Water Economics and Governance
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Lecture - 15
Water Sustainability: Conflicts in Viewpoints

Hello everyone, in the previous lecture, we have been talking about the various viewpoints onto the water sustainability. We did talk about the various like viewpoints, including social viewpoints, environmental viewpoints and then economic viewpoints, and of course, technological viewpoint or engineering viewpoint.

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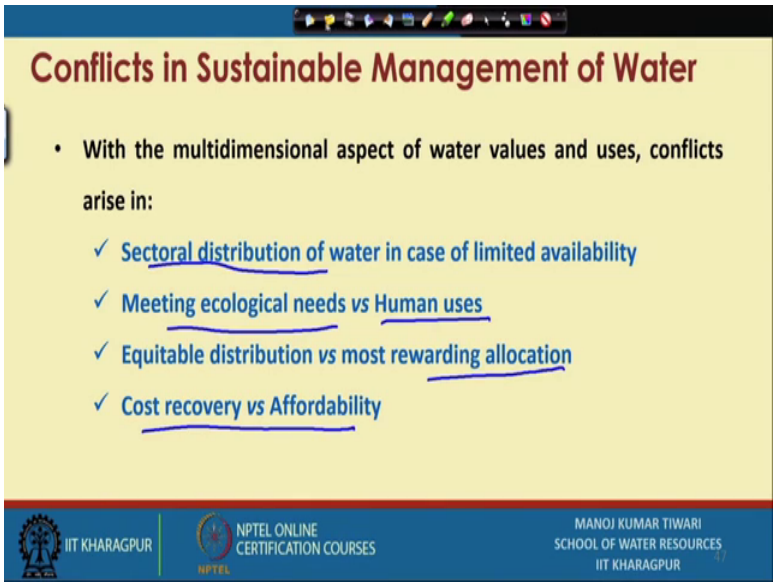

There is when we set up different objectives. For those viewpoints what we see that with multi dimensional aspects of water value, and uses there are various conflicts that arises in these sort of assurance of these viewpoints or assurance of the various objectives, which we have been discussing in the previous lecture ok.

So, if you; at times, what happens that if you go on to fulfilling your social objectives, you have to, you may have to sacrifice on the ecological or environmental objective or economic objective. Similarly go if you want to fulfill your environmental objective, you may have to sacrifice on your social viewpoints or financial viewpoints. So, all those things at times arise in terms of the conflicts, which is primarily, because of the multi dimensional aspect of water uses. So, water has multi dimensional aspect in term of uses,

and in terms of values as well. So, there is a domestic use of water. Again if you see the value within the domestic uses, there are different values, there is a value, there is a separate value for drinking water, which is priceless. One can pay any price for drinking water, if he is not getting that then there are four water needed for cooking, for bathing, for house cleaning, then for gardening. So, all these different uses, would sort of have fetch different values to water.

For example for drinking purpose you will be happily buy a bottle of fifteen to 20 rupees per liter water for drinking purpose, but if I say that you buy that water and put into your garden. So, people will not be willing to do that, because the value of water for that particular use for gardening use is not that high. So, you will not be able to, like provides the bottled water for gardening purpose probably; however, you can do that, you can sort of provide.

You can buy water for drinking purpose or even at times for cooking purpose. Apart from that, this is just from one sector domestic sector. Similarly there are industrial sector, there are agricultural sector, there are other sector, there are ecological demands of water. So, each demands of water may have a different value, and because of this, there are sort of multi dimensional uses, as well as multi-dimensional values. And this turns into the conflicts at time, which could be in the form of that sectoral distribution of water in case of limited availability.

So, when water is limited, how judiciously you will distribute water in the different sectors. So, that is your one major challenge over here. Then there is meeting of ecological needs versus human uses, that again turns could, that could again turn into a major conflict that whether you want to fulfill the ecological demands first or the human needs. So, then there is an equitable distribution versus most rewarding allocation? Most rewarding in terms of the finance. So, equitable distribution may not be the most rewarding, because if you are distributing water to a slum area or to a very low income group area, you will not be go for that high return from the those group as compared to, maybe in a sort of multi story residential complex.

So, that way equitable distribution, whether one should go for equitable distribution or most rewarding distribution, is also need to be seen. And then whether its one should go for cost recovery of the water utilities, or water systems or the affordability of water

systems, that also needs to be seen. So, this sort of can lead to the conflicts, the community wanting the demand, if it is unable to afford the expense then what to do ok.

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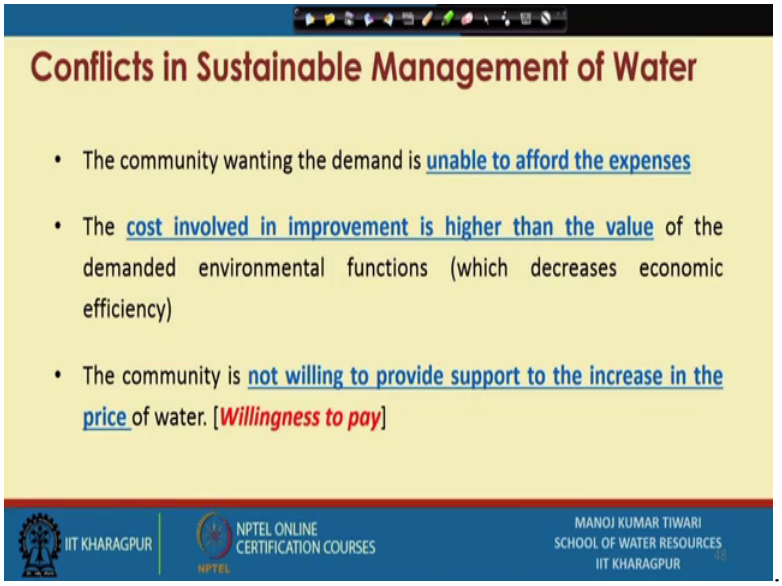

So, these are the sort of situations or scenarios when one, when a policymaker or when a manager, water manager has to take the decision on to sort of resolve a conflict between the different objectives of sustainable management of water. So, that is typically done through tradeoffs. We will talk about that.

So, one of such cases could be like the community to which water is being supplied, is unable to afford that expenses. The cost involved in the improvement is higher than the value of the demanded environmental functions. So, that could arise into this sort of thing. Then if community is not willing to provide to the increase in the price of water. So, there is a concept of willingness to pay. So, I like in management people do this very often that they study for a particular product or for a particular service, how much people are willing to pay. So, for product like the; this kind of studies, makes an important component in pricing, certain products or services, and same thing happens over here in water also. So, what if people are not willing to pay high tariffs. So, then what to do, because as per their right to water and right to sanitation. The water has to be provided to them at the affordable cost. And let us say a section may have, may not be able to afford that water; that is one aspect. Other aspect, even if community, a community is able to afford, but they are not willing to pay that much.

So, what you will do, whether you will withdraw your water services as a state, or as a government body; that is a big question. So, these kind of things at times turned into the conflicts, which could be in terms of either financial sustainability or economic sustainability or social concerns, what to look after.

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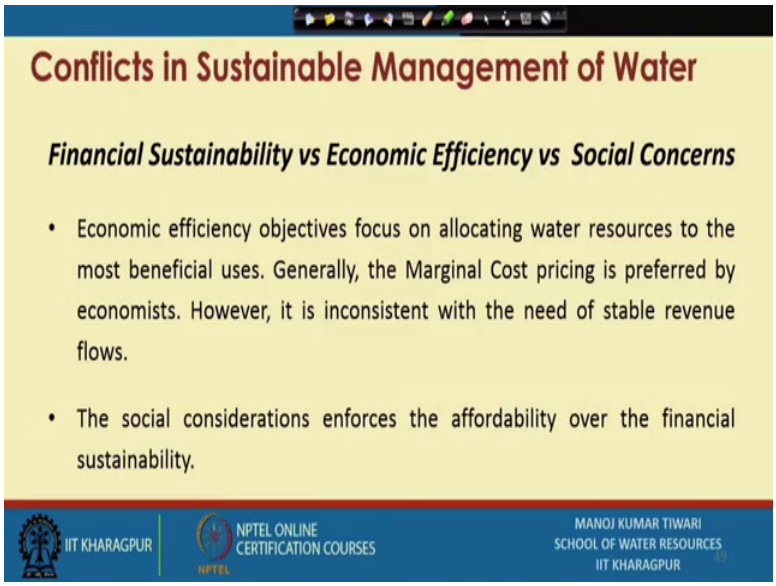

So, the economic efficiency objective focuses on to the allocating water resources to the most beneficial uses, as we discussed earlier. Generally your marginal cost pricing is preferred by the economist, but it is inconsistent with the need of stable revenue flows. So, that is the problem, then your social consideration enforces the affordability, while financial sustainability enforces for the cost recovery ok.

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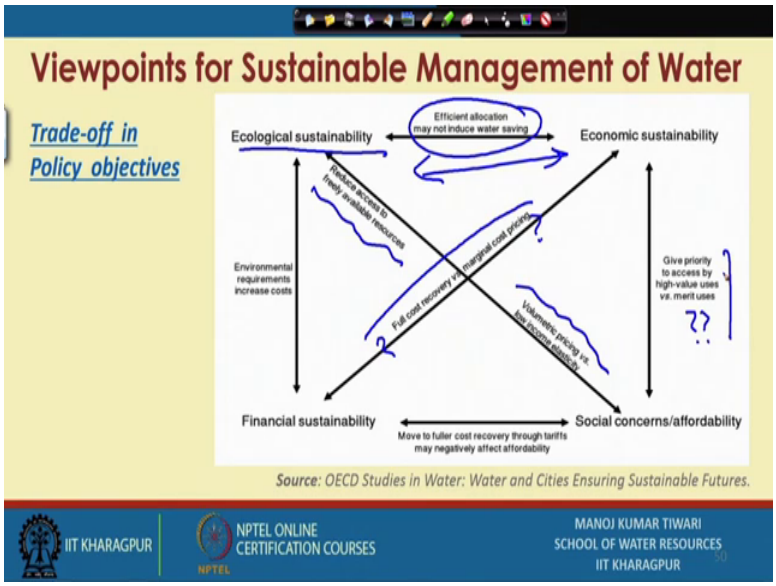

So, all this thing actually needs to be taken into the concept, and then one has to be tradeoff between policy objectives. So, if your policy objectives include ecological sustainability, economic sustainability, financial sustainability or social affordability or social concerns, then what to do. So, there are various tradeoff options. As you can see each of them could be sort of considered over there. So, if you see this ecological sustainability thing first. So, ecological sustainability and financial sustainability has a direct tradeoff relation, in terms of environmental requirements, increasing the cost what.

Actually it means that if you are living pure water, or if you are sort of putting environmental sustainability objective as one of your prime focuses. Then the cost is increased. For example, let us say you are, you want to discharge the sibylline, you want to discharge these city's sewage into some waterways into a river or into a lake or canal. Now what will happen that from ecological sustainability point of view that water which you are discharging should be treated to the best possible level? So, that it can match the resource polity, and does not deteriorate the quality of the resource.

Now, for meeting those requirements for go, for sort of fulfilling those requirements, or meeting those requirement, one must treat that water which has its own financial implications. So, if you want to, go treat water to its natural or pristine level. It will increase your cost huge. Now your financial sustainability suggests that the cost should be kept as low as possible, but your economic, or sorry ecological sustainability suggests

that the system or the discharge, or the whatever water services in perspective to the environment should be as clean as possible. So, at one point of time, you will have to make a tradeoff between the two, whether you want to go for ecological sustainability. Means you will, then you have to invest more in terms of treatment. And those things which will likely to make your system, maybe financially unsustainable at times or financially not that rewarding or cost expensive in those sense. Or if you want to go for cost saving, you will allow little polluted water also to be discharged into the environment ok.

Which is not fulfilling, which is against your environmental objective. So, you will have to tradeoff between these two; that is one aspect. Then you can look for a tradeoff with economic sustainability as well of ecological sustainability again. So, you will see that if you go for economic sustainability, as you are saying that economic sustainability. What it wants. It wants to the purest, like to the most rewarding, most rewarding uses to prevail more. So, it suggests, economic sustainability suggest that you allocate your water to for a particular use, which is most rewarding, but ecological uses are not rewarding, at least in monetary terms, or there could be many intangible gains of environmental sustainability, but tangible benefits are limited. You cannot count those benefits that this particular is the gain.

Ah intangible terms, it is very difficult actually. So, if you are not accounting for those intangible benefits, you may see that it is not that rewarding or that financially justify that recoverable as to supply water for other uses. Maybe for agriculture maybe for industrial or those kind of uses. So, your economic sustainability will suggest that you allocate more water for other applications, while ecological sustainability will suggest that you leave significant amount of water for environment purpose. So, this tradeoff between these two kind of needs to be considered at times, then for ecological sustainability you have tradeoff with social concerns or affordability as well. So, again whether you are, you want to leave water to the resource itself, or the economic for the environmental uses, or you will go for, you will abstract more water leaving more impact on environment, but fulfilling your social concerns ok.

So, those kind of things are there. Then similarly you can have a tradeoff between economic sustainability and financial sustainability, whether you are going to full cost recovery or marginal cost pricing. So, what kind of system you are willing to put into the

practice. There could be a tradeoff between economic sustainability and social concerns. So, give priority to access to the high value uses or to the merit uses. Merit uses means thus more socially relevant uses or the high value uses. So, those kind of tradeoff decision has to be taken at times. Then you can have a sort of between financial sustainability and social affordability as well. So, these are some of the decision that needs to be taken at times.

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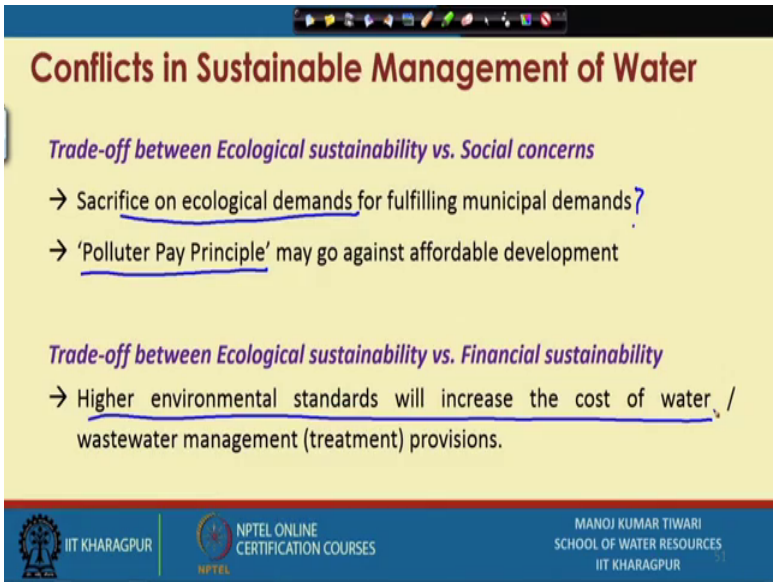

If you see these tradeoff in specific. So, there is the tradeoff between ecological sustainability, and social concern will cover whether you sacrifice on to the ecological demands for fulfilling the municipal demands.

So, that kind of tradeoff question will come in between that what to choose, or for what to leave. Then there are pollutant polluter pay principle, or this kind of systems may go against affordable development from for a society. So, a polluter pay principle, actually is a concept where if someone is polluting the environment. Let us say small industry or small scale industry, which may not have sufficient resource or infrastructure for treatment of their waste, or they are affluent. They can discharge it into the. They can be allowed that concept has been adopted much into the western countries. So, they were allowed to discharge the effluent into the natural systems, into the environment, whether a water body or whatsoever.

But they had to pay the price for that price for the reclamation. So, that was known as polluter pay principle. So, if somebody is polluting a resource, he has to pay, he has to pay two states in form of taxes, or in form of some price. So, that kind of taxes or that kind of that, kind of fines imposed onto the polluter, may go against affordable development. Particularly with the small scale industries. So, if somebody is, let us say having a small set up, small system putting up water generating, may not be generating too much of profit, and if government enforces him to pay these kind of prices or these kind of. For these kind of services he may eventually, it may eventually not go well with the social objective of the development ok.

Similarly, there could be tradeoff between ecological sustainability and financial sustainability, which suggests that higher environmental standards, will increase the cost of water or wastewater management treatment provisions. So, again the thing that we were discussing, that when you look of the tradeoff between ecological sustainability and financial sustainability. So, you will have to see that how much cost is increasing, if you are enforcing the higher environmental standards, in terms of release or in terms of, sort of overall holistic management. So, wastewater being released to the let us say river. If you stringent your river discharge or waste discharge norms for a river body. So, that will; obviously, increase the cost of the treatment procedures, which eventually will increase the overall cause or the tariffs, and this kind of things.

So, that is going to the effect the other as other objectives as well. So, this kind of tradeoffs are to be, are have to be make at times.

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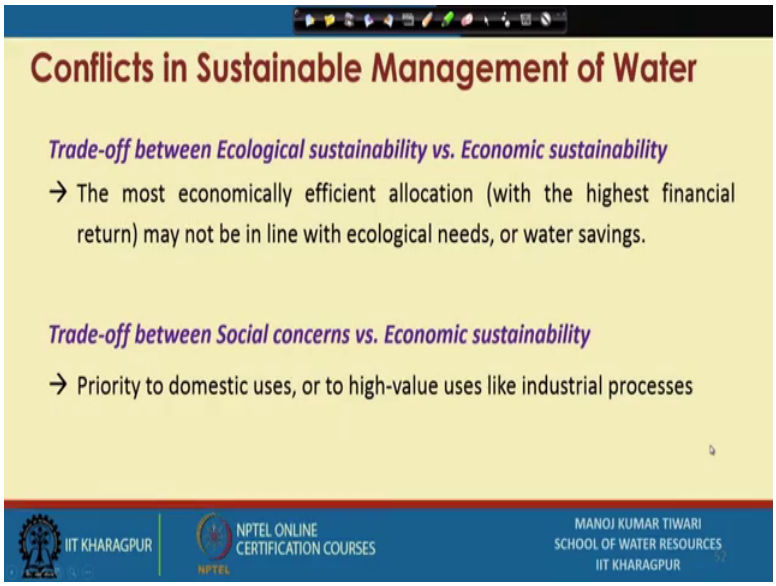

Then there is between ecological sustainability and environmental sustainability.

So, the most. Again the most economically efficient allocation, which is with the highest financial return, may not be in line with the ecological needs or water saving. So, that is we discussed this earlier, it is very obvious, then there has to be tradeoff or at times between social concerns versus economic sustainability. So, there we give priority to domestic use or high value uses. Like industrial processes. This has to be, this kind of decision has to be made. So, although your economic sustainability suggests that you go for high value uses, like industrial processes, but social concerns suggest that priorities should be given to the domestic uses. So, there you are trading of your economic sustainability, objective with social concerns. So, you are giving more priority to social concerns, at the cost of, at the cost of economic fulfilling. The complete fulfillment of the economic sustainability objective.

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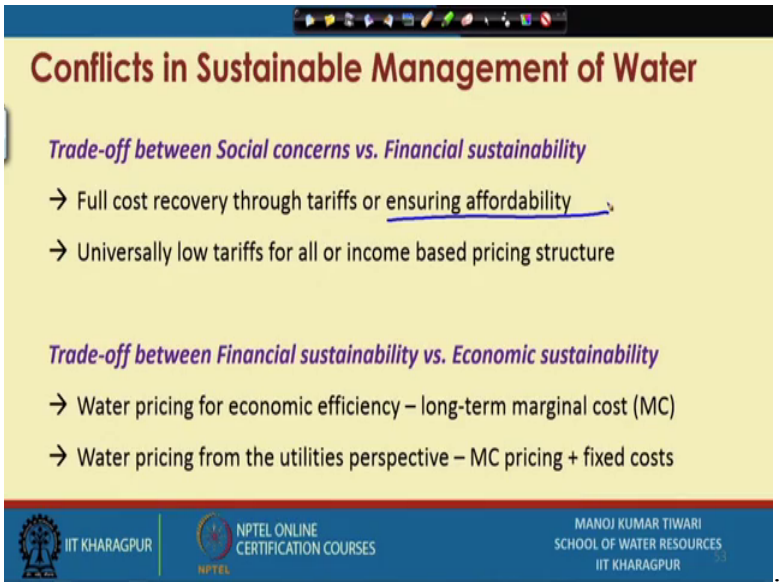

Ah then there could be tradeoff between social concerns in financial sustainability. So, whether go for full cost recovery through tariffs insuring of, or ensure affordability. This is again a very sort of important decision that people has to make at times. If you go for a full cost recovery, you will set a tariff, which would be wood, which would ensure the entire recovery of the expenses that you are doing in the water services. So, starting from putting water from the source, then its treatment purification, then supply system. So, lot of investment is being made. Now if you said the tariff accordingly, it could be very high. For example, the Chennai, if you see the treatment, because part of Chennai is fed with the. There are two big desalination treatment plants that are working in Chennai, where the seawater is obstructed and desalinated and then supplied.

Now, this cost of desalination is very high, because they have to be basically go through ro, and this kind of setups. So, the eventual cost comes over 60 rupees per kilo liter, or in fact, higher also. At times this is just operation and maintenance cost, it does not include the installation and infrastructure, and all those things it does not include. So, your onm cost or operation and management cost itself could be that high. So, that it sort of gives, it gives this much of, this much of target for the recovery for onm cost, but 60 rupees per kilo liter is a too high tariff to be sort of, to be beard by the deprived people or low income group people. So, if you want, if you see your financial sustainability criteria. So, you should sort of aim to recover that 60 minimum plus the installation, and all those

cost further. So, that way tariff will be too high, but even if you consider, just recovery of the operation and maintenance cost.

So, you should be charging 60 rupees per kilo liter of water from the households. If you imagine a household using just 20 kilo liters of water will have to pay 1200 rupees per month for water charges. Whereas, , if you see the low income group people would not have that much of income to, or would not be willing to pay 1200 rupees for just water charges, that to considering just 20 kilo liter per month uses. If uses are higher, one has to basically pay, further this may not be affordable, but your financial sustainability demands this. So, one has to again tradeoff the financial sustainability at the, for the meeting their affordability targets, which is one of the social concerns, because socially the water which is being provided should be affordable ok.

So, that kind of tradeoff is needed at times. So, in order to make the water affordable you will cut down the tariff. Now if you are cutting down the tariff. So, its not a financially sustainable system, because you are investing more and recovering less. So, then you will have to rely on government subsidies, or other revenue sources for management or maintenance of these type of services, which itself could be challenging task. Then for a [lo/long] long period of time, the universally. Then there is another choice at times, you have to make is whether you go for universally low tariffs or income based pricing structure. So, in order to make affordability, let us say I use or in order to make financial sustainability, one model you could adopt that. Let us keep that price to 10 rupees per kilo liter for lower strata people, and the balance of the 50 rupees per kilo liter will put onto the people from higher income groups.

So, higher income groups would be paying, let us say 100 rupees per kilo liter, and the lower income group paying some 10 20 rupees per kilo liter. This kind of pricing structure can be a model, but is this a Weibull model. So; that means, whether you are going universally low tariff, means if you are cutting down tariff for everybody. So, bringing in government money or revenue from other sources in, and then subsea government subsidies, all that across the population, or you are sort of putting income based pricing structure for a finance financially sustainable model, where you are giving discount to low income group people, but recovering that amount from higher income people group that may be financially sustainable, but it is not socially equitable, because

a certain group of people is paying more or its paying for the water used by certain other group of people.

So, again this is not going to work in a long term people, who are capable of pay or people who are capable of paying, should not be in forced to pay for others. Somebody's earning more money does not mean that he is forced to give his money for some other purposes. So, of course, he can be charged at a sort of whatever tariff is justifiable, but should not be forced to pay for the others. So, that is again not a socially sustainable model in that case, whether if you are going for financial sustainability, it may not remain the socially sustainable. So, those kind of questions are to be seen in terms of sustainable water management, and then there could be tradeoff between financial sustainability and economic sustainability.

So, water pricing for economic efficiency or long term marginal cost should go on long term marginal cost, or water pricing for the utilities prospective, where you see the expansion and all these of utilities the construction of utilities. So, how you like for full sustainability. If you are going for full financial sustainability, you will have to see that you do not only charge for onm, but for initial investment, then provisions for future expansion, and all these is to be charged properly, and then you go for marginal cost pricing plus some fixed cost. Again how sustainability is in terms of socially is a questionable. So, all these like the conflicts arises between the objectives of water utility between the four major objectives of the water services, and then a tradeoff between. I can sacrifice on this part, but this like, let us say you consider the socially prime uses are of the most importance.

So, whether you have to sacrifice in terms of your, in terms of your financial sustainability, or in terms of your ecology environmental sustainability, you can sacrifice a little, but put maybe most priority to the social concerns first, then you can give priority to environmental concerns, considering that resource deploitation or resource degradation would have a lot more environmental cost in long run. So, you can actually tradeoff your financial sustainability objectives. The short term financial sustainability objectives with your long term resource protection objectives, and that is why you probably should give more priority to the environmental objectives, then your financial and economic objectives.

So, those kind of questions are to be taken up. So, this sort of ends our discussion on to the sustainable management of water. So, we did talk about what are the different aspects of sustainability, then throughout this week I am talking about. So, we did talk about the introduction, then we did talk about the major documentation in terms of Dublin statement on to the sustainable water this thing. The Dublin agenda discussing about the different aspects of a sustainable development, then what are the key elements, and sort of key viewpoints of sustainable management of water. What are the basic objectives that are kept in mind for ensuring the sustainable development, and what kind of conflicts could arises, and how they are deal with inter objective tradeoffs in the field of sustainable management.

I have framed a couple of. I have framed a couple of questions also.

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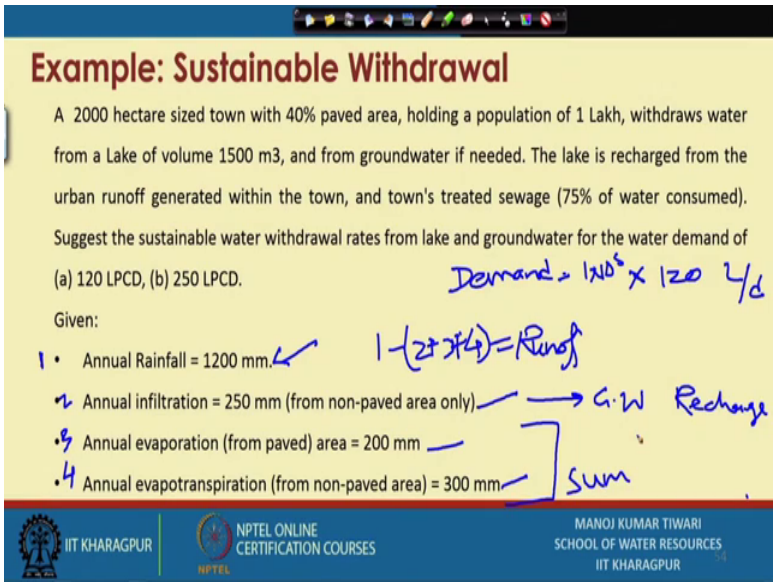

So, which are example questions will not be able to solve this here, but I will just give you an idea of how to deal with these kind of problems. So, for example, this talks about a 2000 hectare sized town with 40 percent paved area, holding a population of one lakhs which the withdrawal water from a lake of volume 1500 meter cube and from ground water, if needed the lake is recharged from urban runoff and towns treated sewage, which is 75 percent of the total water consumed, and then you have been given certain data onto the rainfall infiltration, evapotranspiration and this kind of thing.

There are water demand is given two cases; 120 L P C D and 250 L P C D. And you have to suggest the sustainable water withdrawal rates from lake and groundwater if needed. So, how you are going to approach this, you see that you have annual rainfall given. So, and you know that annual infiltration rate is also given. So, for ground water, this infiltration will act as a groundwater recharge. Now this infiltration will act as a groundwater recharge. So, you can estimate that for a 2000 hectare sized with 40 percent paved area. Now infiltration will take only from non paved area. So, 60 percent of 2000 which is 1200 hectares area be the infiltration rate of 250 mm annually. You can say that how much annual recharge this groundwater is receiving, and that is the maximum cap for a sustainable withdrawal from groundwater ok.

Ah for lake purpose, you see that 75 percent of water returns, 75 percent of the demand. So, demand 120 liters per capita per day you multiply this with the population, the population is one lakh. So, you multiply this 120 with 1 lakh. So, that way you can estimate the total demand. So, your total demand is going to be one lakh, which is 1 into 10 to the power 5 into this. You can take either a or b whichever case you are solving. So, into let us say 120 L P C D. So, this much is the population, and this much liters per capita means per person per day is the demand. So, this much liters per day is the total demand. You can convert it across a year. So, that is the total demand of water in a year or you can do it on a daily basis also. If you want that way of this 75 percent returns to the lake, and runoff can also be estimated we know that total rainfall. So, this is the source of water inflow into the catchment area, then there is evaporation from the paved area this much and evapotranspiration from the non-paved area this much.

So, paved area is 800 hectares, and non-paved area is. Sorry your paved area is 40 percent right. So, paved area is 800 hectares and non-paved area is 1200 hectares. So, 1200 hectares evapotranspiration losses is 300 mm, and from 800 evapotranspiration losses is this. So, this will give you the total evapotranspiration loss, you sum this up, you will get the total evapotranspiration loss, then from the. You already know; what is groundwater recharge what has gone to groundwater recharge. Now from rainfall from number one, let us say you subtract 2 plus 3 plus 4. So, 1 minus 2 plus 3 plus 4 would basically give you the total amount of runoff, which is eventually going to the town, which is eventually going to the lake. So, this is the amount of water which is lake is

receiving from the runoff and 75 percent of this demand is the lake is receiving from the wastewater treated wastewater discharge.

So, how much total amount lake is receiving that you know that would be the maximum withdrawal amount from the lake. So, you know the maximum withdrawal amount from the lake. You know the maximum withdrawal amount from the groundwater recharge. So, for these two demands you can figure out what source you should look after. So, that way you will be able to deal with this.

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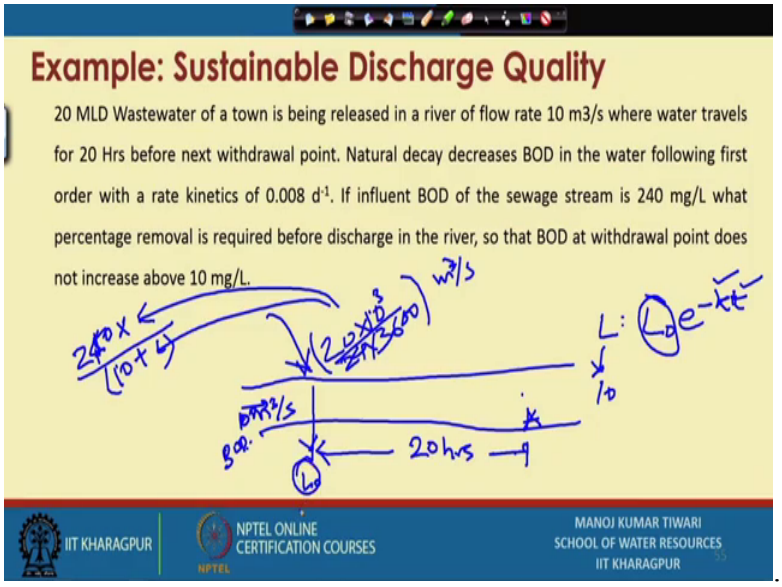

There is another small problem, which says that there is a wastewater discharge is being done in a river, where there is a flow rate of river and flow rate of wastewater is also given. So, considering instantaneous mix, we can know; what is the quality of the water, quality of the river at that particular. This is the river and you are having industrial outfall meeting here. So, this is your 20 m l d 20 million liters per day came and. So, this needs to be converted to 20 into 10 to the power 3 meter cube. And then you convert it to 24 hours and 3600 seconds. So, this will be converting to meter per meter cube per second now, and you have a basically flow into the river which is given to you 10 meter cube per second let us say. So, this is flow into the river. So, just by a simple mass balance you can compute what would be the concentration of B O D here, ignoring any previous beauty in the river water.

Then the next withdrawal point is somewhere down the line, let us say this is your next withdrawal point for example. So, it takes some 20 hours for water to reach here and in this 20 hour there is a natural decay. So, whatever initial B O D here or initial pollution level here, B O Ds by the way biological oxygen demand which is measure of a organic form of pollution in the river. So, whatever B O D here will undergo natural decay, following first order and that will be sort of that initial level is 240 here. So, by a mass balance one can find out, here the B O D level. So, this one is having let us say 240 milligram per liter into the flow from whatever flow is coming here, divided by the total flow this 10 plus, again the flow which is coming here.

So, that will be summed up considering B O D 0 here, considering B O D 0 here. So, that way we will be able to find out, and then following standard first order kinetics, we can know what is the, what would be the b o d at this point of time. Now that question says that B O D should not be more than 10 milligram per liter. So, first order decay is, let u s say if you consider b o d has l. So, l is equal to l 0 e to the power minus k t, t is given to you. How much time it takes, k is given to you. Remember k is per day and t is hours. So, you convert this hour to day. So, k t is given to you, is given to you. This has to be maximum 10; that is given to you, that at this point it should not be more than 10. So, you can figure out that what l 0 is needed here at this point, and this is your initial b o d.

So, what percent is to be treated? So, that percentage can be estimated. This question can be again further discussed over to the forum, and there we can provide you the complete solution. We will recommend that you try this out first by your. So, with this we will end this discussion on to the sustainability and next week we will talk about the water price.

Thank you.