Advanced Aquaculture Technology
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Lecture 23
Topic - Design of Prawn Hatchery

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Hello everyone, welcome to the third lecture of module 5. Technology of larval rearing, my name is Professor Gourav Dhar Bhowmick from the Department of Agriculture and Food Engineering, IIT Kharagpur. So, in this particular lecture, the concepts that I will be covering is how to when we will be designing a prawn hatchery. What are the different site selection criteria that we need to follow. The hatchery facilities and equipment, the components of prawn hatchery, the spawner and the broodstock transport, larval rearing, post larval rearing and

harvest, packing and transport so it is like from its initial stage to the execution stage how hatchery design has to be proper has to be designed and all.

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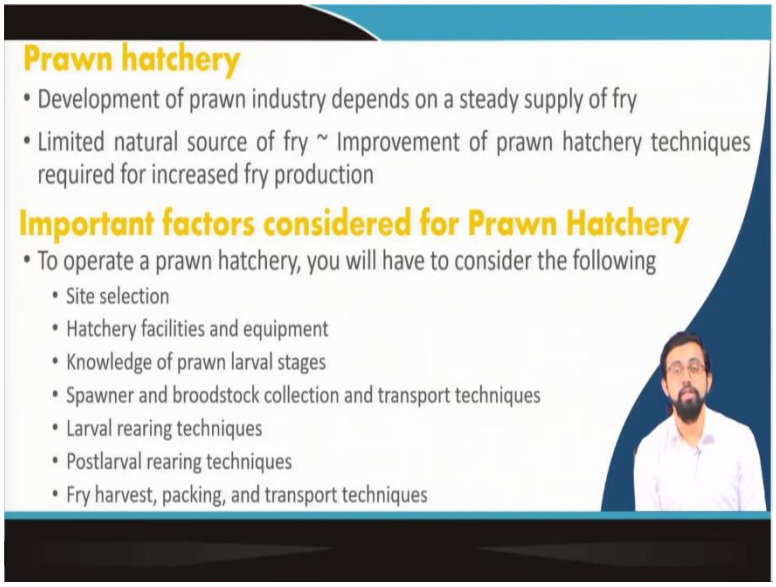

So, when we design a pond hatchery it in general development of prawn industry it really depends on the steady supply of fry because natural limited source of fry is like it will like we does that is one of the major reason why we need to go for designing a proper hatcheries because the natural supply of price like limited and most of its it disrupts the wild population around because of that we need to improve the prawn hatchery techniques which will require to increase the fry production which is one of the major reasons.

What are the important factors that need to be considered for designing a farm hatchery as like the carp hatchery it is almost the same but there are certain changes that I will be discussing in coming slides. First of all the site selection the hatchery facilities and equipment that we will be designing, the knowledge of prawn larval stages, the spawner and the broodstock collection and transport techniques, larval rearing techniques, post larval rearing techniques and also the fry harvest packing and transport techniques. So, these are the very important operating parameters and techniques that we need to follow we need to like properly consider before we design a prawn hatchery.

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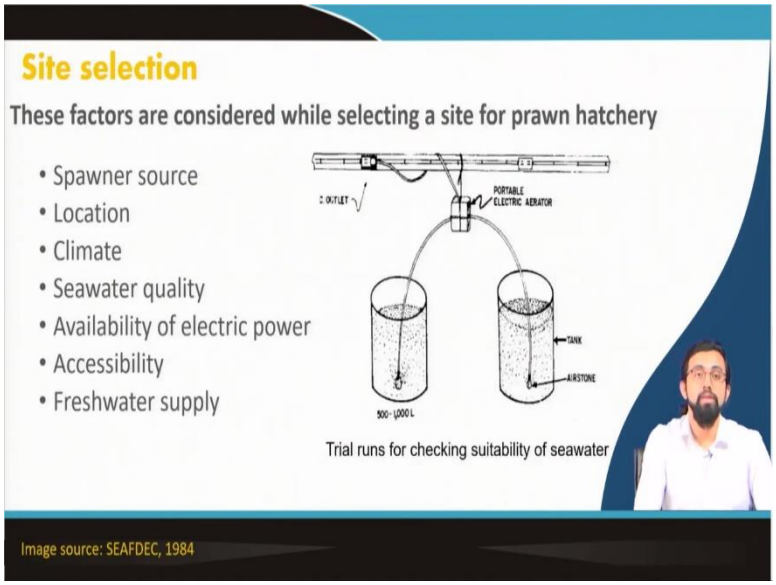

In terms of site selection, I do not want to discuss more details because we already discussed in the last lecture if you remember about the carp hatchery, so, there are also major of them those factors are actually still like the same for the prawn hatchery as well. Other than that, the spawner source is important, location is important because in case of prawn hatch in case of carp, you can do it in inland water bodies as well near to the inland water bodies as well but in case prawn or shrimp, you have to make it as near to the coastal region or otherwise, you have to mimic the seawater which is actually doable nowadays people are doing in different countries, but still it requires a huge amount of chemical demand and all.

And so, the location is very important, the climate is very important, sea water quality that you are supplying. Depending upon the though they shrimp and these prawns and shrimps they can sustain the wide range of salinity, but still depending upon the target spaces, it can be it is better to be in as specific as possible for them to not to have any stress in any physical stress in their system in their body. So, sea water quality has to be maintained as less in our range as possible, availability of electric power definitely very important accessibility and the fresh water supply.

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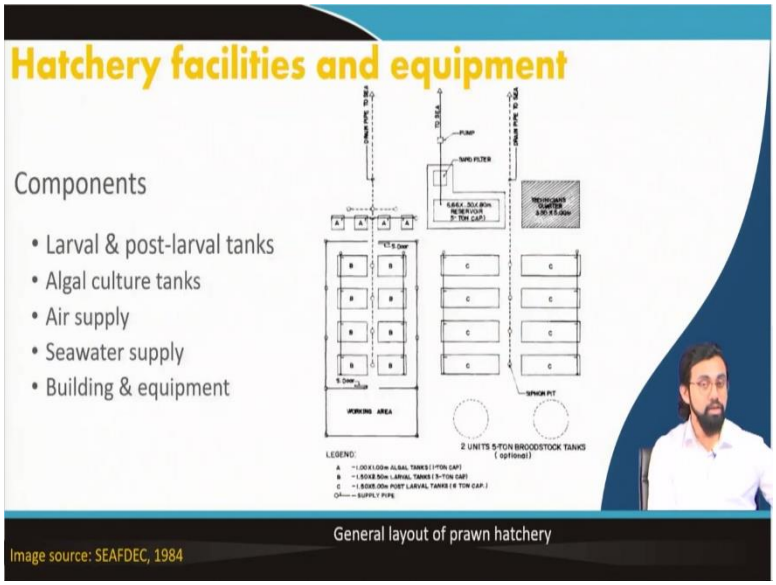

When we go for the facilities and designing of a equipments of hatcheries, if you see the structure if you see this drawing so on the left hand side if you see in the left hand side bottom is the working area with the proper larval tanks are being placed in a regular manner and at the top you will see the algal tank so algal tank is for what, algal tank is like a feeding tank for them, other than algal tank sometimes you provide there some like artemia tanks also small artemia production units also, some rotifers unit also. So, what these things do these rotifers, this Artemia is like which we call brine shrimps also this algae they are actually feed for your target crop.

So, that feed this live feed also be you need to be need to farm in your hatchery as well. So, that can be done you see the design in the leftmost figure in its top there you can you provide it with this kind of live feed installation systems and all, then there comes this larval tank in this larval tank you see like it is a pretty huge (())(5:16) sized in structure. So, here the from the post larval stage to fry stage we try to rear them and from larval tank once it is one is once it reaches to the fry stage then it is transported to the rearing units or the different rearing units and in the rearing units we can go ahead with the further production.

On the same hand, if you see on the post-larval tanks, we call it a rearing unit or a post-larval tanks, if you see in the right side bottom there is a dotted circle. So, these are like five tonne broodstock tank that is optional, because it can be of any design and we already discussed in the earlier discussion earlier lecture material that how broodstock for tank has to be designed, what are the considerations and all. So, what it is done what is done in the broodstock tank, we have the proper healthy breeders we have the breeders or healthy individuals or healthy, I would

say like parent fishes we collect them we nurture them in a proper manner in a broodstock with a very high efficiency so that ones they will reach to their spawning stage.

So, they will spawn and they will this is a very important structural design is very important when we go for designing a farm prawn hatchery especially, the layout is very important because every each and every structure, each and every farm, I mean like farming inputs and farming outputs has to be designed in such a way so it will take as less footprint as possible. I am talking about in terms of space, I am talking about in terms of transportation and all. So, suppose you have a feeding unit, which is like very far from the broodstock unit. So, your broodstock unit will be at stake because it has to provide I am just giving an example. So, suppose you need to provide aerational line.

So, suppose you need to provide aerational line or say like any feeding continuous feeder that is available that is that you are providing to your post larval tanks but suppose is electrical line is far away or suppose the tank that you have the design is very important each and every aspect of design is very important where you are where the electrical connections will be there where what type of aerators has to be provided the aeration efficiency will reduce if you have a central aerator line say like Central aerator and from there you are supplying the aeration to the different due through the conduit system to different tanks, the farther aeration tank it is the less the efficiency of the aeration unit it will be so, just to give you an example like how why these small things matters.

So, how you have to when you design you have to design all the things very precious very cautiously. Another important thing is like the renewable energy source, you have to think about the renewable energy source when we will be designing a hatchery like you have to provide you with a solar roofing provided with a geothermal energy to maintain a certain temperature in your system. So, you can provide it with the so, have a proper say like digester proper digester you can provide or where all your bio waste can be thrown on that from there the gas digested this biogas can be generated that can be utilized for different purposes as well.

So, I am just giving an example of when you will design when you will design a hatchery facilities and equipment you have to think about all these factors. This is not a standard design, this is only to give you a certain perspective of how it looks like. So, when you will be designing depending upon the size of the area, land layout like the soil properties, the sloping characteristics, the number of the amount of culture that you required, the amount of tank that you need to design. So, based on all these parameters you will go and design your farm.

So, it depends with the time to time. So, just I want to make sure that you will understand the basic amenities that it requires and basic parameters that it involves that it depends on. The components if you see the larval and post-larval tanks, algal culture tanks, air supply line, sea water supply line and the building and equipment, see water supply is another important parameters that I will be discussing in coming slides which have not been discussed yet.

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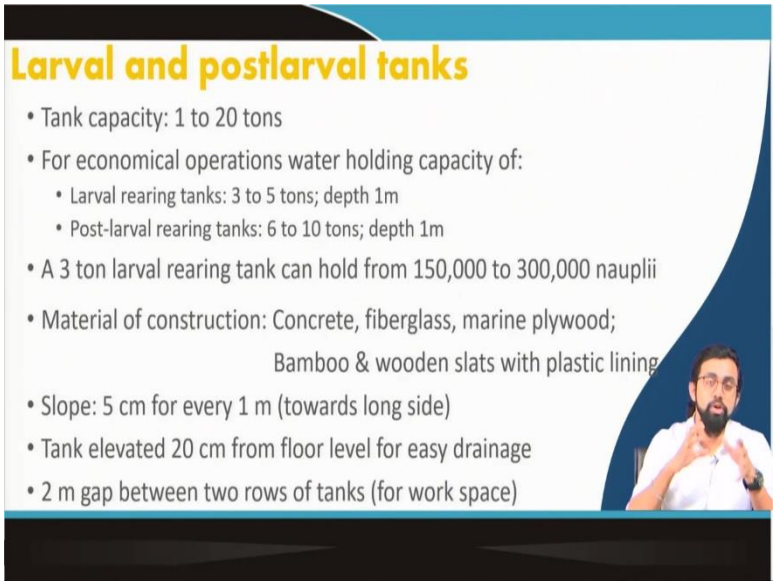

So, when we go for larval or the post-larval tanks in general, the tank capacity has to be around like 1 to 20 tonnes depending upon the size of the farm. For economic operation, water holding capacity of larval rearing tank has to be in between 3 to 5 tonnes with a depth of at least 1 meter do not make it very deep, not more than say like 1.2, 1.3 meters, around 1 meters is okay. Post-larval rearing tanks are also around 1 meter with a capacity of around 6 to 10 tonnes are expected. In general say like in a 3 tonne of larval rearing tank can hold around 1 lakh 50 to around 3 lakh naupliis. In general it is prawn naupliis.

Material of construction concrete, fiberglass, marine plywood, bamboo or wooden slats with a plastic linings anything like which is depending upon the size and depending upon the capacity and the economic how to say the capital cost that you can approach, the slope 5 centimeter for every 1 meter towards the long side it is better, tank elevated to 20 centimeter to the floor level for easy drainage and because it will make proper flow through the drainage line to do not to sedimented, suspended solid will not be sedimented it will be definitely go out of the system by the drainage line. 2 meter gap between the two rows of tank it is very important for workspace.

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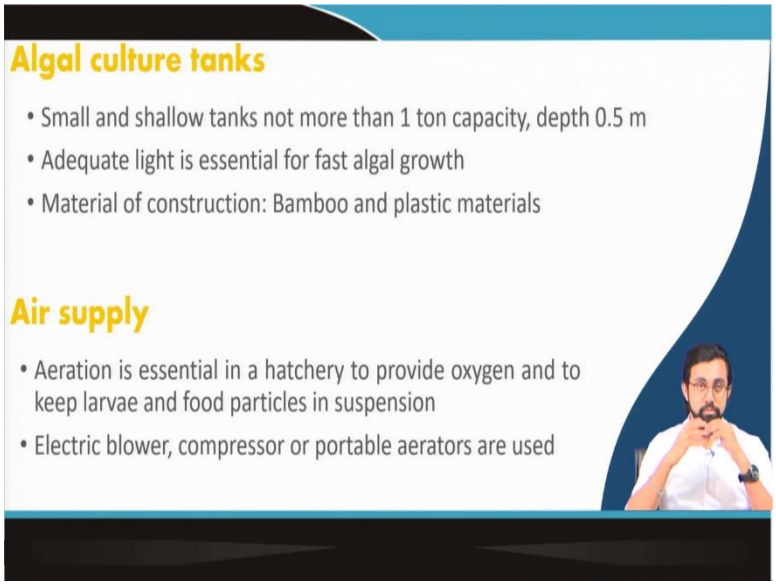

Algal culture tank the smaller shallow tanks not more than 1 tonne capacity of depth around 0.5 meter. Adequate light is essential for fast algal growth. Material of construction has to be bamboo or the plastic materials. Air supply, aeration is essential in a hatchery to provide ample amount of oxygen and to keep larva and food particles in suspension. Electrical blower compressors and also the portable aerators are used to sometimes.

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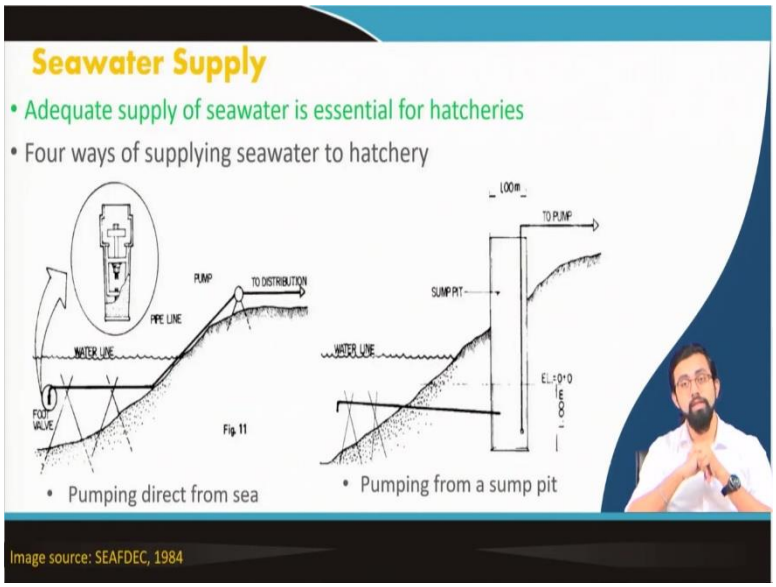

The seawater supply in general, adequate supply of seawater is very much essential for the hatcheries. And I remember I discussed with you in the very beginning of the lecture that we will be discussing in details about how the sea water supply is provided. So, how do you think the seawater is supplied to your farm? What can be the provable techniques by which you can

go ahead with this. Here, I have already discussed the four different ways of supplying seawater to hatcheries. I am 100 percent sure you will come out with thousands of more ways and different techniques by which you can supply the seawater to your hatchery or to your farms.

These are the general ways of supplying seawater. First pumping directly from the sea, where you have the you can see the foot valves are there with a proper filter mechanism so that it will not be choked very easily. So, with this foot valves this line quite deep to the seawater and then the water is actually it has to be lower than the lowest low tide level you know why it is because there should be a continuous supply of water and the water has to be the foot valve has to be below the waterline at any point of time.

In order to do so, lowest low tide level low tide level is the one at which at least water will prevail for sure no matter what happens unless until some very rare a tsunami went or something. So, most of the cases the one lowest low tide level is like considered as the lowest point at which the sea water will prevail at any point of time. And so, your foot valve has to be below that low level water level.

Then there comes the pumping from the sump pit you can have a proper line in a sump pit where the water will seep through it and which you will collect with time and from sump pit you can just pump the water, what is the additional benefit of it like it is like already filtered water not in a not 100 percent. You have to do it again before supplying to your farm though, but still it is like quite filtered because it will go through the stratum of gravel and rocks and it will come to the sump pit.

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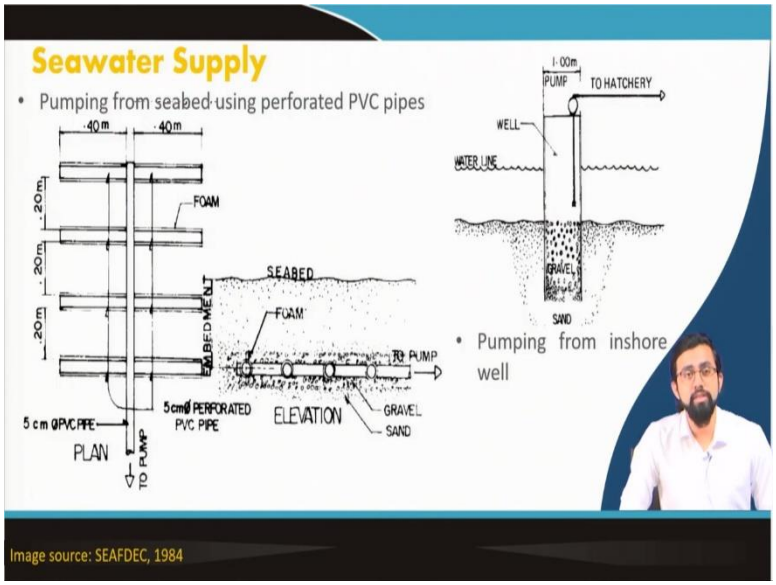

The third method is like continuous it is like pumping from seabed using the perforated PVC pipes which is sometimes does not make sense actually frankly speaking. We normally do it like just below the seabed they would like perforated UPVC line we call it in this UPVC we there is like perforations, in the perforations we have this small foam these foams are acting as a kind of filter material, when we sunk the water through the pump through this perforated tubes the water will come in contact because first of all the water is getting filtered through the sea bed and then through the foam and at the end the pure water, pure sea water you can collect. So that is one way of getting rid of the additional filtering mechanism or the cleaning mechanism of seawater, creating the seawater before supplying to your farm.

Forth, mechanism is like pumping from an inshore well, what is an inshore well? You have to have you can have proper you can have a proper structure concrete well you can develop by the side of your coastal region and that coastal unit will be filled with gravel. So, water definitely by because of natural phenomena water has to be water line has to be almost same inside the well outside the well and then the when you capture the well depending upon the different pressure anyway.

So, when you capture the water when you like suck the water through this well for your hatchery purposes, the requirement of additional treatment of water is getting reduced. So, these are some of the ways by which we normally collect the seawater, but this not the only one. So, if you want you can definitely design your own way of doing so.

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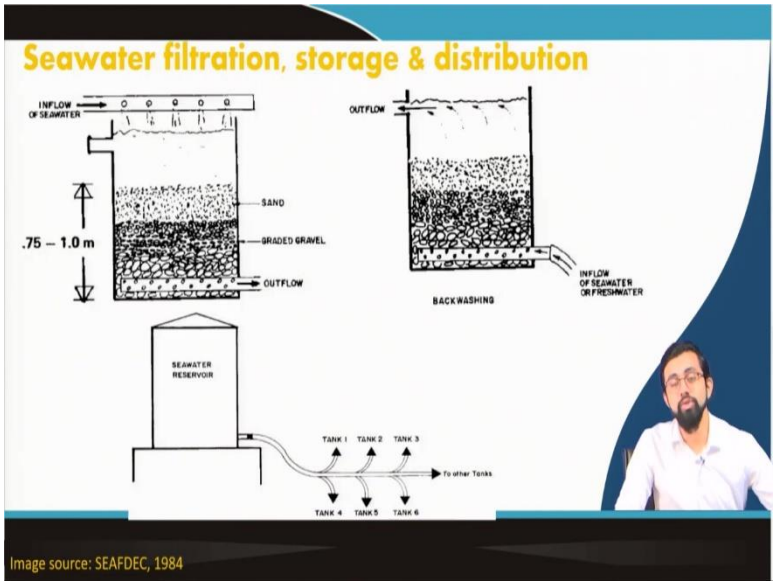

So, sea is the in case of the sea water which is incoming like which is like you can see the with the arrow the inflow of sea water in the first picture on the left upper side. So, it is it actually has gone through filtration unit, filtration procedure, sand, graded gravel then etc and then at the end it will go you have to see out flow region. So, from where it is collected.

So, the depth of this filter bed has to be around 1 meter 0.75 to 1 meter in size. So, the proper treatment can be done. And with frequently like what will happen it will get choked very easily because these sand particles has a very small specific surface area. Like in general, that is where poor areas are getting clogged easily, how to get rid of this clogging, sometimes what we do we do a reverse back flushing we call back flushing on the back washing, when we do the back washing like through the outlet and we connect the inlet and we pump it what will happen.

So, because of the fresh water pumping the all the clogging particles or like what are the pollen particles, which are the reason for this clogging, they will get out of the we can get rid of this clogging particle and it will go out along with outflow whatever it is that also we can again throw it back to the seawater. So, that is how the back washing is actually taking place. So, the we are collecting the seawater through this filtration unit you can see the seawater reservoir, so tank one, tank two, tank three, tank four, tank six and to the other tanks is going like this way you will normally design the distribution channel.

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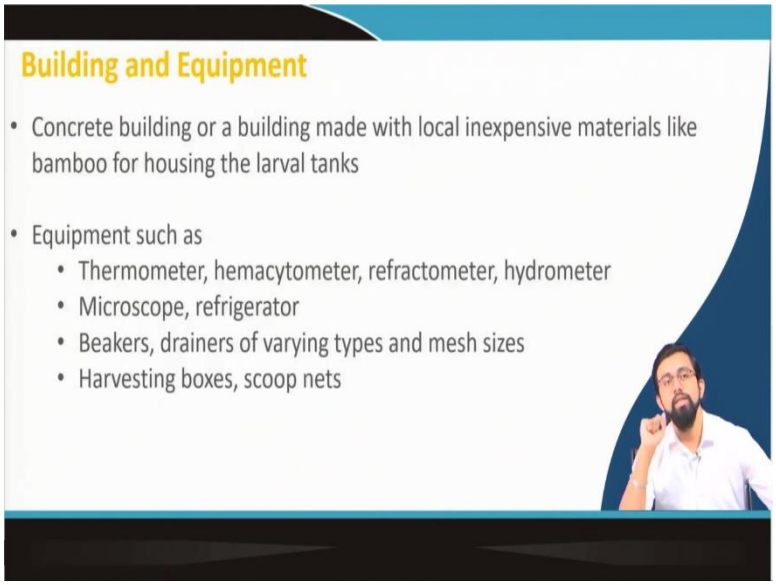

So, when we design this hatcheries the prawn hatcheries the building and equipment is very important. We normally go ahead with the concrete building or a building with a local inexpensive materials like bamboo or housing or the larval tanks and etc. Sometimes, what we do now is we do the poly housing also which actually helps sometimes in the temperate region, because of the poly housing the temperature inside the poly housing outside the outside is it really matter it really varies.

So, even if the temperature outside is a little bit less the temperature inside will be at least 4 to 5 degrees Celsius higher than the outside because of the greenhouse effect. The low wavelength, high wavelength sunlight phenomena (())(18:26) anyway. So, because of that, it also sometimes makes sense to design a poly houses for this kind of hatchery design and all.

Equipment like thermometer, hydrometer, hemocytometer, refractometer has to be there. Microscope and refrigerator, refrigerator has to be. Beakers, drainers of varying types, mesh sizes, harvesting box, scoop nets, these are the equipments that equipment that we need to have in your hatcheries and all these equipments that you will procure based on the type of involvement and the type of users. So, it depends.

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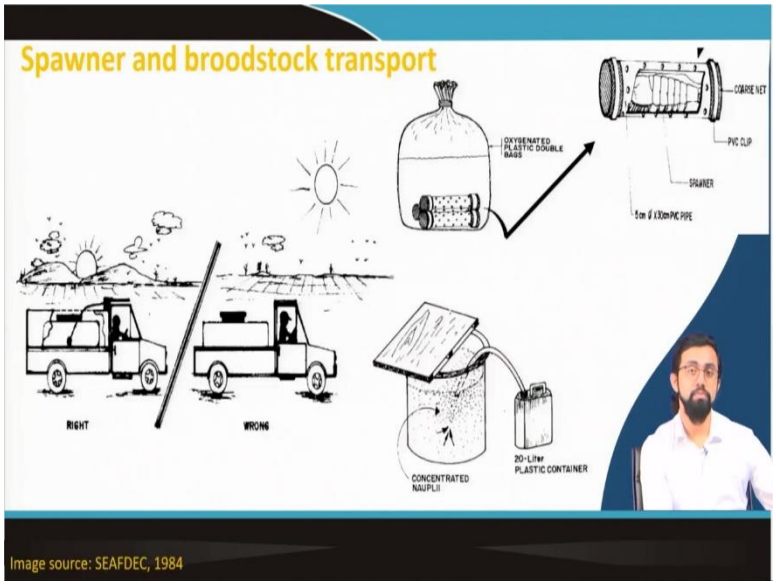

So, these are the things that we normally follow these are things that we normally collect, we normally offer designing, we normally put in our (())(19:16) system. The spawner and the broodstock transport, which is very important and if you see in the picture in the left, what is the right time for transport definitely in sunrise time or in the sunset times, they are still in the not at his high active stage.

And in case of sunlight exposure also what will happen in case of white day and what will happen it will be it will cause some anxiety and additional stress to your broodstock so that is why it is better to collect them and transport them in early sunrise or early after sunset time. So, normally it is collected in oxygenated plastic double bags and then it can be transported from one place to another.

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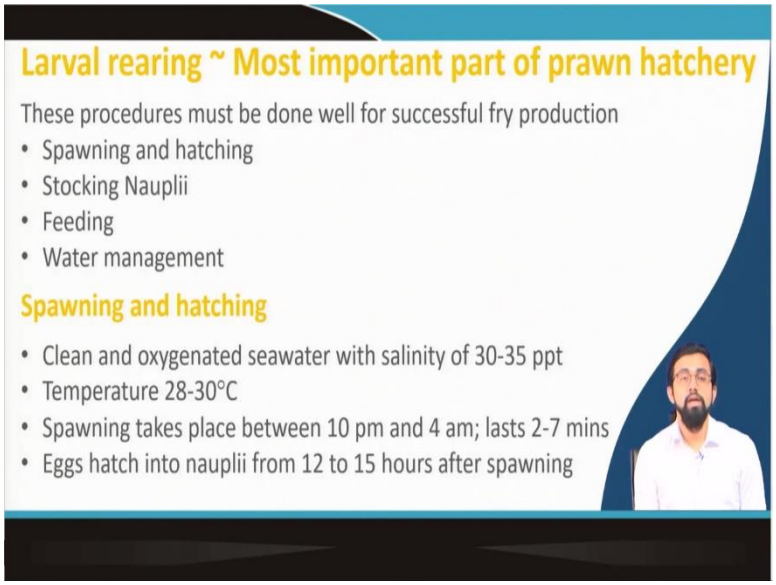

Larval rearing, so which is one of the most important part of prawn hatchery. So, these procedures must be done well for successful fry production like spawning and hatching, stocking of naulpii, you know what is naulpii like naulpii we discussed about it in the very beginning of the lecture like I mean like earlier lectures, the feeding because naulpii is like initial stage of prawn. So, it is their stages of their maturation stage actually, early stage of their maturation level. Feeding and the water management in order to go for successful fry production, we have to take care of these procedures.

How spawning and hatching is important. Clean and oxygenated seawater with the salinity of 30 to 35 ppt is required with a temperature range of around say like 20 to 30 degrees Celsius and the spawning it will take place between 10 pm to 4 am which is in the late night, so in the late night is the best time for the spawning to take place and it lasts for around 2 to 7 minutes. And the eggs hatch into the naulpii from 12 to 15 hours after that spawning. So, for this period of time it is very important, it is very precious time because any small environmental changes or any small manual error can completely disrupt your farming product.

So, during this 12 to 15 hours you have to be very cautious. And once the hatchlings are out of your eggs, then you have to like which we call there is naulpii's so this naulpii's you have to take care of it you have to start rearing them in a larval tanks.

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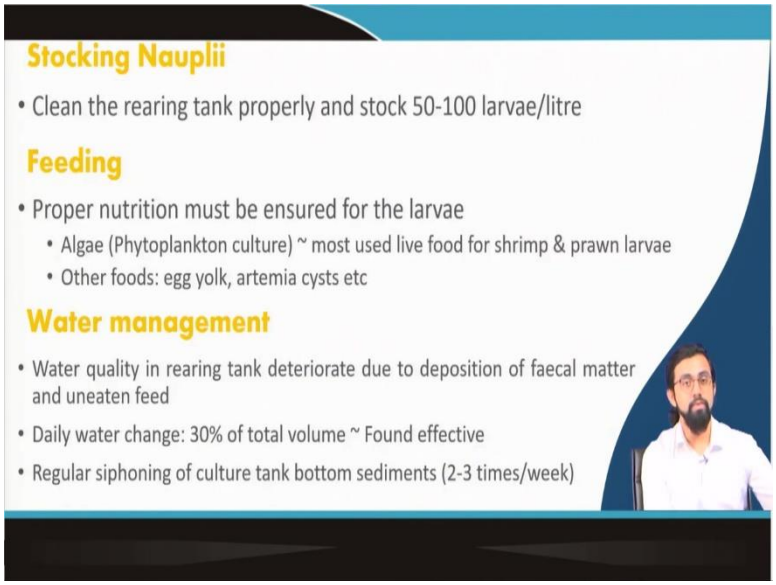

Stopping of naulpii in general the rearing tanks properly we have to clean the rearing tanks and we stock like 50-100 larvae per liter of diesel say like 1000 liters 1000 multiplied by 100. So that many larvae can be easily cultured or how to say sheltered or produced in a farm in your rearing time. Feeding, proper nutrition must be ensured for the larvae algae can be phytoplankton culture, mostly used for food for shrimp and prawn larvae. Other foods like egg yolk, artemia, cysts, etc can also be provided. This is for the larval stage because for them they need live food mainly as we already know, what is the reason behind it, what we to provide live feed and why they need this live feed and how they can get more benefit out of it.

Water management, water quality in the rearing tank deteriorate with the deposition of the fecal matter and the uneaten food. And because they are in a very early stage of development, the fecal matter their feeding rate is also very high, their fecal matter generation is also very high. And because of that the water quality get deteriorated very fast. So, that is why daily water exchange of around 30 percent of the total volume is like almost necessary and which is like really huge.

Like you cannot just do it with a regular freshwater exchange nowadays because, or like I mean, let us see water exchange nowadays because it will cost you a lot. I am not talking about the seawater cost, I am talking about the convinced charge, I am talking about the transportation charge, cleaning charge, pumping cost and etc. So, it is a lot of cost that that involves with it, so, how to get rid of it.

Again, I am telling you again and again the best thing is the recirculatory aquaculture systems, you design it, treatment unit, treat it and take it back to the water system again, it is like in a how to say insitu solution like there are only you have the solutions ready with that you do not have to go outside and think about procedures and problems and how to troubleshooting measures and all. Regular siphoning of the culture tank bottom sediment is very important at least 2 to 3 times per week.

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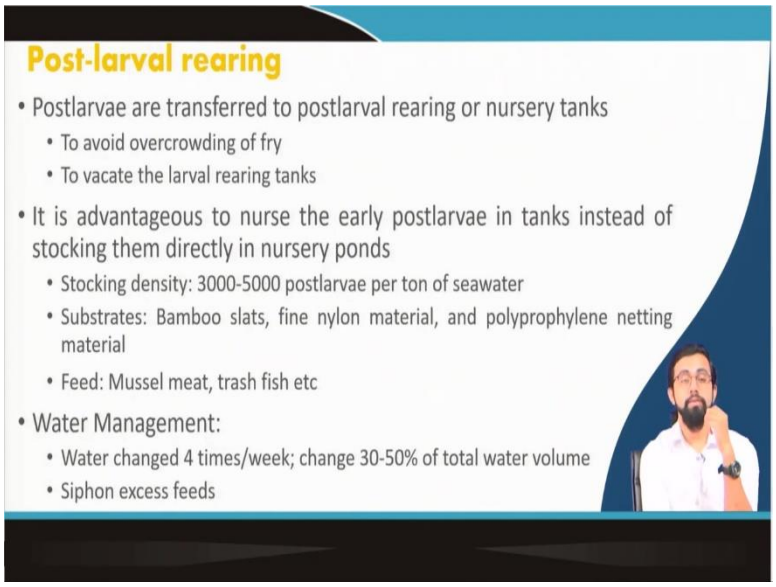

And once it reaches the post larval stage, they transfer to the nursery tanks or the post larval rearing tank to avoid the overcrowding of the fry in the rearing tank or say like larval tank and to vacate larval rearing tanks. So, the reason why we transfer it, so, it is advantageous to nurse the early post turbine tanks instead of stocking them directly in the nursery pond because in case of tanks, you can better control the environment in a very precise way and stocking density of around 3000 to 5000 post larva per tonne of seawater is possible with a substrate of bamboo slats, fine nylon materials and polyprophylene netting materials can be used.

As a feed we provide the mussel meat, the trash fishes etc. Because they already reach a certain stage so for them they very high animal protein is very much essential for them and not only essential like they the more the better the food that you provide the better the production yield that you will be getting as simple as that. Water management at least four times a week around 30 to 50 percent of change of water volume each day and siphon excess feeds that is very important in case of post larval system as well.

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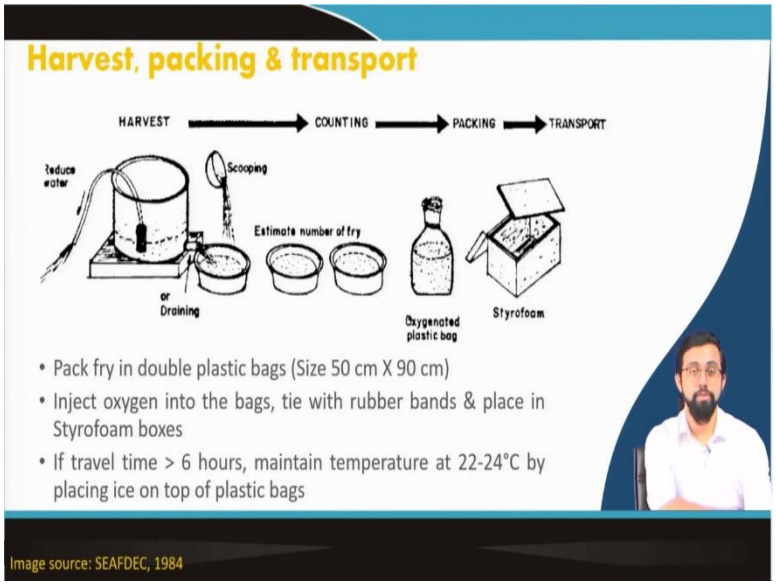

So, now, the post larval system is designed now, we need to think about the harvesting of the catch harvesting of our product, packing and transporting them. What is the standard way of doing that, you just harvest the product by using the netting or just reduce the water and then collect the product or the fry and then count them there is like counting mechanism is nowadays it is not that earlier like earlier days we used to do it by manually but thanks to the technology now you do not have to do that there is a manual there is the electronic counting machines which are available.

So, you just put the water through it like so, there will be like laser unit so, it will it can easily catch count the number of fingerlings that crosses the that particular boundary and because of by means of which we can easily calculate the number you can easily count the number of fingerlings of your system of your farm.

Then you pack it pack them in oxygenated plastic bags and then transport it to the Styrofoam inside of Styrofoam. So, that is obsolete now not obsolete there things still people are doing that but there are thousands of other mechanisms are coming out nowadays and were very enhanced packing mechanisms are nowadays are there which helps them to be in its stage for long.

So, other than that we have to when we transport it be it is better to have a proper the freezing mechanism we call it is freezing trucks and all that you have to have so you can have the proper freezer trucks or you can have this ice cube bags and all where you can also put your inside of styrofoam these ice cube bags to make your make the proper temperature sometimes we

supplied with the salt mix this ice cubes or we call it ice crust. So, that actually what it does, why we mix the salt to reduce its melting point because in general the ice it melts at 0 degrees when you add it with the salt and all it will reduce as its melting point after further couple of degrees.

So because of that it can sustain for long in its ice stage and all. It is a scientific phenomena(())(27:53) you can Google it and you can get a better idea about it. And if the travel time is more than 6 hour these plastic bags are also has to be placed up and down. So, to with the air filled plastic bags which will further give it additional protection from the radiation based effect from the outer atmosphere and all.

So, anyway, you have to make sure that there is no temperature exchange, whether it be conduction, convection or radiation. So, that the ice can be at its stage for long and then it will definitely possibly help your produce or possibly help your yield product to sustain for a longer period of time.

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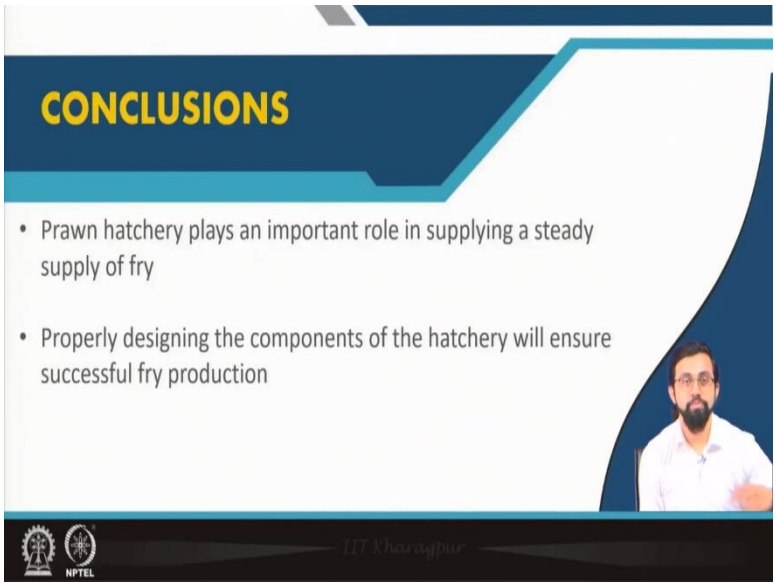

So, in general in conclusion, what we can say the prawn hatchery plays an important role in supplying a steady state supply of fry. It properly designed the components of the hatchery can ensure a successful fry production.

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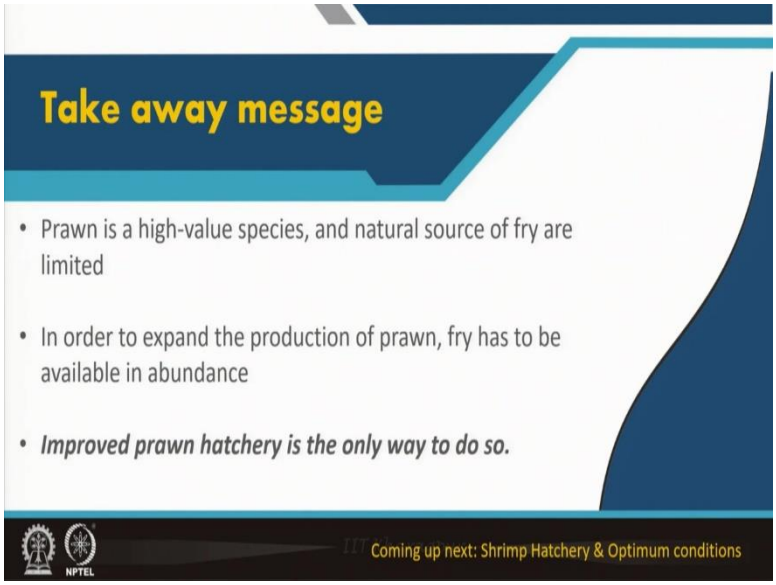

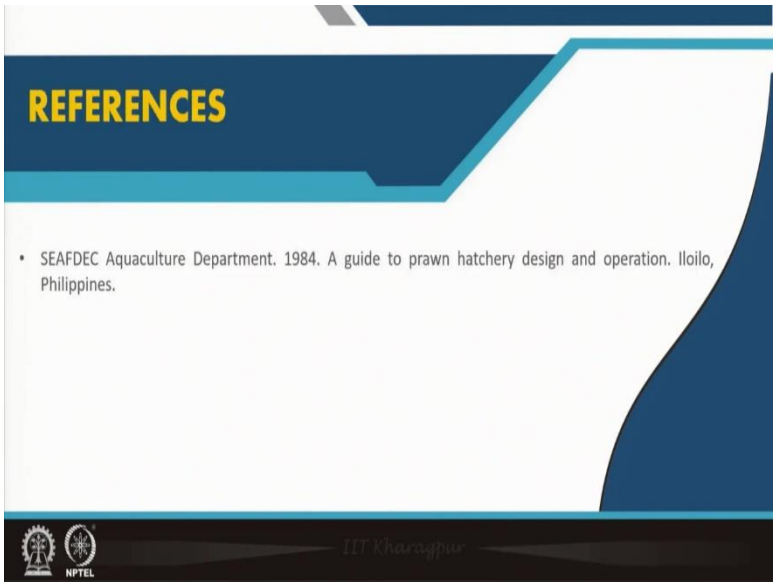

And this is as because prawn is a very high value product, high value species, natural source of fry are limited and in order to expand the production of prawn fry has to be available in abundance and what is the only way of doing it is the only way of doing it is the improve the prawn hatchery design. So, we can design proper prawn hatchery and which will definitely give us a way to collect the fry which is sufficient enough for the supply of or requirement of all the market and all, so that is it for the prawn hatchery, the shrimp hatchery. Next, we will be discussing about the design of shrimp hatchery and all this is the reference from which I have taken couple of pictures and the material. So, thank you so much. We will see you in the coming lecture. Thank you.

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