Advanced Aquaculture Technology
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Lecture 43
Integrated Farming

Hello everyone, welcome to the third lecture of module 9 technology of organic farming. So my name is Professor Gourav Dhar Bhowmick, I am from the department of agriculture and food engineering of IIT Kharagpur. So in this lecture I will be discussing about the integrated farming.

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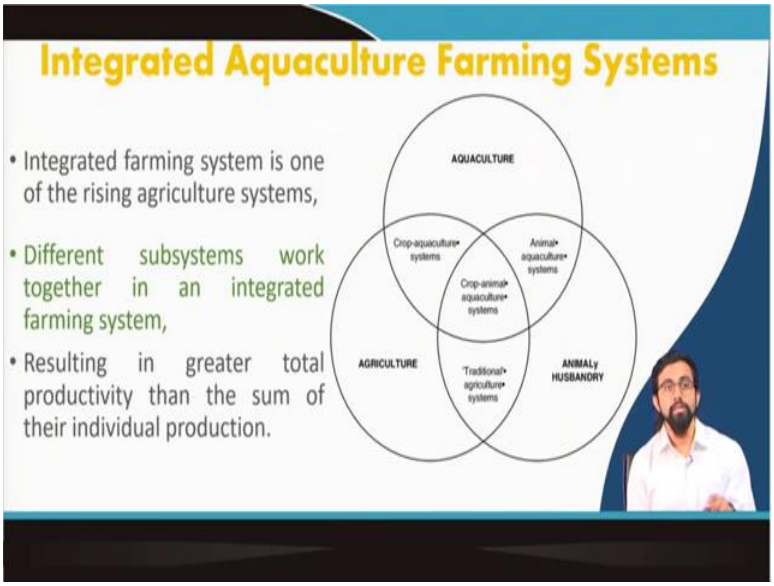

The concepts that I will be covering in general in this particular lecture material is the integrated aquaculture farming systems, what are the basic principles of it, and what are the

different fish livestock farming systems that is available, how to design and what are the consideration that is there for when you go for integrated aquaculture farming systems like pig-fish culture, duck-fish culture, other livestock fish cultures, etc.

In general when we discuss about the integrated aquaculture farming systems it is actually the different sub system which are working in this in an integrated manner. If you see these Venn diagrams, aquaculture, agriculture, animal husbandry; if you see the the overlapping area between the aquaculture, agriculture it is a crop aquaculture systems what are the examples it can be rice aquaculture systems, it can be rice and say like koi culture in China it is very famous or tilapia culture, there is like agriculture and animal husbandry it is a traditional agricultural systems like where we use agriculture plus animal husbandry like normal ducks to get rid of the pest from your agricultural land.

We can have the aquacultural Venn and the animal husbandry Venn the overlapping portion is showing the animal aquaculture systems, majorly the duck and fish aquaculture systems, poultry and fish aquaculture systems, there is one in the middle if you see it is the crop animal aquaculture system that is the most productive one where you are producing crop, where you are producing animals plus you are producing aquaculture where it is possible.

It is possible for duck, fish, rice aquaculture channel it is just to give you an example where fishes because for rice it needs a standing water in it and to grow it to grow their rice crops and because of that in the standing water you can have the fish dwelling on it and also the fish excreta can be utilized as a nutrition for your crop.

Plus, you can have the ducks growing in the same pond, what will do this duck will also help getting rid of the weeds and the pest from your land, and it will help growing each other, it will provide the food to each other and this way we can have a multiple production line and multiple high economic benefit out of using the same land footprint, you understand the point.

So that is why it is called integrated aquaculture farming systems, so it results in a very high productivity because the sum of production is increased.

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What are the basic principles that it adheres to; first thing is the utilization of synergistic effect of interrelated form activities, second thing the conservation including the full utilization of farm waste, these two things are possible and these are the basic principles that we normally follow when we design any integrated aquaculture farming practices. It is based on the concept given by the FAO, food and agriculture organization 1977 and this is a very opt sentence if you realize it.

See it is written they said there is no waste and waste is only a misplaced resource which can become a valuable material for another product. You remember I also told you couple of lecture back that for us the wastewater is nothing is wastewater is a waste that is why you say it is a wastewater, but can you realize it is much more beneficial for those microorganisms which are dwelling there for them which is the food because wastewater is like their food source.

So for them it is not wastewater for them it is a place it is like they are place to where we can have enough amount of food for survival, so for you it is waste for other other person it may not for other product or other principles it may not, so this is the concept, so this concept is well utilized in integrated forming system.

The waste that is generated by your aquatic species is a nuisance, you have to treat it otherwise it is nuisance for this aquatic species itself, what people are doing they are kind of utilize this waste, who can utilize this waste, the plants why, because animal excreta or this fish excreta or uneaten feed they have huge amount of nitrogenous compound.

This nitrogenous compound when it converts into the ammonia and this ammonia because of the presence of nitrifying organisms, nitrifying bacteria nitrosomonas and nitrobacter it converted into nitrate. This nitrate nitrogen is a feed for your plant, so they can utilize this nitrogen for to convert it into their own biomass and not only that they utilize the other different organic matter also and so this means they are kind of helping each other.

Fish is helping the plant to grow providing the nutrient like unknowingly actually like their excreta are actually being used, again the fish, how plant is actually being helpful in this case, the plant because of the presence of plants because of the presence of the proper environment there is a chances of different kind of phytoplanktons which is there, different soil matrices are there and different type of insects can grow in its benthic zone, those paste is been utilized by the fish.

So that is how they are actually having a symbiotic relationship, they are helping each other, so that is why we call it integrated farming is the same way it works for duck also. When ducks are there they normally have the unwanted pest and all from these crops and also they help to get rid of all these weeds from the plant, other than the weeds which they can have it and which they normally help when they are dwelling they get rid of the weed infestation as well. So if you have this multi-tropic culture it will get and give you benefits in a multiple way and also you can get higher economic return from your system.

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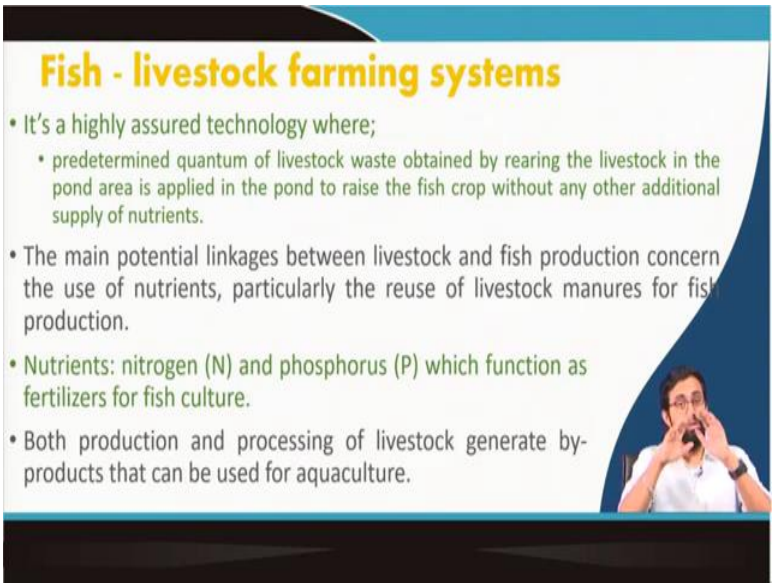

In general the aquaculture which was traditionally developed in an integrated basis mostly in the Asian countries still operates in this way and this integration involves growing a variety of aquatic species in a single body of water. Water reuse for successive aquaculture species or other crops, integration of aquaculture with other farm production or byproduct.

The ponds are fertilized by the faeces from pig, duck, humans, etc and whatever is reared and used on the farm, waste from the crop that is the stubble from the cereal crops may be added to the pond as food for benthic feeder and the detritivores, because of that the fish can also get higher amount of nutrient from the pond itself. In some cases the aquaculture animals are added to fields where rice is grown partially submerged in water as I already discussed.

Whatever the fish livestock farming system, it is a highly assured technology where predetermined quantum of livestock waste obtained by rearing the livestock in the pond area is applied to the pond to raise the fish crop without any additional supply of nutrient. Those excreta from those livestock is enough or livestock waste is enough for your aquatic species, so you do not have to go for further supply of nutrient or feed, can you realize it is the major recurring cost in any aquaculture farm that is the feed almost 20 to 30 percent even sometimes 40 percent of a cost actually caused because of the recurring cost involves the feed supply.

You get rid of all these additional economic requirements, the main potential linkage between the livestock and fish production is like constants use of the nutrients particularly the reuse of livestock manure for fish production, also they need these nutrients it consists the nitrogen and phosphorus which function as fertilizer for fish culture.

Both the production and the processing of livestock generated by products and that can also be used for aquaculture, so it is like multifacet utilization of this kind of polycultures and all.

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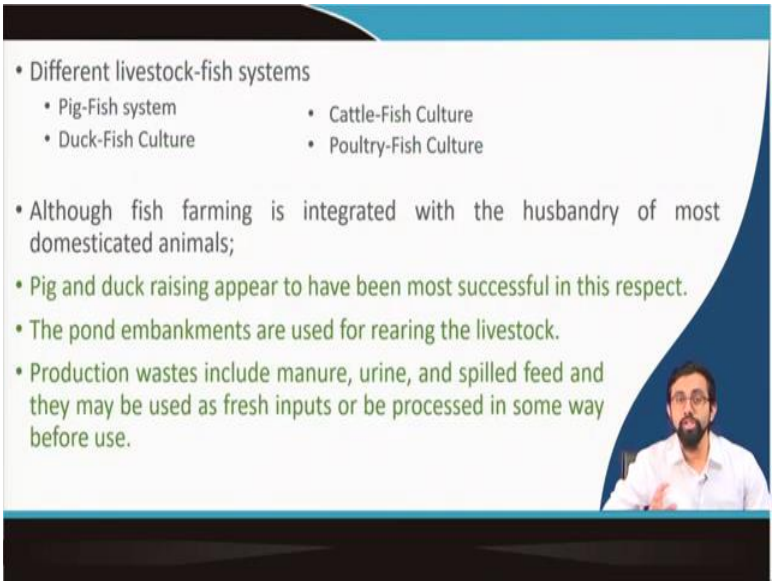

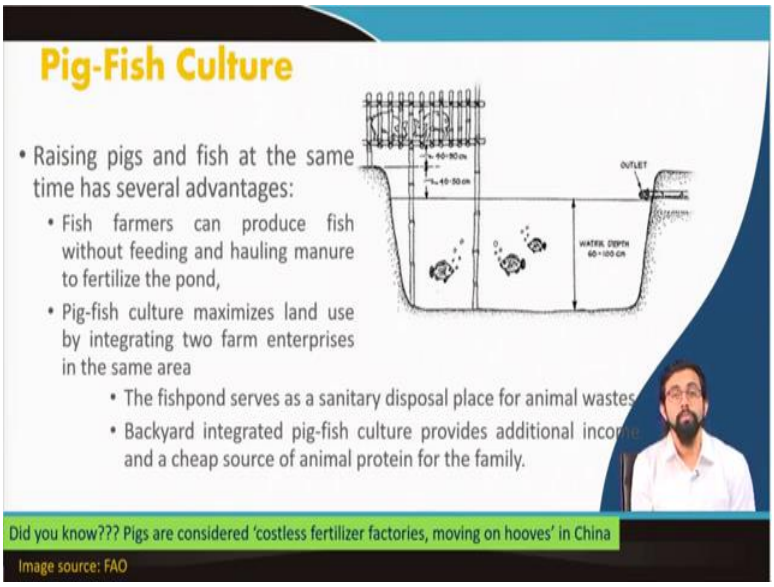

Different type of livestock fish culture systems as an example pig-fish, cattle-fish, duck-fish, poultry-fish cultures, etc. so where all these animals excreta and all the animal by products are actually used in aquaculture pond, sometimes we design in such a way this pig farms and all, there is like the agriculture farm and just above it you have this pig farm and poultry farm and with this knitting structure, so what will happen their excreta can directly fall into the pond. Although the fish farming is integrated with the husbandry of most of the domesticated animals the pig and duck raising appear to have the most successful in this regard.

The pond embankment are useful, used as a rearing for livestock and also production waste include the manure, urine and spilled feed may be used for as a fresh input or be processed in some way before using it for aquacultural practices or aquacultural product.

One such example is pig-fish culture, you see this if raising pig in a bamboo structure like this and they can easily stay there and there is splitter and uneaten feed will directly fall into the aquatic pond or the tank just installed beneath it. So what will happen, the fish can easily utilize those as a feed for their survival.

It has a different several advantages like fish farmers can produce fish without feeding and hauling manure to fertilize the pond and pig-fish culture it maximizes the land use by integrating two farm enterprises in the same area, do you realize that it reduces land footprint like anything. Also this fish pond serves as a sanitary disposal place for the animal waste plus the backyard integrated pig-fish culture provides the additional income and a cheap source of animal protein for all the family or the dependent family or for the local market area.

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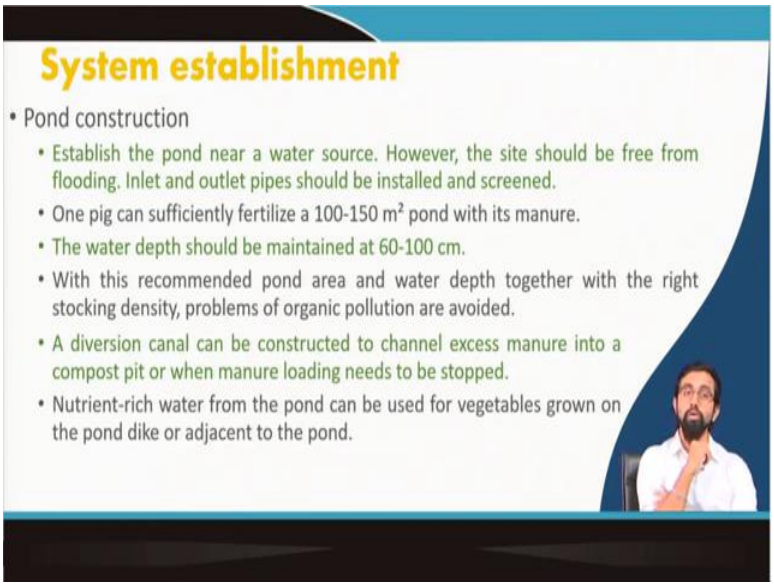

How to establish the system, the pond construction we have to establish the pond near to our water source definitely. However, the site should be free from flooding inlet and outlet pipes should be installed and screened properly, so that it will not lose any aquatic animal. One pig can sufficiently fertilize 100 to 150 square meter of pond with its manure, based on that you have to calculate your number of pigs that you can have in your farm.

The water depth should be maintained at 60 to 100 centimeter with the recommended pond area and water depth together with the right stocking density, problems of organic pollutions

are avoided. A diversion canal can be constructed to channel the excess manure into the composite pit and when manure loading needs to be stopped, so this diversion canal is very important when you are designing this structure for your pig farm.

The nutrient rich water from the pond can be used for vegetable grown on the pond dike and adjacent to the pond also, because anywhere you have very high enriched manure based wastewater in your system.

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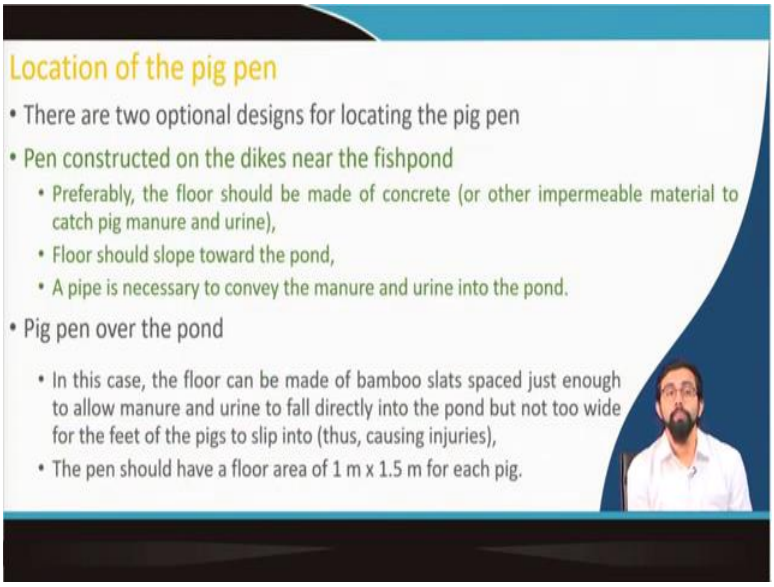

Location of the pig pen, there are two optional designs for locating your pig pen or the structure where we are actually being cultured. The pen constructed on the dikes near to the fish pond preferably the floor should be made of concrete or some impermeable material to catch the pig manure and urine and floor should slope towards the pond so you can simply wash it thoroughly and it will directly go to the pond, there will be some outlet point from which it will directly go to the pond.

A pipe is necessary to convey the manure and the urine into the pond area that is also possible or even further reduce the land footprint you can directly design the pig pen over the pond, but in this case the floor can be made of bamboo slats spaced just enough to allow the manure and urine to fall directly into the pond and not too wide for the feet of the pig to slip into and which can cause injuries. A pen should have a floor area of around 1 to 1.5 meter per pig, for each pig we have to have this area total 1.5 square meter of area.

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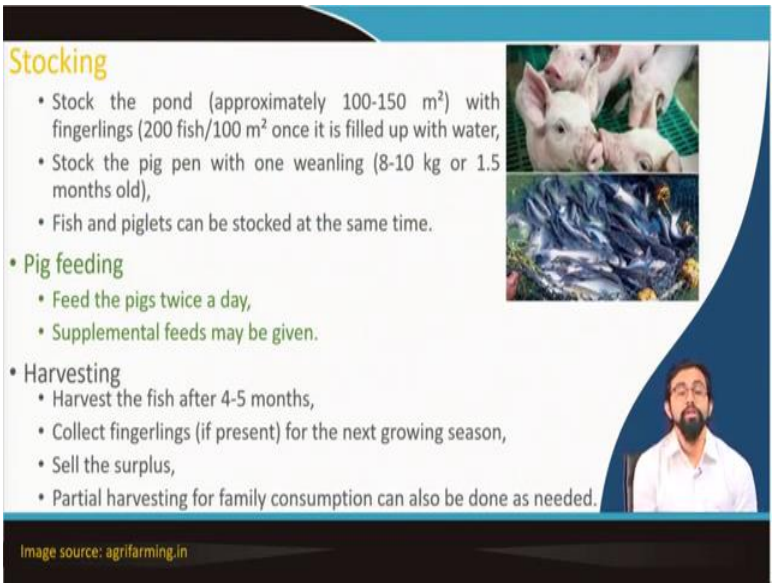

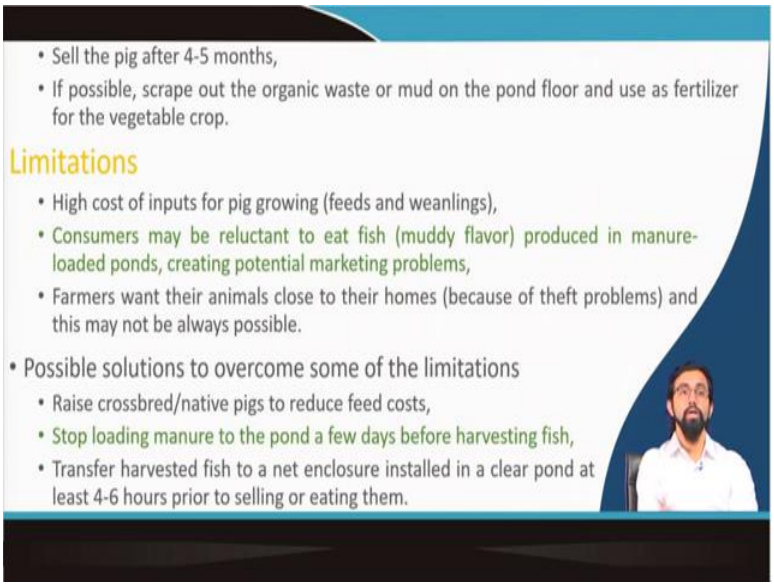

Stocking as I already discussed approximately the stock of pond like 100 to 150 square meter with the fingerlings of 200 fish per 100 square meter can be used with the fill up of water and stock of pig pen with one weanlin 8 to 10 kg or 1.5 month of old. Fish and piglets can be stocked at the same time, pigs can be fed twice a day, supplemented feed can be given and harvesting of fish after 4 to 5 months is possible based on the target species and collecting the fingerlings present for the next growing season and the sell of the surplus and partial harvesting for family consumption can also be done as needed.

So it is a very standard good and old practice for your integrated farming culture. Sell the pig after 4 to 5 months and if possible scrap out the organic waste or mud on the pond floor and use the fertilizer for for growing the vegetable crops in surrounding places.

What are the limitations? There is high cost of input for pig growing for its feeds and weanling, however, this can be minimized if you have a higher return because within 4 to 5 months you can get a lot of return in terms of economic benefit like the aquatic species plus see this pigs you will get a lot of economic return. The consumer may be reluctant to eat fish because of this muddy flavor produced in manure loaded pond and creating a potential marketing problems, there are a lot of troubleshooting major to get rid of it so that you can follow to to get rid of these limitations.

Farmers want their animals close to their homes because of the theft problems and this may not be always possible. Possible solutions to overcome some of these limitations first is raise the crossbreed or native pigs to reduce the feed cost, stop loading the manure to the pond a few days before harvesting the fish so it will help you to get rid of this muddy flavor of your fish, so it will solve the problem of this potential marketing issues.

Transfer the harvested fish to a net enclosure installed in a clear pond at at least 4 to 6 hour prior to selling or eating them, so it will help help them get rid of the muddy flavor.

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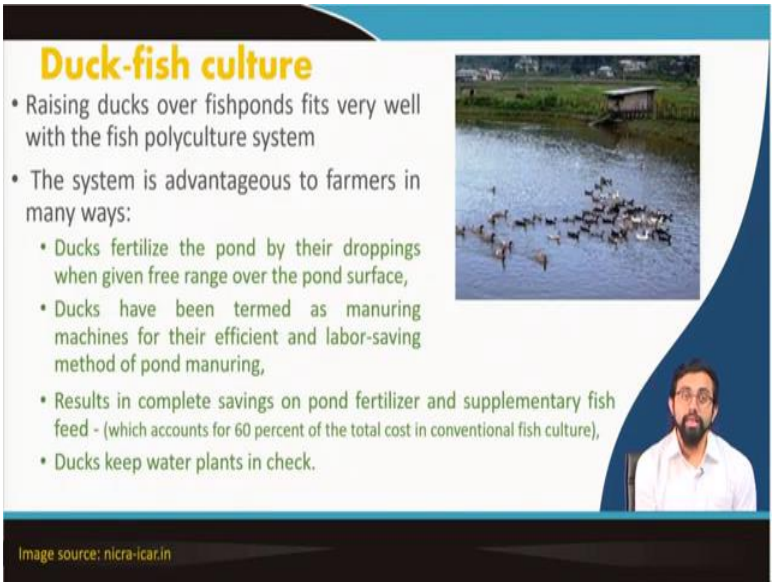

Second example is the duck-fish culture; raising ducks over fish ponds feeds very well with the fish polyculture system. The system is advantageous to farmers in many ways, ducks fertilize the pond by their dropping when given a free range over the pond surface, ducks have been termed as manuring machines for their efficient and labor saving method of pond manuring, results in complete savings on pond fertilizer and supplementary fish feed which accounts for 60 percent of the total cost in conventional fish culture, you remember we discussed about in very beginning of like I think second or third module.

So that can be completely minimized if you are culturing your duck in your pond. It can also keep the water plants in check so that is also good it will not cause any unwanted weed or unwanted water plant to grow, so that is also one way good for your systems.

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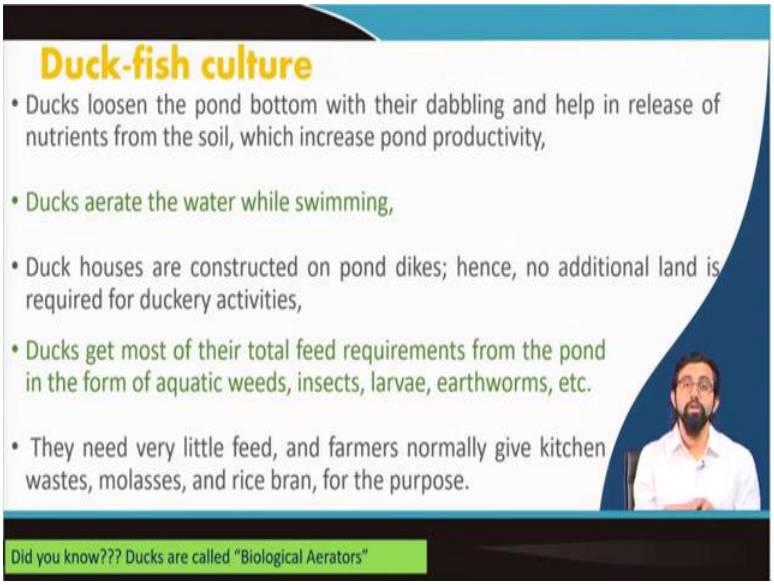

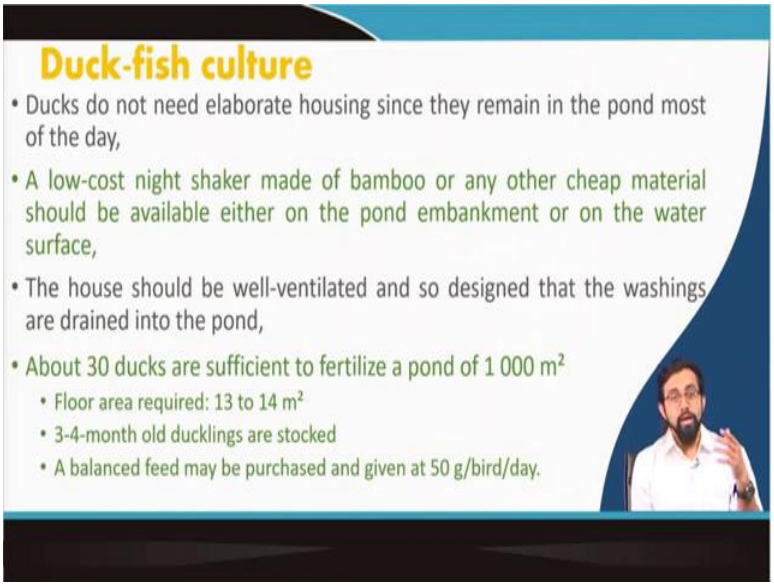

So all these factors like this ducks can loosen the pond bottom with their dabbling and help in release the nutrient from the soil and which will also increase the pond productivity, ducks aerate the water while swimming that is why ducks are called biological aerators, because they aerate when they are swimming they are increasing the aeration rate, they are somehow creating some turbulence on the surface and because of that the dissolved oxygen concentration can be increased, so it is like a natural biological aerators for your pond so you should go ahead with it so that it will reduce the requirement of your additional aerator.

Duck houses are constructed on pond dike hence no additional land is required for duckery activity; ducks get most of their total feed requirement from the pond in the form of aquatic weed, insects, larvae, and earthworms, so we do not have to worry about their feed. They need very little feed and farmers normally give kitchen waste, molasses and rice bran for this purpose, so your problem with the kitchen waste can also be solved, you just provided with them and they will be very happy to have them, that is it.

You can realize by multiple way your production can be enhanced, multiple way you can realize huge amount of profit while doing this kind of culture practices, rice and fish culture practices. Ducks not only need any elaborate housing since they remain in the pond most of the day, but also as I discussed it can be placed if you have a small amount of duckery you can just simply put it in your dike of your pond, so that is enough so no additional places required.

Low cost night shaker mode of bamboo or any cheap material should be available either on the pond embankment or on the bottom surface for the ducks, to dwell, the house should be well ventilated and designed with the washing or draining or so that the washings are drained into the pond.

About 30 ducks are sufficient to fertilize the point of around thousand square meter, floor area around 13 to 14 meter square is only required for 3 to 4 month old ducklings are normally stocked and a balance feed may be purchased and given at 50 gram per bird per day that is more than enough, if you really want them to survive in a very well condition it is like they can be very well survived with the kitchen waste and the whatever the earthworms and the living organisms present in the pond.

But additionally if you want to grow it much faster you provide it with the 50 gram per bird per day of balance feed.

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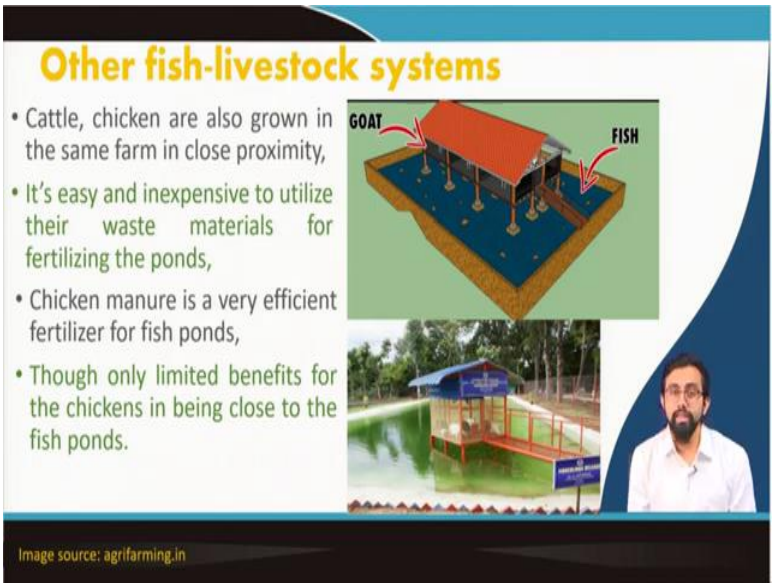

What are the other fish livestock systems, goat and fish livestock systems are available, cattle and fish livestock systems are available, chicken and fish livestock systems are available, so this cattle, chicken are also grown in the same farm in close proximity, it is easy and inexpensive to utilize their waste materials for fertilizing the pond and chicken manure is a very efficient fertilizer for fish pond, because it constitutes a huge amount of protein and this nutritions required for your fish to grow faster.

Though only limited benefits for the chicken is being close to the fish pond, but it is doable you can go ahead with the culture of goat and fish in the same farm, this goat excreta can be utilized for your fish culture or you can provide it into your pond, the chicken droppings can be added and by this way you can increase enhance the productivity of your system.

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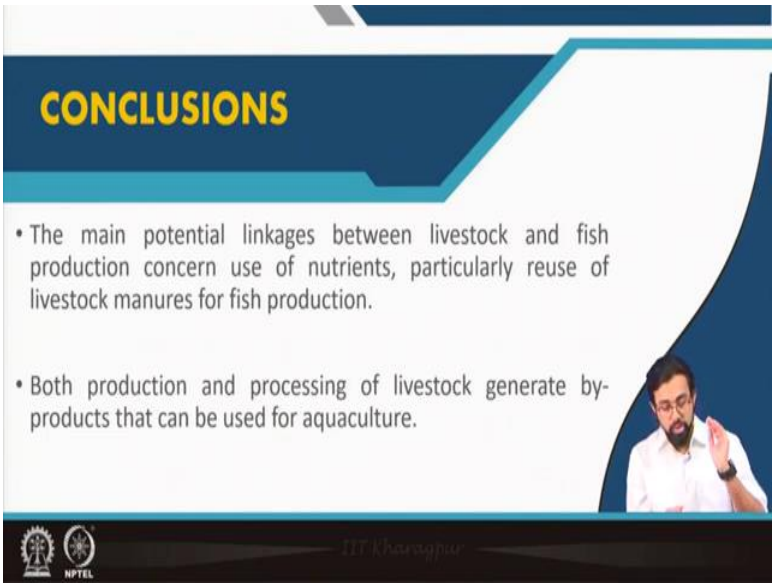

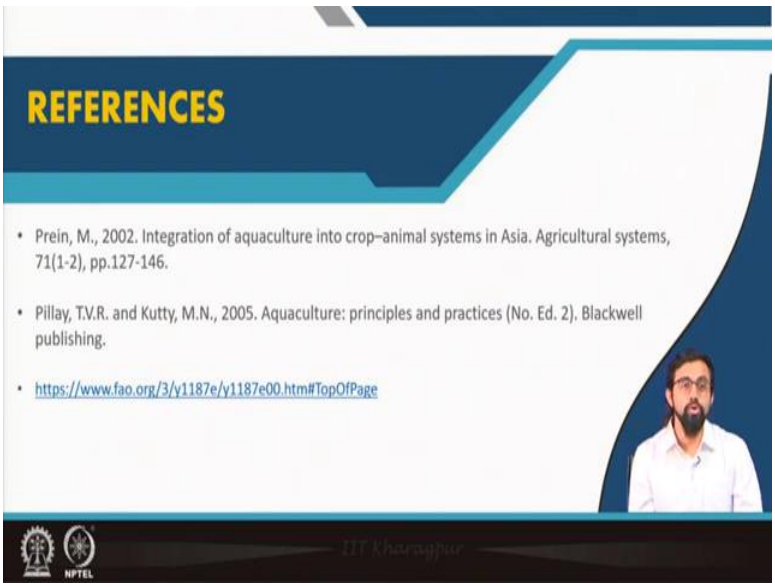

So the main potential linkages between the livestock and fish production concern the use of nutrient, particularly the reuse of livestock manures for fish production. Other than that what are the benefits it will increase the economic yield, economic benefit it will increase the total yield, it will help to go for multiple production line in a same plant footprint, it will help giving some ecological benefit because we do not have to provide it with additional nutrients, additional pest concentration will be reduced, the unwanted weed can be in in stake so all these things is possible when you do for this multi-tropic aquaculture, if you go ahead with this aquaculture practices.

Both production and the processing of livestock generate by products that can also be used in aquaculture. So in all the way it is beneficial, so you just need to design it properly, you have to stock it properly and you have to start your business right now. So do not worry about it you just go ahead with this, it is very beneficial for your entrepreneurship development and it does require a very minimal experts opinion, anyone can do that and if you have any issues the troubleshooting measures are already available in Google if you just go and search for it and you will get ample amount of material for you to develop this kind of practices and if you have land just go ahead and just go start doing it, it will give you a huge economic return for sure.

So that is all about integrated aquaculture farming. We will continue it further in the coming lecture but as I take away message I just want to show you this small figure if you see this the left figure which is separate and standalone operation and in the right side if you see the integration results of similar levels of benefit to both components and which increases the overall benefit which means like if you go ahead with similar, same amount of culture practices you can do if you do it separately the benefit, you just see the size of the Venn diagrams the benefits will be minimum.

If you somehow make a symbiotic relationship between these two different farming practices it will increase the productivity you see the Venn diagrams size is much higher. It will increase the productivity not only that because of this integration you will get multiple benefits, multiple economic benefits, productivity benefits, byproduct recovery, ecological benefit like environmental benefits, it will give you a lot of other positive, how to say like in a positive gaining out of doing that.

So that is why it is very important I would really request you all of you to go ahead and search for it much if you want to do a more research if you go and search in Google and try to

find out different literatures available on it and if you have a land just go and start it that is the first thing I would say because if you have a land and at this moment if you want to start creating some employability opportunity that is the right time and people really do not follow it, but there is a chance of getting huge benefit out of it.

So that is it for the day and I would like to request you to go ahead with this references if you want to know more in details about all the details, all the discussions that we have. This FAO, this food and agriculture organization their page have more details much more interesting informations regarding this integrated aquaculture farming practices and in China it is really famous in Southeastern Asia, it is really famous in India also it is there for long period of time, but now it is time to accelerate it because there is a huge demand but in order to meet those demand and in order to make it in a exportable quality the recent generation we should go ahead and we should start practicing all these things.

It will give us economic benefit and it is not something to be shame of, this kind of jobs will give us food this type of jobs will give us the things that is required for our living that is food, so it is it is nothing to be ashamed of go ahead and start working on it will give you economic benefit, it will give you a lot of employability opportunity to your neighboring area and definitely it will give some environmental benefit as well if you properly culture it.

So that is it for today's lecture, we will continue with this discussion in the coming lecture, thank you so much.