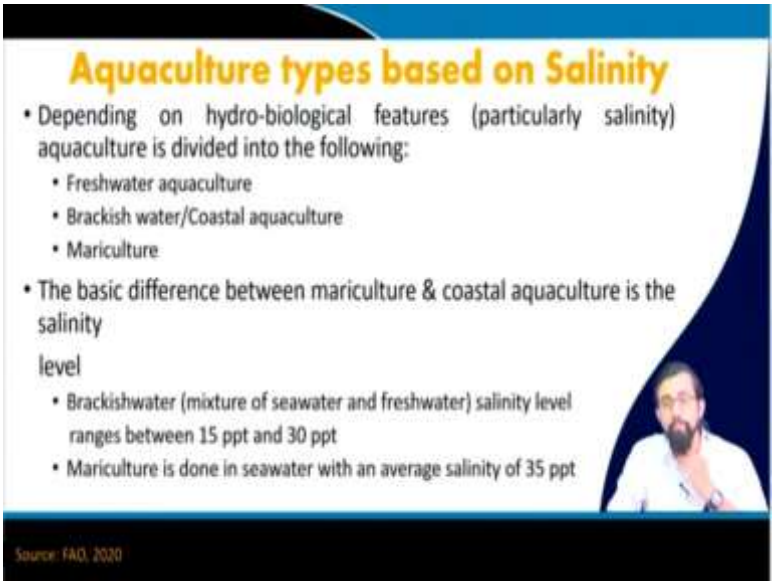
Advanced Aquaculture Technology
Professor Gourav Dhar Bhowmick
Department of Agricultural and Food Engineering
Indian Institute of Technology, Kharagpur
Lecture - 12
Coastal Aquaculture

Welcome everyone, my name is Professor Gourav Dhar Bhowmick; from the agriculture and food engineering, department of IIT Kharagpur. So, in today's lecture we will be discussing about the coastal aquaculture of this subject advanced aquaculture technology.

(Refer Slide Time: 00:42)

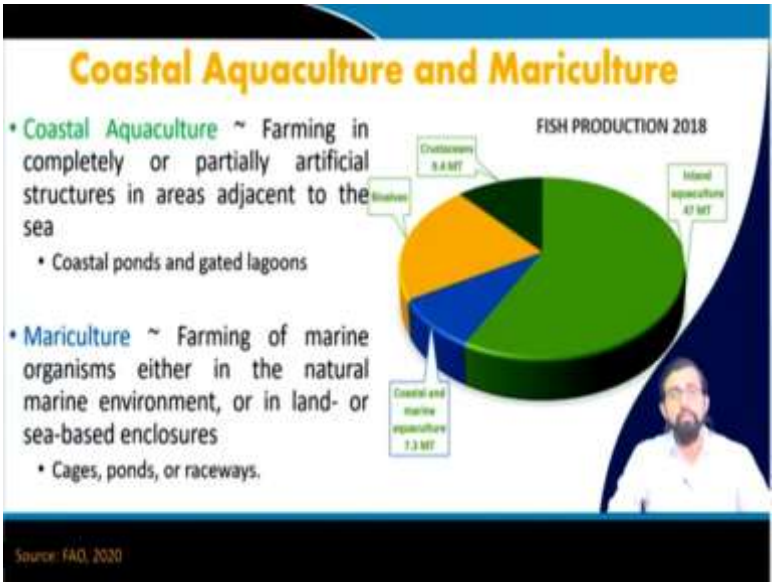
The concepts that I will be covering are the coastal aquaculture and the mariculture and its definition. Coastal aquaculture in India the site selection criteria that involves with the coastal culture; advancement on in coastal aquaculture and what are the benefits of coastal aquaculture in general.

(Refer Slide Time: 00:59)



So, aquaculture types based on the salinity as we discussed in the last lecture material also that there are three types of it; freshwater, brackish water and the mariculture. The basic difference between the mariculture and the coastal aquaculture is the salinity. So, brackish water, in case of brackish water the salinity level ranges in general between 15 to 30; but it can be as low as 10, 5 to 10 ppt as well. There are instances where the brackish water has the ppt level of less than 10 PPT as well. Mariculture is done mainly on the seawater where, where average salinity is around 35 ppt.

(Refer Slide Time: 01:42)



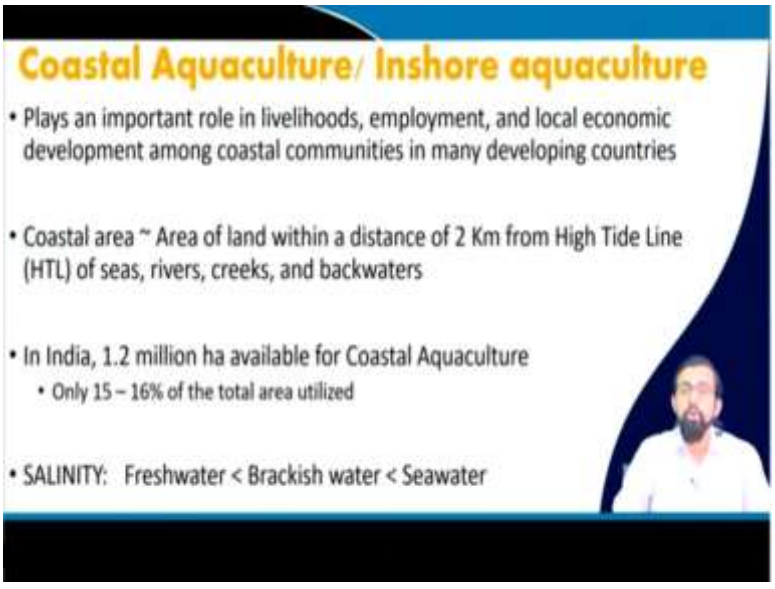
So, in general, the coastal aquaculture it is the farming practices, which is done completely or partially on artificial structures in areas adjacent to the sea like coastal ponds or the gated

lagoons et-cetera. Whereas, the mariculture it can be the offshore ones. It can be the farming of marine aqua organisms, either in the natural marine organism environment or inland or sea based enclosures like pen culture and all. However, we are utilizing the actual sea water in this kind of culture practices like cages, ponds and raceways.

Like we call it tide fed farms, this kind of things; we call it normally tide fed farms and all. So, we are normally we either we rely on the tide the moment high tide will happen; the water will come through the, come to the water will directly diverted to the k to the ponds. And this tide fed farms and the tide fed farms we have different specific type of design we have to do. And based on that and based on this sluice gate design and all, there are a lot of things involved with it. So, maybe in this particular lecture series, it is not possible to cover all those things. In maybe in later I will come up with other subjects, where we will be discussing on those particular things.

In case of fish production, if you see 2018 data all over the world, it is bivalves and crustaceans, coastal and marine aquaculture, and inland aquaculture data is given. See inland aquaculture is almost it like almost 47 million ton; whereas, the coastal and marine aquaculture 7.3 and crustaceans in only 9.4, it is a 9.4 million ton.

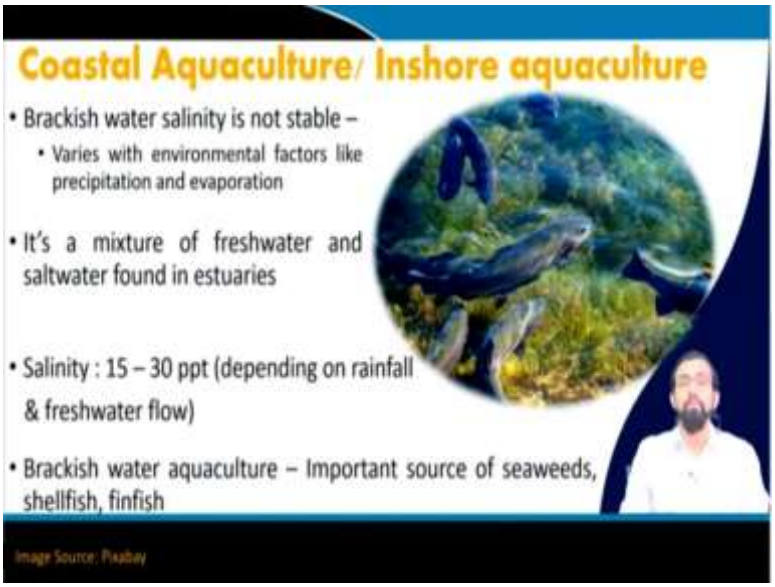
(Refer Slide Time: 03:17)



The coastal aquaculture or the inshore aquaculture, it plays an important role in the livelihood employment in the local economic developed development of the coastal communities of most of the developing countries. In general, the coastal areas are the area which is within the 2 kilometer distance of the high tide line. So what does that mean?

In case of high tide, the level up to which the water comes in contact with the landmass is called the high tide line. So, from there up to the 2 kilometer stretch is called the coastal area. So, in India, total 1.2 million hectare of available coastal area is a coastal area is available; so only 15 to 16 percent of which are actually being utilized. Based on the salinity, we already know the freshwater, brackish water and the sea water. Sea water has a maximum salinity level than the brackish water than the fresh water.

(Refer Slide Time: 04:07)



In case of brackish water, salinity is not stable, because it varies with different environmental factors like precipitation and evaporation; because, because that is because it is in the coastal region. So because of the because of that, when the rainfall happens in the nearby land masses; and all, so the huge amount of freshwater recharges happen in the it is normally taking place in those coastal regions; and because of that the salinity level goes down. And sometimes because of the evaporation and suppose it is a drought season, and because a huge amount of evaporation; the evaporation losses will happen and because of that salinity level goes up.

So, depending on the precipitation and evaporation level in the nearby environment, nearby the near vicinity; so this brackish water salinity may drop and may increase as well. So, it is actually a mixture of freshwater and seawater which is found in the mainly in the estuary region, where or the river mouth region.

The salinity as I already mentioned, it varies 15 to 30 ppt, and brackish water aquaculture is an important source of seaweed, shellfish and the finfish. Why brackish water aquaculture is so important? You know, the one of the major reason behind it, the moment mainly the brackish

water places in the coastal regions what happened? The river or most of the the the it takes the, like literally swept away the whole landmass is from where it is coming.

And it takes all the important nutrients from its nearby places like all the debris and all; and also the wastewater coming from the waste nearby municipalities or nearby rural areas and all. So, all together it comes down and drop off everything; dump everything in the sea in its river mouth in the estuary region.

And because of that, it is a very high, very enriched zone for the aquatic species; and for them, it is the best place to survive to have an ample amount of food, food availability and all. Because of that, these places are normally a very enriched zone, like the sea, sea animal any kind of aquatic species enriched zone.

(Refer Slide Time: 06:20)

Traditional coastal aquaculture in India: In general, in the traditional system the seawater is allowed to enter through the sluice gate. And marine market size of the produce is harvested later using the nets practicing placed in near the sluice gate. No feeding and fertilizers are required in these kind of places; because the normal natural wastewater with natural water, which is coming natural seawater, which is coming into the coastal aquaculture systems are being utilized for the feeding and fertilizer purpose. Production level can be as high as 500 to 750 kg per hectare per year, and 20 to 25 percent of the total production in India. Specifically, the shrimp farming in Kerala is very famous and which is a very nice example of this kind of coastal aquaculture in Indian subcontinent.

So, in perennial perennial farms are there, where shrimp culture are practiced year-round using the traps and the culture methods. However, there are seasonal farms also. You will be it will, it is very nice; it is a very important information for you as well. There is a variety of rice which is called Pokkali. This Pokkali variety of rice is grown in the monsoon season. After the monsoon season is over, after harvesting the rice, they they completely trap the they trap the seawater using the dye, using the proper canal systems and all.

They trap the seawater and then they use that same field for growing the shrimp. So, this is a kind of (poly) this is a kind of a seasonal farming; we call it seasonal shrimp farming, which is very commonly you can witness in the Kerala and Southern in South India, southern part of the India.

(Refer Slide Time: 07:54)

The brackish water resources in India are majorly the estuaries, the coastlines, the backwater, the mangrove area and the lagoon area. The most important species culture in the brackish water, brackish water are the Giant Tiger Prawn, which is also known as scientifically known as Penaeus monodon.

So, this is one of the major species which is cultured in the brackish water zone in Indian context. The culture of exotic species like Penaeus Vannamei is also gained momentum for last a couple of decades. And it is it gives us a huge benefit to all the farmers and to the pond farmers and other shrimp farmers and all.

And they are actually getting a lot of economic benefit out of it. And Government of India is also trying to push the farmers and the all all the enthusiasts, the aquaculture enthusiastic to go

ahead with culture in this kind of these species; so that to have maximum economic advantage. And also it will give some added benefits like providing the employment to the unemployed people around the coastal line and all.

Other species with the high potential like the Penaeus indicus, Penaeus merguiensis, Penaeus semisulcatus. So, like this kind of species are there which are very important. Other than that common species in brackish water ponds like seabass, the mullets, the milkfish, pearl spot, catfish, et-cetera et-cetera.

(Refer Slide Time: 09:23)

So, what are the strategies for enhancing the fish production in the coast coastal area that is happening in India and also in global point of view? It increases the water area under the aquaculture product practices definitely; because in general, the aquaculture practices like in general, either it is. Earlier it used to be done either in the street in the in the in the ocean body by means of offshore culture systems and all, either in the inland bodies. So, but recently it is this coastal area developments are happening and this coastal area aquaculture is getting highly bloomed with all over the world, especially in Indian context.

It can increase the total available water area for aquaculture practices because of that; it increase the productivity of the existing water bodies is definitely as I discussed already, diversification of the candidate species. Because, as I mentioned that this is a very rich source of nutrient, now this coastal regions and all; and there is a chance of having a huge diverse diverse varieties of aquatic species present in the in this land. And that can be cultured very easily in the natural environment without ruining the, ruining the natural habitat; or without ruining the environment of the nearby places.

Research Support for sustainable and eco-friendly output of this kind of coastal aquaculture is needed. And for that government of India is really working on it and they find the policymakers of our country are working on it. They come up with this Pradhan Mantri Malsya Sampada Yojana and all. So, from there, they try to emphasize on the culturing of these kinds of coastal aquaculture systems and to improve the overall impact on the employability status of India. So, techno-economically viable hatchery and the culture system design which is very important. And that is how it comes it is it lies on us like how good of an engineer we are, how good of a technologists we are, how we can develop proper and viable farm practices in India.

And which can be practiced with in terms of economic and environmental sustainableness and sustainability and all. So, that we have to worry that we have to really think about. Fish health management and the disease; disease diagnostic is another important issue that we need to worry. Where you have to have a proper nutritionist to go and suggest, consult with the nutritionist for providing proper feed, proper nutrition that is available for your fish. You can you can consult with the doctor or the veterinary doctors and all, who can who are a specialist in fish health management and all other fish health enthusiastic.

You can talk to them and you can get an idea about the perfect optimum management practices that is needed for culturing this kind of species in a coastal areas. And the disease diagnostic is very important thing; nowadays even you will be really happy to know that even nowadays in India, even people are working on it, scientist in our department also working on it. So, we are actually working on different kind of computer vision technologies and all by which we can identify the diseases of different kinds of fishes by by using the simple computer vision and all.

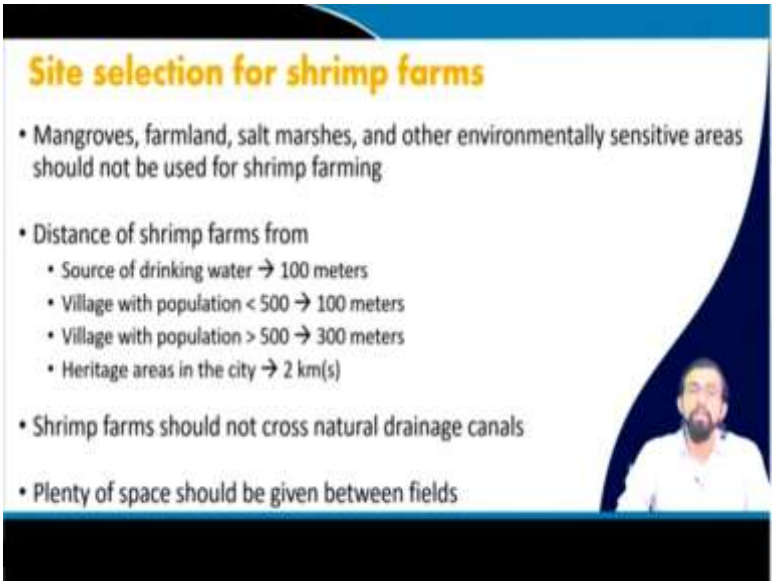
So, we do not have to, by their behavioral analysis by a different body mass index and all, we are trying to identify the disease and all, even before they can be in a in a position to spread very rapidly. So, that what happens in general? This rapid spread of diseases is like one of the major nuisance in aquaculture farm; so, we are working on it. There are scientists working on all over the world who are trying to reduce this impact at its maximum way; and using the all the advanced technology possible. And it is not actually something very costly process actually; it is actually in our mind. It is there that it is a very costly affair and all.

But actually, if you really think about, you really do the economic analysis, if you can reduce the possibility of disease in your farm and all by utilizing these simple practices, which is there already in the technologies are already available. It can drastically reduce the impact of risk

management, it can drastically reduce the impact of any kind of can calamities and all. So, that is what we want to target and that is what in this particular course; I want you guys to understand. And you know to realize the power of advancement in the technology in this aquaculture sector; and how we can utilize it in aquaculture sectors for the development of aquaculture community in India in Indian context specifically.

Other than that the fish genetics and the selective breeding is it is very good; and we need to practice these kinds of things to have the maximum benefit with the maximum body mass index, and maximum eco economical, sustainable environmental approach has been. The utilization of the inland saline soils for aquaculture, this inland saline soils are actually been utilized. We can be we can utilize those inland saline soils also for aquaculture practices by using this specific farm practices.

(Refer Slide Time: 14:31)



The site selection for shrimp farm in general, if you want to go ahead with the farming of shrimps and all the mangroves, farmland, the salt marshes, the other environmentally sensitive areas should not be used for the shrimp farm. Because, see you are not going to disrupt something which is already naturally enriched with the with its biodiversity and all. You do not you. It is not a sustainable approach to go ahead and disturb the already existing biodiversity. And go ahead with the land, go ahead with the places which are already been utilized for agricultural purpose, or maybe seasonally utilized for the agriculture or any other purposes.

And you can utilize those land, you can utilize those land, if you want to go ahead with the perennial farming and all. You go ahead with the lands which are already demolished and somehow utilized by the human anthropogenic activity. Use those land, there are a lot of lands available; do not go ahead with the distance. Do not disturb the actual existing natural habitats and the natural enriched biodiversity, and the biodiversity areas and all. So, distance from the shrimp farms from the source of drinking water should be at least 100 meter because of the chances of wastewater inclusion in the drinking water sources.

Village with a population less than 500; it should be 100 meter. If it is the village with a population of more than 500, it has to be around 300 meter away from the drinking water source. Heritage areas in the city, it has to be at least 2 kilometers away from the those kinds of heritage area should be like shrimp farm should not be near to those heritage areas, because of different environmental impacts. Shrimp farms should not cross the natural drainage canals

definitely not because it will. So, if somehow it got leaked because of the seepage; and it will get into the contact with natural drainage line and all.

It will in the either way it is very harmful; because first of all, it will it can cause the increment in the production of increment in the treatment of the water quality water, waste water that you are targeting to clean. And also it can there is a possibility of inclusion of drainage water also in the farming land; and which will definitely destroy the water quality and which will cause harm to your farmland and farming culture species and all. Plenty of space should be given between the fields that is obviously that is needed for like any kind of farming practices.

(Refer Slide Time: 17:06)

Improper site selection, improper planning and layout design can lead to the environmental issues. What is the major environmental issues? First of all, the salting of agricultural land. As I mentioned shrimp for shrimp culture, we normally go for this like this kind of shrimp farms. We go ahead with the seawater and all the brackish water; so they have a high salinity level, if you use those things and if you somehow get a discharge; if you discharge those water that is already utilized to the normal aquaculture for the irrigation purpose.

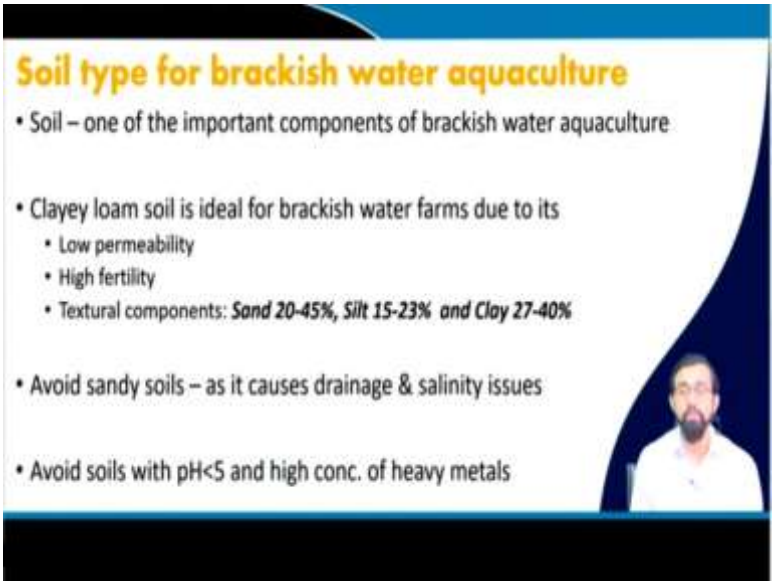
And what will happen? It will lead to the salting of the agricultural land in in a very small portion, small quantity it is helpful; but in a higher quantity, it it will completely demolish the productivity of the soil. Drinking water contamination, as I mentioned, it can go and leach up to the groundwater, it can contaminate the drinking water. Because, of the higher salt concentration it can it is not, it is not acceptable. Because, in the sea water there are different kind of unwanted salt particles are there, which are really harmful even in our human consumptions, even if it is like a small quantity.

Destruction on the ecologically sensitive regions like mangroves and all; definitely, we do not want to go for it. Like as I already mentioned, it is it is just it is a quite a criminal if you go. It is a crime if you go for this kind of disruption on the natural naturally enriched ecosystem for the production of your, for the development of your farm and. The level of intensification and the lack of awareness of management practices can lead to the spread of disease; it can lead to this severe economic loss as I already discussed. Definitely, if you have if you do not have a proper management, if you do not know the exact science behind it; and you just go ahead with let us go let us go have some design.

Let us go produce some shrimps and all without knowing something. You just buy those seeds and you start growing in your pond and so it will definitely do nothing. Everything has to have some management; proper management has to be there. And if you do not have proper management, if you do not have proper expertise available with it just consult with us. Consult with the person who are involved with this kind of research, who has a better idea about what to do and what to not. Consult with them and get in touch with them; and try to involve enhance your knowledge on this particular field for first couple of days, weeks, month; and then, then you start doing it by your by yourself.

Or just go study subjects like this and, or maybe more go ahead with and involve with the aquaculture technology subjects, and like try to learn them through NPTEL or through any other media, through YouTube also you can search, find a lot of practice videos and all. You can directly come and contact with the persons like us to get more idea about your business, about your farm ideas. So, these are the things that you need to know to to be to, to reduce this kind of to eliminate these kind of practices, this kind of malpractices possible. And enhance the management quality and it will definitely increase your production output as well.

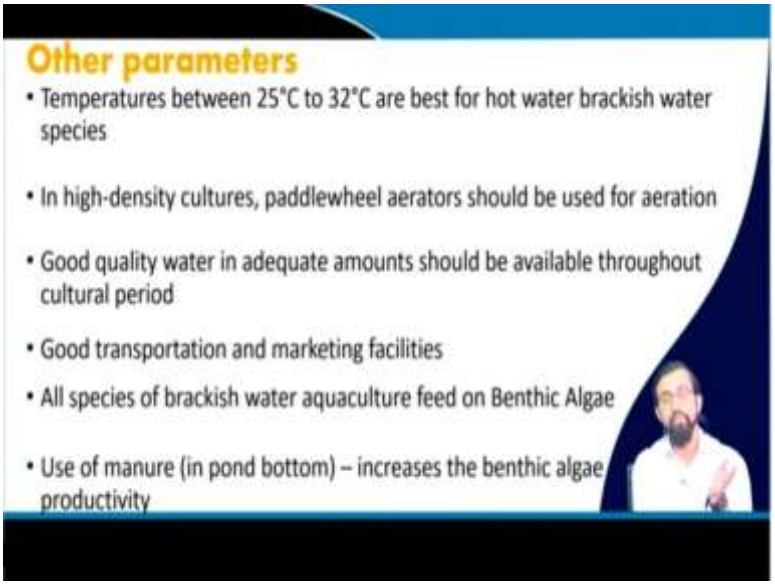
(Refer Slide Time: 20:09)



What are the soil types for the brackish water aquaculture? One of the major (impor) component for this brackish water aquaculture; in general, clayey, loam soil. Loam soil is ideal for the brackish water ponds due to its low permeability, high fertility and the textural component of around 30 percent is of sand, around 15 to 20 percent is of silt, 15 to 23 percent and the clay of around 27 to 40 percent of clay. Try to avoid the sandy soil; definitely it will cause a drainage of the leakage of seepage of your level upon water and the salinity issue. Avoid the soil with a very low pH and the high concentration of heavy metal.

Definitely, it will lead to the cause of different unwanted behavior, unwanted parameters or unwanted repercussions in your farming species, say shrimps or whatever you are targeting in your brackish water aquaculture system.

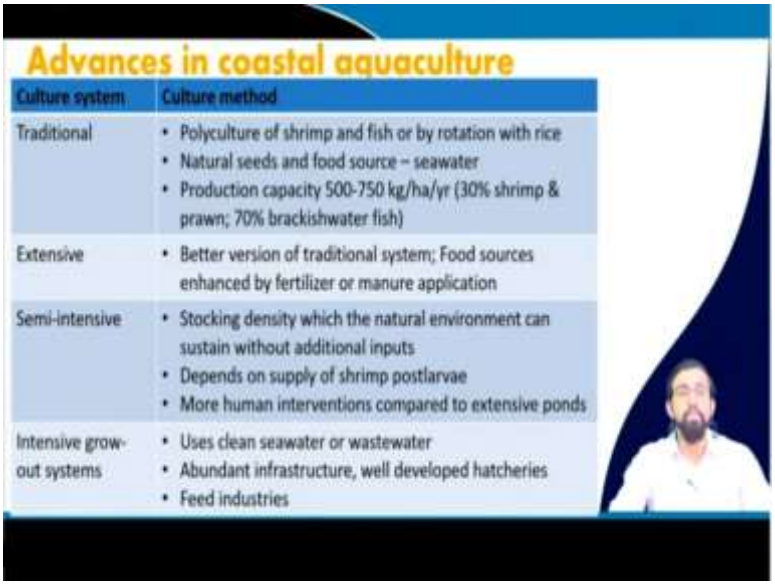
(Refer Slide Time: 21:02)



So, temperature between the 25 degree Celsius to 32 degree Celsius is the best for the hot water brackish water culture. For high density culture, like paddlewheel aerators should be used for aeration; it is definitely should introduce this kind of aerator system, so to increase the dissolved oxygen level in your pond. Good quality water in adequate amount of should be available throughout the culture period. Good transportation and the marketing facilities has to be there. So, you can develop all by yourself or you can develop your farms in a way in a place where you have this available.

Like you know the proper transportation facilities are available or marketing facilities are available; you have to take a take a good care about that. All species of brackish water aquaculture feed on benthic algae, so you have to use the manual to increase this benthic algae production. That is one of the very important thing that you need to you need to really worry about like the production of the benthic algae population. You need to increase the population of benthic algae by producing introducing different kinds of fertilizers, different kind of bio manures and all. So, to enhance the benthic algae which will definitely be helpful for in a long run for your brackish water aquaculture species.

(Refer Slide Time: 22:18)



What are the advances of aqua coastal aquaculture systems? The in case of traditional culture methods are like polyculture of shrimp and fish or by rotation with rice. Remember I discussed the in case of Kerala, they have this. They uses natural seeds and the food source like the sea water is used. Production capacity of around 500 to 750 kg per hectare per year, which is 30 percent of shrimp and for prawn 70 percent of the brackish water fish is possible. In case of extensive, better version of the traditional systems; food sources enhanced by fertilizer or manure application.

Semi-intensive: stocking density which the natural environment can sustain without additional input; depends on the supply of shrimp postlarvae and more human interventions compared to the extensive ponds. We you already know this culture systems. What will happen in case of intensive grow-out coastal aquaculture systems? It uses the clean sea water or the wastewater. Abundant infrastructure and well developed hatcheries should be there and feed industries are there. And they will increase the total production of the system; they will increase the environmental sustainability. And all together the aquaculture the benefits of the aquaculture like the producers or the harvesters or the aquaculture farmers, those are there.

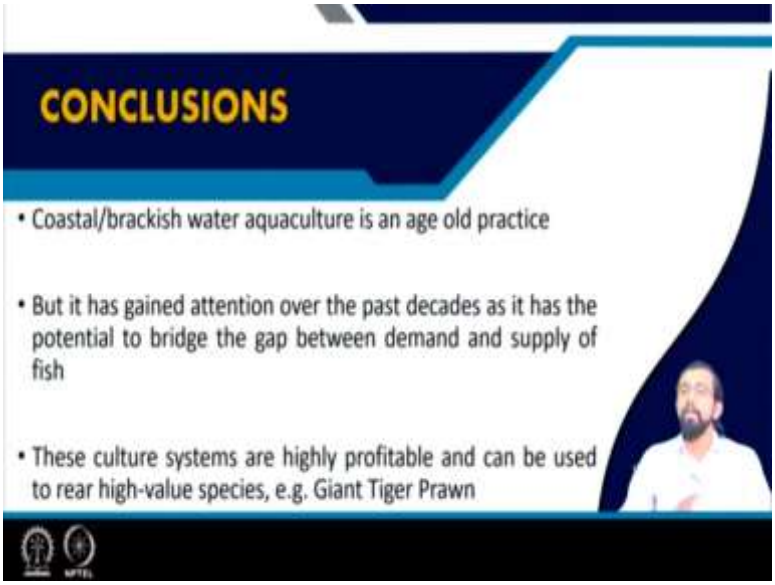
(Refer Slide Time: 23:35)

So, in general, what are the benefits of coastal aquaculture that we discussed till now? It plays a significant role in the development on the fishery sector. And there is a huge bloom nowadays and India is actually like India is having a lot of plan on this develop further development of the coastal aquaculture. So that is the perfect time for all of you to go, just go ahead and learn things about these coastal aquaculture systems; and try to go for entrepreneurship and try to develop and some idea. So, to incorporate to your for increasing the employability status of your nearby areas and all; and make a team and go ahead with the entrepreneurship, go ahead with the starting of business on it.

So, there is huge demand, huge sector availability, huge spaces available in India; just go ahead with this. There are a lot of insurance policies are available, those are very important; a lot of government benefits you will be getting. So, these are the benefits of coastal aquaculture you need to go ahead with this like Tiger shrimp, milkfish et-cetera are very efficient; domestic and foreign exchange earners. Highest investment or high investment is required, but highly profitable; that is the good thing about it.

Brackish water species require extreme care, so farmers practice the best management practices like pond preparation, fish health management, et-cetera et-cetera. Though it requires the extreme care. But if you can go ahead with the best practices as I always say, go ahead with the best practice possible; best management practice possible, contact with the proper experts and try to formulate the proper management practices for your system. So that to have a proper fish farming practices and pond preparation and the fish health management can also be done.

(Refer Slide Time: 25:26)



So to conclude it, the coastal and the brackish water aquaculture is an age old practice. So, in general, it is an age old practice. But, now it has gained a vast attention over the past decades, because of its potential to bridge the gap between the demand and the supply of fish. For because of one major reason is that it is a enriched source of nutrients. So, there is a high chances of having very high yield compared to the inland and the compared to the normal marine culture; so do not go ahead with this, it is a general statement. There are, there are seawater marine culture where you can get higher number of yield as well.

So, I am discussing I am I am telling you in general, on an average. So, the coastal aquaculture can be much more beneficial than any other kind of aquaculture systems. Second thing, it will give you the culture species, it will give you the output which are very profitable, which has a very high market demand. People really liked it because of its taste because of its proper texture and all, like the culture species like this Giant Tiger Prawns and all. They can be used for to

rear this kind of like, this culture system can be used to rear this kind of high value species, which which has been valued not only in India, but also outside India.

And you can easily export them and you can involve; you can not only get a very huge revenue, very huge market out of it, you will also go ahead with creating employability. And also you can go ahead with the generation of the huge amount of GDP for your nation. So, these are the references that I have that I have used. So, you can go ahead with it to get some more idea about it. And in general, we keep on discussing more different kinds of farming systems in the coming lectures. So for the time being, thank you.