Advanced Aquaculture Technology
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Lecture 35
Chemical Treatment

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Hello everyone, welcome to the last lecture of the module 7, Water Quality Management for the subject Advanced Agriculture Technology. My name is Professor Gourav Dhar Bhowmick. I am from the Agriculture and Food Engineering department of IIT Kharagpur.

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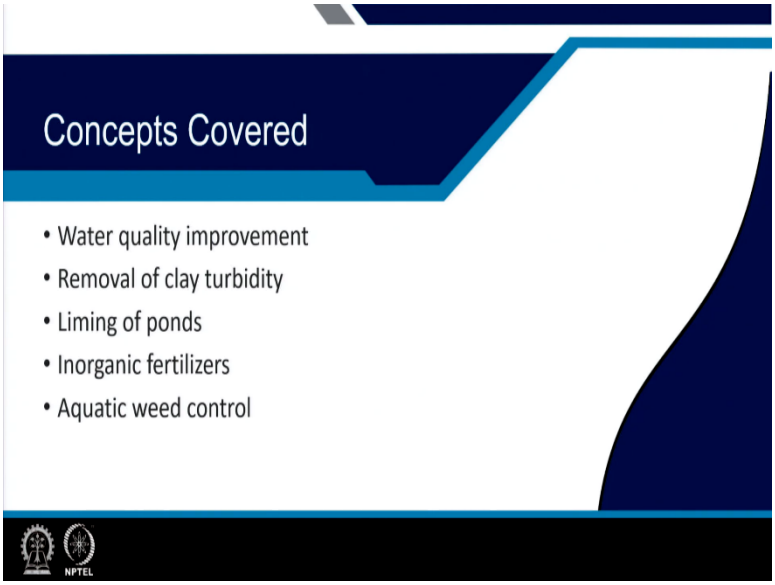

In this lecture material I will be covering the concepts like water quality improvement by using the chemical fertilizers, removal of clay turbidity, liming of ponds, inorganic fertilizers and aquatic weed control measurements measures and all.

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In case of water quality improvement in general, we already discussed about different physical means and all. So, now we will be discussing about the chemical means by which we can improve the water quality parameters and all. Okay ! So, in terms of improvement of water quality parameters, what does that mean? Like why I am saying this improvement of water quality, you know, the different parameters, like physical parameters that we discussed, chemical parameters and the biological parameters that can be improved by using the different kind of chemicals like say, we can maintain the optimal pH condition, we can remove the clay turbidity, we can optimize the total alkalinity and total hardness of our pond.

We can increase the productivity of the pond by applying the fertilizer to we eradicate the unwanted weeds. We can use the herbicides sites and algaecides. These are the different means by which we can treat the water. We can increase the quality of the water using chemical means. Okay! So, that's what we are going to discuss in this last lecture material of water quality module.

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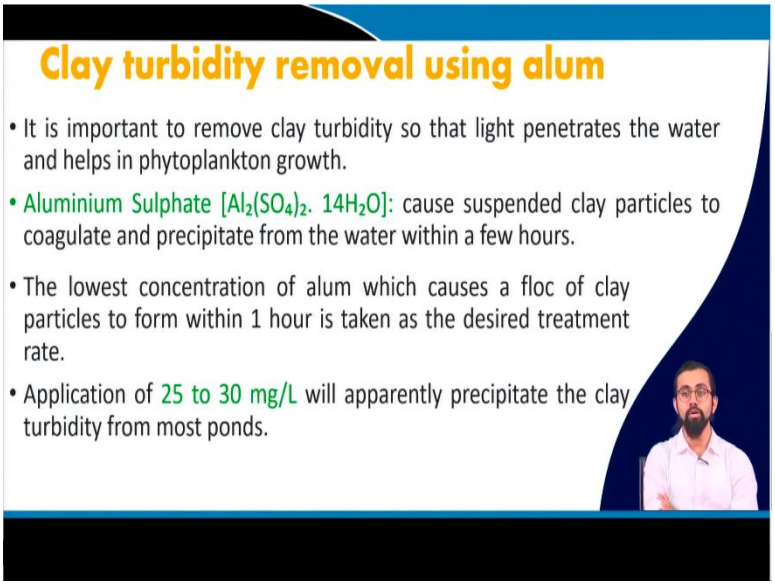

The first discussion will be on the clay turbidity removal. How we can remove the clay turbidity of our pond or say like our tank using alum? You know, alum in general we use aluminium sulphate which in short we use it we used to name it alum. I think it is very famously used in Indian context, I think even earlier generation, even now also, if you go to the rural areas, they still after shaving, they use the alum which is used for fast clogging of your blood and all.

So, this alum and also it is used for purification of the water in our wells in earlier days and not even earlier now also people are using this. So, how it works and what is it like this alum which we normally use, it actually has a very much beneficial utilization, like like a lot of benefits actually to be precise, to remove the clay turbidity which is a major problem in pond or any tank ecosystems. Okay!

So, it is really important that this clay turbidity is removed, otherwise what will happen the light which is penetrates to the water which has some issues and it will help in phytoplankton growth and at the end it will cause you know in eutrophication and all these things. So, we use this aluminium sulphate which can cause you know so there are two situation in this case.

First of all, if you have clay turbidity, if you are not removing it, that is also detrimental because if you are not removing it, what will happen? Light cannot penetrate and if light will not penetrate, the phytoplankton will not bloom accordingly. And that is the basis of your food chain. Right? The pond ecosystem, that is the basis of the chain. If you do not have enough amount of phytoplankton, it will harm the whole ecosystem. It will harm the zooplankton productivity, it will harm the small fishes that they dwell there and it will harm the whole ecosystem in general.

So, because of that, we need to supply with some agents by which we can chemical agent by which we can reduce the clay turbidity. Alum is one of them like this is aluminium sulphate which is one of these coagulating agents we call because of its structure because of its you know ionic behaviour, it can easily attract the suspended clay particles and it will make a bond or form of clog and that clog will because of this clog or this clog formation, it will have higher specific gravity and it will sediment it on the bottom by which you can easily get rid of this clay turbidity and all.

The lowest concentration of alum which causes a flock of clay particles to form within an hour is considered as a desired treatment rate. Okay! Based on the place to place and based on your desired application designs and all Okay! in general, around 25 to 30 milligrams per liter will apparently precipitate the clay turbidity of most pond. So, that is the standard like around if we do not have anything for any information about the turbidity of your pond and all in general, if you see the visible turbidity is there, just go ahead with the 25 to 30 milligrams per liter of application rate and it will be enough for hopefully it will be enough for it will solve your purpose.

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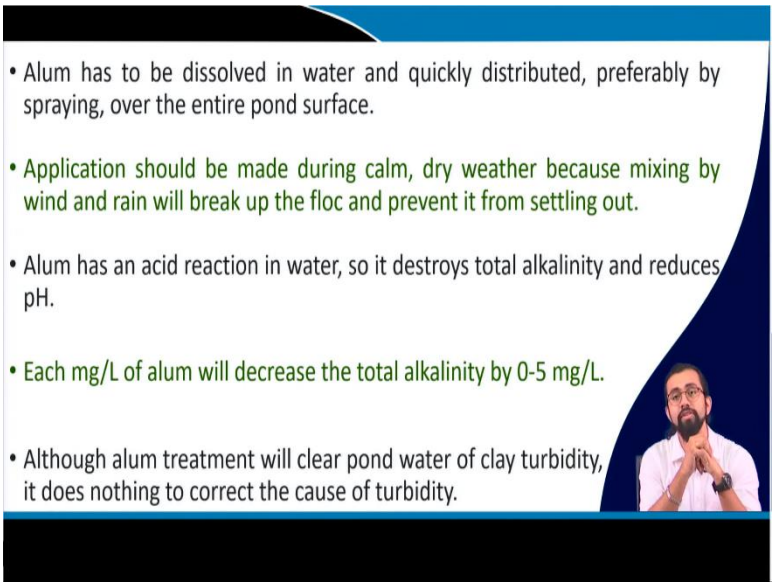

Alum also has to be dissolved in water and quickly distributed, preferably by spraying over the entire pond surface. Application should be made during calm and dry weather because mixing by wind and rain will break up the floc and prevent it from settling down. It's very easy, right? You understand. When there is rain, there is wind what will happen? The alum it takes time to make this floc formation. When there is wind, when there is rain, this floc will again

disseminate and because of that it will dissociate and because of that, the the actual necessity, the purpose will not be solved.

So, that is why you have to choose some summertime, like late summer time or like wintertime and all so late summer time also, it is difficult in certain places because this North-western and this kind of activities can happen. This kind of strong movement can be taken place. So, it is better to choose somewhere you know in a in later autumn or winter, so that would be better so that the mixing can be taken place and the mixing will not happen.

The pond will be as calm as possible and you can use this alum to reduce this clay particle, this clay turbidity phenomenon. But it comes with some factors. Some problems, like it's not as detrimental as you know the clay turbidity does. So, alum actually has some acidic reaction in water. So, it destroys the total alkalinity and reduces the pH. So, you have to deal with that. In that case, what you can do in order to neutralize this, you have to neutralize this ionic acid. You can provide it with some additional neutralizing agent or some alkaline material which is a calcium or magnesium salt also, you can supply as a buffer solution. So, it will somehow manage this issue.

Each milligram of each milligram per liter of alum can decrease the total alkalinity value up to 5 milligrams per liter. Just take into that consideration it's a really huge. I am talking about 20 milligram per litre, 30 milligram per litre of application. So, it will reduce your alkalinity by 100 to 150 milligram per litre which is very drastical. Okay! So, if you are not supplying with some buffer solutions or enough alkalinity is not prevailing there, it can also cause some irritation to your aquatic species. So, that has to be taken care of. Okay!

Although alum treatment will clear the pond water by this pond clay turbidity removal like in general, it does nothing to correct the cause of turbidity. Okay! So, that you have to remember, it will not reduce the cause of turbidity. If there is turbidity, it can reduce the turbidity level but you have to act on its cause like when it is source. What is the reason of this activity? What is the reason of this turbidity? Maybe you're doing over aeration that is possible. You just go and check like the standard oxygen transfer rate and all these things, if it is well within the limit, the expected range and if it is meeting in the field situation or not. So, that you have to calculate based on the amount of species that you have and you have to do some calculations.

Otherwise maybe if it is over aeration is taking place, what will happen? It will keep on increasing the turbidity level. It could by eroding the bottom, the sediment of your pond. Okay! that is only one example that I can think of right now. So, I am giving it to you. There are

thousands of other reasons by which you can see that turbidity can be increased. So, you have to act on that first. We cannot just keep on adding chemicals there and reducing the clay activity and all. Okay!

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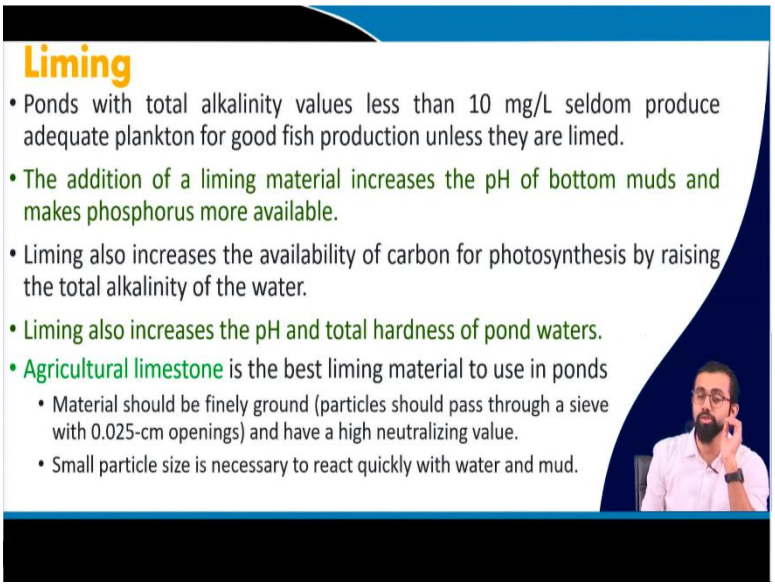

Liming is another important factor. Ponds with a total alkalinity value less than 10 milligrams per litre, its seldom produce the adequate plankton for good fish production unless they are limed. Okay! The addition of a liming material increases the pH of bottom marks and makes phosphorus more available. This is the that is the necessary of lime. Okay! You have to provide with the different liming materials. In general, when we talk about lime in general, maybe you know about the agricultural limestone and all that is a very standard liming material which we normally provide and it will help in enhancing the alkalinity and all.

How it will enhance the alkalinity? You know Limestone when it acts with, we say like carbon dioxide which is in different form, it makes some carbonate or bicarbonate form. It like converts into some bicarbonate or carbonate form and which is like stable in nature and because of that because once it is carbon dioxide is prevailing there in your surface and in your system and all just to give you it is one of the example, one of the example of how this alkalinity can be enhanced, enhanced alkalinity can be witnessed when you provide the liming.

This calcium oxide to calcium carbonate formations will give the increment in the alkalinity in your pond and all. Okay! Liming not only increases the pH and also it increases the total hardness of pond water. Right? Because it is a salt, calcium and magnesium salt will be increased. So, definitely the hardness will also increase. Right? Liming also increases the

availability of carbon for photosynthesis by raising the total alkalinity of the water. And also, liming this agricultural limestone is the best liming material to use in ponds because material should be finely but it should be finely ground and to have the best high neutralizing value, small particle size is necessary to react quickly with water and mud.

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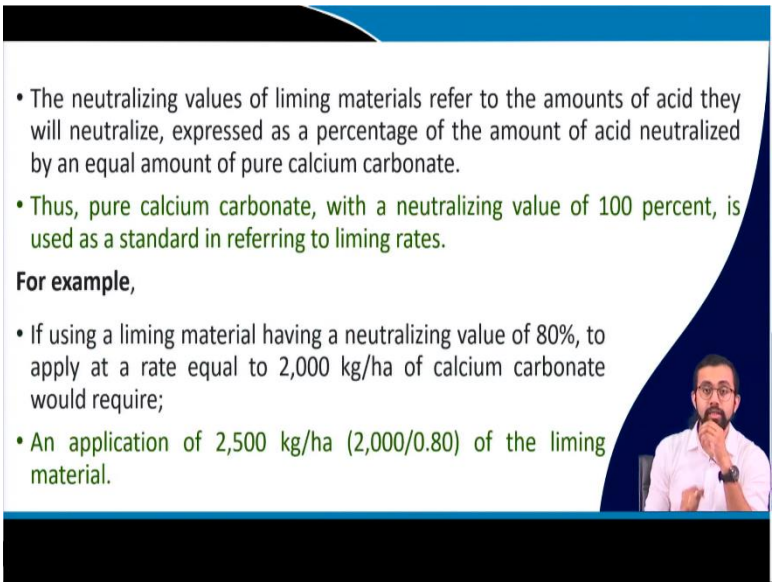

The neutralizing value of liming materials refers to the amount of acids that they will neutralize, expressed as a percentage of the amount of acid neutralized by an equal amount of pure calcium carbonate. Okay! Thus pure calcium carbonate with a neutralizing value of 100 percent is used as a standard in referring the liming rate. For example, how to calculate this? Suppose you are using a liming material having a neutralizing value of 80 percent to apply at a rate equal to 2000 kg per hectare of calcium carbonate. That means what will be the required amount of liming material? It will be 2000 kg per hectare divided by divided by 0.8. So, it will be 2500 kg per hectare of the liming material is required in order to meet this meet your neutralizing value, desired neutralizing value.

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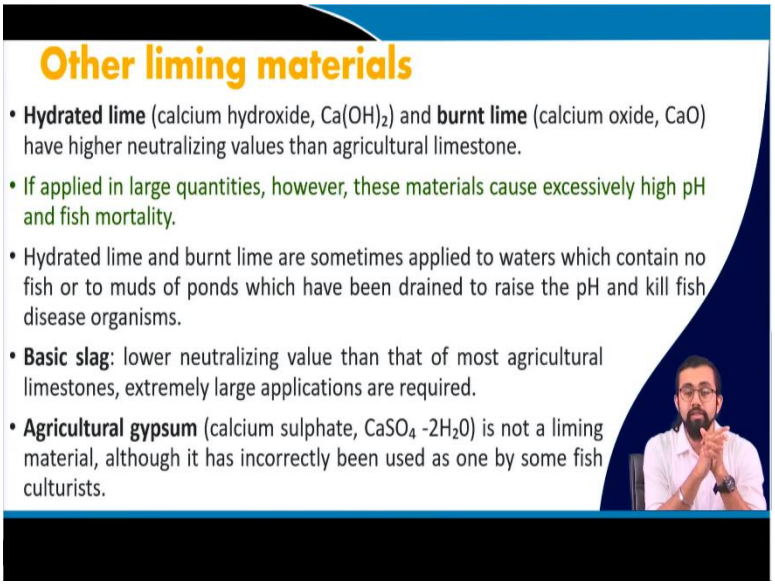

What are the other type of liming materials? There are hydrated limes like calcium hydroxide, burned limes like calcium oxide which also have a higher neutralizing value than the agricultural limestone. But if applied in large quantities, however, these materials can cause excessively high pH and fish mortality. So, that has to be well taken care of. Okay! Hydrated lime and burnt lime are sometimes applied to water which contain no fish and to muds of the plant which have been drained to raise the pH and kill the fish disease microorganisms. So, it has some positive, some additional benefits as well when you use it for different purpose.

Basic slag is also used which has a very low neutralizing value than the most agriculture limestone but extremely large applications are required because of that. Agriculture gypsum though it is not a liming material, it is a calcium sulphate. Okay! It is not a liming material but it has been incorrectly used by the fish culture, this aquaculture is channel because of its affectability. Okay! it is effective as well, but it is not actually the liming material.

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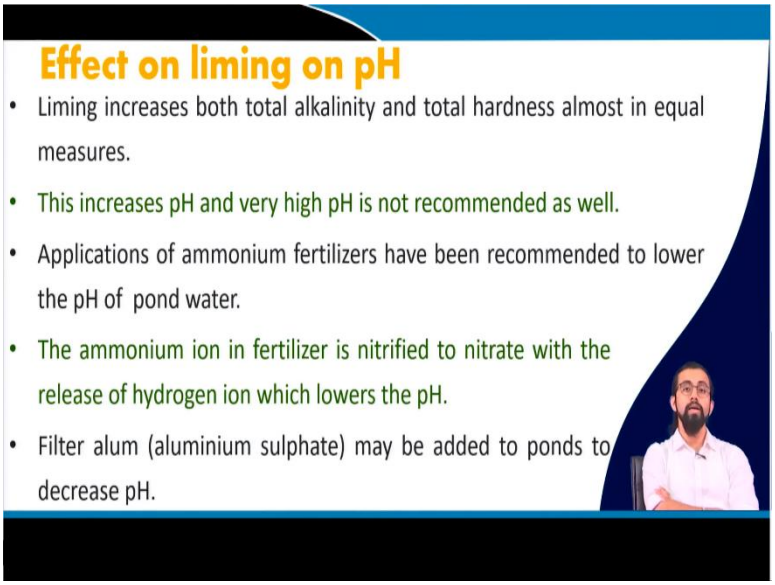

What is the effect of liming on pH? We already discussed it increases both the alkalinity and hardness almost in equal measure. The increase in the pH and high pH, but very high pH is definitely not recommended. Application of ammonium fertilizers have been recommended to lower the pH of pond water in some cases, like if we use lime at a very high rate, this ammonium ion in fertilizer is nitrified to nitrate with the release of hydrogen ion which lowers the pH and this filter alum like the alum the ammonium sulphate, aluminium sulphate may be needed to pond to decrease the pH. So, these two are like you have to use it optimally liming material or this different alum, this aluminium sulphates and all. You have to make a proper balance between these two to maintain the pH of your pond or your farm.

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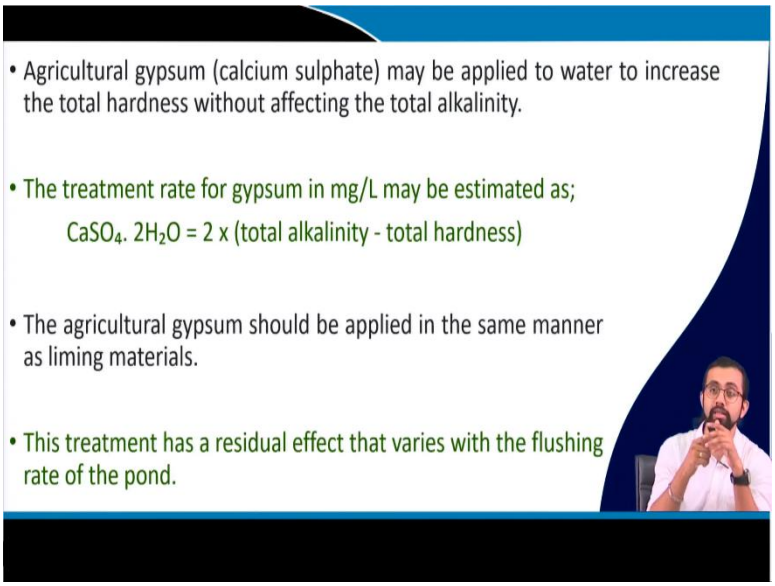

Agricultural gypsum or the calcium sulphate may be applied to water to increase the total hardness without affecting the total alkalinity. The treatment rate of for gypsum in milligram per liter may be estimated as calcium sulphate. That is like gypsum equal to 2 into total alkalinity minus total hardness. This value, the agriculture gypsum should be applied in the same manner as liming material and the treatment has a residual effect that varies with the flushing rate of the pond. So, that has to be well taken care of.

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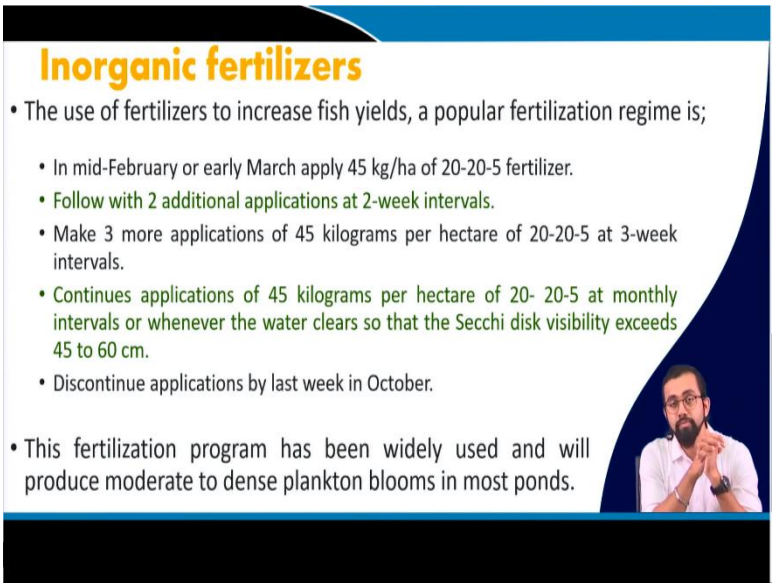

Inorganic fertilizers if we talk about it, it holds first we need to remember, we need to realize what is the best fertilization region that we can follow to increase the fish yield. Okay! The most popular one is like even in Indian context also we do in mid-February or early March, we apply the 45 kg per hectare of 20-20-5 fertilizers. Now, you may be confused with what is 20-20-25 fertilizers? You know, when we talk about fertilizer, it is always NPK, nitrogen, phosphorus and potassium. These three are the very important element.

When we talk about this fertilizer, when you talk about any kind of fertilizer. So, this 20-20-5 fertilizers with a rate of 45 kg per hectare is required to be applied in early March or late or mid-February time. Follow it with two additional application at two weeks of interval, then more another three applications of 45 kg per hectare of 20-20-5 at three week interval. Okay! Then continuous application of 45 kilograms per hectare of 20-20-5 at monthly interval and whenever the water clears so that the Secchi disk visibility exceeds 45 to 60 centimeter.

You know what is Secchi disk visibility? You remember when we discussed about turbidity? We discussed how we can finalize, how we can discuss the planktonic turbidity. Turbidity caused by the planktons, we can identify by the Secchi disks and measurement. Okay! so it is

a circular disk by which we can calculate we can find out the visibility, it has to be at least 45 to 60 cm from the surface of the water body so to make sure that the application is required or not, Okay!

Discontinue the application by the last week of October. Let it be like this for at least two to three months and no need to apply at least for two months no need to apply any fertilizer during that time. This particular fertilization program is widely used and will produce moderate to dense plankton blooms in most of the ponds. Okay!

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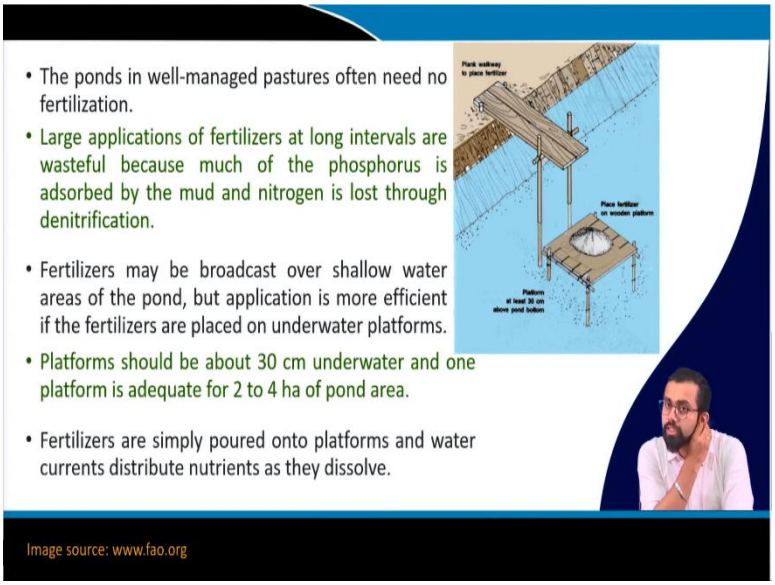

So in general, the ponds are well managed. If it is like well managed ones, often need no fertilization in general. Large application of fertilizer at long interval are wasteful because most of the phosphorus is absorbed by the mud, absorbed by the mud particle in the bentic region and also nitrogen is lost through the denitrification using the density of the new organisms present in the pond.

Fertilizers may be broadcasted over a shallow water area. Broadcasted messenger is just simply spread it but application is more efficient if the fertilizers are placed in the underwater platforms and all Okay!. platforms should be about 30 cm underwater and one platform is adequate for two to four hectare of pond area. Okay! The fertilizers are simply poured into these platforms and water currents, they will do all the other jobs like they will simply distribute the nutrients as they dissolve.

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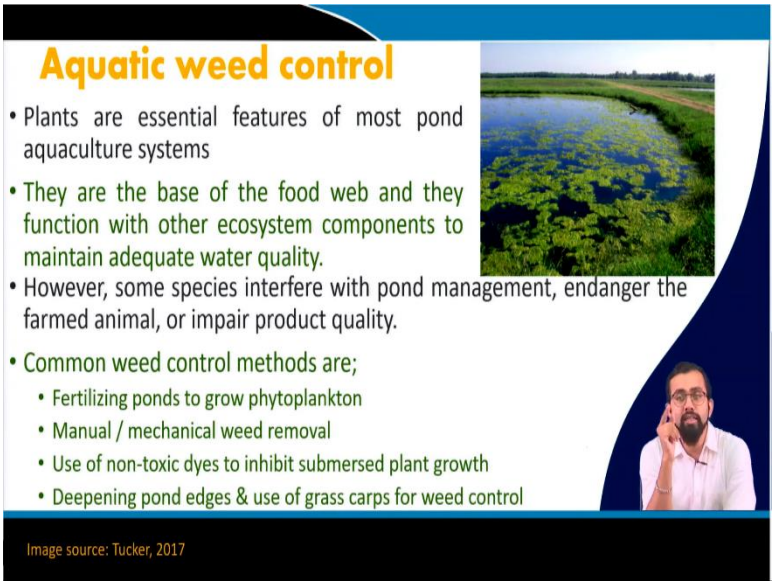

Another important thing for chemical fertilizer application is the aquatic weed control. Aquatic weed is it is like simply like weed is what? Weed means anything that is unwanted, anything that it may have some value definitely it may have some value, but it does not fulfil the requirement of your purpose. Okay! suppose in your case, you are culturing some specific type of crop, say like maize or say like wheat or anything, Okay! But instead of that, you are getting some crop which must may have higher value in terms of revenue or in terms of economic value. But it does not solve the purpose of you know your crop because you need to have culture that particular crop. Right? So, this aquatic weed control is very important. They are the base of the food wave and it acts as they function with other ecosystem components to maintain the adequate water quality also sometimes.

So, some species interfere with the pond management and endangered the farmed animal and impaired the product quality. That's why we go for these different weed control measures like we use the fertilizer sometimes to grow the phytoplankton so that the weed cannot grow manual or mechanical weed removal. We use non-toxic dyes to inhibit the submerged plant growth. We sometimes deepening the pond edges and use the grass cups for the weed control procedures.

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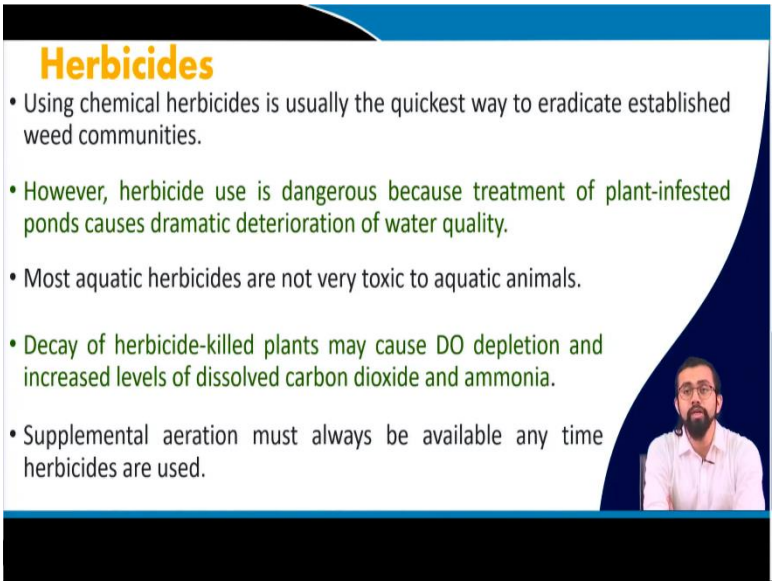

Other way of doing it is the herbicides. It is actually the quickest way to eradicate the established weed community. However, it is dangerous because sometimes if you treat it for long, it can drastically deteriorate the water quality and very toxic for aquatic animals as well. Decay of herbicide kill plant may also cause the DO depletion and increased level of dissolved carbon dioxide and ammonia. That is why supplemented aeration has to be available when you will be applying the herbicides in your pond. So, that is very important to take care like you know when you will be applying this kind of herbicides in your pond. Addition is already provided so at least the depletion of DO can be maintained.

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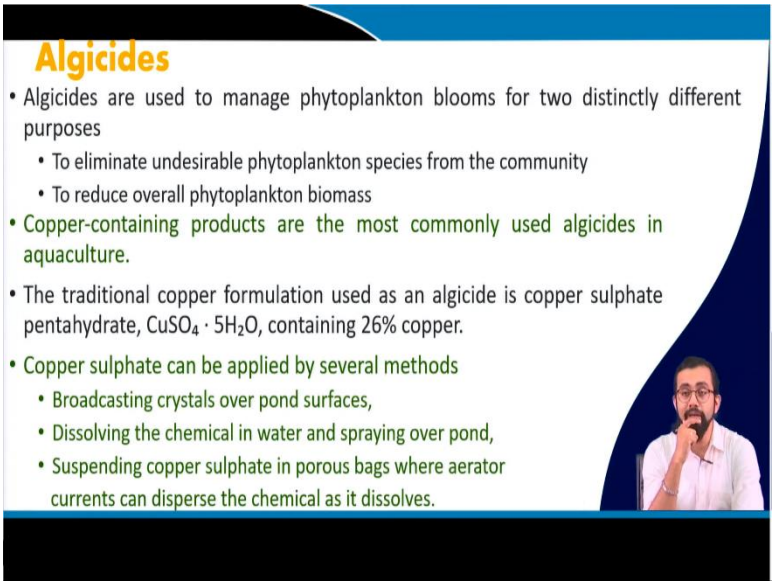

Other things definitely nowadays experts won't prescribe you to go for any kind of herbicides or pesticides or any kind of algicides also because any chemical utilisation at that moment of time, it will solve your purpose. Okay! But in case of emergency, you can definitely go ahead with this.

Algicides for the same reason where algicides, it will help you to manage the phytoplankton blooms in two distinct for two distinct purpose. First of all, to eliminate the undesirable phytoplankton species from the community. Second thing, to reduce the overall phytoplankton biomass sometimes. Sometimes what happens when there is a favourable condition so they actually try to bloom very fast. So, that has to be managed well and that is the reason why we go for these different kinds of algicides and all. Okay!

Mainly we use different kind of copper containing products, copper sulphates and all this, this is a very famous one. However, this copper sulphates pentahydrate that we normally use, it act as a very good algicides but it has a very drastical effect on the ecosystem. So, that is also I am telling you know again and again that you only go for these applications when it is utmost important, Okay! because this can disrupt the whole ecosystem and it can be toxic. It has a very high bioaccumulation capacity and which is not expected. Okay!

Copper sulphate can be applied in several methods. You can simply broadcast the crystals over pond surface, you can dissolve the chemical in water and spray over the pond or you can simply suspend the sulphate in polar backs where aeraotor current can disperse the chemical as it dissolves.

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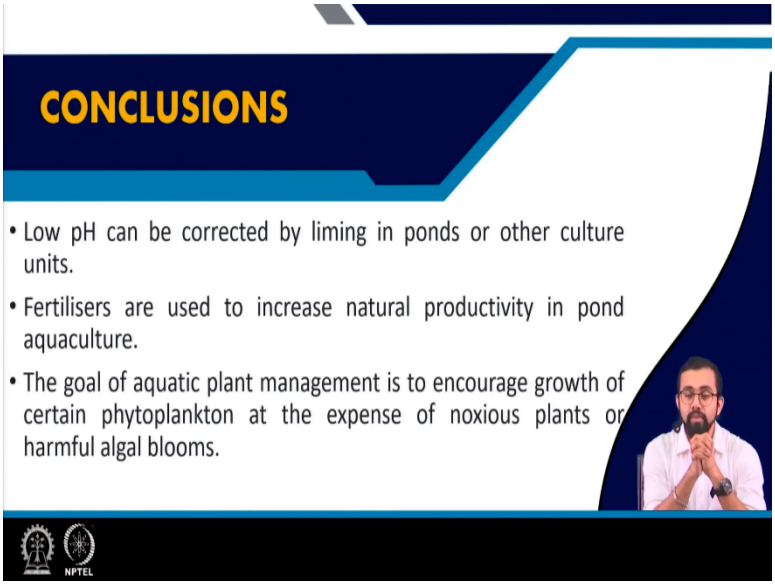

So, in conclusion, whatever we discussed, whatever the chemical methods that we discussed for water quality improvement, I would really suggest you to minimize these uses of chemical fertilizers or chemical methods. Go for physical methods, biological methods, chemical methods, you only go only when it is really important and in case of emergency only. And however, the liming is important, very important when we talk about it. So, initially liming and alum, you can provide it when the pH is up and down based on the pH availability, you can provide alum or the liming different limes.

So, alum can also help you with the maintaining the proper turbidity of clay turbidity level. But however, it fertilizes overall, it increases the natural productivity of your pond. However, it has to be optimally provided. The provision has to be maintained that the application of fertilizer is just optimum for supply of enough amount of natural productivity of your pond ecosystem. Okay!

In general, the goal of aquatic plant management is to encourage the growth of certain phytoplankton at the expense of noxious plants or harmful aquatic blooms. And all Okay!

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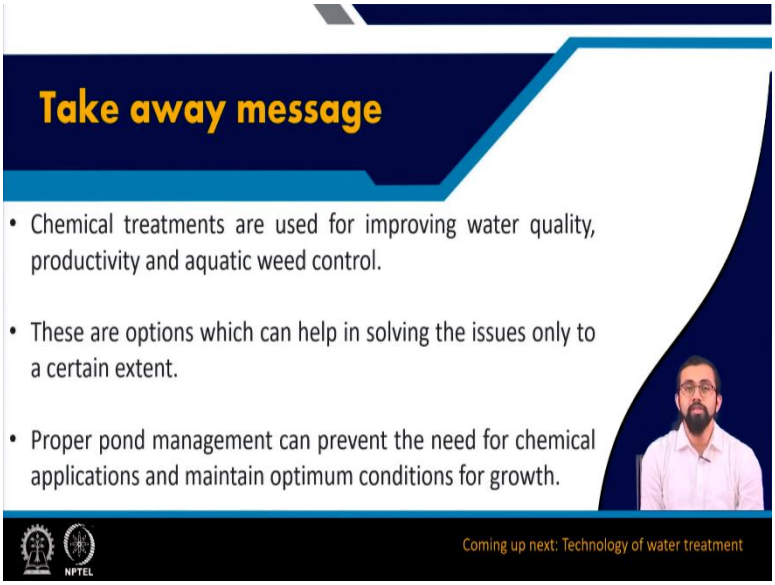

So what is the takeaway message from this lecture? That chemical treatments are used to improve the water quality and productivity and aquatic weed control. These options are helpful to solving the issue only to a certain extent and proper pond management can prevent the need of chemical application and maintain the optimum conditions for growth.

However, a very cautious application is very necessary, very much necessary. Okay! perfect. So, that is all for the day and we end up with this module. We will come up next with the technology of water treatment, different water treatment in the coming lecture material.

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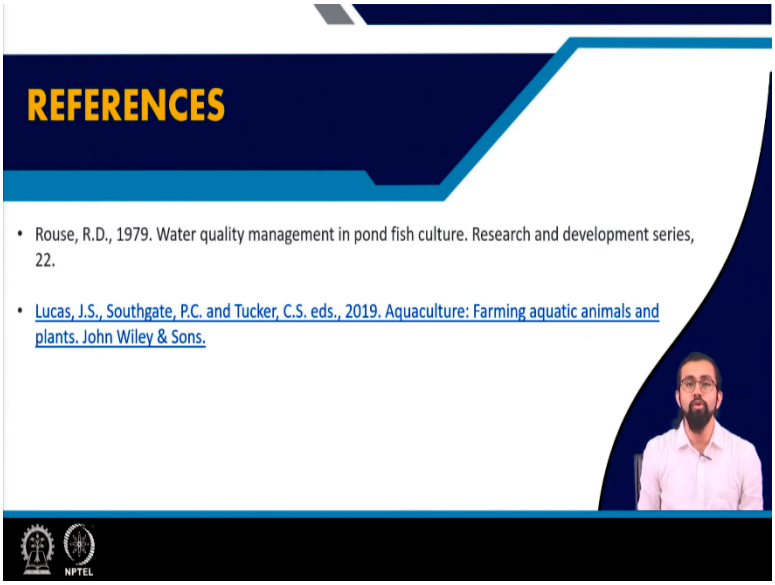

So, these are the different references that you can follow. Thank you so much. See you in the next module.