Advanced Agriculture Technology
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Lecture - 16
Topic – Introduction to Freshwater Prawn Culture

Welcome everyone. My name is Gourav Dhar Bhowmick, I am from the Agriculture and Food Engineering Department of IIT, Kharagpur. So, welcome to this NPTEL online certification course on Advanced Agriculture Technology.

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Today, we will start the module 4 on technology of Crustacea farming on the lecture 1 of introduction to the freshwater prawn culture.

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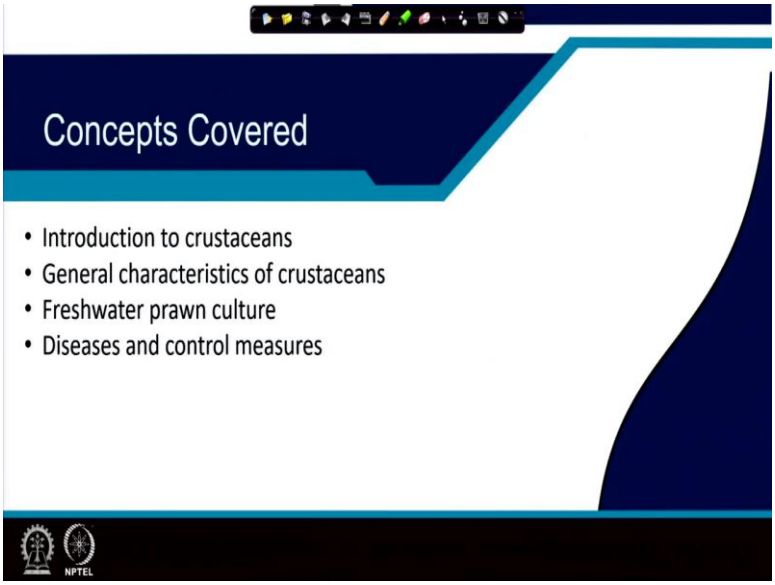

The topics that I will be covered is the introduction to the crustacean, general characteristics of the freshwater prawn culture, diseases and the control measures in case of prawn culture.

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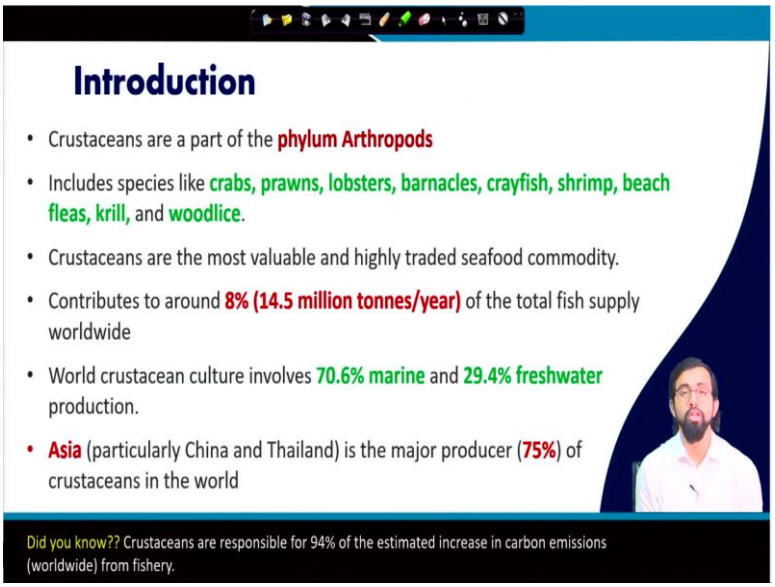

So, in general the crustaceans are a part of phylum Arthropods. So, in general the species like crabs, prawns, lobsters, barnacles, crayfish, shrimp, beach fleas, krill and woodlice are the ones which are considered under this category that is crustacean category. These are the one which we normally people like we farm and we use it for different purposes. They are actually the most valuable and the most highly credit seafood commodity out of all the available market that is like there in the Aquaculture Industry. It contributes to around 8 percent of total fish supply worldwide, almost 14.5 million tonnes per year.

The world crustacean culture it involves almost 17.6 percent as Marine and 29.4 percent is freshwater production. In Asia itself, actually the China and Thailand specifically, they are the major producers almost 75 percent of the crustaceans in the world. Surprisingly, you will be astonished to know that these crustaceans are responsible for 94 percentage of the estimated increase in the carbon emissions from fishery sector. So, you know it has this good part as well as like a constant process there. So, the pros part is like it is a major source of seafood supply for the most of the part of the world.

However, it comes with a huge amount of disadvantage of becoming the major carbon producer, carbon producer, carbon emitter in the world. So, that is why we that I mean, like the farming process itself. So, that is why we need to adhere to or we need to start thinking about actually the technologies are already available by the researchers by the scientists we need to go and ask them to search for the available optimal on design of the farm, so, that is carbon emissions can be minimized.

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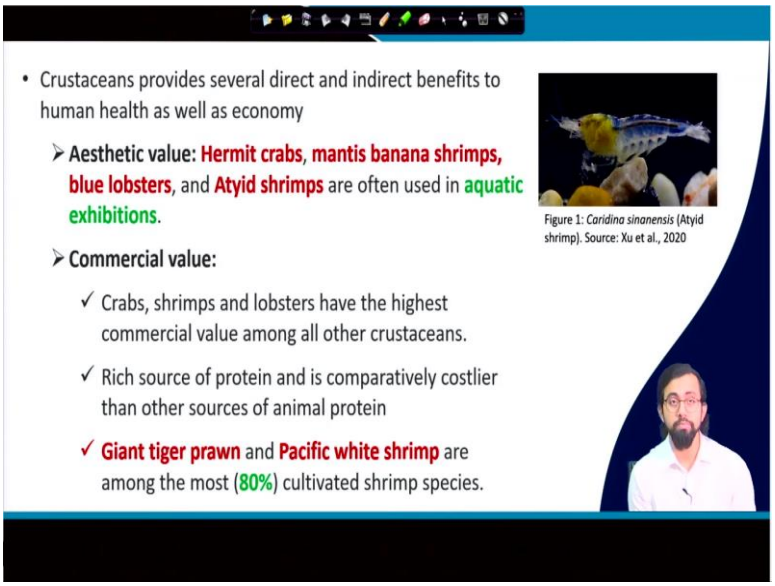

They have actually some direct and indirect benefits on the human health like in terms of aesthetic value, this hermit crab, this mantis banana shrimps, this blue lobsters, this atyid shrimps you see the atyid shrimps one example of how it looks like. So, they are often used for the aquatic exhibition or they lose they are very rare and they looks very nice actually. So, that they look very nice, so, that is why they put it we put it in the aquarium and marine aquarium and like for aquatic aesthetic enhancement.

Commercial wise the crabs, shrimps and lobsters they have the highest commercial value among all other crustaceans. They are the very rich source of protein and comparatively much costlier than other sources of animal protein. However, this is like very much product or products in this particular sector in aquatic sectors. Giant tiger prone and the Pacific white shrimps are among the most cultivated shrimp species it accounts for almost 80 percent of the total cultivated shrimp species, giant tiger prawn and the Pacific white shrimps.

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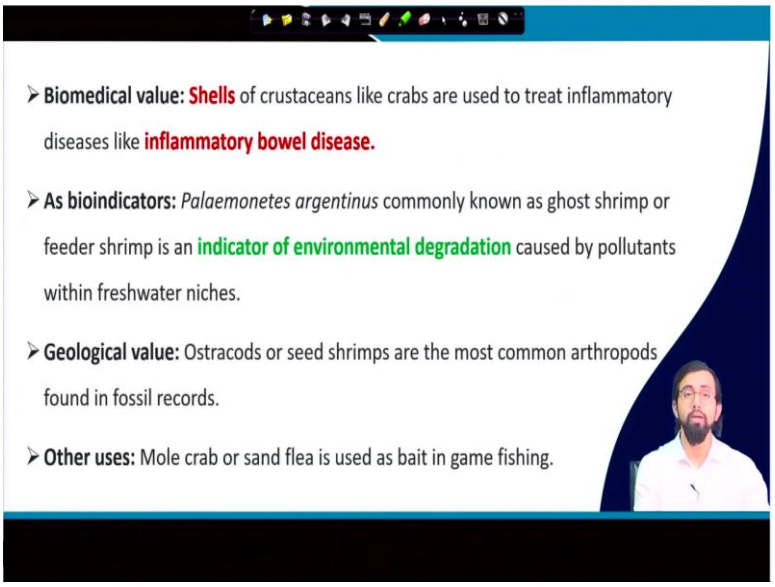

So, in biomedical value, the shells of crustaceans like the crabs they are used for treating the inflammatory disease like inflammatory bowel diseases and all. So, it has a medicinal purposes also medicinal utilization as well. It used as a bioindicators, what do I mean by the bioindicators, it can indicate the environmental degradation. If the water is polluted or not that we can easily identify if we go for culturing the ghost shrimps. So, scientific name is *Palaemonetes argentines*, so we this *Palaemonetes argentines* they also known as ghost shrimp or the feeder shrimps is an indicator of the environmental pollution or the amount of pollutants present in the freshwater niches. So, that is a that is what we call it bioindicators.

Geological point of view Ostracods or the seeds shrimp, so they are the most common arthropods found in the fossil records. So, based on that also we can have an idea about the evolutionary point of view like evolutionary point of view how like in terms of it is a big of a thing for the scientists who are working with the fossils.

So, other uses, the mole crab or the sand flea are used for bait in game fishing, I think what is game fishing or so, this is game fishing is like you will have a competition of games. So, it is

like very famous in different parts and parts of world where people go for recreational fishing.

So, recreational fishing is like one when there is like already cultural species are available you go for fishing there and the amount of fees that you can harvest based on that you will be given a prize or something like this is a game fishing is a kind of recreational activities there all over the world in different places you will find this kind of culture. So, there as a bait, we use this sand flea or this small crab so this is the crustaceans that we normally use as a bait for the other fish species to collect for the game fishing, sports fishing also we call it.

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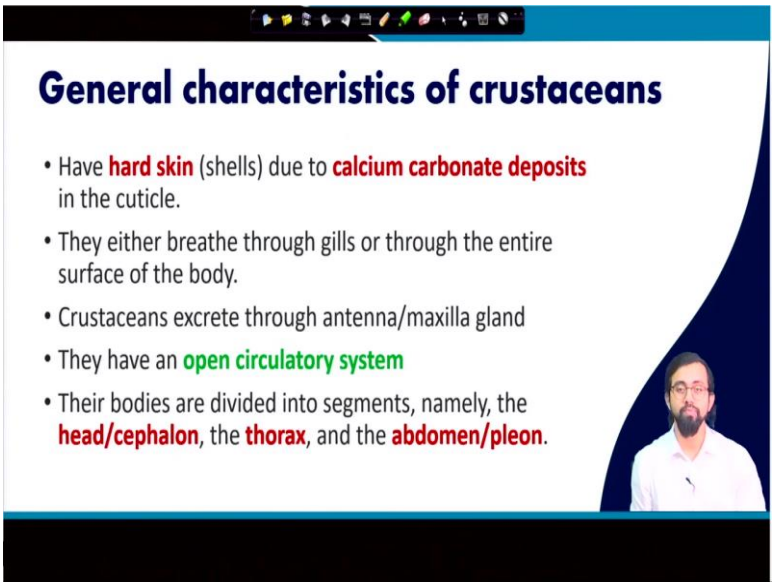

What are the general characteristics of crustaceans they have very high hard skin, although we call it shells because of the calcium carbonate deposits in the cuticle region. So, because of that the calcium carbonate layer it says that hard in structure. It either they breathe through their gills or through the entire surface of the body based on the type of species that we are culturing. Crustaceans they excrete through the antenna or the maxilla gland, they have an open circulatory system and the their bodies are divided into mainly the three segments. First, the head or the cephalon, the thorax and or like the neck part and the abdomen or the pleon part.

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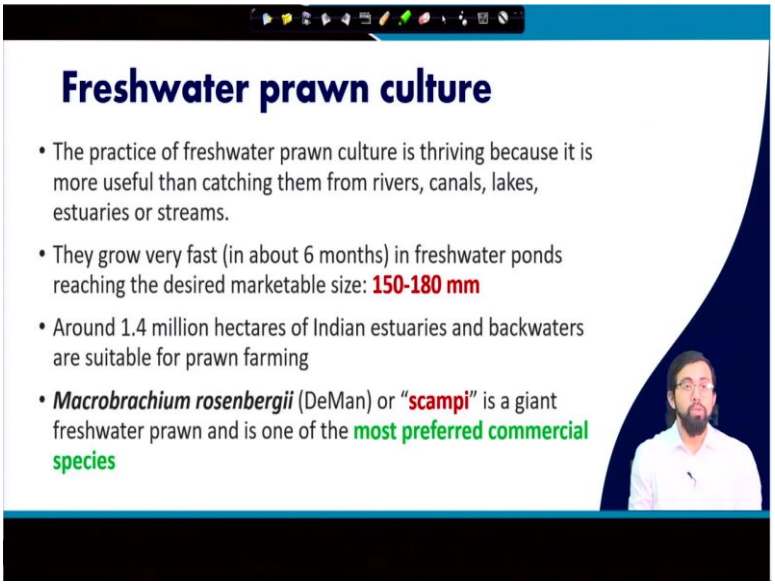

So, freshwater prawn culture, the practice of freshwater prawn culture is thriving because it is more useful than catching them from the rivers, canals like estuaries or the streams because it is sometimes nowadays it is started depleting even in the natural resources and because of that the freshwater prawn culture is becoming very big of industry and all over the world. So, it grows very fast actually on within 6 months it comes to its natural stage or the marketable size of 150 to 180 millimeter and around 1.4 million hectares of Indian estuaries and blackwaters are suitable for prawn farming but it is not being utilized fully.

So, there are ample amount of opportunities with live with this particular sector, the freshwater prawn culture in Indian scenario and definitely there is a possibility of designing proper farm, so, that we can get maximum benefit as well in the economic benefit as well considering the environmental benign. *Macrobrachium rosenbergii* or the scampi is the very most preferred commercial species available in India and not only India, like in India and Southeastern Asia also.

It is a giant freshwater prawn we call it so they are the scampi hatcheries are the one which is very famous and we in India also we have different organizations who are working on it and they have developed different methods and they have developed a very nice design on the hatchery farms, which are optimal in nature which consider all the environmental benefits, which was considered all the economic benefits and that is already available.

So, it just need to be popularized right now, so far to have a more amount of farms in future to have in India. So, to provide the ample amount of shrimp into all the market that is

available in India not only in India, but also it can start exporting to the outside India, so, because there is a huge market lying outside India, especially in Europe region.

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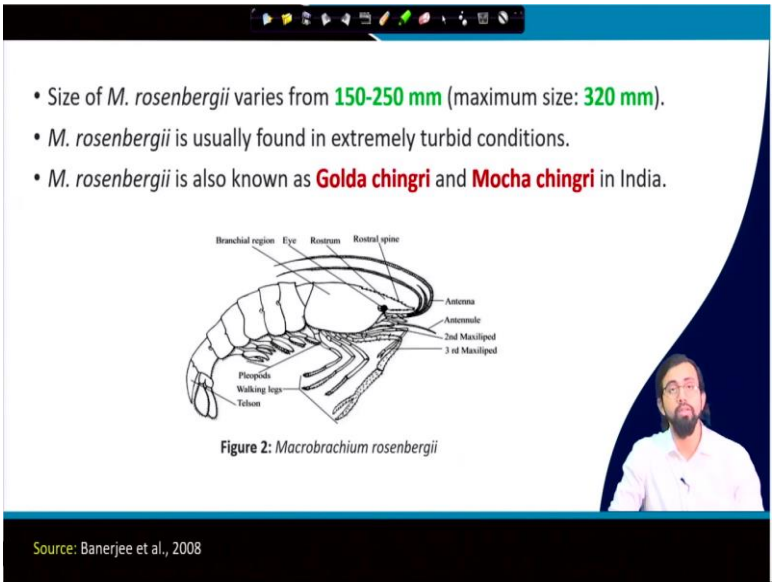

So, the size of this *Macrobrachium rosenbergii* or this can be varies from 150 to 250 millimeter, maximum size can be 320 millimeter, which is really huge. They are usually found in , we can find them in extremely target conditions and they are also known as called Golda chingri or Mocha chingri in India.

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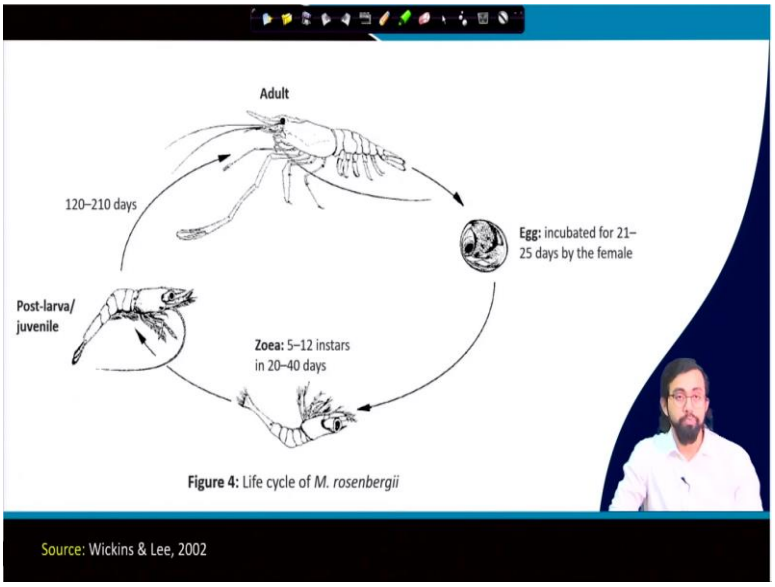

If you see the lifecycle, so in general they are incubated, the eggs are incubated for 21 to 25 days by the female they carry, then these zoea stage where it is like 5 to 12 instars in like 20

to 40 days they have different stages of development. Then there come this post-larva the juvenile stage where from this juvenile to adult it will take 120 to 210 days for them to mature come to the marketable size, which is like all together it is like if you calculate like altogether it does not take more than 180 days which was like around 6 months of time.

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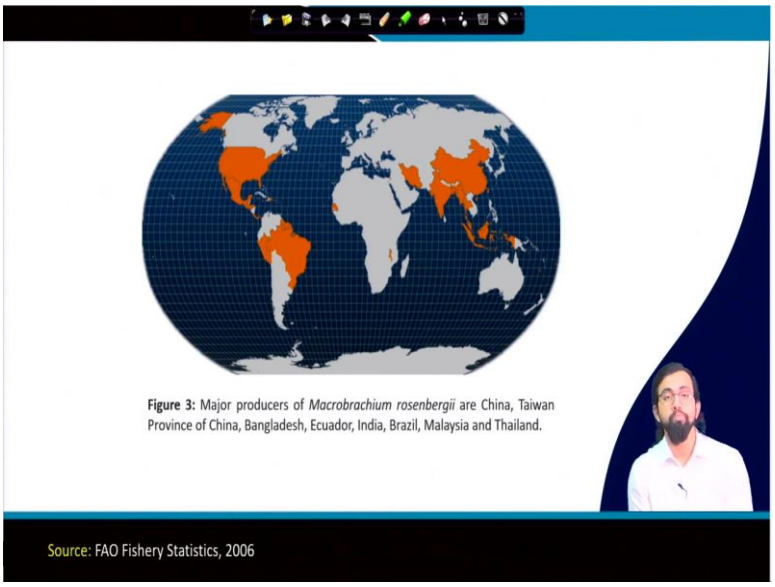

So, the major producers of the *Macrobrachium rosenbergii* are if you can see, it is like China, Taiwan, the one which is like measuring the province of China, Bangladesh, Ecuador, India, Brazil, Malaysia and Thailand are the ones who are leading in this sector.

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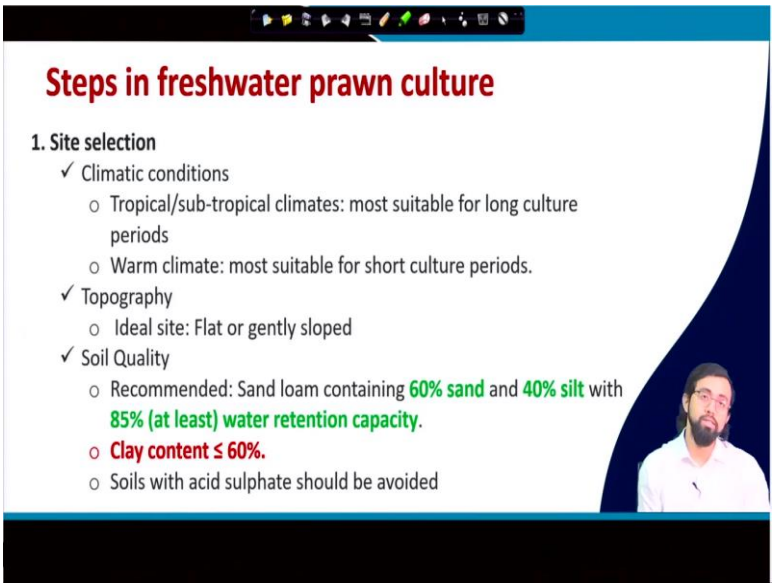

The states in freshwater prawn culture, when we try to design a freshwater prawn culture or the hatcheries we need to think about certain parameters, which are very important. So, first of all, look to start with the site selection, climatic condition is very important or like it is one of the major consideration for the site selection, tropical or subtropical climate is that most most suitable for long cultural period.

Warm climate suitable for short culture period like if you go ahead with the temperate region and further in the polar regions, it has to be very, you have to be very precise that's sort of standard site for the production of the freshwater prawn and on but you can do it there are possibility and there are people doing it right now.

So, they are trying to mimic this environmental condition in a controlled environment in a controlled atmosphere in greenhouse and all. Topography the flat and the gently sloped land is needed, soil quality the recommended is the sandy loam soil containing 60 percent of the sand and 40 of the silt with 85 percent of water retention capacity at least. The clay content cannot be more than 60 percent, the soil with the acid sulfate should be avoided. so, to have a harmful impact on your product.

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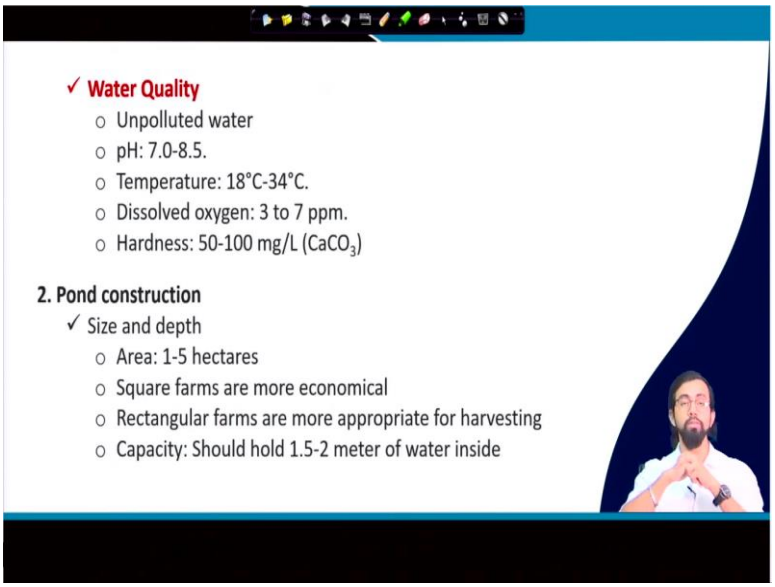

Water quality definitely unpolluted water, what does that mean like it should not have any kind of pollutions with it can be like all the organic species it can be inorganic species, it can be metal contamination, it can be thermal pollution, it can be radioactive pollution, you need to think about all this pollutants in your system, you have to take the water first check it in the water quality lab and check that all the parameters are well within the content well within the

limit or not. If it is not, then you have to treat that water before going for or you have to go for the freshwater exchange, it can be sea water, it can be brackish water exchange. So, to have a proper quality maintained in your farm.

So, the pH has to be well within 7 to 8.5, the temperature 18 to 34 degrees Celsius, dissolved oxygen 3 to 7 ppm, hardness of around 50 to 100 milligram per liter of calcium carbonate, so, that has to be maintained. It is just to have a proper quality of water for the supplier for the production of your crustacea or target, whatever the target like prawn you have.

So, the pond construction, size and depth area should be around 1 to 5 hectare to have a maximum economic benefit actually. Square farms are more economical in terms of easy to knitting and all. Rectangular pumps are more appropriate for harvesting in that sense and capacity should hold at least 1.5 to 2 meters of water inside.

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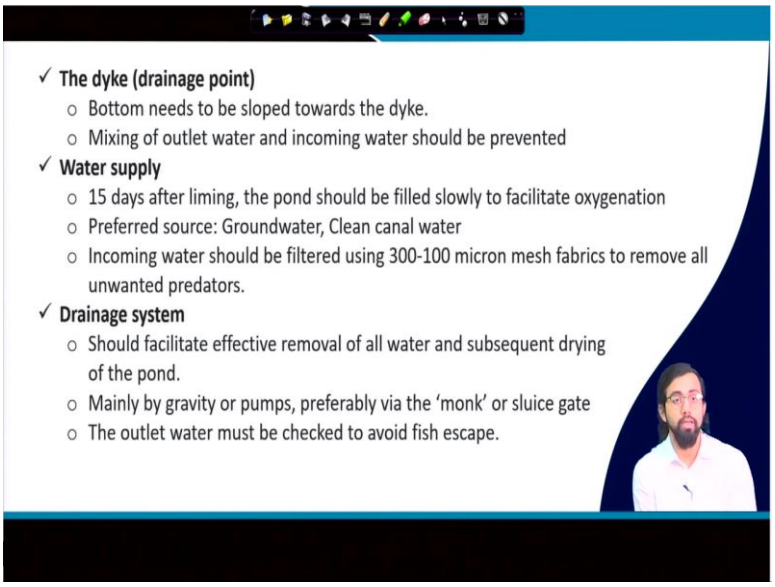

And the dyke, the drainage point on the dyke that you have to maintain the bottom needs to be sloped towards the dyke and mixing of the outlet water and the incoming water should be prevented, what does that mean, the dyke has to be maintained size as the end so the slope when it ends, so, there will be like outline, outward pipe from where the drainage water will go out outlet water. So, this outlet water has not cannot be in touch with incoming water which is coming from the other side. It has to be coming from the other, you have to design it accordingly.

Water supply, 15 days after the liming so why do I only need liming? Liming is a phenomenon, liming is the method that we normally use to get rid of to prepare the land. It is

very important it has a drastic influence in the pond ecosystem. So, I am not going into details what is the purpose and all because I can take a full lecture on this lining material, the usefulness of lining measuring before pond construction and even after the pond also, we provided some time, but what are the reason behind it, you can better search for it in Google and what is the requirement of liming and what is the need of liming in the pond development the pond and all.

The pond should be filled slowly to facilitate the oxygenation. So, slowly you have to fill so, that they will get much time to for diffused oxygen from the air to come in contact with water and it will enhance the oxygenation or the oxygen content, a dissolved oxygen content in the water. Preferred source is obviously the groundwater and the clean canal water, incoming water should be filtered using the 300 to 100-micron mesh fabrics to remove all the unwanted predators and all.

The drainage system you have to design it should facilitate the effective removal of all the water and the subsequent drying on the pond. Mainly, the drainage system should be done, drainage should be done by gravity or by pumps preferably via a monk structure or a sluice gate structure. So, monk is a construction term which we use in the like I will discuss with you in details in the later lecture how to design a sluice gate for tide fed farms and all. The outlet water must be checked to avoid the fish escape. So, you can put a net material which has the mere size lower than the minimum size of the fish that is dwelling in your farm.

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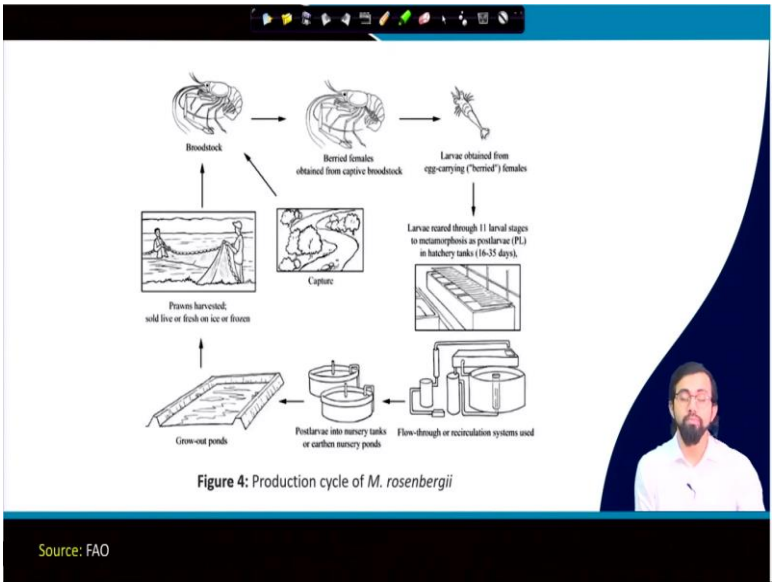

This is a standard structure on the production cycle of *Macrobrachium rosenbergii* if you see. It starts from the berried females which obtained from the captive broodstocks. Broodstock you see from them the larva obtained from the egg-carrying berried, you see the first is the broodstock, from the broodstock we have these berried females from these berried females they have they produce this larva, they have these eggs they produced and egg carrying females they provide the egg, the egg is hatched and the larva is provided. Larva is obtain, this larva is reared in 11 larval stage from to metamorphosis to the post-larval situation for it will take 16 to 35 days in a hatchery tank.

From there it comes to the recycling systems with the flow through other recycling systems and it comes to the post larval pond and this post larval pond to the nursery tank or the earthen nursery for the further growth of the juvenile stage and then from then they convert it they shipped it to the grower from pond where they with time they will become mature and they will they are harvested either in a sold in live fish on ice or frozen condition. So, that is the production cycle of *Macrobrachium rosenbergii* it looks like. The broodstock can be collected from the prawn that is harvested or from the capture fisheries also from the wild habitat.

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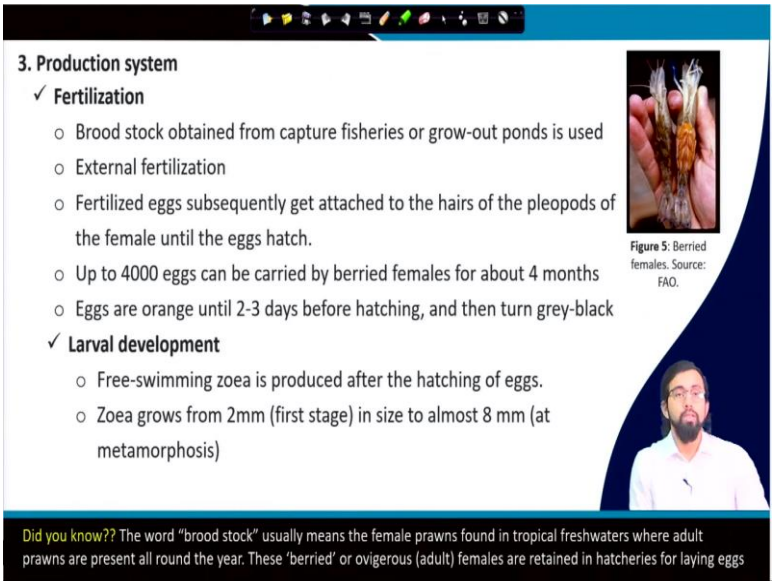

The production systems of fertilization so the broodstock it is actually the female prawn which found in the tropical freshwater where the adult prawns are present in all around the year. So, in general, we use this broodstock obtained from this capture fisheries or grow-out pond for the external fertilization process.

The fertilized egg subsequently get attached to the hairs of the pleopods of this females as you can see from the figure how it looks like until the eggs hatch. So, up to 4000 eggs can be carried by each these berried females for about 4 months. Can you imagine like and then these eggs are orange in general, so until the 2, 3 days before hatching, at the end, they will almost if you see the color change in the right side if it is like a small orangish in color and the left side is grayish-black. So, that means it is about to hatch.

So, larval development after the it is hatched, so it is called the zoea stage, so then the zoea stage in the free swimming zoea is produced after the hatching of egg. The zoea grows from like 2 millimeter in the first stage to almost 8 millimeter at the end of the metamorphosis.

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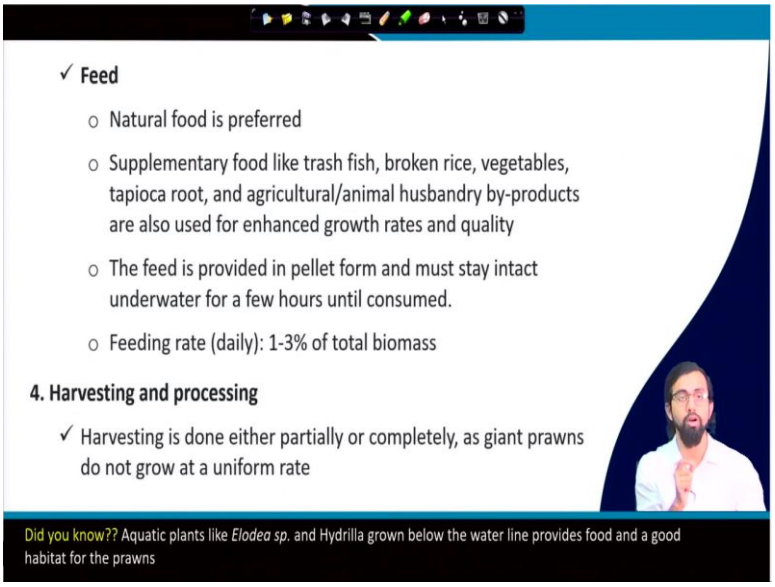

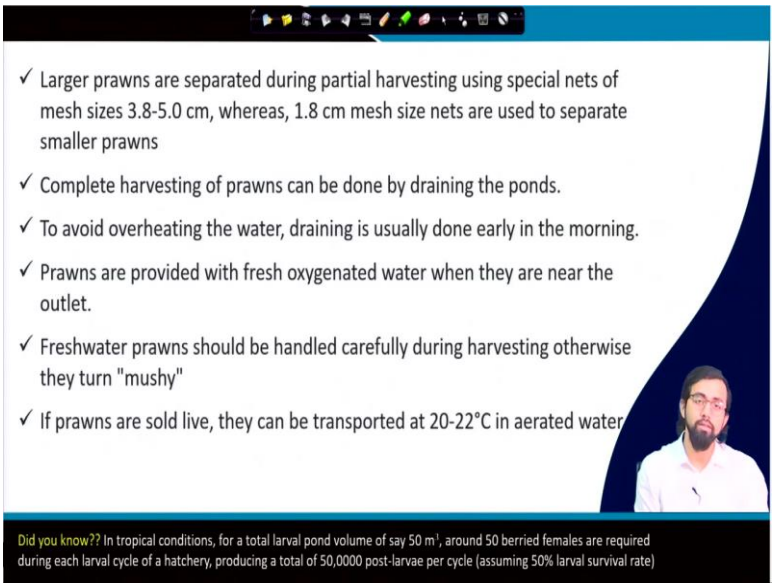

What is their natural food? What is their food? In general, they go for the fresh fish, broken rice, vegetables, tapioca root, agriculture, animal husbandry byproducts, for enhanced growth rates and the quality. The feed is provided in pellet form and must stay intact in underwater for a few hours until consumed. Recently, the trend has changed also, recently people are as we discussed in earlier lecture series, that we go for live feed as well. So, now it is even artemia are use, this artemia or this brian shrimps are used for the content consumption as well.

So, there is actually used there we culture this artemias and they are being used as a feed for the larval feed as well. The harvesting is done either partially or completely as giant prawns do not grow at a uniform rate. So, we harvest it only the one which is already mature enough and we leave it back the other we bycatch our, you can call it bycatch like the one which is not mature we just leave it back to the system so that will grow and once they will grow in the mature stage then only we will take it out of the pond or the tank or the target production farm.

So, the larger prawns are actually separated during the partial harvesting using the special nets of mesh size of around 3.8 to 5 centimeter whereas 1.8 centimeter mesh size nets are used to separate the smaller prawns. So, concrete harvesting options prawns can be done by draining the pond. So, once that it is complete natural stages major stages already attained by all the shrimps. So, you completely drain the pond and you collect all the shrimps. To avoid the overheating of the water draining is usually done early in the morning. So, we drain the water, we go for the freshwater exchange in the early in the morning.

So, at that time the overheating problem is not there especially in the summer season especially we go for this tropical and subtropical region there is a chance of overheating because of the like sunlight maximum amount of sunlight present in this thing. So, the prawns are provided with the fresh oxygenated water where they are near to the outlet and this freshwater prawns should have to be handled carefully during the harvesting otherwise they can turn mushy. So, if prawns are sold live they can be transported at 20 to 22 degrees Celsius aerated water.

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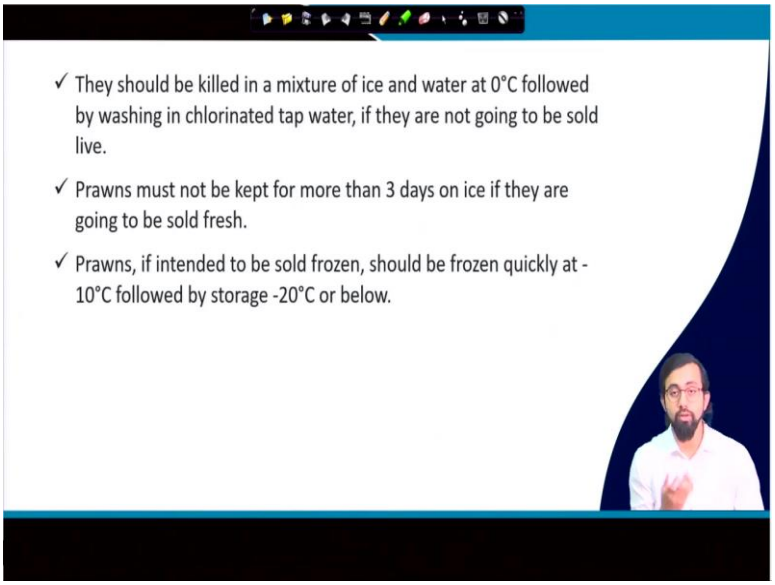

Sometimes if it is like frozen or a condition we can have a proper ice chambers what is it called this cold storage vans and all. They should be killed in a mixture of ice and water at 0 degrees Celsius followed by washing in chlorinated tap water. They are not if they are not going to be sold live, why they should be they should be killed in nature of ice and water is essential it is like it is a kind of a shock, hyperthermia shock.

So, this hypothermia shocks are needed for kind a less cruel way of killing them and it can make them in intact condition almost intact conditions before they have been consumed by human consumption or maybe for any other reasons. Prawns must be kept for more than 3 days on ice if they are going to be sold fresh. And the prawns if needed, if intended to be sold frozen should be frozen quickly at 20 Celsius at minus 10 degrees Celsius followed by storage up to minus 20 degrees or below.

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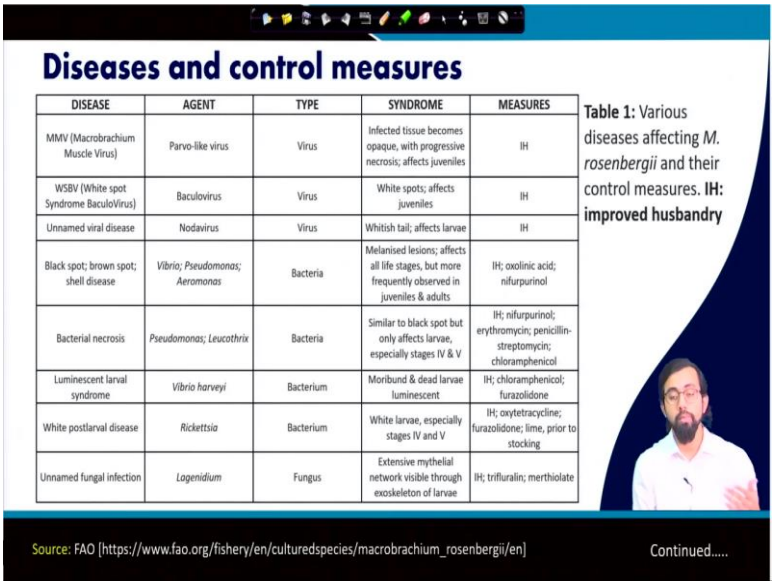

For its maximum to retain its authenticity the maximum that we normally like test and all. So, diseases and what are the diseases that can normally be happen in case of fresh water prawn on Macrobrachium rosenbergii and what are the troubleshooting measure that we can attain that we can obtain.

So, this is the chart it is like it is a it is given by it is taken from the FAO standard procedures that is kind of experienced or like all over the world, people are using it this chart, all over the world this particular, see, I am giving you some one example the MMV, macrobrachium muscle virus, so which is like agent is like Parvo like virus, the type of the living organism is virus and the syndrome is infected tissue becomes opaque and with progressive necrosis and affects the juveniles as well.

So, productive measure is improve the husbandry, improve husbandry means try to improve the farming practices and all, so or in try to get them in a separate them into quarantine pond and do some, separate the quarantine pond and try to improve the quality of the husbandry that is the basic thing that you can do. In case of say like bacterial necrosis, in case of bacterial necrosis like Pseudomonas or leucothrix, so, they are the bacterial in nature they are in like living organism, which are responsible for that is bacteria which is similar to the black spot but only affects the larva, especially stages 4 and 5.

In that case, not only animal husbandry will fulfill the situation but also you have to supply it with some chemical, supply with some pharmaceuticals like the nifurpurinol etc. So, these are the one penicillin streptomycin and also these are the one which will help them to get rid of it

is like a kind of medicine for them to or the measures there are controlled measures that we can take while they will be affected by this particular disease, I am not going to details for each and every diseases, it is actually available in online you can definitely search for a data and have a better idea about what type of agent and what type of syndromes are actually present and which can cause that specific type of disease and what are the measures that can be taken.

So, once you will do the farming practices, you have to have this chart ready with you, we have to have this chart or table ready with you. So, once you will see those syndromes which are written here, if you see those syndromes in your farming species or farming whatever I will say like the target species, what you need to do, you just first thing you just go ahead with the initial measures go for improve husbandry or you go for an definitely parallel you go and talk to the experts and talk to the veterinary expert who knows more in details about these diseases, how the syndromes are actually caused by that particular disease or other. Then they will suggest you the measure that you need to take the amount of the water the chemicals that you need to provide them so to get rid of that particular type of microorganisms. So, that is the way that we need to go ahead.

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DISEASE	AGENT	TYPE	SYNDROME	MEASURES
Unnamed fungal infection (often associated with IMN - see below)	*Fusarium solani*	Fungus	Secondary infection; affects adults	IH
Unnamed yeast infections	*Debaryomyces hansenii; Metschnikowia bicuspidata*	Fungi	Yellowish, greyish or bluish muscle tissues in juveniles	IH
Protozoan infestations	*Zoothamnium; Epistylis; Vorticella; Opercularia; Vaginicola; Acineta; Podophyra; etc.*	Protozoans	External parasites that inhibit swimming, feeding and moulting; affect all life stages	IH; formalin; merthiolate; copper-based algicides
IMN (Idiopathic Muscle Necrosis)	environmental disease	Unknown	Whitish colour in striated tissue of tail and appendages; when advanced, necrotic areas may become reddish; affects all life stages	IH
MCD (Mid-Cycle Disease)	undetermined aetiology	Unknown	Lethargy; spiralling swimming; reduced feeding and growth; bluish-grey body colour; affects larvae, especially stages VI and VII	IH; hatchery disinfection
EED (Exuvia Entrapment Disease), sometimes known as MDS (Moult Death Syndrome)	undetermined aetiology	Unknown but probably multiple causes, including nutritional deficiency	Localised deformities; failure to complete moulting; affects late larval stages; also seen in postlarvae, juveniles & adults	IH; dietary enrichment

Source: FAO [https://www.fao.org/fishery/en/culturedspecies/macrobrachium_rosenbergii/en]

So, there are other diseases as well, a lot of them I am not going into details like it can be the type, you can see that the type of microorganism responsible for it can vary a lot, it can be virus, viral, it can be bacterial, it can be fungal, it can be protozoan and there are some unknown organisms which are also involved with like, idiopathic muscle necrosis, it is a environmental decisions called, why the type of species is still unknown, why still under

process, there are different how to say suggestions or different expressions by the researchers and they simply they say like simply we should go for the hatchery disinfection and dietary enrichment or the improvement in the hatchery improvement in the husbandry. So, that is one of the major correcting mechanism that you can go before for this kind of disease elimination.

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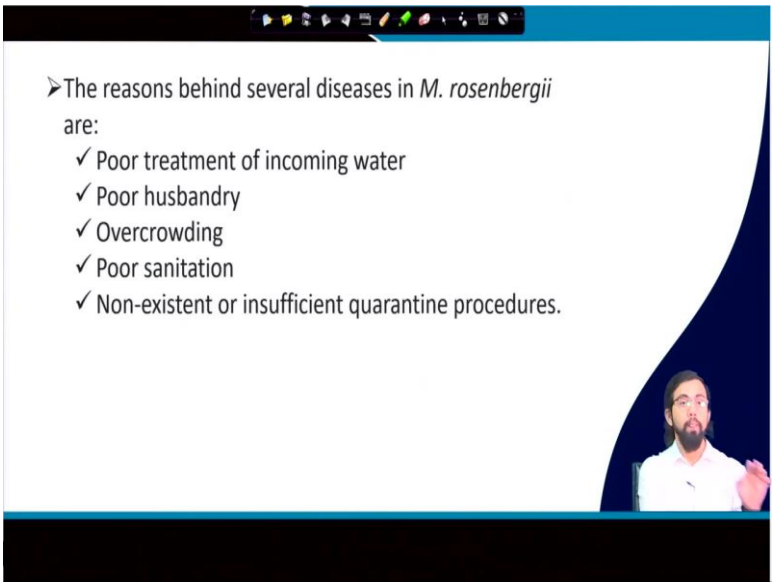

So, the reason behind the several diseases are maj0rly the poor treatment of the incoming water. The fresh water that is coming it has to be properly treated, that is why RA systems are started becoming a very famous, RA system re-circulating aquaculture system. The water because it needs a very frequent freshwater exchange like I mean like it can be the water exchange is very frequent.

So, what you need to do whatever water that is coming out of this plant of this farm or this tank, what you need to do, we can do you can have a proper recirculating aquaculture systems, which will treat that wastewater and the water after being treated that water can be again circulated back to the pond itself.

So, the treatment can be the treatment problem can be minimized treatment problem can be properly controlled by having this kind of recirculating aquaculture systems. Poor husbandry definitely it is a bit of an issue like overcrowding or the higher stocking density, poor sanitation, if you do not have the proper cleanliness is maintained here and there is like dark particles here and there, it is it can cause a huge amount of nuisance in your pump.

Non-existent or insufficient quarantine procedures, I told you, the moment you get to know about the disease or disease causing particular sites, like particular species, you have to shift

them now and they are like this, that moment only because they can spread very fast, very fast in this kind of species, this microorganisms which can which are causing this disease, disease causing microorganisms they can spread very fast. So, the moment you identify the identify, no matter what you just simply catch them and shift it to the quarantine pond. And then you do the next kind of next stage of troubleshooting, that is the first thing that you need to do.

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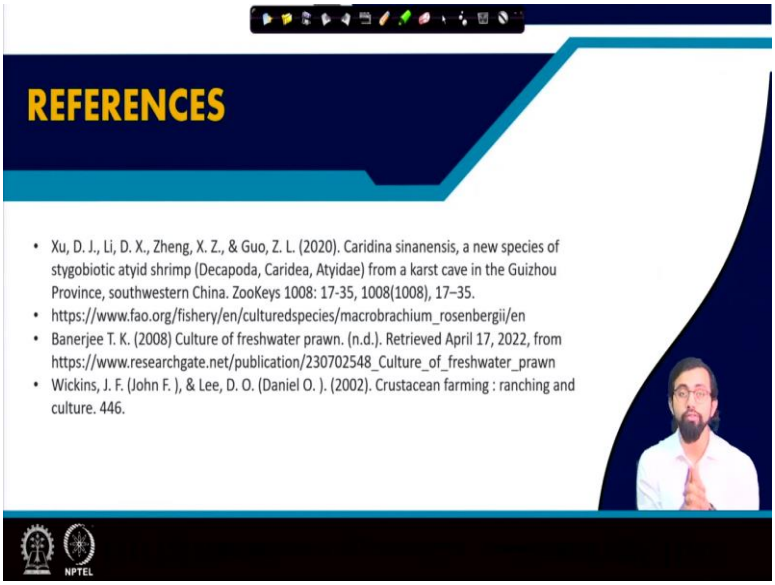

So, what are the conclusions from whatever we have discussed in this particular lecture that the crustaceans are most valuable and highly traded seafood commodity. Most crustaceans culture involve 76 percent of the dislike this, world crustacean culture it involves almost 70.6 percent of the marine and 29.4 percent of the freshwater production. It shares the major

producer of the crustaceans and the *Macrobrachium rosenbergii* or scampi is a giant freshwater prawn and is one of the most preferred commercial species in India and specifically, in Asian region.

Major producer of this scampi are China, Taiwan, province of China, Bangladesh, Ecuador, India, Brazil, Malaysia, Thailand, etc and like these countries and then mostly the Asian countries. What are the takeaways, crustaceans are the most valuable and the highly traded seafood commodity the golda chingri, the mocha chingri which are actually more famous in India like with these names rather than the scampi, is the most preferred commercial species in India.

Tropical, subtropical and the warm climates are the most suitable climate for the prawn culture, if you want to do it in the temperate region, if you want to do it in the polar region, if you are going to like more in the polar side, so like whether it be north whether it be south, you have to take care of the environment, you have to focus more on the optimal condition that you can supply for your to your greenhouse.

So, that you mean like you have to maintain that situation you understand, you have to provide a heating arrangement so that temperature will be optimum for them to grow in the system. It is a lot of activity, but it is doable and it is being done, it is being done in different Scandinavian countries.

Then the external fertilization occur, sometimes it requires in freshwater prawns, giant prawns are harvested either partially or completely as they not do not grow at a uniform rate. And it has to be handled very carefully during harvesting as they tend to turn mushy. This *Macrobrachium rosenbergii* is affected by several diseases, which is the reason behind because of the poor treatment of incoming water, overcrowding, poor husbandry and sanitation and insufficient quarantine procedures available in the farm. I hope this discussion that in this lecture will definitely enlighten you with the standard practices for freshwater prawn.

So, though I cannot go in details with the detailed engineering discussion and all how to design and what will be the detailed concern, the technical concepts and all. For that you can go ahead with the references that is available here or if you have any issues, you can mail it to me, I will be very happy to give you detailed lecture material or I can share you my lecture material from other from a regular class in IIT, Kharagpur. So, that will give you some better

idea about how to design these farms in general. So, that is it for this lecture. See you in the next section. Thank you so much.