Advanced Aquaculture Technology
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Lecture 22
Topic - Design of Hatchery for Craps

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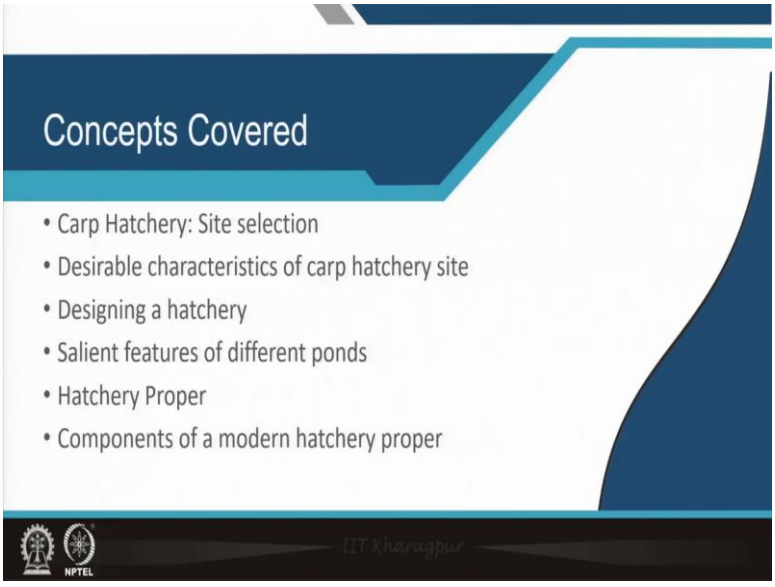

Hello everyone, welcome to the module two of lecture two of module five Technology of Larvae Rearing. My name is Professor Gourav Dhar Bhowmick from the Department of Agriculture and Food Engineering from IIT, Kharagpur. So, in this particular lecture material will be discussing on the carp hatchery, site selection, desirable characteristics of carp hatchery sites, designing of a hatchery, salient features of different ponds, hatchery proper and the components of modern hatchery proper.

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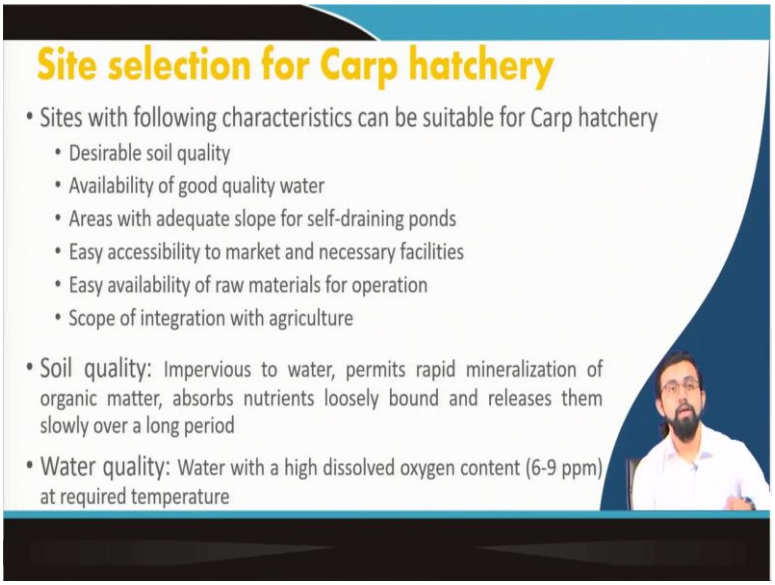

The site selection when we go for the site selection of carp hatchery, the sites for which we like normally we go for before finalizing our design and everything. So, we need to finalize we need to choose the property we need to choose a particular site or particular farm at which you are going to design your farm or put your farm.

So, when we do that, so, what are the desirable characteristics that we need to follow, the first thing is the soil quality you need to know that the soil quality in which your property is there or I mean like when where you are going to farm develop your farm whether that soil quality of that farm has all the characteristics suitable for construction of a farm or not that you need to take care of first.

Availability of the good quality water because the water is one of the like one of the major component of it and you need to provide the water for freshwater exchange, you need to provide the water for the farm cleaning and all, you need to provide the water for the all the manpower that they are there, so, for their daily expenses and all.

Other than that, we need water for post harvesting procedures alone. So, it requires it depends upon the design of the farm and what type of farm actually you are designing on. So, the third thing is the area, area which should have with an adequate slope, why we need a proper slope because when see we start a when you when we design a farm suppose you are supplying you are designing a tight fit farm or a pump fit farm or say like in a normal any kind of farm. So, what will happen?

So, suppose you can have the water which is like incoming water from a particular source, it can be a surface water source, it can be a groundwater source, whatever it is, but if you do not maintain the inclination if you do not have the proper the slope in your ground, so, what will happen you cannot drain the discharge water you cannot drain the used water. So, in order to design it properly and in order to reduce the burden in more amount of earth work. What do I mean by earth work?

You have to cut the slope if the slope is not available then you have to cut the property in such a way so that they will be a proper slope by means of gravity only the water will be on the side of the drainage canal and you can just open the sluice gate and the water will be in the drainage canal and through drainage canal you can easily discharge the used water or you can re-circulate it back to the farm as well depending upon the design and depending upon the type of what type of recirculatory aquaculture system that you are designing.

So, these are the very important that is why we need a area with the adequate scope. We need it has to have easy accessibility to the market and necessary facilities because otherwise suppose you are farming your target species and you have to transport it say like 24 hour in a transportation medium it can be anything but these are most of these are perishable items when we talk about the aquaculture products all of them are most, almost all of them are perishable items. So, 24 hour of transportation it may not sustain, so in that case it can be a big of issue so that is why you have to have a market or necessary facilities like say like storage facilities, say like freezing facilities, everything has to be near vicinity to the farm that you are designing.

Easy availability of the raw material for operation, let us give you an example. Suppose you need to seed, you need to supply with the ample amount of fry, you need to supply with ample amount of the construction materials. So, all these things all these raw materials has to be available in the near the place where you are actually designing your farm or farm or you are actually producing your farming products.

So, other than that the scope for integration of with agriculture not only with agriculture, but other purposes also we can do it like we can go with the integration with the livestock also. So, we call it integrated multi trophic aquaculture or we simply call it sometimes polycultures we simply call it a different type of there are different types of it like integration of culture.

So, sometimes with agriculture, sometimes with the livestock, sometimes within itself, so, it depending upon the type and variant, we call it, name it differently. So, in case of agriculture, I am giving an example like rice fish culture people do. So, in that case, what happens those the fish actually like the, because of this combined culture procedure, you do not need to provide it with the nutrient, you need to provide it with the fertilizers because the fish droppings and excess the feed actually acts as a enhancing the quality of, enhancing the nutrient availability of the for the plant whereas, the all the pest and all as being is normally like normally the fish and all these aquatic species they actually feed they actually use it as a feed.

So, because of that, the pest infestation can also be reduced. So, there are like different other advantages as well. So, I am not going to details in different lectures, we have already discussed about it. So, the next criteria for such selection of crop hatcheries the soil quality as I already discussed, impervious to water, that is a very important thing. So, that what will happen if it is not impervious, the water will seep through gradually and you will loss a huge amount of water it will go ultimately charge the groundwater. There are like lot of disadvantages of it, major two is first of one, you will lose the water. So, you have to do a very frequent freshwater exchange.

Second thing, the water contains a huge amount of waste or pollutants that pollutants will leach if it will leach along with the water through the groundwater, it will disrupt the groundwater quality and once it will disrupt the groundwater quality suppose you are using that same groundwater for irrigation purpose, for municipality purpose or any other purposes. So, it will definitely be Detroit the subsequent operations.

So, that is why the soil quality is major, one of the major parameters here when we go for the site selection of carp hatchery and the soil has to have a proper properties to the for rapid mineralization of the organic matter, it has to absorb the nutrient loosely bound and releases them slowly over a long period. And when we talk about the water quality, water with the high dissolved oxygen content is actually required at a desirable temperature, so, depending upon the place of farming.

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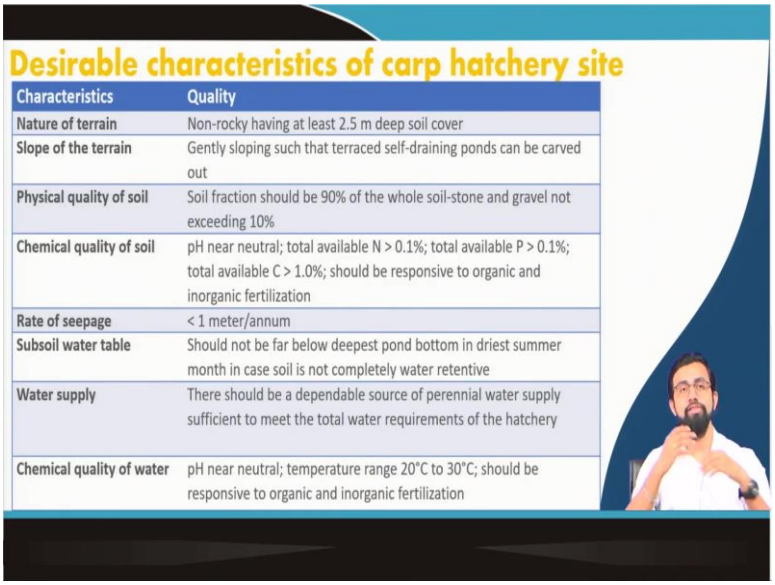

So, if you go for more minute details of the characteristics based on the quality if you see in this table it is like properly tabulated. The nature of the terrain it has to be at least non rocky having at least 2.5 meter deep soil cover on its surface, slope a gentle slope has to be provided as we already discussed, physical quality the soil fraction has to be around 90 percent of the whole 90 percent with the whole soil stored on the gravel not exceeding more than 10 percentage.

Chemical quality the pH has to be, pH of the soil has to be neutral or maybe slightly basic but better to be in a neutral region. Total available nitrogen has to be more than 0.1 percentage, total available phosphorus has to be more than 1 percentage and then carbon has to be more than 1 percentage and it should have to be responsive to the organic and inorganic fertilization.

What does that mean? When you apply the fertilizers organic or inorganic whatever it may be. So, it has to be responsive to the fertilization, means that it has to work on, there should be some micro fauna or flora available in that soil vicinity in that soil. So, which will act on those fertilizers and which will help convert into the reliable or the desirable nutrient available for the plant or target crop species that you are targeting your farm.

So, this is and that the same way the same like way I can say about the different kind of carp production as well because it is a pond, in the pond also whenever designing, so, there has to be a proper lining of a particular type of micro fauna or flora on its surface. So, for them also it is very important to have this chemical, properly chemically feasible soil available for the

designing of the carp hatcheries. Rate of seepage has to be as less than 1 meter per annum. Here 1 meter per annum, it says like say it is like a meter cube per meter square, so I am giving you one example.

So, if there is like seepage of 1 meter cube, 1 meter cube means 1000 liter, 1000 liter of water through a 1 square meter of land, area of land. So, the seepage will be considered as 1 meter per annum. So, like one meter cube of water is seeped through a one square meter of landmass land area, so, one cubic meter divided by one square meter, so, it will be like one meter per annum.

So, that is the rate of seepage that we normally calculate in this unit. So, the sub soil water table it should not be far below the deepest pond bottom in dry summer months. So, what will happen, sometimes if the in a very dry season the subsoil water levels should be ample enough so, it will let some amount of water available in the pond available in your farm.

Water supply you have to have a dependable source of perennial water supply, sufficient for to meet all the total requirement of the hatchery I told you already there are like different requirements, it has to fulfill all the requirements of hatchery, you have to have a certain source of water, a dependable source of perennial water, it can be groundwater, it can be surface water. However recently government of India is pushing us to not to go for depending on the groundwater sources rather try to go for recycled aquaculture system or go for surface water bodies which can be utilized for further use.

Chemical quality of water as we discussed it has the pH has to be neutral, temperature has to be between 20 to 30 degree and should be responsive to the organic and inorganic fertilizations. And another important thing it has to be the quality of water that you are supplying it has to be free from all the other pollutants, especially the xenobiotic compounds, you know what is xenobiotic compound like different kind of chemicals which are persistent to the nature and which can which actually caused, which actually come in contact with the nature by the anthropogenic activities only, like say our personal care products and all.

So, these compounds are very much hazardous and even, it is a very nano, even it is in its nanogram stage or level. So, that is why we need to make sure that it is free of all the xenobiotic compounds and all. It is not possible to go for how to say checking on each and every parameters because there are like thousands of parameters available, thousands of chemicals available. So, you just do a very standard test in a standard laboratory based on the

central pollution control board or namami gange or different WHO guidelines. So, depending upon the guidelines of the regulatory authority, you have to maintain the quality of the water.

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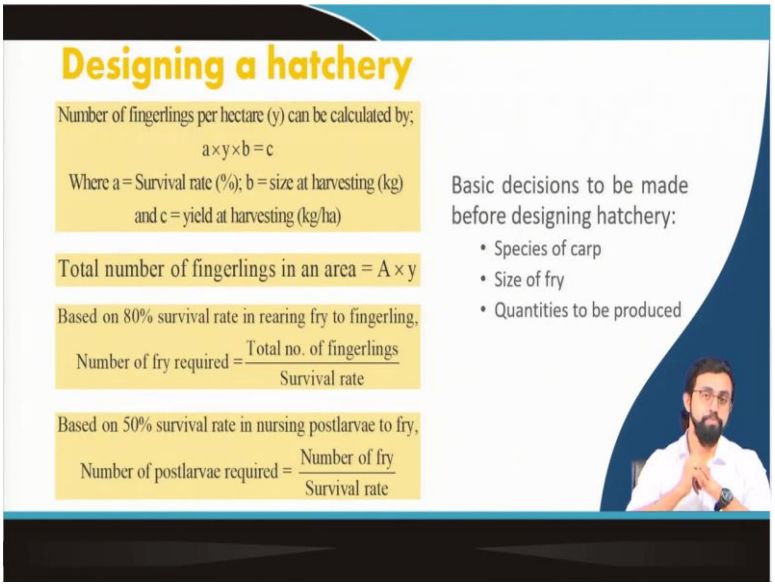

So, when we design a hatchery, so what are the basic decisions that we need to make before going for designing hatchery? First of all, what is the species of carp that you are choosing that you are going to farm? Second thing is the size of the fry. Third is the quantity to produce. So, how do the quantity?

Suppose, I am giving you one example. Suppose you want you have a say 10 hectare area, so it is a big area like huge farm that you have, say a 10 hectare pond, 10 hectare farm you are culturing certain type of carp, say like common carp. So, when you are having farm area of 10 hectare, you know that 10 hectare is farm area and the culture species is common carp.

How do you know the number of fingerlings per hectare that is why you see the equation

a * y * b = c. Here a is the survival rate in percentage, b is the size of the harvesting; size at harvesting and c is the yield at harvesting. How do you calculate these values?

So, when you go for the size of the harvesting, suppose you have the common carp like say like it can go to a size of 10 kg just giving you an example. So, if it can go up to a size of 10 kg and the yield of harvesting is like say like if you see the number of fingerlings per hectare can be which can be calculated by multiplying a * y * b = c. here, c is the yield at harvesting, a is the survival rate and b is the size at harvesting.

Just to give you some a number here, suppose the size of harvesting is like 1 kg and the survival rate is say like 80 percentage. So, if you have 100 number of fingerlings, 100 number of fingerlings at the end per hectare. So, 100 multiplied by the size which is like say 1 kg multiply by the percentage survivability which is like 80 percentage, so 100 into 1 into 0.8, how much it is the total the yield of harvesting how much, 80. So, 100 into 1 into 0.8, so it is like 80. So, 80 kg per hectare is the yield at harvesting. So, when 80 kg per hectare is the yield like yield at harvesting.

So, suppose you have a number of fingerlings, how you calculate the number of fingerlings, total, what is the area total area 10 hectare and what is the yield at harvesting is like 80 kg per hectare. So, and what is the number of fingerlings per hectare? 100, so 100 into 10 so total 1000 number of fingerlings are available for your area that is your target. You need 1000 number of fingerlings for your production is just a very like it is just an example, do not take it seriously the numbers are very like not in real scale. Total say 1000 number of fingerlings are available for your 10 hectare area, 1000 number of fingerlings available.

Now, in order to get 1000 number of fingerlings at the end of your production, what are the number of postlarvae that you need? How you calculate that? We go like reverse engineering process? Why do we go for this reverse calculation process or reverse engineering process? I give you an example. Suppose number of fry, so the total number of fingerlings you need 1000, that is for sure. So, now, that the number of fry how you calculate the number of fry, in general in standard we consider that 80 percent of survival rate from fry to fingerling stage.

So, if fry to fingerling stage it is 80 percent is a survival rate. So, total number of fingerlings is 1000 / survival rate which is 0.8, so it will become 1250. So, 1250 is the number of fry that is required, if we have to have 1250 number of fry it will end up having 1000 number of fingerlings. So, that is the general calculation procedure.

Now, so, to have a 1250 number of fry, what is the number of postlarvae that you require, from postlarvae to fry it is a very early stage of their development, there is a very less chance of survival. So, it can we for the sake of calculation, we select 50 percent survival rate. if 50 percent survival rate from post lava to fry, so number of now we know 1250 and percentage of survival rate is 50, so if we divided by like 1250 / 0.5. So, total number of postlarvae will be 2500.

You understand my point, so total number of postlarvae that you need to supply to your, you need to have your farm is 2500. If you have a postlarvae stage of 2500 amount of carp in your hand, so at the end you will get the final production stage you will get like I mean like at least fingerling stage you will get around 1000 fingerlings which then can be transferred to the grow-out pond. You understand the calculation here, how we go for when we design a hatchery how we calculate the quantity of it. So, let us move ahead with it.

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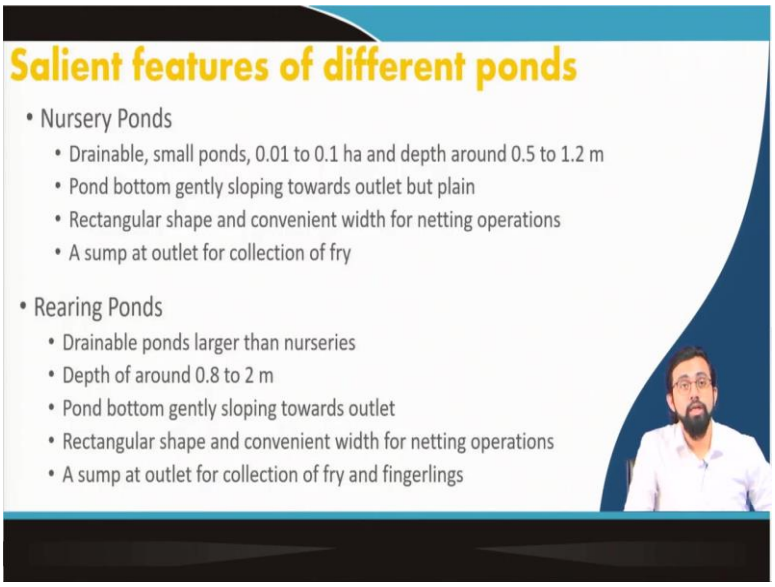

So, what are the other salient features of different ponds? So, like we know that we have a broodstock pond, we have nursery pond, we have rearing pond. So, there are like different maybe there is some spawning grounds or spawning ponds are also there in depending upon the type of farm or like sometimes they also put it like this. So, anyway, so nursery pond, it has to be, but what are the criteria's that should be there for the nursery pond, it should be drainable, small size like around not more than 0.1 hectare, depth should be 0.5 to 1.2 meter and pond bottom has to have a gently slope towards the outlet point, outlet plain.

The rectangular shape or the convenient width will be like convenient because rectangular shape is convenient plus the width has to be convenient enough for netting operation. A sump at the outlet for collection of fry has to be there. Rearing pond in case rearing pond the drainable ponds this larger than the nursery actually because the size of the fish is much higher than the nursery pond here. The depth of, depth is around 0.8 to up to 2 meter. Pond bottom same gently sloping towards the outlet, rectangular shape and convenient width for netting operations. And a sump at the outlet for collection of fry and fingerlings.

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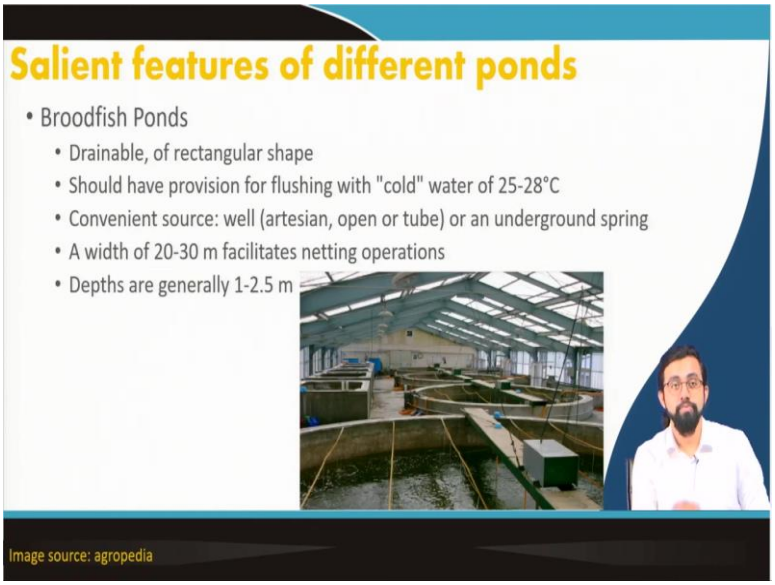

Broodfish pond, broodfish pond or the pond where we culture the broodstocks. So, like drainable of a rectangular shape in general broodstock ponds we are expecting to have this design. It should have provision of flushing with cold water at 25 to a 28 degrees Celsius. Convenient source like artesian, open or tube or underground spring water has to be there. A width of around 20 to 30 meter facilitates the netting operations and depth are in general 1 to 2.5 meter.

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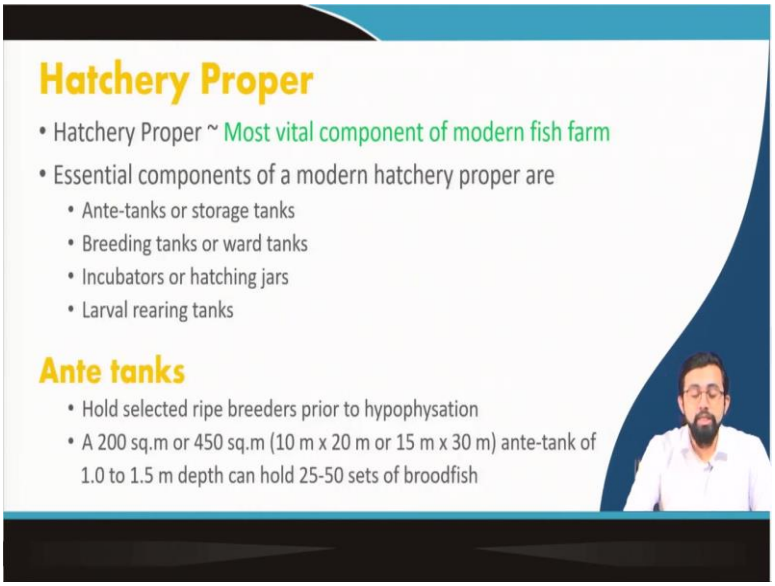

So, these are all the design criteria that you have to maintain when you will be designing the different kind of ponds inside your hatchery. So, when we design a hatchery proper so that is the most vital component of modern fish farm. So, when we design a hatchery proper, so,

essential components of a modern hatchery proper are anti-tanks or the storage tank, breeding tanks or the ward tanks, incubators or the hatching jars and the larvae rearing tank. So, this four are the very important one. First one, the storage tank where we store the right breeders or say like broodstocks or like parents prior to the hypophysation, we know hypophysation like we artificial propagation methods, we can we sometimes provide.

Then say like around 200 to 450 square meter of area with a 1 to 1.5 meter depth can hold at least 25 to 50 sets of broodfish. So, this is the first storage time that we talk about or broodstock ponds sometimes we talk about in earlier slides we discuss.

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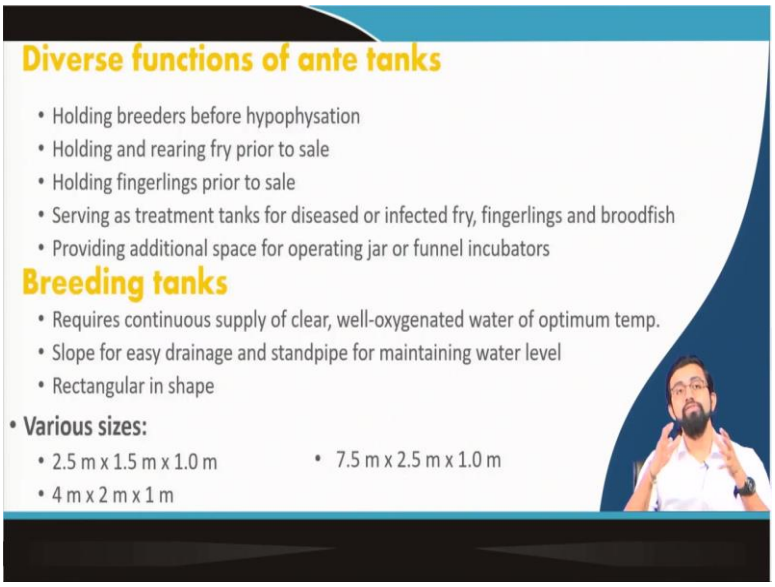

What are the diverse function of anti tanks, the it holds the breeders before the hypophysation, it has the capability to hold and rear the fry even prior to sell, you can use the same tank for holding fingerlings prior to sell and also it can serve as a treatment tank for diseased or infected fry fingerlings or broodfish which sometimes called quarantine tank as well. It can provide additional space for operating jar or funnel incubators to collect the waste and all.

Brooding tanks, breeding tanks where it requires a continuous supply of clean and well oxygenated water at optimum temperature, the slope for easy drainage and standby for maintaining the water level are rectangular in shape it is better it can be of various shapes 2.5 * 1.5 * 1, 7.5 * 2.5 * 1 like it depends upon the type of the design and the expectations from the farm that you have.

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So, in general, if we talk about the circular breeding tank, they are like they provide if you see the bottom picture. So, if you see the flow is given from angle wise because of that there is a continuous flow maintaining the water body at least on its surface and up to a certain level and as because height is not much so, this circulation is maintained. So, continuous flow it keeps us gives a reward like environment and you know why it is given, the fingerlings or the like the breeding tanks they have the tendency they because they normally grow in a natural environment in the rivers. In the rivers what they do, they go to the upstream region, sometimes they go to the downstream region depending upon the type of carp.

So, they go and they lay egg there, so, they in order to mimic the natural, how to say the process, we provide this kind of structure. So, it has also this circular breeding tank so with a pro provision of river like environment with the continuous flow. So, depending upon this breeding carp the whatever the breeder it is, so, they will go against the upstream or they go towards the upstream and try to breed at its level, so, at least to up to a certain extent to mimic the natural environment. Uniform distribution of oxygenated water is possible because of the continuous flow and centrally located outlet with the screen protects the egg better from getting better from the getting washed away.

So, in the middle if you see there is a screen here. So, it functions like a rearing, hatching and breeding and also it can combine these all three operation in this kind of tanks. What are the drawbacks? It has a very high water consumption. But nowadays, scientists have found out

the solutions for that as well. They have, they know that the when the water consumption is very high what we do we simply provide it with a treatment unit. A small treatment unit you can provide it can be biological treatment unit, it can be like sand filter where something like it is a physical treatment unit, it can be some UV or ozone like where it can get rid of all the biological pathogens or microorganisms, so unwanted microorganisms.

By means of this, we can clean the water we can give it to get back to the tank again. So, by this way you can troubleshoot the this drawback this like higher water consumption. One major problem is repairing a central outlet because sometimes it is huge and to repair the central router and you have to completely drain the whole tank and then only you can utilize it for the purpose so that is one of the (25:07) for this kind of structure is kind of, how to say the design(25:13).

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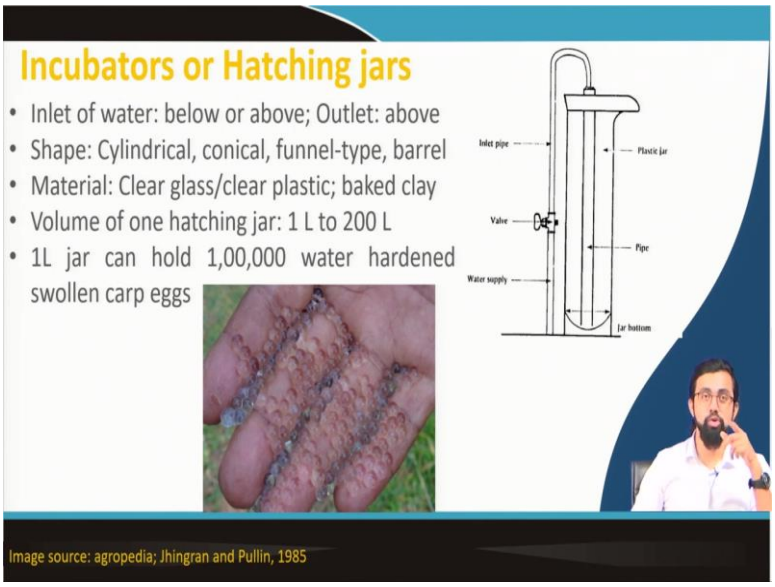

Incubators or the hatching just the inlet of water below or above and outlet has to be above of it. So, if you see the structure how it looks like the incubators in general the hatching jars where we normally the hatching is take place, the design is given in the right side if you see, the inlet pipe wall, water supply line, the jar bottom pipe and the plastic jar how it looks like and in general, the shape of its like the cylindrical shape one is shown here. The material is normally the clean clear glass or the plastic or sometimes the baked clay, I will show you the baked clay how it looks like next slide. And the volume of one hatching jar can be 1 liter to up to 200 liter. Each jar of like 1 liter of size can hold up to 1 lakh of or 100,000 water hardened swollen carp eggs.

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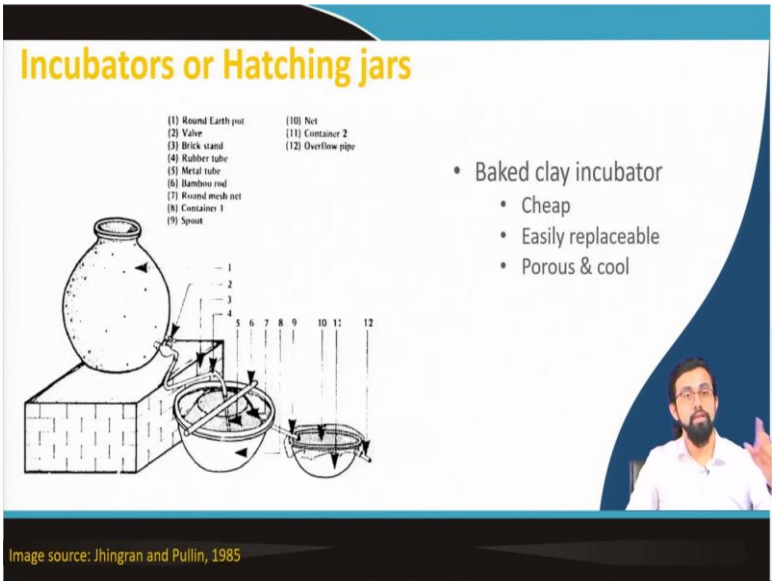

This is the earthen clay incubator that I wanted to show you, how it looks like, it is like it is actually very cheap and easily replaceable and porous and cool and it used to be there in earlier days people used to use this kind of hatchery, this kind of incubators and all.

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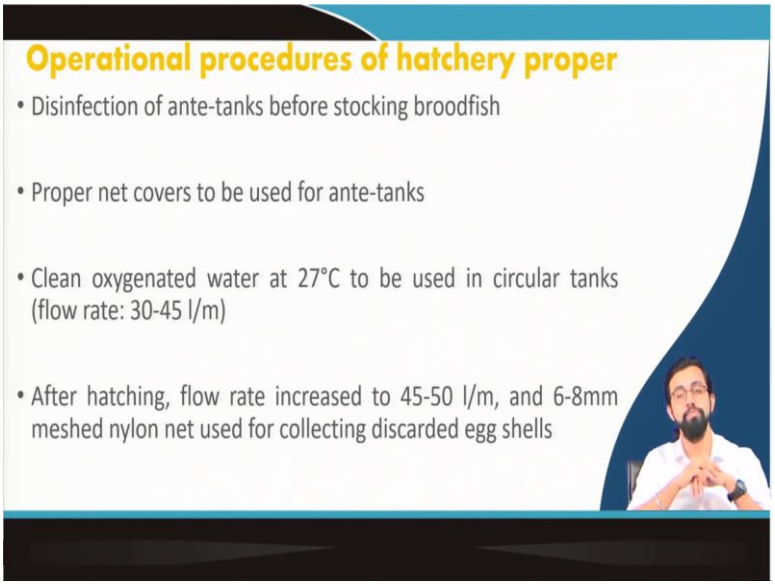

So, operational procedures of a hatchery proper, first you disinfect the whole anti tank before stocking the broodfish. Proper net cover has to be provided. So, that there is a less chances of any unwanted particles or the droppings or say like predators (26:47) can catch the broodfish because they are very much slow than their normal maturation stage. Clean oxygenated water continuous supply of clean oxygenated water with the dissolved oxygen concentration more

than 4 to 5 if it is possible, at 27 degrees Celsius to be used in the with the flow rate of around 30 to 45 liter per minute to mimic the natural river environment.

After hatching the flow rate increased to 45 to 50 liter per minute and 6 to 8 millimeter meshed nylon net is used to collect the discarded egg shells to just so that it will not get sedimented and not be in touch with any sharp object or any sharp, for them it is sharp object and it will just we cannot use it anymore. So, we just in order to increase the efficiency of a collection we increase the flow rate and all.

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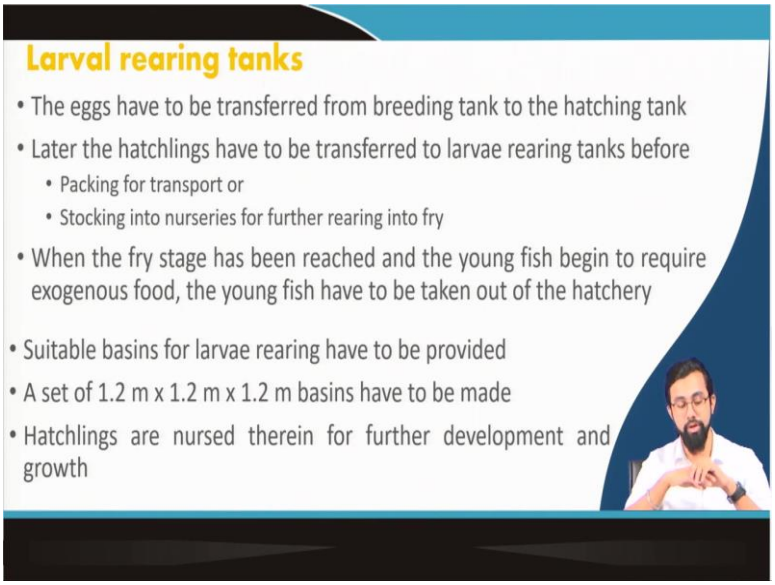

So, then the last thing comes as the larvae rearing tanks in case of this hatchery proper. The eggs has to be transferred, eggs has to be transferred to the breeding tank to the hatching tank and later the hatchlings have to be transferred to the larvae rearing tank before tacking for transport or stocking into nurseries for further rearing into fry, depending upon our some hatcheries, their only purpose is to transfer the larvae to different hatcheries, different other hatchery and all. So, and some actually want to go ahead with their own farm only. So, in that case it will transport it to the nurseries for further rearing into the fry.

When the fry stage has been reached, and the young fish begin to require the exogenous food they are then taken out of the hatchery and we put it in rearing pond, a proper larvae rearing pond, so, where will they go for fingerlings stage. Suitable basins for larvae rearing have to be provided in general a set of around 1.2 to 1.2 to 1.2 meter cube of basin have to be made and the hatchlings are nursed therein for further development and growth in case in this hatcheries and all.

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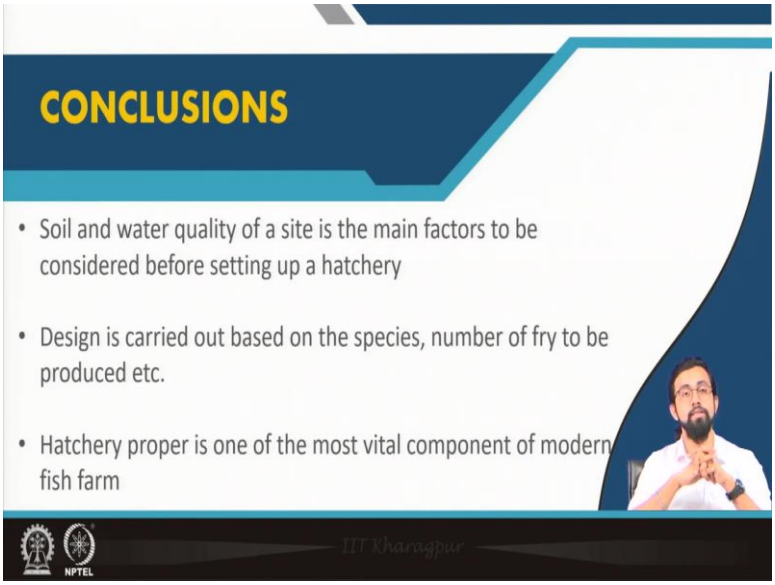

So, whatever we have discussed about the carp hatchery. So, we can conclude that before designing whatever I have discussed is the very basic things. I am not going into the engineering details much because I know if you go for the engineering it will take a huge amount of time and also it requires a proper classroom discussion not only classroom even online also it is possible but it requires a huge amount of time.

So, if you want to know more about it, you can contact me or you can maybe in later in other the course we will discuss more in details about the design of each and every individual part of hatcheries. Design is carried out in basis on the basis of species, number of fry, etc and is a hatchery proper is one of the most vital component of modern fish farm. So, these are the things that we have discussed.

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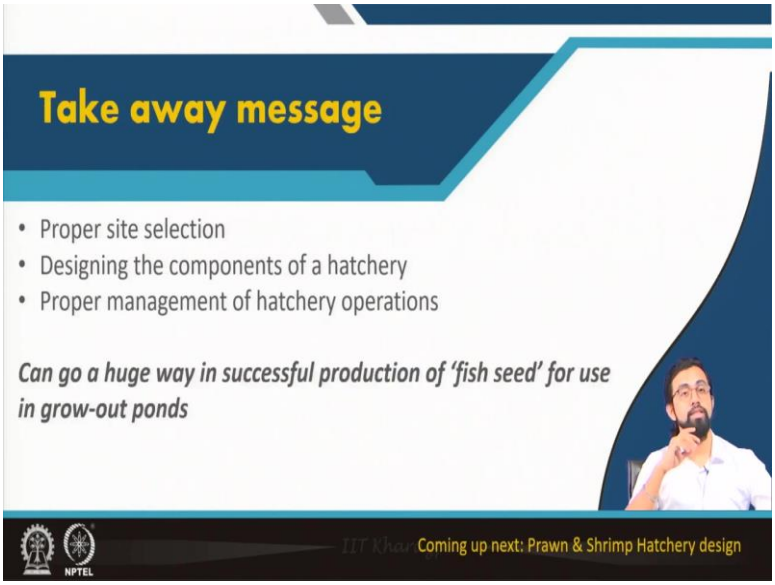

And what are the takeaway message? Proper site selection is very important, designing of components based on the proper site selection, based on the selection criteria, based on the type of species, based on the type of environment or the place that you are having your farm depends. Proper management of hatchery operation is very important when you go for any kind of carp, it can be common carp, it can be silver carp, anything.

So, it can go a huge way in successful production of fish seed for using grow out ponds in different other purposes. So, anyway, so in the coming lecture, we will be discussing about the prawns and the stream hatchery design unless the carp one that we discussed today.

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And this is the reference from which we have taken some information’s and we will see in the next class. Thank you so much.