Advanced Agriculture Technology
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Lecture - 17
Topic - Introduction to Shrimp Culture

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Hello everyone, welcome to the second lecture of the module 4, Introduction to Shrimp Culture for the course, Advanced Agricultural Technology. My name is Professor Gourav Dhar Bhowmick, I am a professor from the Department of Agriculture and Food Engineering department IIT, Kharagpur.

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So, the concepts that I will be covering in this particular lecture is the introduction to the shrimp culture, the site selection, the design of ponds for different types of shrimp culture systems, and the pond management systems required for the shrimp culture.

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That shrimp is like the mostly traded and the most, one of the most valuable marine products in the world today, it is called as a pinkish gold of the sea because of its great taste, its unique value realizations and also the increasing demand like all over the globe. And also, these shrimps actually, it accounts for more than 55 percent of a total shrimp production in a global scale is actually accounts for the farm shrimps. So, the major the countries who are responsible for this kind of farm shrimp production are China, Thailand, Indonesia, India, Vietnam, Brazil, Ecuador and Bangladesh.

In general, the type of species the same species that we found in India are as follows like the *Penaeus monodon*, *Penaeus indicus*, *Metapenaeus ensis*, etc, etc. So, you may heard about the tiger prawn, white tiger prawn and all we already discussed about a little bit in last lecture material and as well.

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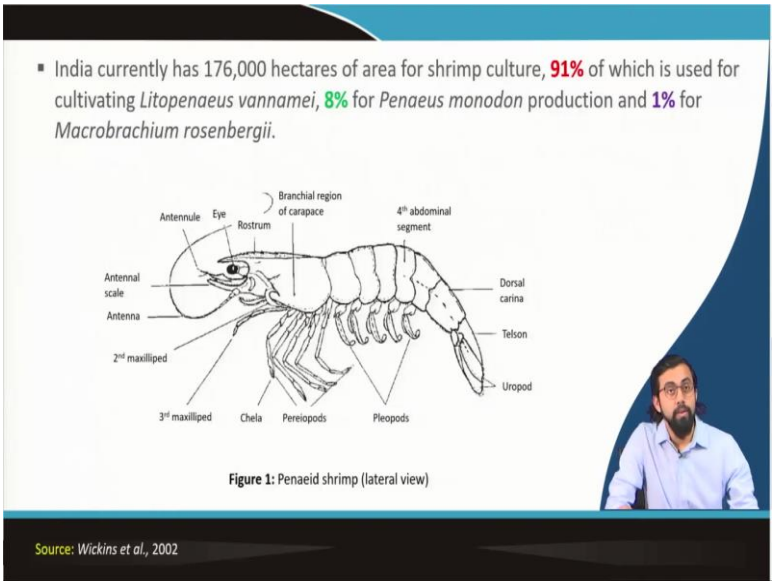

So, in general in India right now, almost 176,000 hectare of area is culture is actually used for culturing of different kinds of shrimps, 91 percent of is actually used for cultivating the *Litopenaeus vannamei* and 8 percent is for the *Penaeus monodon* and 1 percent is for *Macrobrachium rosenbergii*. So, in general the Penaeus shrimps, if you see this is the lateral view of Penaeus shrimps, if you see its structure, so, it has this pleopods if you see that this like, it has this pleopods, you can see this, it has the specific structural difference between then the other type of shrimps like it has this fourth abdominal segment which and also the dorsal carina on its telson region.

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Sl. no.	Local Name	Scientific Name	Peak Season	Distribution	Areas of Abundance
1	White Prawn	*Penaeus indicus*	Through out the year except monsoon season	Entire West Coast and South-East Coasts of India	Kerala & Karnataka Coasts
2	Tiger Prawn	*Penaeus Mondon*	November to May	East Coast and South-West Coasts of India	West Bengal and Odisha Coasts
3	Pink Shrimp	*Metapenaeus dobsoni*	July to October	West & East Coast of India	Kerala & Karnataka Coasts
4	Brown Shrimp	*Metapenaeus monoceros*	November to May	West & East Coast of India	Coasts of Andhra Pradesh & Odisha
5	Marine Shrimp (Karikadi)	*Paraenaeopsis stylifera*	May to September	Both the Coasts but more in South-West Coast	Kerala & Karnataka Coasts
6	Deep sea Shrimp	*Solenocera sp.*	February to May	Both East - West Coasts	South - West Coasts

So, this is the these are the different types of shrimp species that we normally culture in India like the local name is like the white prawn like the penaeus indicus, the tiger prawn like the penaeus monodon or pink shrimp or the metapenaeus dobsoni which is not very common, but still people are culturing it in Kerala and Karnataka regions, marine shrimps, karikadi brown shrimps, a deep sea shrimps etc. So, for each of the shrimps different kind of this important shrimp species, they have their own peak season. So, in general the white prawn penaeus indicus you can almost grow throughout the season like throughout the year only other than the monsoon season.

Whereas, in case of tiger prawn it can grow it has a peak season of around November to May, pink shrimps July to October. So, for different types of species it has its own peak season and the distribution if you see mainly the Kerala, Karnataka region or the one which is mostly the you can find the abundance of this kind of different type of shrimp species in India.

Other than that, and if you go to the, if you come to the West Bengal or Odisha coastal region you will find that production of tiger prawn a lot. If you further go to the Andhra Pradesh, Odisha this reason if you like go for the southern side of the eastern coast like metapenaeus monoceros, so, there you will find his brown shrimps production the abundance of brown shrimp production in this region.

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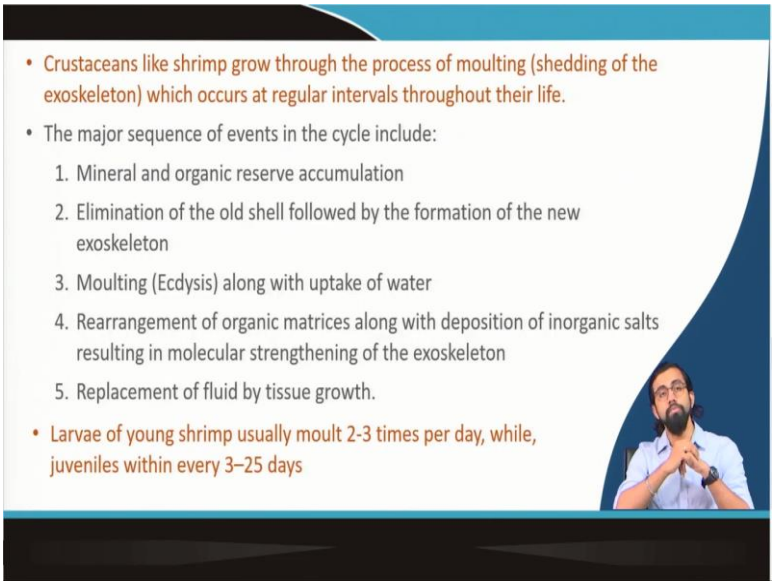

So, in general the crustaceans like the shrimp they kind of grow in the process of molding which is like the shedding of the exoskeleton so, they keep on shedding the exoskeleton at regular intervals throughout their life, well definitely it depends. In case of young shrimps,

they are usually more like 2 to 3 times a day, while as like juvenile stage it can the frequency goes up to 3 to 25 days. So, after 3 to 25 days, they keep on shedding their exoskeleton or that process is called the moulting process. So, by which they are they keep on grow during their till their maturation stage.

The major sequence of events in the cycle is actually involved the mineral and organic reserve accumulation, the elimination of old shell followed by the formation of the new exoskeleton the process which I already mentioned the molding or the egg diocese along with the uptake of water.

And other than that the rearrangement of the organic matrices along with the deposition of inorganic salts, which also results in the molecular strengthening of the exoskeleton and majorly their exoskeletons are made up of different types of calcium and magnesium products this mostly this type of species. And also, they have a they do they like when their tissues actually keep on growing in this kind of species as they kind a replace their fluid the body fluid very frequently and this body fluid replacement is a major process for their tissue growth and all.

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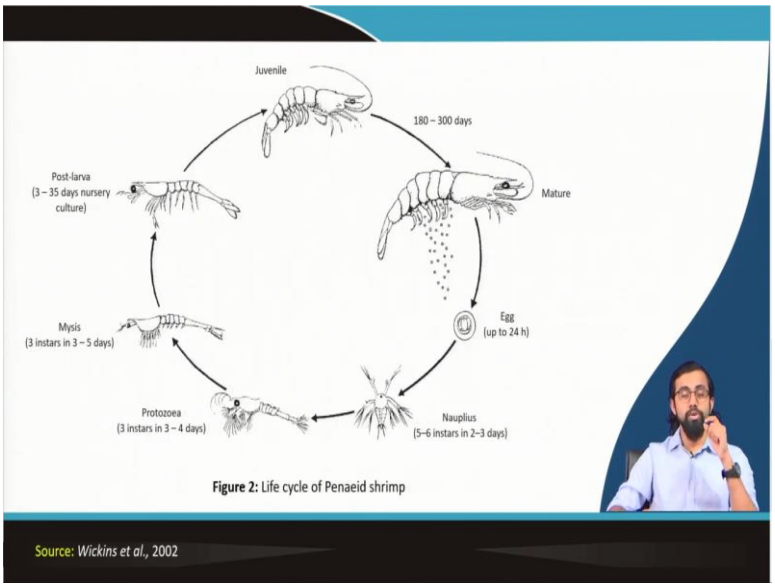

So, in general if you see the whole cycle of the penaeid shrimps like right from the egg which up to say like 24 hour of period and then it is called nauplius period then in the nauplius if you see it has the 5 to 6 instars or in 2 to 3 days of sequence, then it is called protozoea stage from there it stays for like another three instars in 3 to 4 days. And then it goes to the mysis

and then post larva and then the juvenile stage. So, it is from juvenile stage to the mature final maturation stage requires around 180 to 300 days.

So, all total around 350 around 360 days require the max form the for your year long production from your initial the pre-preparation management to the execution stage like after the maturation stages in reached the if you want to netting out all the materials, so, all this procedure would take around one year of time period.

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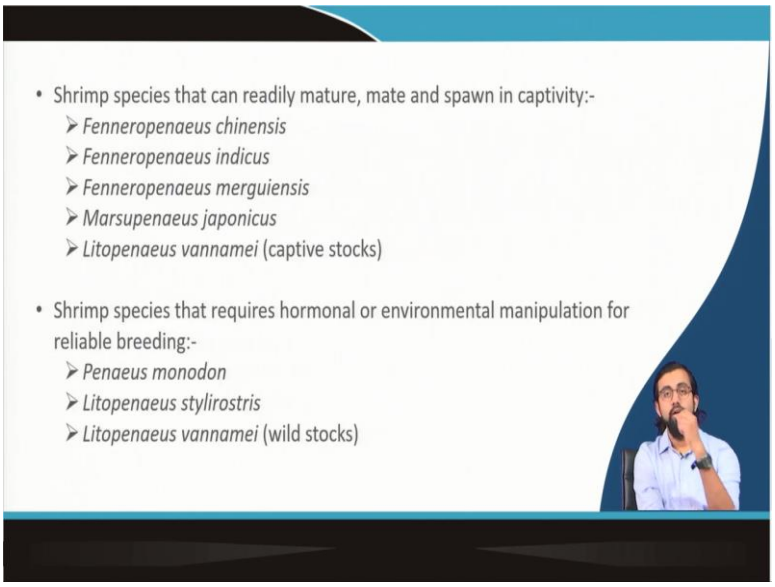

So, in general when there are different types of shrimp species, shrimp species where it required the either the hormonal or the environmental manipulation for their building lithopanaeus vannamei or this fenneropanaeus chinensis and all, so, this type of spaces is they do not need they can they can be readily natural mate and spawn in captivity. But whereas, in case of penaeus monodon, in case of lithopanaeus vannamei, the wild stokes one they need some hormonal or environmental manipulation for reliable breeding in captivity.

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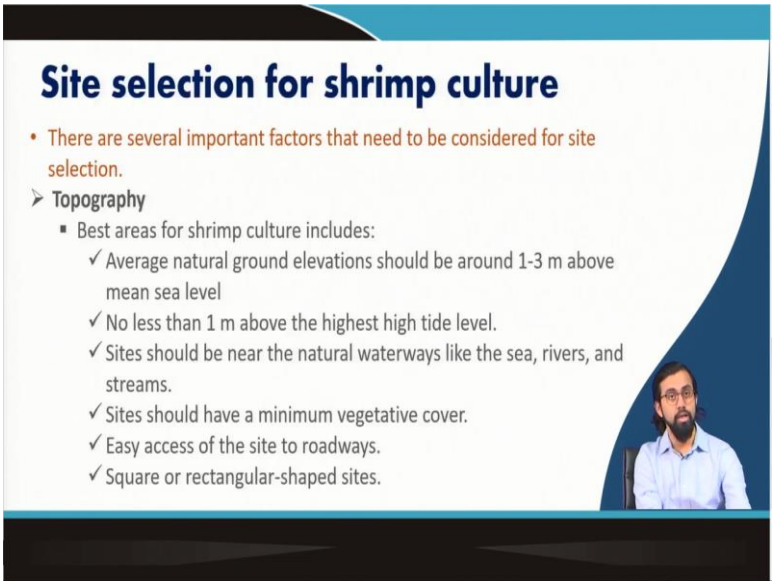

So, before you start any culture of any shrimp, so, what are the consideration what are the factors that you need to worry about, remember whenever you will be starting your own farm in this kind of aquaculture practice using aquaculture species and all, you have to worry about the site selection first, that is the very first and foremost criteria about the site from which type of species that definitely you have to search for at the beginning, then followed up thing will be like when you will be designing a farm what is the topography of that farm? I mean like the what is the topography, what is the natural ground elevation, let at least that you have to understand like from the mean sea level how what is the elevation from there you have to maintain at least 1 to 3 meters above the mean sea level this ground elevation.

Because if you are not maintaining this particular height what will happen, mostly they cultured in a coastal region in a tide fed condition. In a tide fed condition, because in the high tide and the low tide this fluctuation though in case of high tide situation the water should come from the sea to your pond or to your culture area.

So, that provision you have to provide using a proper design of sluice gate and all and proper designing of a canal. So, using a proper canal design and the proper sluice gate design and maintaining the ground elevation of around like in the range between 1 to 3 meter above the mean sea level is like the standard practice.

Second thing not less than one meter above the highest high tide level, what is highest high tide level and what is lowest low tide level. So, the high tide level, low tide level it fractured diurnally. However, this highest high tide level, it is like the is the some particular days of

year, so what happened, the tide level reaches its maximum. So, when the difference between the difference from its mean sea level average means like a mean sea level to the highest high tide level is the maximum.

And the same happened in the lowest low tide level also. So, in general there is a average high tide level, in general there is highest high tide level, so we will be discussing more in details about all these particular terminologies because there are lot of things to discuss about it. If I want to go in details, so but in this particular subject does not give me enough provision or the time period to go on more discussion about it. So anyway, maybe in future we will discuss about it in details in aquaculture, design of aquaculture farms and practices.

So, the site when which you will be choosing it should be the near to the natural waterways like sea, rivers or the stream region and with it has to have at least a minimum vegetation cover to reduce the erosion, soil erosion practice, soil erosion and also to get rid of the erosion that can cause by the wave thus it can be the sea wave, it can be the, because of the wind erosion, because of the wind factor and all.

It has to has a easy site access to the roadway. So, that you can make it in a square or rectangular shape and have to have you can have a tank with a proper broad weight so, that the transportation will transportation carriage and all they can come or even human transport manual like human transportation is also possible.

It has to have a particular width top width and I will be discussing about in details like what should be the top width based on the size of the pond and the best of the size of your farm. Not only that like climatic situation is also a matter to really worry about, short dry season and moderate rainfall throughout the years the best suited for the shrimp farming, if it has a long dry season, what will happen, just imagine if it has a long dry season because of the sunlight because of the presence of the sunlight what will happen, the water will keep on evaporating.

So, the if the water first of all you are using your shrimp farming is done in tide fed farm mainly on the pump fed farm also it is possible, in general I am discussing about in general tide fed farm when the sea level rises that water because of the high tide situation the water from the sea it reaches your farm.

So, when it reaches your farm, so, it is a high saline water it is anyway it is high saline water no matter whatever the coastal interference it does have. So, but with the evaporation, what

will happen, the water will evaporate, the salinity of your existing farm will keep on increasing, which is also not good. Those shrimp can sustain a huge amount of range of salinity level but still, if it has a really long dry season then what will happen the water will keep on evaporating and because of that the salinity level will keep on increasing in your farm practice, in your farming pond or farming culture tanks, so, that is not a good practice.

So, you have to worry about you have to think about the you have to choose place or somehow manage situation when there is like areas which are having short dry season and a moderate rainfall more much if it has a very high rainfall area that is also not suitable, you know the reason. If it is a high rainfall area, what will happening because of the rainfall, the pond will be diluted the pond water will be diluted, the salinity level grows highly like it will decrease like anything it will reduce like anything and that is also not good for your shrimps.

So, shrimp needs a moderate level of salinity for their survival. So, that has to be maintained in your culture pond or culture farm. So, these are the things that you have to worry about before choosing a farm, aquaculture farming especially the shrimp farming. Infrastructure, not need to say about it, you have to have a proper accessibility by road, by waterways whatever means so, to have a proper supervision and also you can easily transport the materials and the products or the final products.

It has to have a proper electricity supply like availability of the reliable and relatively cheap power source has to be available with a backup generator as a secondary power source and also if it is possible nowadays people government of India is really pushing all the farmers of the fishermen all the farm practitioners to go ahead with the renewable energy sources.

So, what you can do, near to your shrimp farming you can just simply shared it with the solar panels and or simply you can use the wind energy because anyway it is a coastal region there is you can have a, the wind will definitely flow all the time. So, I mean like either from the land to the sea or the sea to the land depending upon the time of the day.

So, you will get a lot of wind energy and it is really, really a good practice if you want to go ahead with the designing all the energy demand for your farm through the renewable energy sources, either solar, either wind, either you because you are near to the coastal regions you can use the wave energy as well you just simply designed those wave platforms and it will give you enough energy sources for you to supply energy for all the necessary equipments all the necessary farm necessities for your farm. So, that is also doable and now it is common are

also different government practices are also available, you can go and ask the experts available in this field, so, to design you with this kind of systems.

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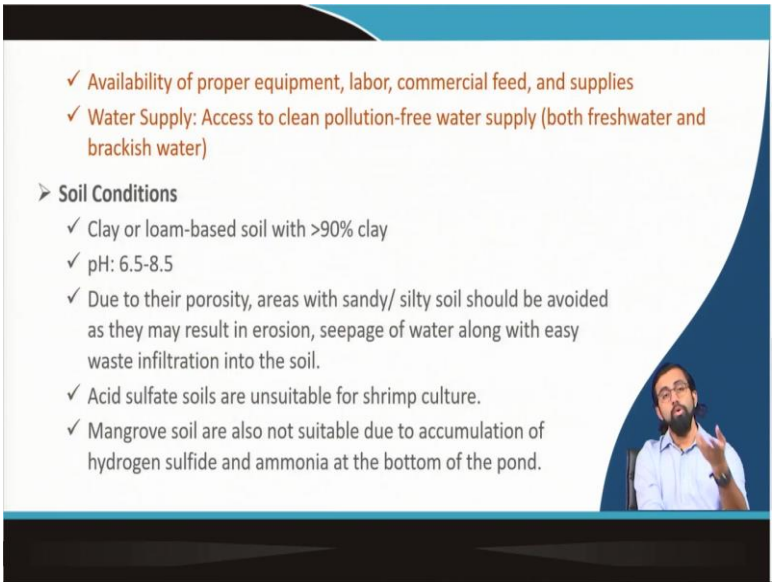

So, proper security is another important thing that you have to worry of because otherwise what will happen that there may be people from outside they will come and steal your catch. So, that is not a good practice anyway, but you have to worry about that also, you have to have a proper fencing and all.

Availability of the proper equipment, labor, commercial, feed and supplies definitely you have to have a labor cheap labor as possible or not only cheap, he or she has to be well versed with the techniques and all the necessary, what to say troubleshooting practices that is possible for your farming, for your farm and all.

Proper equipments are needed, proper aeration, proper aerators and all proper pump systems and all the commercial feed has to be available with the minimal cost and it has to be it has to have all the possible nutrients possible for your shrimp to grow faster. And as it is said like the more you supply the good amount of animal feed especially to the shrimps they can grow very fast and it is really a very that is a reason why it is called like the pinkish gold like in a sea. So, it has a lot of money and a lot of people are earning in crores in even in India also with this kind of farming practices.

Water supply you have to have a water supply clean pollution free water supply both freshwater and brackish water because brackish water culture water brackish water that you are supplying to your farm it is actually nothing but the high tide sea water. So, before it

reaches to your farm, you have to have a proper how to say means of filtering out all the see larger sized foreign particles which you do not need in your system definitely and the all the other filtering mechanisms that you can have to get rid of the materials which are detrimental to your farming or to your farm or can cause choke or can cause some further hazard to your system.

So, that you have to think about it for a while we will be designing just before the sluice gate or just after this before the sluice gate or after the sluice gate depending upon the size of the pond, you can design those filters and all. Soil condition definitely it has to have clay or loamy soil with more than 90 percent clay, why you need more than 90 percent of clay?

First of all, it kind a give you some give you a what to say it is like it will give a kind of concreteness to your system first of all to your pond bottom to your farm bottom, why, because first of all, there is a chances of when the there is a low tide condition the water may leach out from the from your pond if it is some it is higher amount of sandy's provided and because of the sand, the leaching efficiency leaching possibility will be higher and because of that, you will lose the farm pond very farm water very easily.

And at the same time, if there is like high tide condition highest high tide condition, if your form is already filled up with the water you can close the squeeze gate, no matter what the sea water level is your dyke can your pond bottom has to be designed in such a way, so, there will be no further penetration of this lower vicinity water to your pond.

So, that you have to make sure and for that you need to have a clay or loamy soil of around more than 90 percent of clay which gives us this stability, this concentrated effect then this pH of around 6.5 to 8.5 is necessary because sometimes what happen when it goes above 8.5 say the present because of the presence of different ammonia called product and all or say below 6.5 or like it may happen due to the different reason of nitrogen species that can be present in the aquaculture wastewater because of different phenomena, first of all uneaten fish, uneaten feed, the excreta and all these things.

So, anyway the soil condition when we will be thinking about it, it has to have a 6.5 to 8.5. I was thinking about the water but it is actually the this is the soil page that we are discussing here, 6.2 to 8.5 it has to have this range. Due to the porosity with sandy and silty soil should be avoided as they may result in the ocean, seepage of water along with ease waste penetration into the soil. So, these are the things that I have already discussed. Acid sulfate

soil is obviously unsuitable for the shrimp culture, because that will cause the different kind of irritation diseases for the shrimps. The mangrove soil is also not suitable due to the accumulation of the hydrogen sulfide and ammonia at the bottom of the pond.

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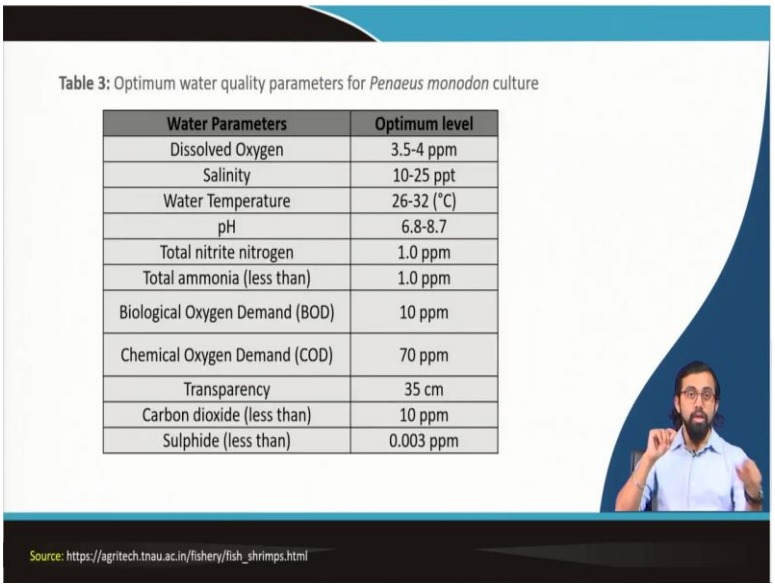

Optimum water quality parameters for say like penaeus monodon culture is as follows the dissolved oxygen concentration which is like amount of oxygen present in your farming water has to be in the range of 3.5 to say like 4 ppm or like milligram per liter, salinity 10 to 25 ppt, water temperature around 26 to 32 degrees Celsius, pH 6.8 to 8.7.

Total nitrite nitrogen has to be 1.0 ppm, better be less than that total ammonia less than 1 ppm. What are the major sources of this ammonia nitrate, definitely the ammonia is first of all the uneaten feed, it has a very high amount of protein sources that will convert to the ammonia and all like because of the different kind of bacteria's and then this what they do they again this there is a chances of having different kind of nitrifying bacteria, which will again work on the ammonia connect to genetic will convert it to the nitrite or nitrate.

So, nitrate is really detrimental even ammonia, if it is in free ammonium form that is definitely not a good sign. So, these are the things that we need to worry about. BOD, biological oxygen demand has to be less than 10 ppm, chemical oxygen demand has to be less than 70 ppm, transparency at least 35 centimeter what does that mean, you could see with your naked eyes at least 35 centimeters below the surface of the water body. So, it depends upon the suspended solid level and also depends upon the like the amount of definitely the suspended solids which will cause the turbidity and which will cause this type of

transparency issues and also, so that you have to worry about. So, that is another reason why sandy soil is not preferred in this kind of situation in this kind of farming practices. Carbon dioxide level has to be less than 10 ppm and sulfide has to be less than around 0.003 ppm.

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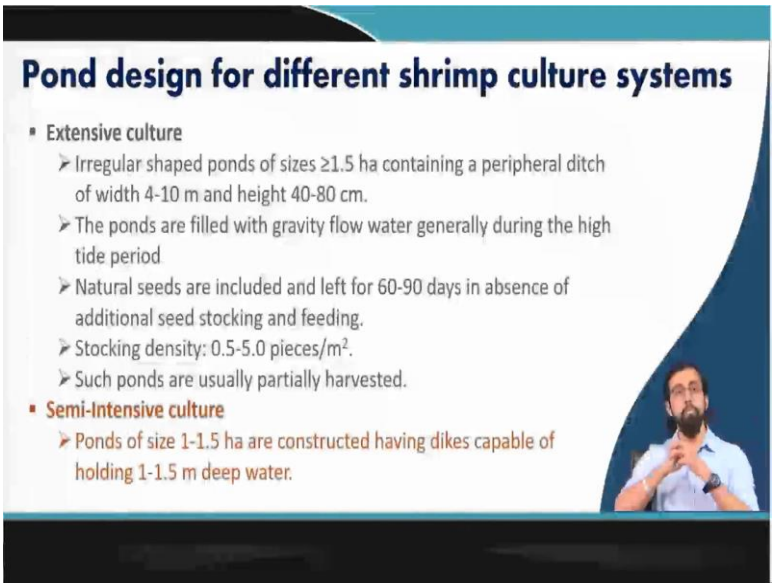

When we design a shrimp, suppose a pond system any pond we are designing it will depend upon the type of shrimp culture system. What do I mean by the type of shrimp culture system? We have discussed in earlier lectures, there are different types of cultural practices in aquaculture, extensive which is like very least human intervention is required it is like very huge area with all the natural amenities possible there presence there, semi intensive, intensive etc, etc.

So, here we will be discussing the I will show you I will discuss with you the what will be the optimum design criteria's for these different type of shrimp culture systems, whether it be extensive, whether it be semi intensive or be the intensive one. So, in case of extensive shrimp culture systems, we have to have a it is not mandatory, but it has to have a irregular shape pond of more than 1.5 hectare, what is hectare, 10 to the power 4 square meter. So, it has to have a more than that size containing a peripheral ditch of width of around 4 to 10 meter for the new transportation purpose and a height of around 40 to 80 centimeter it can go up to 1 meter also.

The ponds are filled with the gravity flow water generally during the high tide period. And the natural seeds are normally included and left for like 60 to 90 days in excess of additional

seeds stocking and feeding and the stocking density can be 0.5 to 5 pieces per square meter. And such ponds are normally usually partially harvested, why it is not completely harvested?

Definitely it is a very common sense because if you completely harvest it, the next season there will be no like there will be you are not getting for the culture at all from your pond. So, it is partially harvested and especially when all the potential, the brood stocks are properly left sometimes in the pond. So, far there is no further harvest further harvest harvesting period and all for the next season. In case of semi intensive one, it is not as high as in more than 1.5 hectare, but if it is somewhere lies between 1 to 1.5 hectare and constructed with the dikes capable of holding 1 to 1.5 meter deep water.

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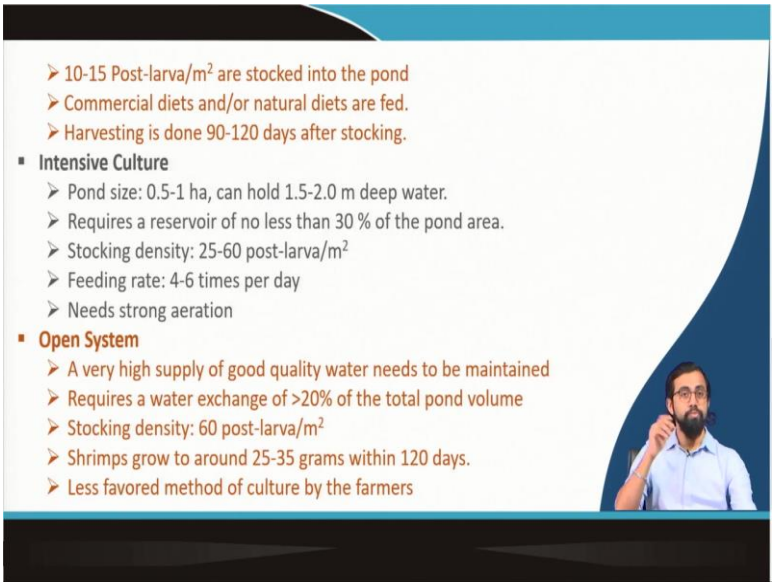

And with a 10 to 15 post larva per square meter of stocking density and in general sometimes why it is called semi-intensive, remember, you have to supply you have to have you need to provide some amount of human intervention like you provide some amount of commercial feed, because sometimes what happen the natural feed that is available for the pond is not sufficient enough, so, or maybe the stocking density has because the stocking density is much higher. So, because of that they need additional amount of feed. So, then we supply the commercial diet and all and we normally harvest it within 90 to 120 days after the stocking.

In case of intensive culture, it is it normalized between 0.5 to 1 hectare and can hold up to 1.5 to 2 meter deep water. And it is actually the intensive one, what does that mean, you are having very high-density culture of your targeting species and with a stocking density can reach up to 60 of the number of post larva per square meter. So, it generally requires our

reservoir of like, say no less than 30 percent of the pond area, the feeding rate will be like 4 to 6 times per day, you can easily imagine like the that with the feeding rate it is like 4 to 6 times per day, so amount of human intervention that it requires.

It needs a strong aeration that is one of the major issue because it is a continuous process and it is an intensive process intensive or huge number of target species are dwelling in your farm. So, they need huge they consume huge amount of dissolved oxygen and the presence of no natural alternative can provide them with the additional amount of oxygen that they require. So, in that case, we need to provide them with the aerators and all, though it can be surface paddlewheel aerators and all, it can be submersible one, somehow you need to provide them with the additional amount of oxygen that oxygen will be dissolved like actually we are providing with them providing actually air.

So, from air whatever that like around 21 percent is of 20.9 percent is of oxygen that is available that will dissolve in the water and that water is actually known it is enriched with the dissolved oxygen and which is actually required it has to have a range of around 3 to 4, 3 to 5 ppm of DO as we discussed.

So, that has to be maintained. In case of open system, a very high supply of good quality water needs to be maintained, it requires the water exchange of more than 20 percent of the total pond volume and stocking density of around 60 post lava per square meter and shrimp can grow to around like 25 to 30 gram within 120 days which is like within 4 months and though it is the less favored method of culture by the farmers.

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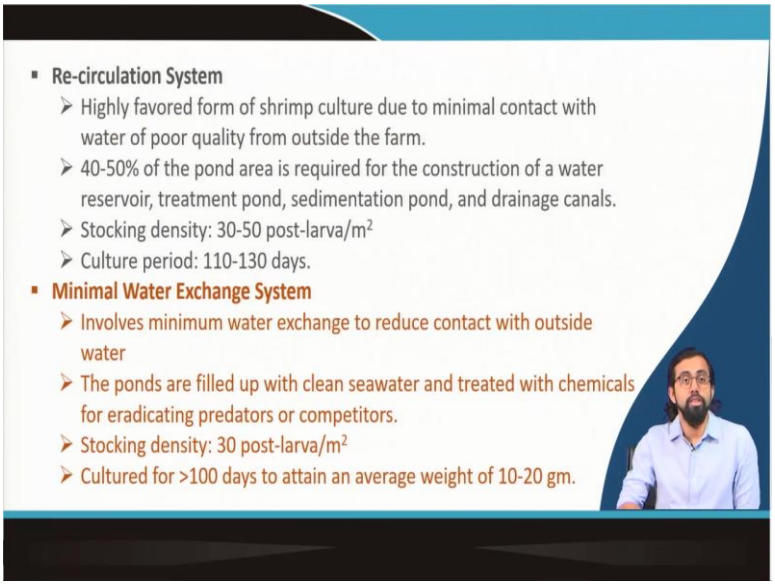

And we discussed about recirculation system in earlier lectures also we take the water out of the pond, we treat it and we like kind of give it back to the system. So, that is how we are minimizing the water requirement, we are utilizing the we are somehow reducing the economic impact though they it comes with some amount of capital investment in beginning when you design the this kind of treatment units.

So, anyway, so the stocking 40 to 50 percent of the pond area in general we may require for construction of the water reservoir treatment pond, sedimentation pond, drainage canals, etc and you may have some additional amount of small treatment units as well and water treatment units as well.

So, it also has it can also sustain with the stocking density of around 30 to 50 post larva per square meter of around culturing period of around 4 months. Then there comes the minimal water exchange systems. So, in case of minimal water exchange systems, when the recirculation along with the recirculation system what is the positive thing about it like in this particular case, it involves minimal water exchanged and it to reduce the contact with the outside water. What does that mean? Outside water, what is the outside water here, it is a clean seawater.

The clean seawater when it is filled with a clean seawater it when it is filled with a sea water and high tide situation, it does not come along with the foreign living organism it does come with the foreign living organism. So, it may cause different kind of disease-causing microorganisms it can come with some predators, which are not beneficial or harm can be harmful for detrimental for your target species.

So, that is why the minimal water emission system are the design where once the seawater is captured in high tide situation then we put the sluice gate off and when we try to use the same water again and again in the system, so to minimize the water exchange with the open with the seawater.

So, that will reduce kind of that will eradicate the any kind of competition or the predator's effect or the any kind of how to say like the harmful microorganisms that can cause diseases to your system. It can be stocking density of around 30 post larva's possible in this kind of systems with almost 100 more than 100 days of culturing is required with an average weight of 10 to 20 meter.

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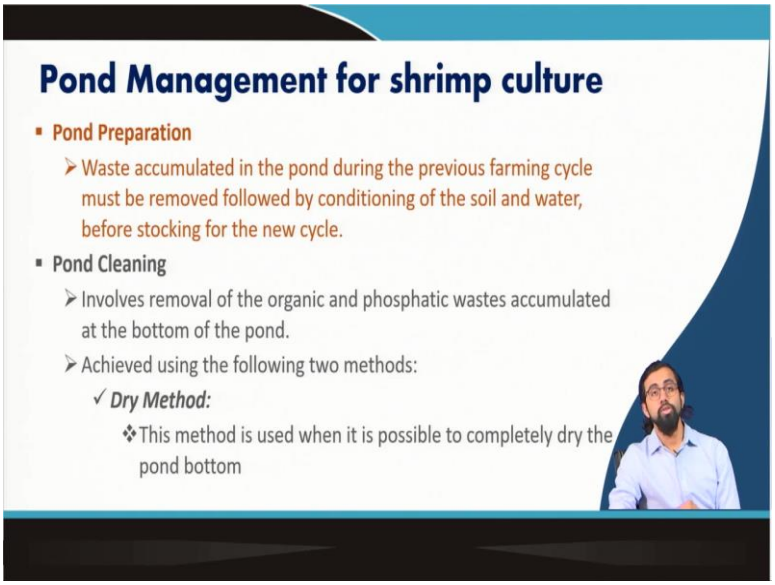

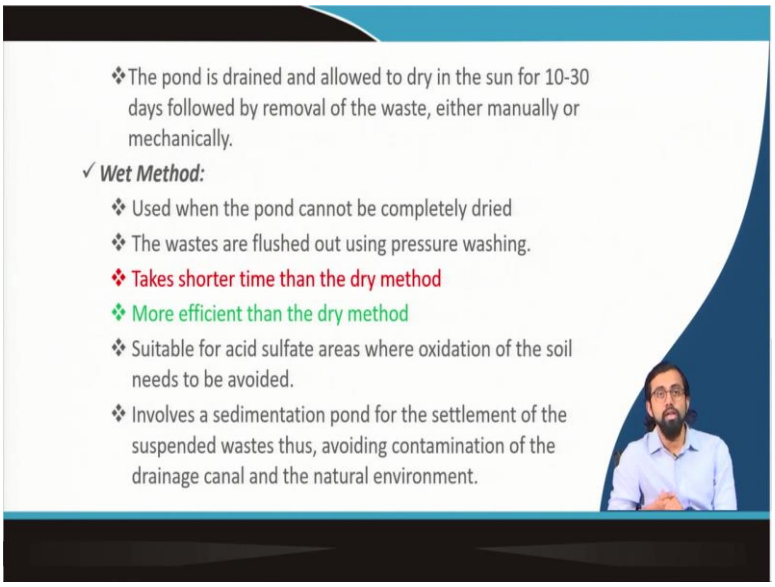

So, other than that, when we go for the pond management, the first is the pond preparation waste accumulated in the pond during the previous farming cycle must be removed followed by the conditioning of soil and water before stocking the new cycle definitely. Pond cleaning it involves with organic and phosphatic waste that you have to remove from the bottom it can be done by dry method you just completely dry the pond and then clean it or you can do it by wet method where the dry method you just have to keep it in like some sunlight for 10 to 30 days dry in the sun and manually or mechanically you can remove the waste harvest and then solid waste and in case of wet method it is more favorable because it takes shorter time because in this case we go for we flushed out the waste using the pressure washing and we it is suitable for the surface areas also and sedimentation pond for the settlement, we can involve the sedimentation pond for the settlement of the suspended solid at the end.

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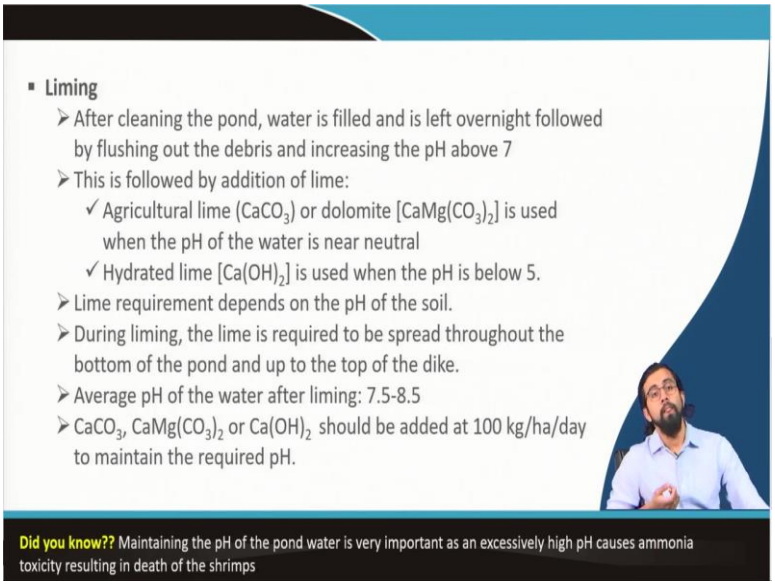

Another important thing in this particular field that I want to discuss about is just liming. After cleaning the pond, the pond is filled with whatever the leftover with the flushing out of the debris and increasing the pH of around 7. And then we followed it with the agriculture lime on the calcium carbonate on the dolomite and used to when the pH is of the water is near neutral and we sometimes use a hydrated lime when the pH is below 5.

So, these limes are actually used to depending upon the pH of the soil and it is it has a lot of important aspects of utilizing the treatment of the like we call it conditioning of pond, we call it conditioning of the pond before starting your form. It is very important to provide it with the different kind of calcium minerals in general we go for this calcium carbonate or calcium hydroxide etc at the rate of around 100 kg per hectare per day to maintain the adequate pH.

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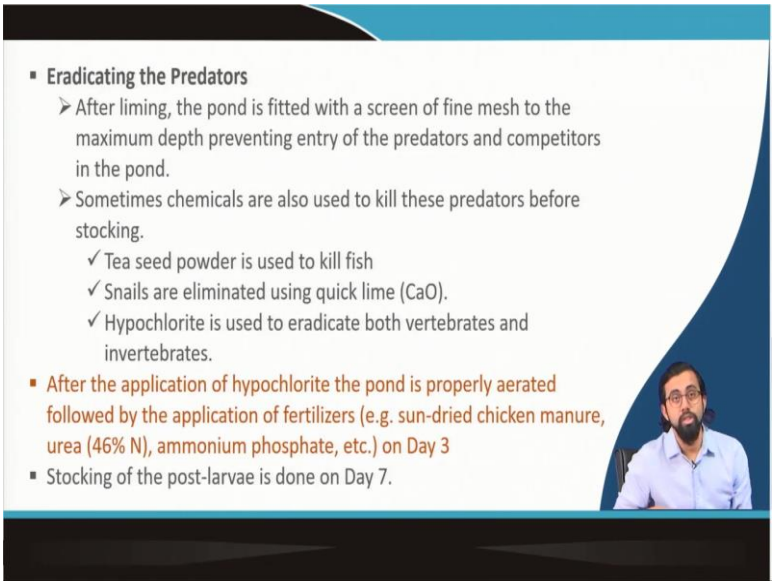

We have to eradicate the predators, we can use the lining method, we can use the Tea Seed powder to use the for killing the fish, snails we can easily eliminate by using the quick limes or the calcium oxide. Hypochlorite doses we can do to eradicate both the vertebrates and invertebrates from your systems and application of hypochlorite in the farm with the properly aerated followed by the fertilization is on day three is the perfect way to do this kind of job and then you start stocking of post larva around day 7.

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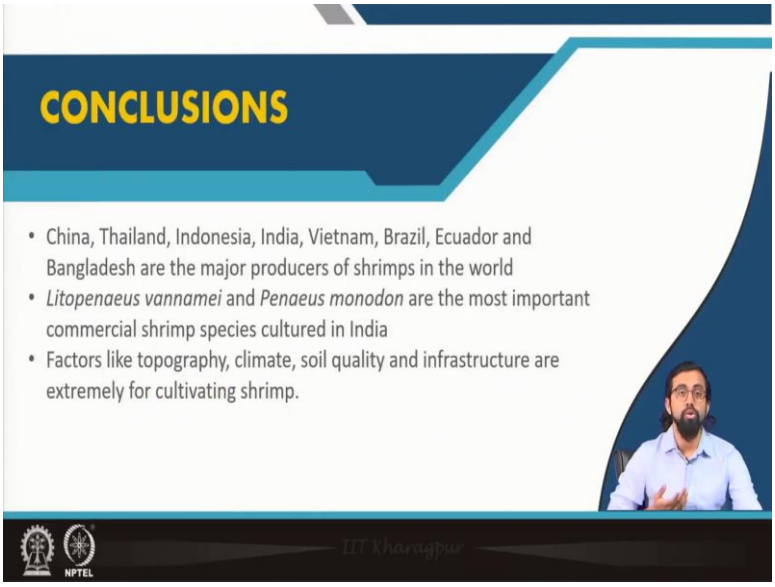

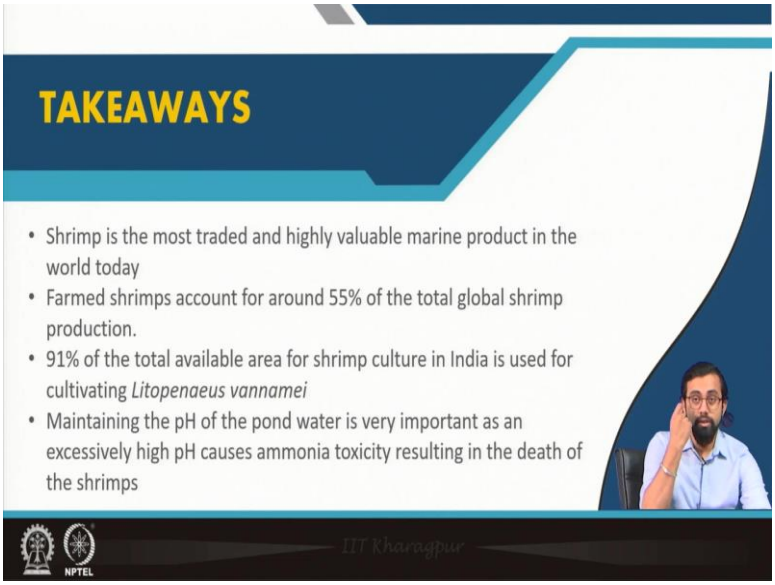

So, that is how you prepare the pond when we go for the culturing of the shrimps in your farm or in your tide fed farm or pump fed farm whatever you are designing, which is utilizing the seawater coming from the coastal region. So, in conclusion, we can say we discussed about different countries which are the major producers of shrimps like China, Thailand, Indonesia, India, and what are the type of species, the most important commercial shrimp species like the litopenaeus vannamei or the penaeus monodon that is famous in India and what are the factors that involves while we will discuss while we selecting a particular site for our farm and what are the climatic and the consideration that we need to design we need to think about before going for pond construction.

We will be discussing more in details in next coming lecture as well. So, the major takeaways, again you can see the pH is also important factor, the soil conditioning is very

important liming and all be discussed. You better think like it is a very important information's that we discussed in this particular lecture and really take this. Remember this information. This is the references that I used, so thank you see you in the next lecture.