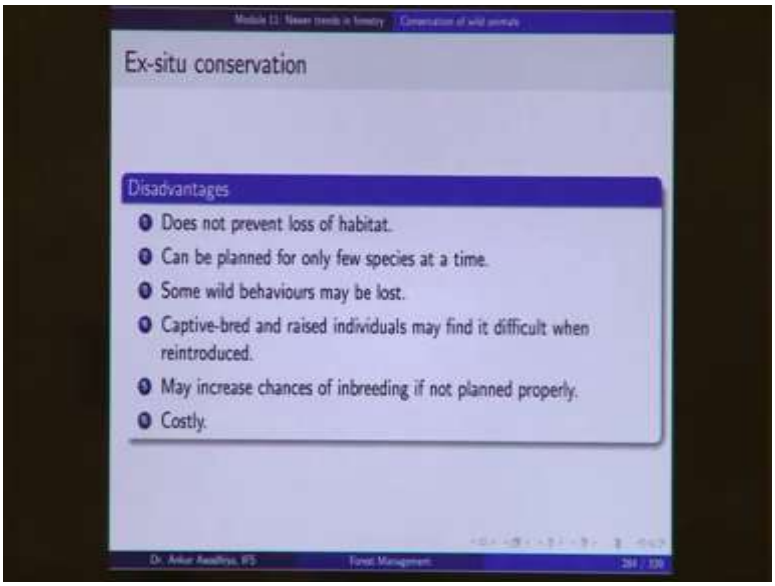
(Refer Slide Time: 49:45)



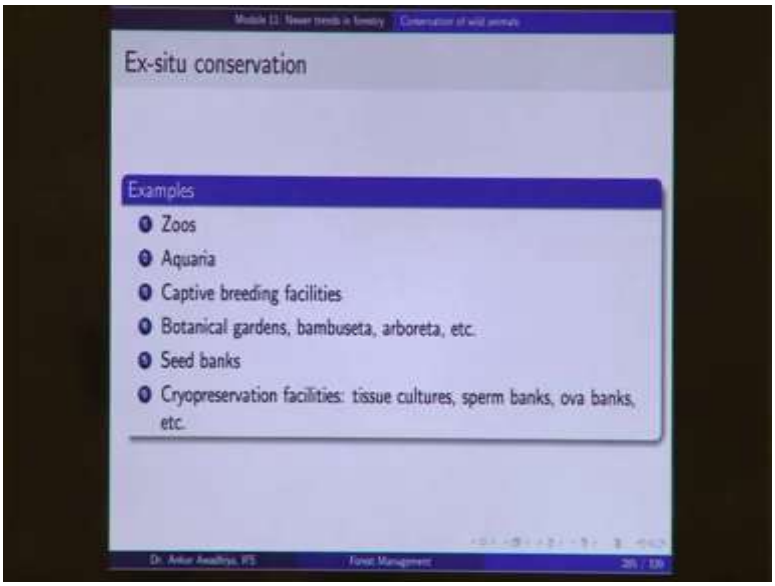
(Refer Slide Time: 49:48)



(Refer Slide Time: 49:49)

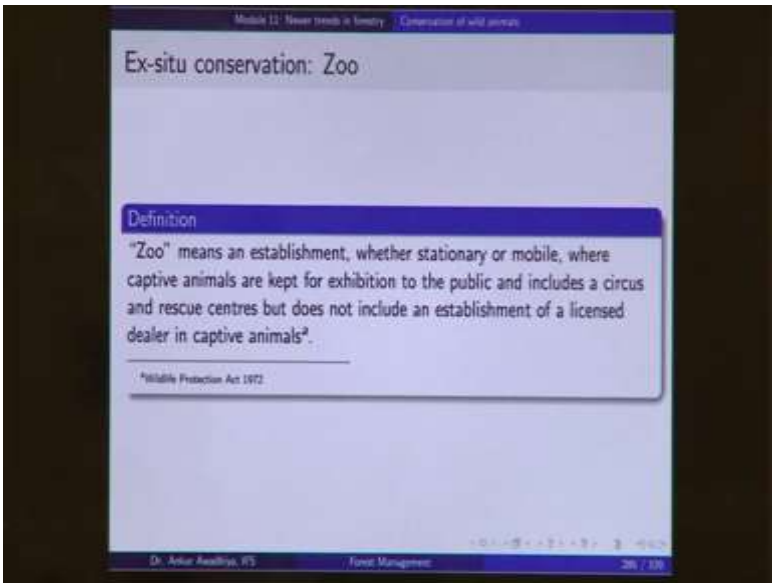


(Refer Slide Time: 49:49)



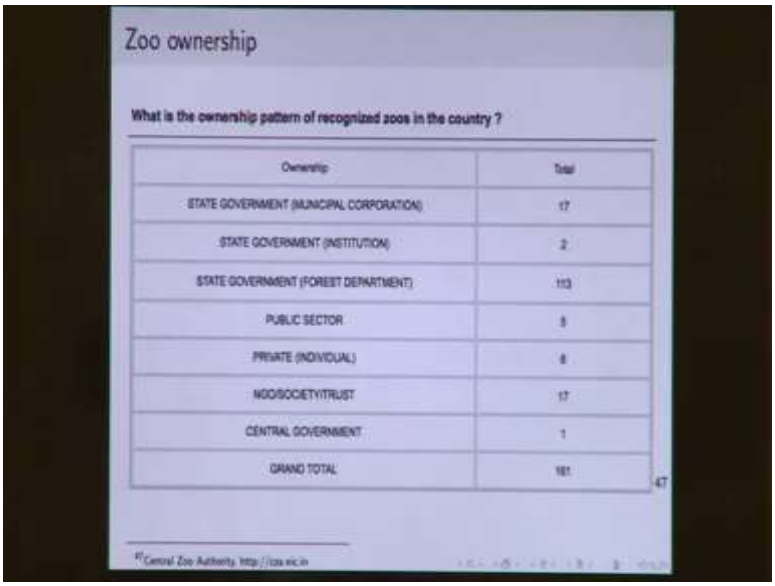
Now, in the case of ex situ conservation, the examples include zoos, aquaria, captive breeding facilities, botanical gardens, bambuseta, arboreta, seed banks, cryopreservation facilities and so on.

(Refer Slide Time: 50:03)



And then, we looked at zoo as an example of ex situ conservation.

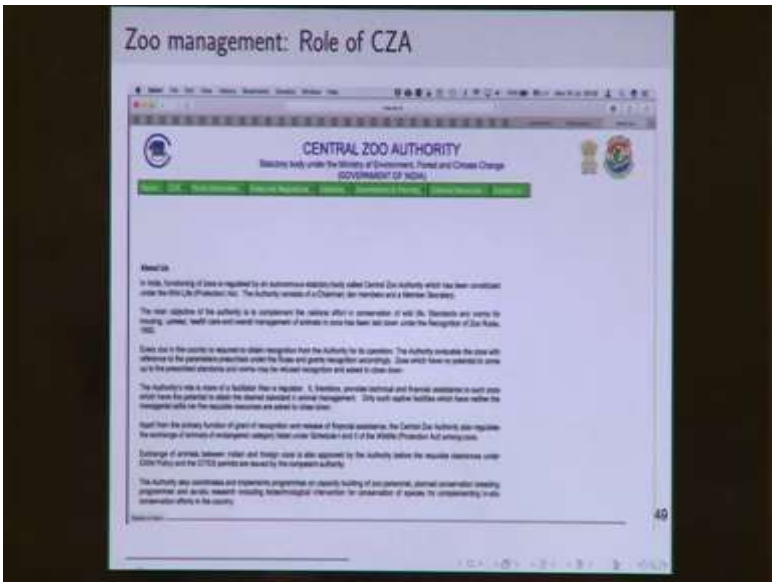
(Refer Slide Time: 50:07)



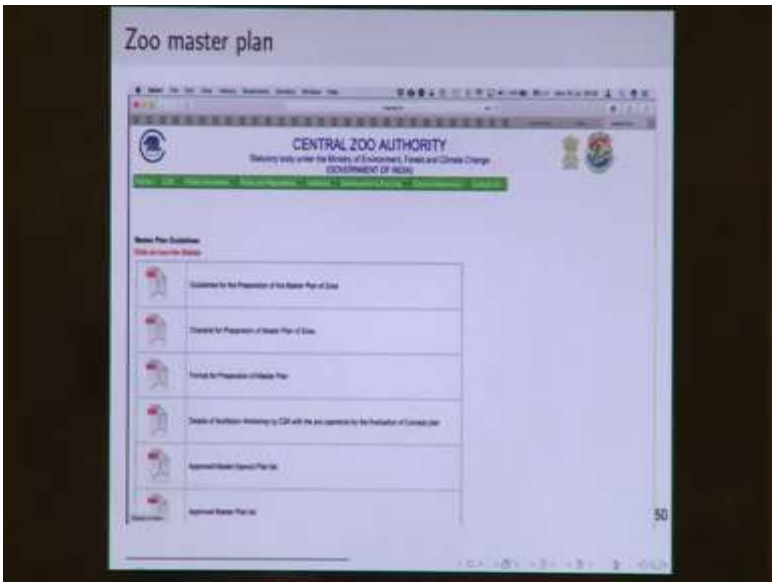
(Refer Slide Time: 50:08)

In our country, the zoo is the zoos are regulated by the CZA.

(Refer Slide Time: 50:11)

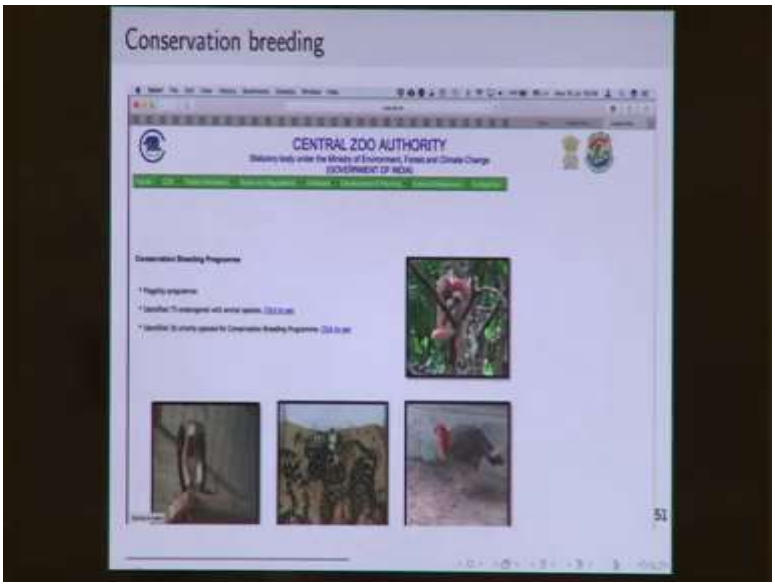


(Refer Slide Time: 50:12)

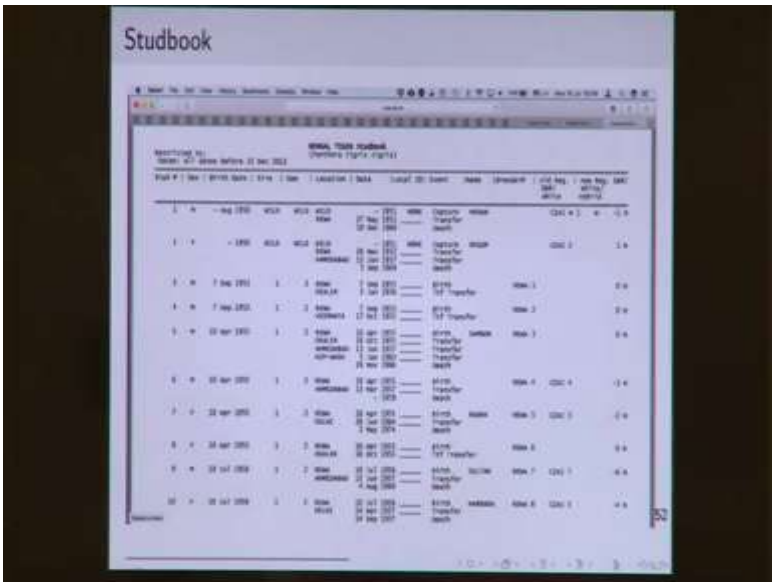


Or the Central Zoo Authority, which approves the zoo master plans.

(Refer Slide Time: 50:16)

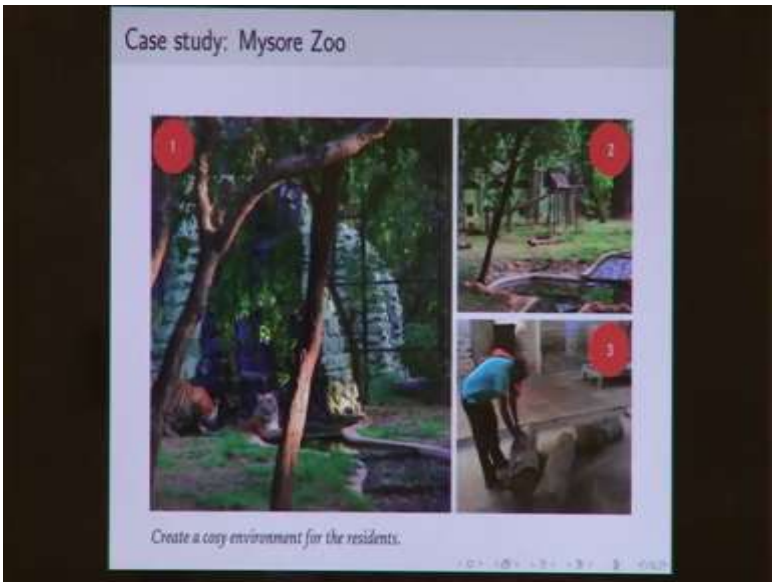


(Refer Slide Time: 50:18)



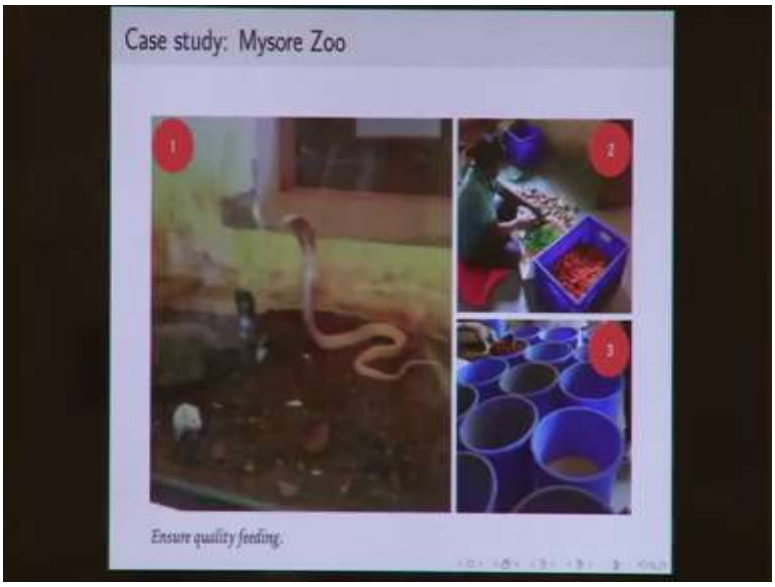
Helps in conservation breeding, helps in standardization of stud books.

(Refer Slide Time: 50:21)

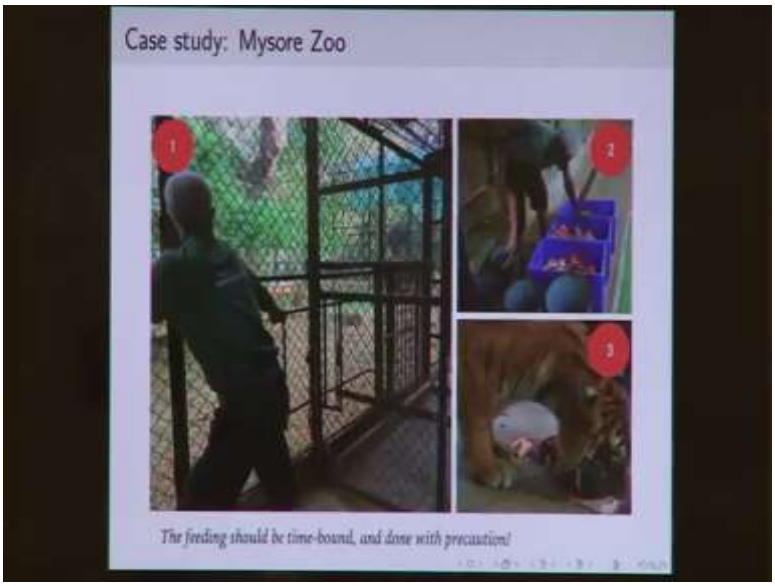


And, we looked at the case study of Mysore zoo as an example.

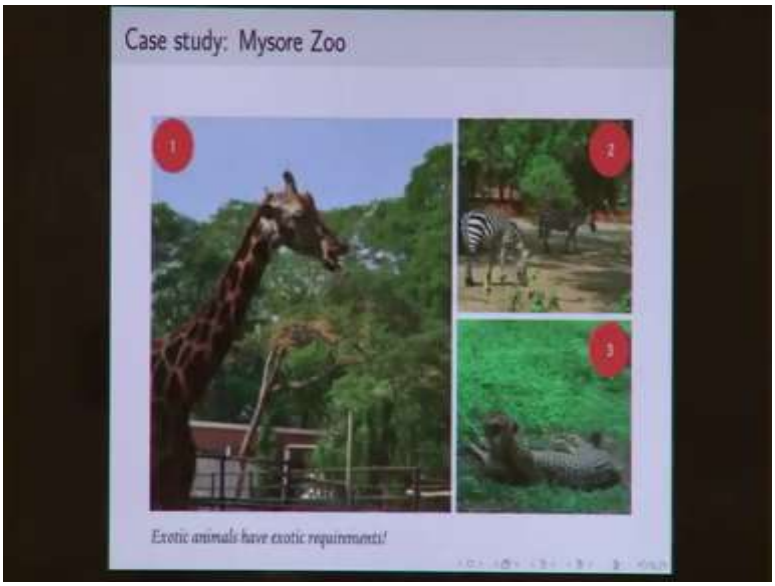
(Refer Slide Time: 50:26)



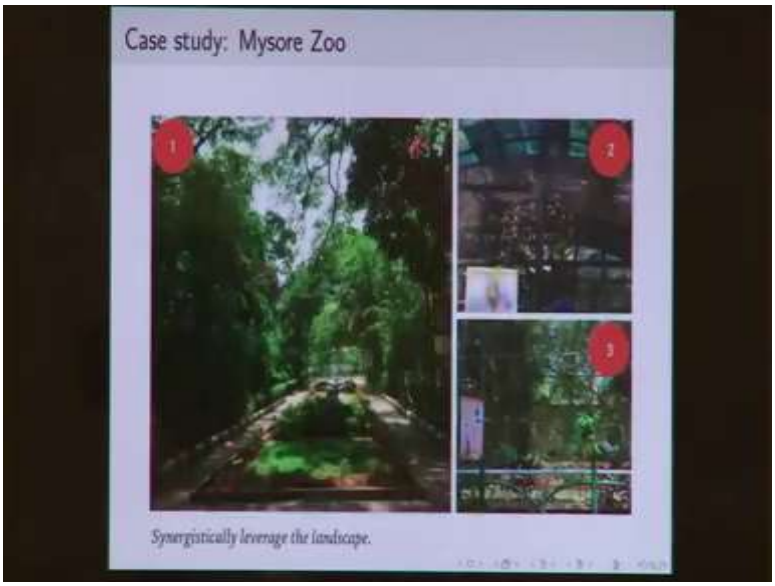
(Refer Slide Time: 50:27)



(Refer Slide Time: 50:28)



(Refer Slide Time: 50:29)

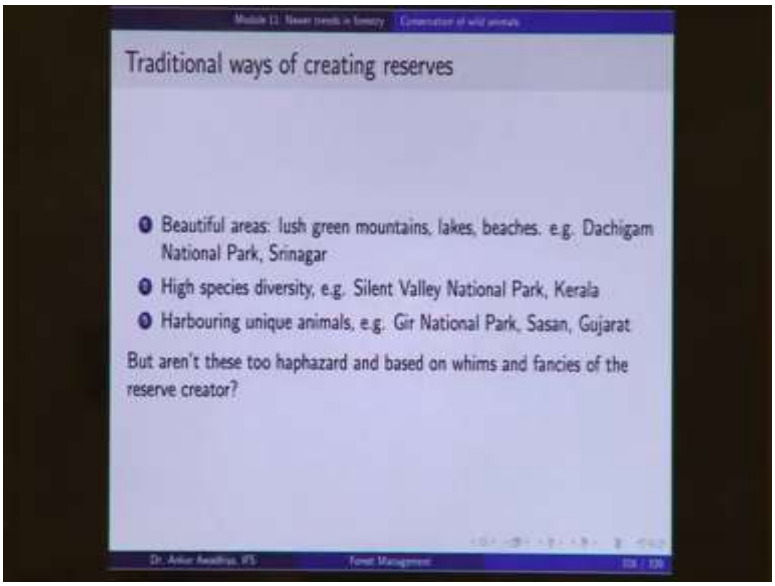


What all things are done, how animals are cared for.

(Refer Slide Time: 50:36)

Then, we looked there to bear rescue facility and so on.

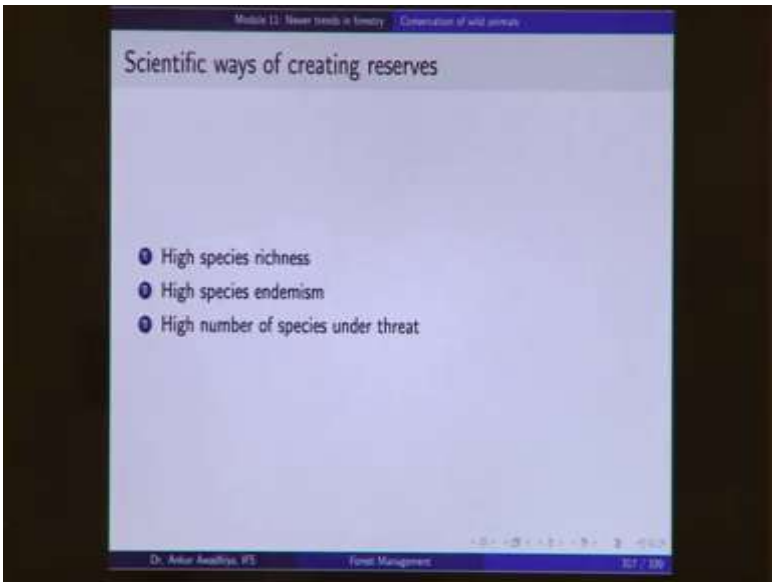
(Refer Slide Time: 50:40)



(Refer Slide Time: 50:42)

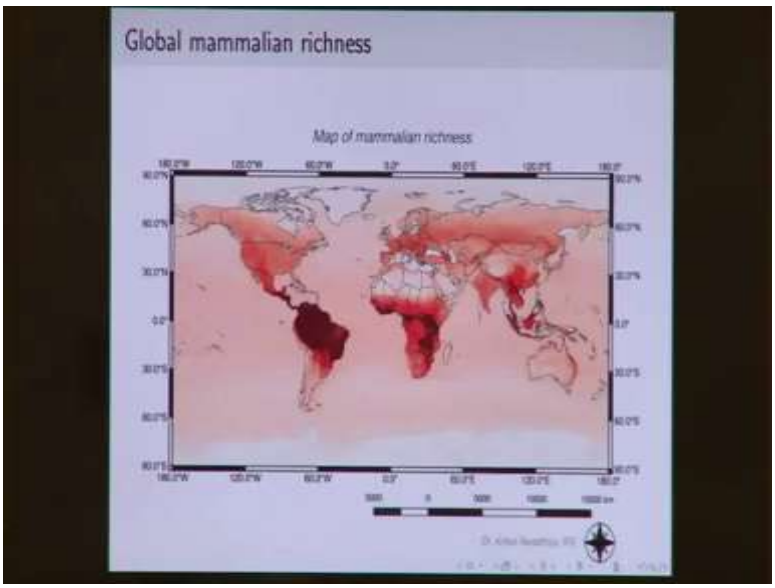
And also, the need for behaviour enrichment so that the animals do not feel bored. Now, next we looked at in situ conservation. So, we started with the traditional ways of creating reserves. Earlier results were created by looking at beautiful areas, high species diversity or areas that are harbouring unique animals.

(Refer Slide Time: 50:58)

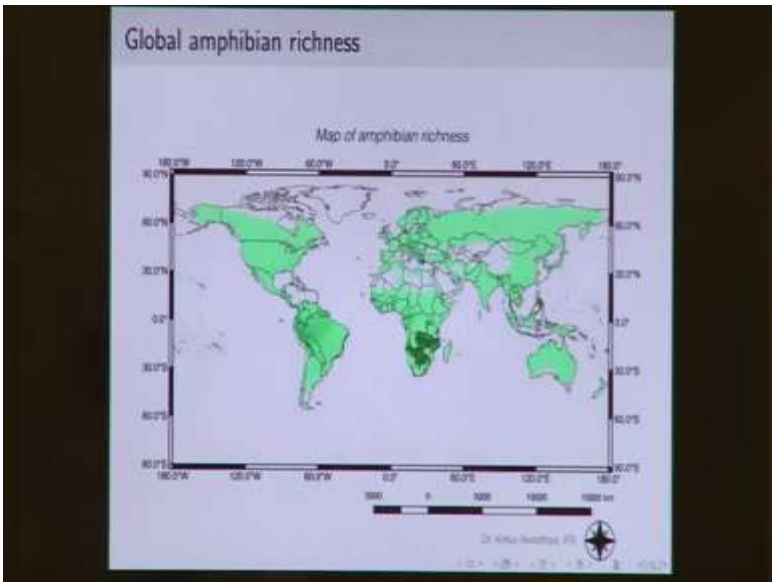


But these days, if you look at the scientific creation of reserves, we have to look at areas with high species richness. So, that is more number of species per unit area, high species endemism which is those species that are only found in certain areas, and high number of species under threat.

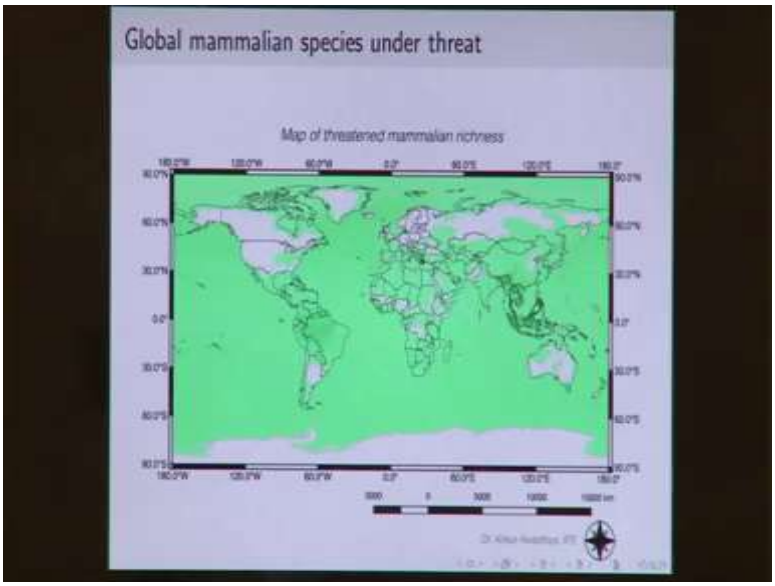
(Refer Slide Time: 51:15)



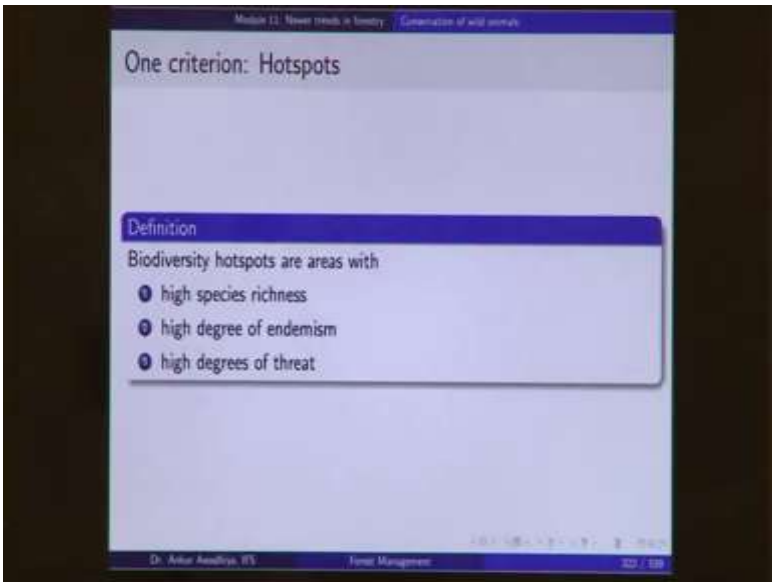
(Refer Slide Time: 51:16)



(Refer Slide Time: 51:17)

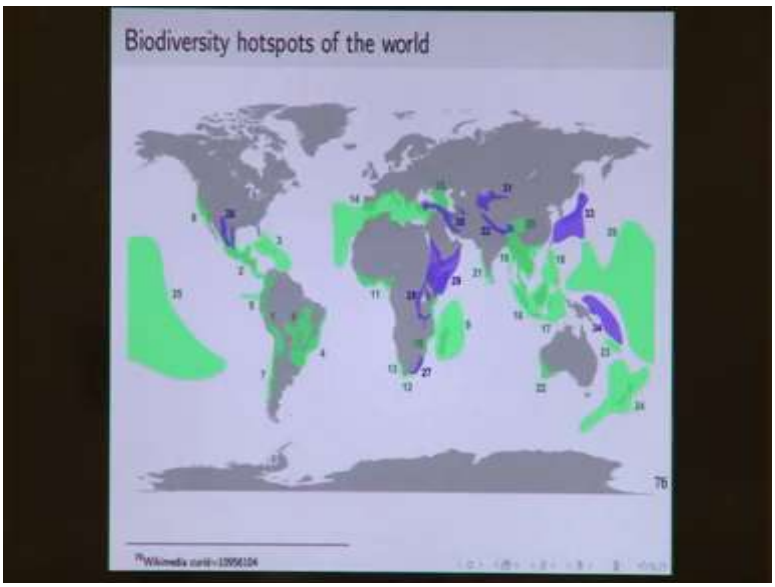


(Refer Slide Time: 50:18)

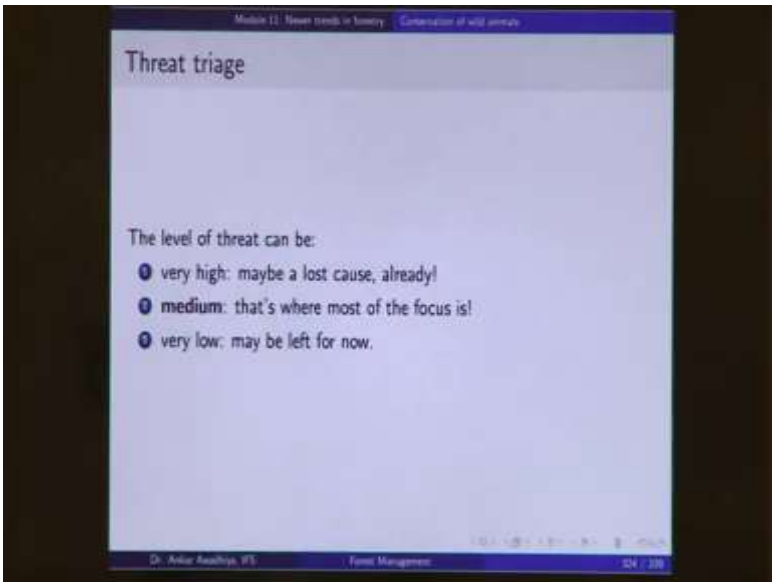


So, we can look at all these different maps and then come up with those sites that have high richness endemism and threat and they are known as the biodiversity hotspots.

(Refer Slide Time: 51:22)

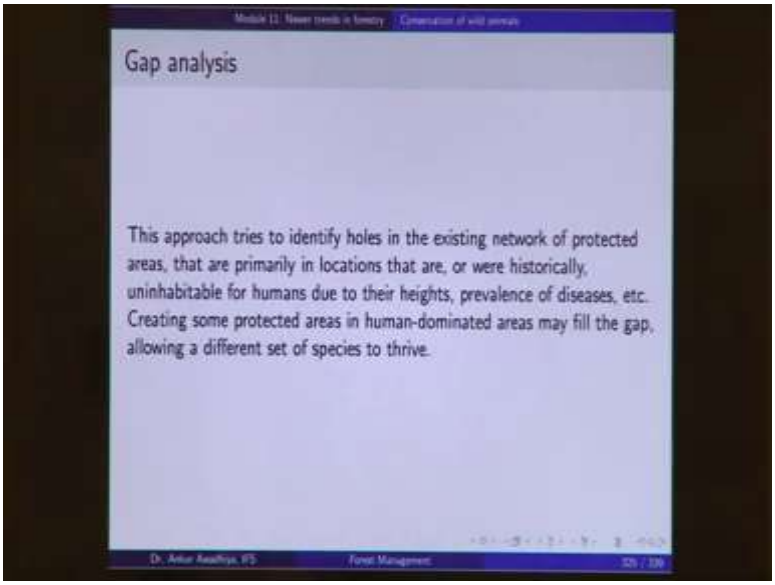


(Refer Slide Time: 51:25)



Now, typically, the level of threat that we are targeting is a middle level of threat, because if it is very low threat then probably you do not need a sanctuary or a reserve and if the threat is very high, than probably even the construction of a sanctuary is not going to help that situation. Or the in the time that it will take to construct the sanctuary, the area will already be lost.

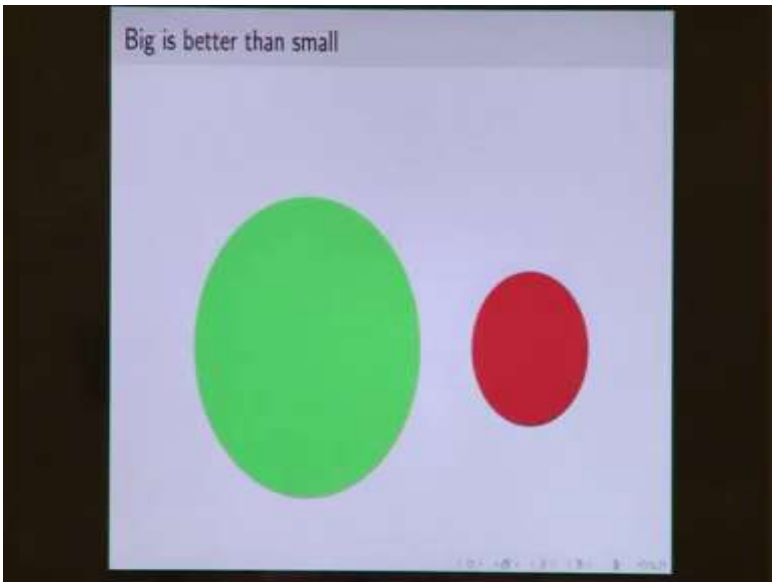
(Refer Slide Time: 51:51)



We also looked at gap analysis, which identifies holes in the existing network of protected areas.

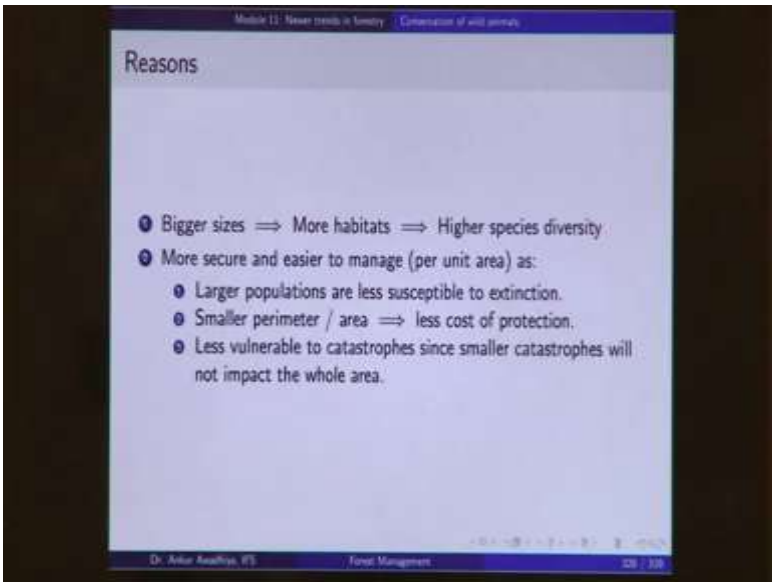
(Refer Slide Time: 51:57)

(Refer Slide Time: 51:59)



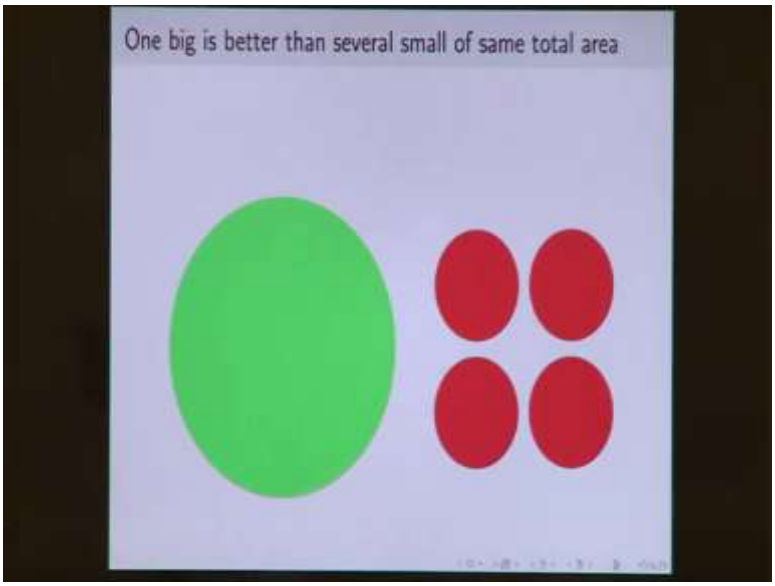
Then, we looked at principles of reserve design; you need to have big reserves, because it is costing cost effective.

(Refer Slide Time: 52:01)

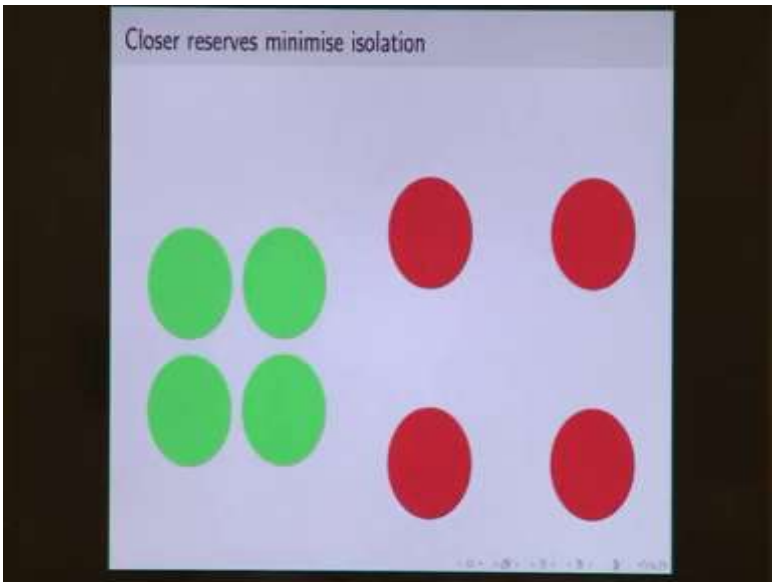


And also, it provides more habitats, it is less vulnerable to catastrophes.

(Refer Slide Time: 52:10)

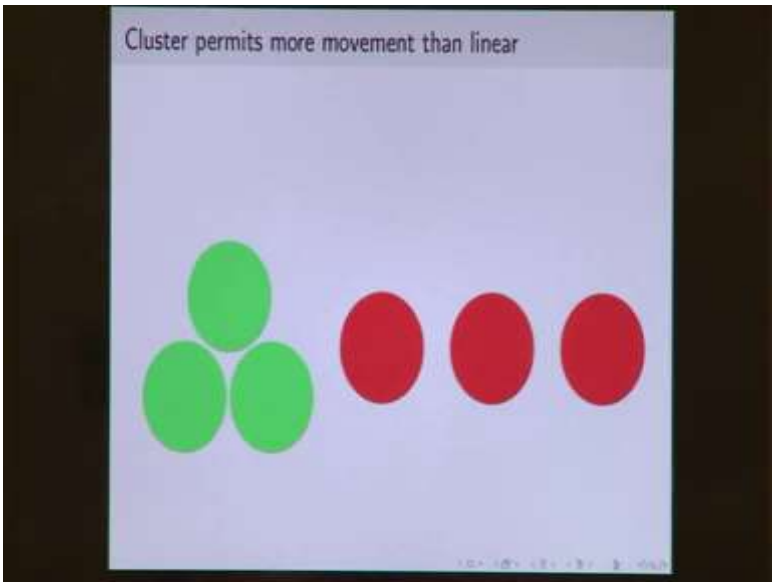


(Refer Slide Time: 52:12)



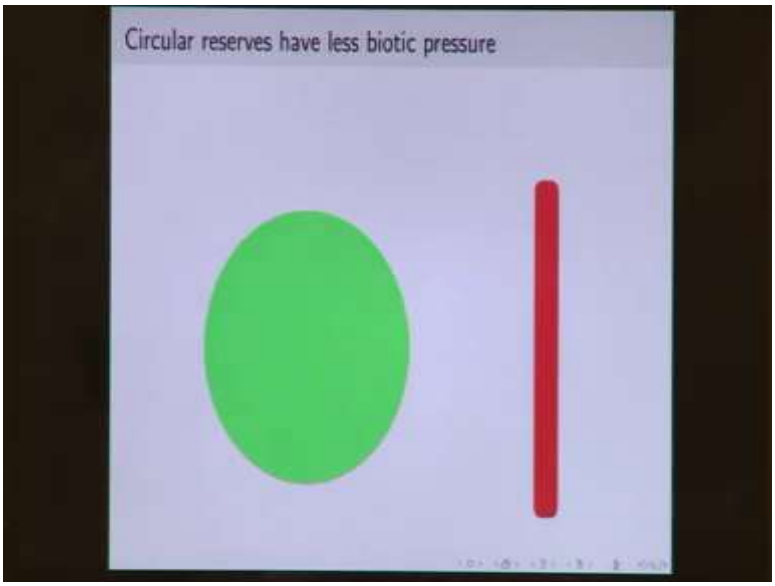
So, one big is better than several small, closer reserves are to be promoted.

(Refer Slide Time: 52:16)

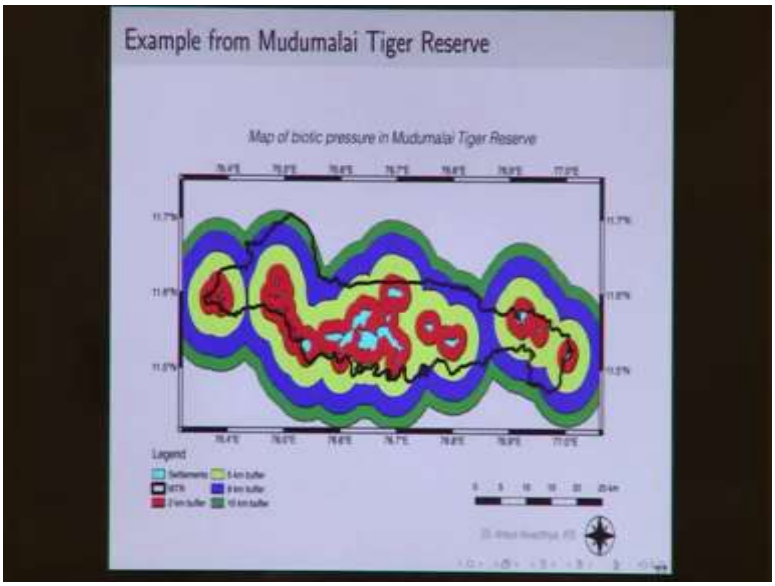


Clustered formation is preferred as compared to a linear formation.

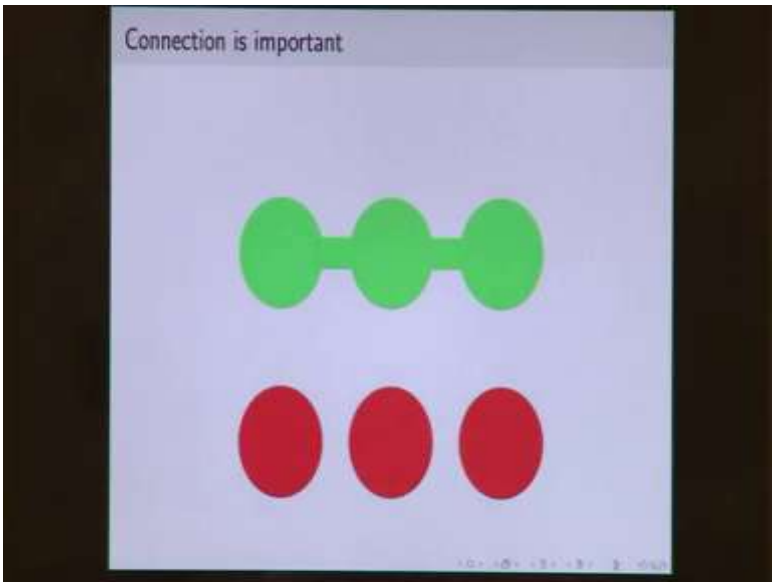
(Refer Slide Time: 52:19)



(Refer Slide Time: 52:21)

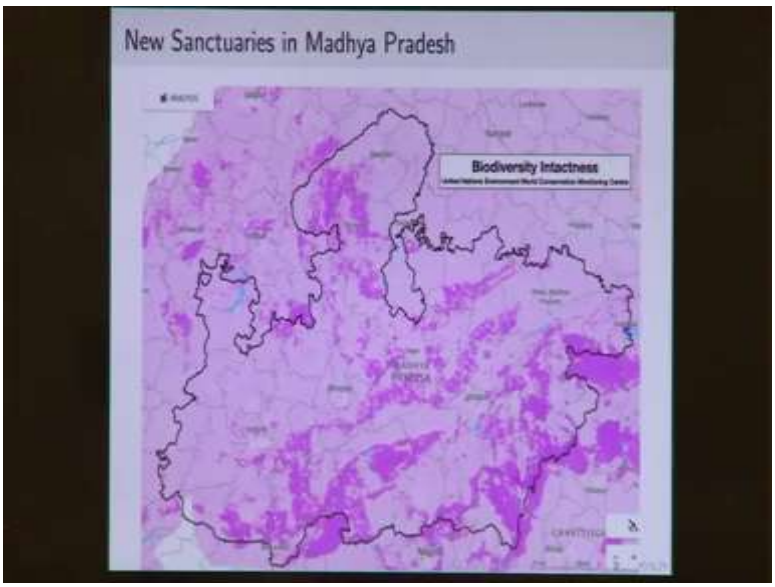


(Refer Slide Time: 52:22)



Circular reserves are preferred because they have low biotic pressure. Connection needs to be made to be maintained.

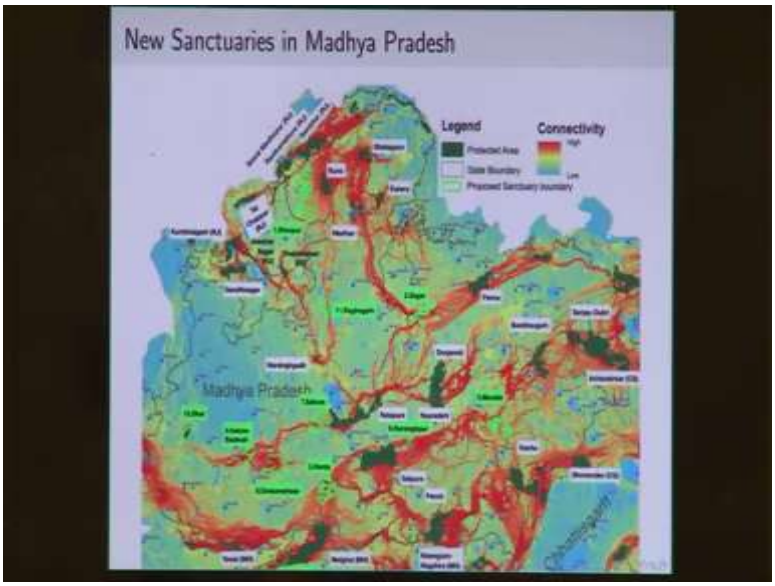
(Refer Slide Time: 52:26)



And then, we looked at of sanctuary creation.

So, like in Madhya Pradesh, we on the government began with looking at the biodiversity intactness index map, which tells us what are the locations where the biodiversity is still formed. So, this is an indication of the species richness.

(Refer Slide Time: 52:43)



Then, gap analysis; then, we also did a gap analysis to understand which are the locations that need sanctuaries and then we also looked at clustered approaches, how to maintain the connectivity of these habitats, how to come up with new stepping stone corridors. While ensuring that the level of threat is kept as low as possible; so basically, we went with only reserve forest areas where all the rights are there with the government, and where we do not have any villages or encroachments or forest right pattas, which have been given over the years.

And with that, we came to the conclusion about what are the areas of the sanctuaries that need to be made. So, that brings us to the conclusion of this course.

I hope you like this course.

Good luck with your exam preparation. Do well. So, that is all for today.

Thank you for your attention [FL].