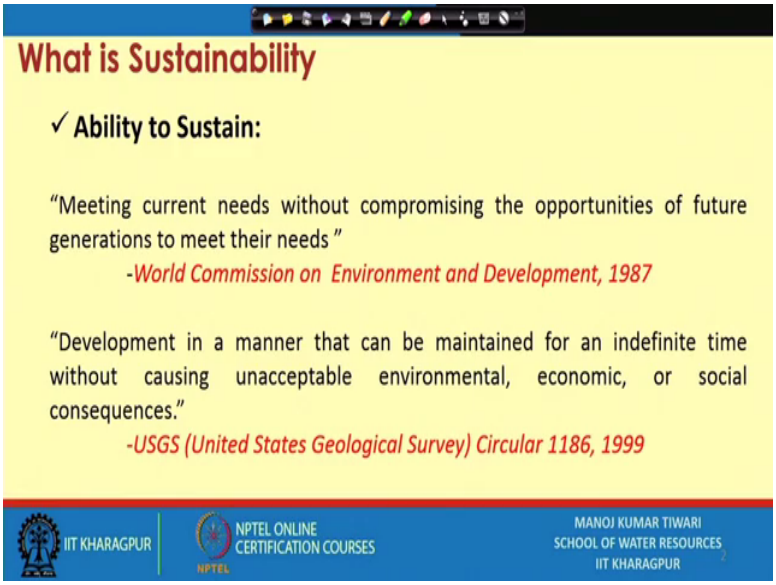
Water Economics and Governance
Prof. Manoj Kumar Tiwari
School of Water Resources
Indian Institute of Technology, Kharagpur

Lecture – 11
Water Sustainability: Basic Concept

Hello everyone. So, earlier we have been, in the previous week basically we have been talking about the right to water and sanitation and then point was put forward which is one of the basic underlying principle of human rights is on to the sustainability. Now, sustainability is a very broad term is actually in fact, if you see it is one of the most used terms these days, sustainable development, sustainable goals, sustainable practices. So, there is a lot of talk on sustainability.

So, this week in our subsequent few lectures, what we are going to talk about the sustainability in terms of water or what we typically called water sustainability. So, we will be basically discussing throughout the week about the various basic concepts of the water sustainability and then its sort of various aspects what it exactly mean, how it is important, why it is important, all these things will be basically talking about.

(Refer Slide Time: 01:47)



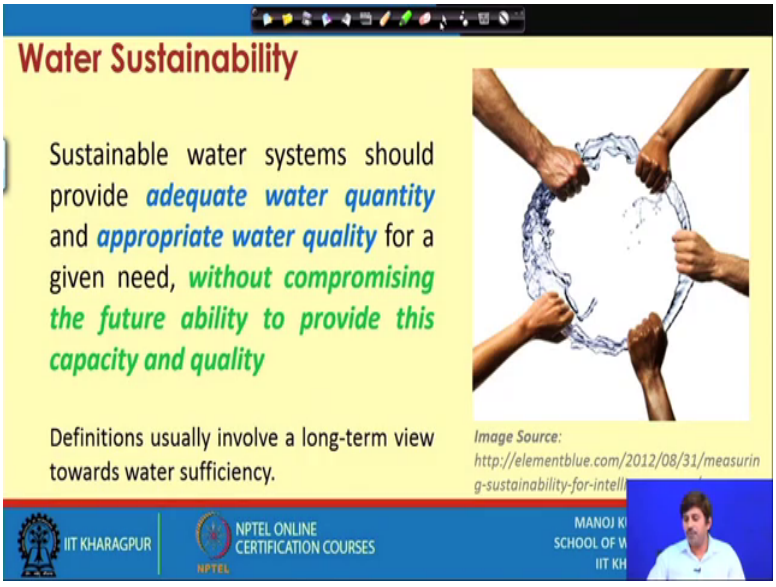
So, to start with, what is sustainability? So, sustainability as if you basically dissect this word sustainability, so, you get that sustain and ability. So, sustainability in fact, means that ability

to sustain. Now, ability to sustain means ability to sustain for what, for how long? So, there has been basically several definitions being given for on to the sustainability. Some of the prominent one is, when we utilize mostly the sustainability is practiced in terms of resource utilization. So, utilization of resource in a sustainable way, particularly when we are talking about the water resources, when we say that water sustainability we are basically talking about the sustainability of water resources.

So, what sustainability is? Basically, there has been a statement by the world commission on environment and development in as early as 87. So, it was said that meeting current needs without compromising the opportunities of future generation to meet their needs. So, that is what sustainability is. One should be able to meet its current need without compromising the future needs. That is what is the basic definition of sustainability it has been put forward in different manner also, like USGS which is United States Geological Survey circular says that, the development in a manner that can maintain for a infinite time without causing unacceptable environmental economic or social consequences.

So, that is what was considered as a sustainable development. So, that basic sustainability definition says that we should be able to utilize or use a resource or grow or develop in such a fashion that we do not pose a threat or we do not hamper our resources and so that our future generations are able to get all those resources for their needs as well.

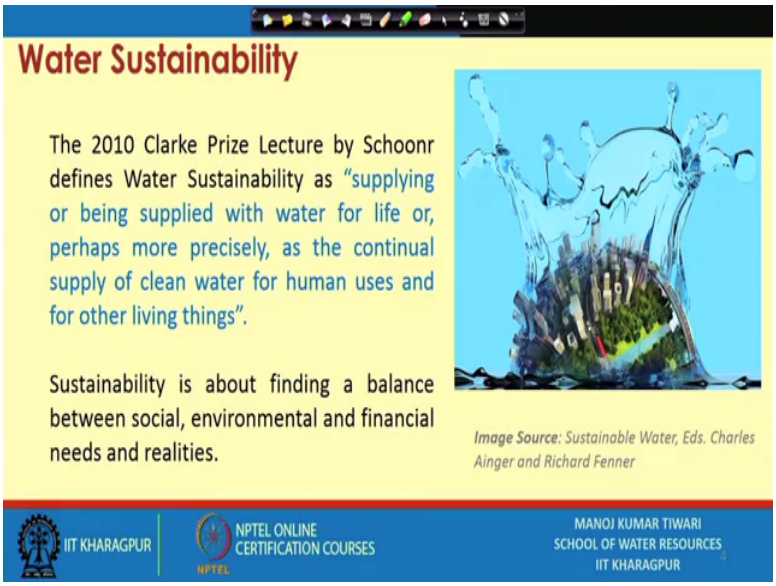
(Refer Slide Time: 04:14)



When we talk about the water sustainability, so, water sustainability is essentially like the definition which is usually incorporates a long term view towards water sufficiency. So, as we have been talking about for any other resource similar is about the water resource that water sustainability is using water in such a fashion that water is available for future generation use for a long time. So, this long term sufficiency if you see that water sufficiency is what basically the important aspect of water sustainability is. So, water sustainable system should provide adequate water quantity and appropriate water quality for a given need without compromising the future ability to provide this capacity and quality.

So, now it is not about just the quantity it is about the quality also. So, when we talk about the sustainable uses of water resources, we do mean that the water similar amount of water should be available for future generation, but that does not mean we basically that does not mean that although we are leaving the water, but we are not bothered about the quality of water. It should be similar amount and of similar quality as well or better quality. So, that is very important for sustainability point of view.

(Refer Slide Time: 06:00)

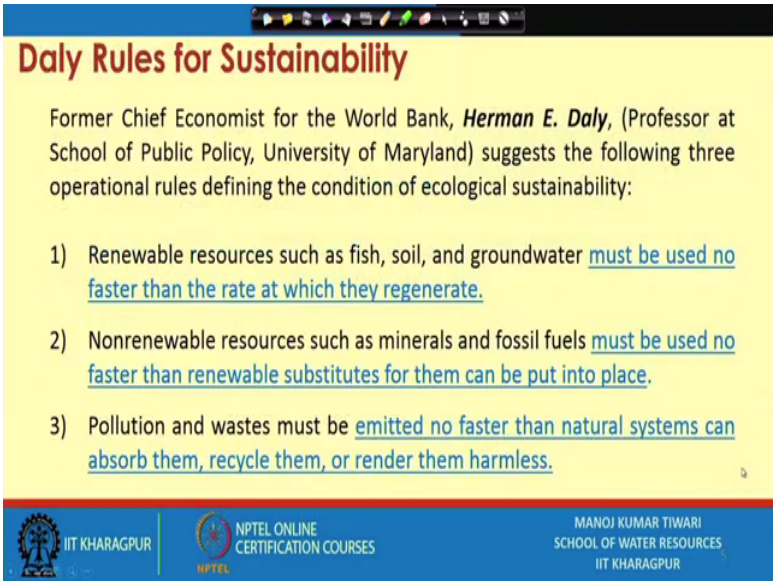


Now, in 2010 the Clarke Prize lecture which was delivered by Schoonr. So, he defines that water sustainability is supplying or being supplied with water for life or perhaps more precisely, as the continual supply of clean water for human uses and for other living things.

So, that incorporates sort of ecological sustainability overall. It is not you are not bothered about the human uses, because many times we are very self concerned. So, we do talk about the amount needed for our own uses or uses of the human being; however, there is a requirement of nature as well. There is an ecological requirement of water. So, when we plan or when we develop policies we should think about this ecological sustainability as well, ecological need of water as well. It is all indirectly linked because many people have their survival depending on to the aquatic ecosystems.

So, if we, let us say, we have water in a river and we are thinking we can take water for our uses and leave that much of water only which is their available for our future uses that may not be the sufficient, because there is a ecological need as well. There is a need of the nature, need of the plants, need of the fishes, aquatic organisms, so, all those things should be basically incorporated. So, it is about finding a balance between social, environmental and financial need and realities. So, that is what the water sustainability is basically.

(Refer Slide Time: 07:56)



Now, there was a former chief economist of World Bank mister Herman E. Daly, which is actually professor at the School of Public Policy at University Of Maryland. So, he suggested the 3 operational rules defining the condition of ecological sustainability. So, these 3 rules were again in the line of the basic concept of sustainability, as we have been talking about that what sustainability is.

So, his these rules first of these 3 rules actually talked about the renewable resources, it was not only for water it was for all resources. So, renewable resources any of the renewable resources like fish, soil or ground water must be used no faster than the rate at which they regenerate. So, that is one of the very sort of underline operational rule or concept for sustainable uses of resources.

So, for a renewable resource one should use one should basically extract that resource like for example; water if you are talking about, so, the groundwater should be taken up or should be extracted not more than the rate at which it is basically getting recharged. So, all the like resources all the renewable resources the rate of using these renewable resources should at max be equal to the rate at which they regenerate. It could be lower also that is even more fine, but it should no case be faster because if it is the rate of usage is faster than the rate of regeneration, we are eventually going to lose on to the total quantity.

Then, there are non renewable resources such as minerals and fossil fuels which are generally non renewable resources. You can see the status of coal we have not left with a significant amount of coal reserve now. We have been using for so many time and now the coal reserve will barely last for 150 years. So, the non renewable resources minerals, fossil fuels all that must be used no faster than the renewable substitute for them can be put into the place. So, that is another aspect where, it says that the non renewable resource what we are using should be used at a rate considering that how fast we can find alternative for this alternative renewable resource for this. So, that again the prospect of future uses are not compromised with which is one of the basic underlying principle of the sustainability.

The third point is about the pollution and waste must be emitted no faster than the natural system can absorb them, recycle them or render them harmless. So, that is quality prospective in terms of ecology where it says that the pollution that is being generated or waste that is being discharged into the system should not be basically, should not be faster the rate should not be faster than the rate at which our nature can absorb them, recycle them or convert them in metabolic sort of decomposed them naturally. So, that is another important aspect.

So, these were the 3 operational rules for sustainability. Now, if we evaluate the scenario based on these 3 rules you will see that where we stand. For example; let us take our groundwater resources as a renewable resource under the first underlined principle. Now, if you see there. So, we have been basically discussing these and seeing these. This is a very

like issue of national importance that the depletion of water table. Water table is depleting very fast at few places the water has gone down below say below 1000 meters, actually 1000 to 1100 meters. So, if we want to pump water from that depth it becomes very cost extensive process and naturally non sustainable process.

Now, why this depletion has taken place, because we have a certain rate of groundwater recharge which usually is through rainfall precipitation occurs and then quite a few of water goes into the groundwater we have discussed this in the first week of this lecture also. So, the rate of groundwater recharge there is a certain rate of groundwater recharge which depends on the precipitation then our soil composition in rate of infiltration all these in combination covered sort of covers that how fast they grow water recharge will take place.

Now, if we are extracting water at a much faster rate, we are bound to lose the total amount of groundwater which leads to the groundwater depletion and eventually lowers the water table and that is what has happened. Similarly, if you see in terms of pollution the river and all that has some self cleansing ability, because waste is being discharged into our waterways or into our nature since ages. It is not a new concept, but that time the amount of waste was less. The rivers were in a better position or better shape.

So, there is a some self cleansing ability of river through which if you put a waste into the river it can decompose; particularly, the organic wastes and all these can be decomposed and by the time river like by as the river flows in the downstream these pollutant level will keep on decreasing, at a certain time it could actually come into this natural state. It still happens like if you see the quality of water where some waste line or sewer line meets the river right downstream of that is very pathetic.

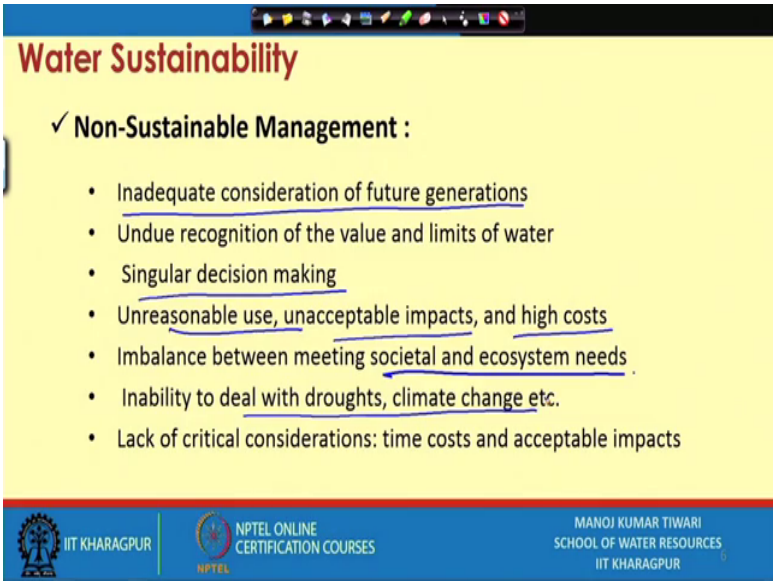
So, all major cities like if you see the quality of water in Ganga this downstream of the Kanpur it will not be that great, but if you see the same if you basically by the time this water travels upstream Allahabad, it would be of better quality. It is not of that great quality now, because the river is losing on to it is self cleansing ability, but still it will be of better quality because some politics would actually undergo natural decomposition.

So, waste put through the soil again gets decomposed and form soil mineral mix in that can be converted to soil organic matter and this kind of thing. So, nature has its own system of dealing with the waste, but it deals with that waste at a particular rate and it can deal only a particular quantity. If we generate or throw more waste then it is capacity of the nature

capacity of a river or capacity of a soil system it is bound to get deterioration of the quality of that particular natural system, be it a river or be it a soil system or be it any other system, a lake or anything or even groundwater.

So, that again is a not a sustainable practiced. For sustainable practice we should only throw that much which can be dealt with the nature, we should only take that much which can be given back to the system through its natural ways of regeneration or recharge. And, for non renewable we can we should basically reduce the rate we should at least plan to use at a rate only when we are able to find some suitable alternative for that.

(Refer Slide Time: 16:49)



Now, there are various non sustainable management practices some of which we are talking about, if you see they include the inadequate consideration of future generation. So, when we are extracting groundwater we are not thinking that groundwater is depleting that rapidly that fast what will happen to our future generations. So, that is one problem. Do not give adequate consideration to our future generation. Then, there is undue recognition to the value and limits of water. So, that particularly means we do not recognize properly what is the value of water and what should be the limit of water one can use or one can basically do this. We will talk about this in great detail when we go on to discuss about the water crisis.

The singular decision making; so, the decision making is not holistic, only one people or one typical government or this can basically make a decision on to the water uses. I can make a

municipal commissioner or this planner can make I will draw this much of water from the city, that should not this much of water from a river for water supply of a city or for irrigation purpose, I will take this much of water for the this canal or I can basically pump whatever amount of groundwater I needed from my own land area. So, this is this singular decision making system is harming the sustainability very badly and water being a sort of multi institutional subject, decision making should also involved multiple stakeholders.

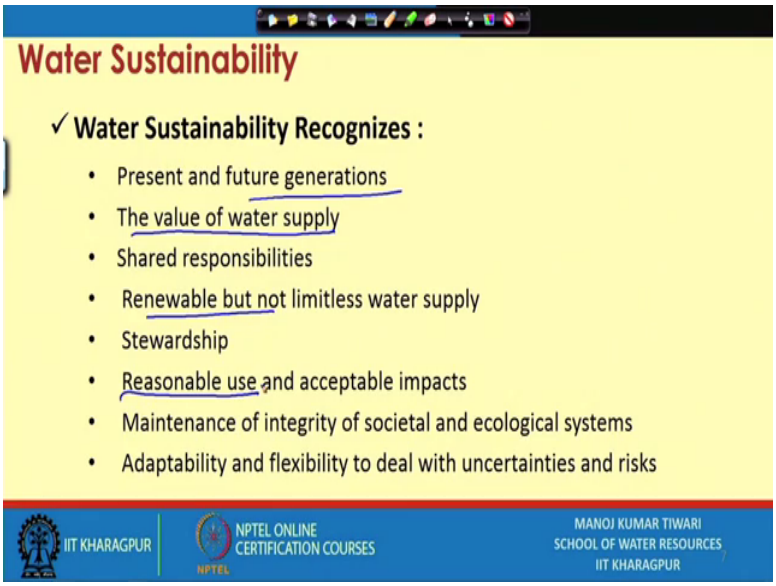
There are various unreasonable uses, unacceptable impacts and very high cost to this. So, like our treatment systems or this water uses, water use practices we have been discussing this earlier in the first week of this course, that at places the water supply or water use is go as high as 400 even at time 600 liters per capita per day.

Now, you see that people are not getting even 50 liters per capita per day water in a maybe neighbor city and somebody is having that privilege of using 600 liters water per day, that too the water which is basically being sourced from someplace, with very difficult it is being treated putting so many financial efforts into that, it takes so much of infrastructure, so much of maintenance, so much of investment in order to make that water usable and supplied to the individual households. So, those kinds of problems are there.

Then there is imbalance between meeting societal need and ecosystem need. We often are more selfish in terms of our demand, we think of what the human demand for the water is or how much maximum water we can extract for our uses, our growth, our development, our industrial industrialization or this kind of thing, we give very little attention to the ecological needs of the water. So, that is another problem which is leading to the unsustainable issues.

Then there is inability to deal with draught or climate change etcetera. We are not ready, we are not well equipped with or well knowledge enough to deal with these situation and there is a lack of critical consideration. So, what is the time cost and what is the acceptable impact of the decision or the implementation practices that are being done. So, we do not think about all those issues or all those aspects with enough critical opinions.

(Refer Slide Time: 21:04)



So, we did talk about what are the non sustainable ways. Now, water sustainability, if you want to move from a non sustainable approach to a sustainable practice, so, we must recognize the various aspects of water sustainability.

Now, what are these? There are basically, if you see the present and future generations security is the first aspect, as we have been basically talking about since the beginning of this lecture. Then, the value of water supply should be recognized. This is a very important point.

The water supply as we have been saying that at many places it is being used injudiciously. Some people are using excessive amounts; some people are not getting even the adequate amount or the minimum needed amount, because many people do not give proper value to the water. You see, at times people will in the morning they will put through the tap or this thing and then start their car washing which goes on for 1 hour.

Now, in just one hour regular discharge for a purpose of car washing, how much water has gone to the wastage now this water the car washing can be done actually is some recycled or that water as well we need not to necessarily put drinking water quality water for the car washing purpose. So, that is not given due value to the water supply or water which is being supplied to our household.

Then there are basically the shared responsibility should be recognized, that water is a shared responsibility. There are multiple institutions are involved and it is basically the responsibility

has to be taken not only by this state or not only by the government, but with all intermediate steps to the end user. So, it is the responsibility of end user, it is the responsibility of operator, the responsibility of manager, then utility director or the higher authorities to up to the government. So, that should be basically recognized.

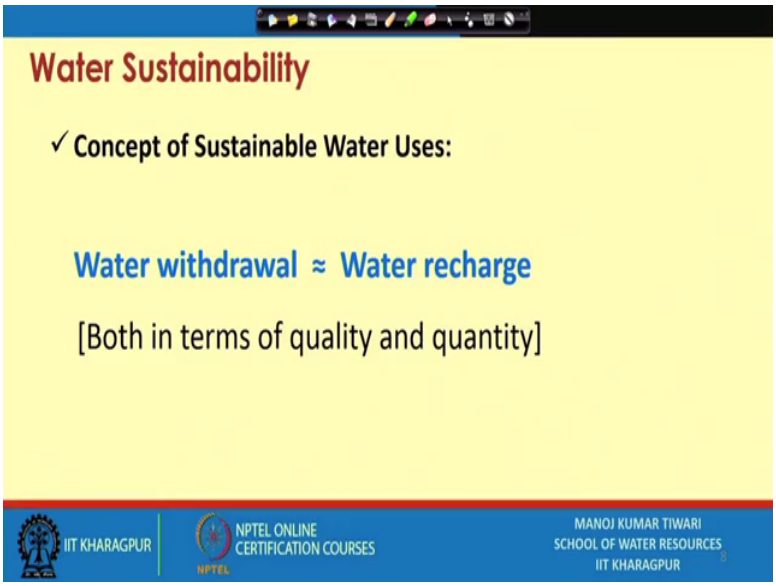
Then, the renewable but not limitless water supply, water could be actually renewable can be considered as a renewable resource like ground water and all that, but it is not unlimited. So, we have the fresh water resources and in fact, if you see, yes water is renewable because it is under a cycle. So, even the saline water evaporates come back again in the form of rain. So, we do get adequate amount of renewable water as well, but it is not limitless that we can actually there is unlimited water available and we can use whatever scale we want.

Then the stewardship is essential in order to managing the problem or bettering the situation the reasonable use and acceptable impacts are of should be basically recognized are of very prime importance that what is reasonable use. Now, this is again very important. The reasonable as we are basically saying that people do not realize the value of water so, if they realize the actual value of water the uses will also become reasonable.

If I am basically, brushing and have opened the tap on that is a totally unreasonable wastage of water because that is not going under any this thing. Now, reasonable use I can take bath with the let us say 20 liter or with the 40 liter of water as well and I can basically stand in a bathroom for hours and spend 200 liters in just taking bath. So, you one can say that it is my requirement, but it is an unreasonable requirement, it is a non reasonable use. So, that kind of things basically should be considered.

Then there is maintenance of integrity of societal and ecological system should also be recognized in terms of sustainable water supply and the adaptability and flexibility to deal with uncertainties and risks should also be there. So, at any particular time, let us say there is a draught coming, there is a flood coming, so, how to deal with how flexible or system is to deal with and take care with all these systems is also needs to be basically considered.

(Refer Slide Time: 25:55)



So, if you see the concept of sustainable water use as we have been saying and we basically discussed about various underline principles also. So, in terms of water the holistic principle of sustainability says that the water withdrawal should be nearly equal to the water recharge. It could be actually less also, that is also fine.

How much fine it will be that is again questionable because we have the capacity of holding water is also limited. So, if we do not withdraw a significant amount of water and we get more and more recharge our areas could be actually flooded, we do not want our all the like we do we do not want fall in the water table, but at the same time we do not want excessive rise in the water table because that is again going to disturb the natural system.

So, for a sustainable practice for a sustainable management it is imperative, it is important to see that rate of water withdrawal is more or less rate of equal to the water recharge in all systems, not only in the ground water. In ground water, lakes, rivers or whatever system of withdrawal we are basically planning, in all those system this rate of water withdrawal should be nearly equal to the rate of recharge or rate of the replenishment of the that particular resource what we are talking about.

Now, this has to be both in terms of quality as well as in terms of quantity. It is not just limited to in terms quantitative measures, it has to be in terms of quality as well. So, it like we are recharging nowadays like there people have been thinking using the treated wastewater

for groundwater recharge because they extract water from subsurface for the meeting their daily needs, so, they can and of around total water consumed close to 80 percent or even higher 80 to 90 percent of water is generated in the form of wastewater.

So, can that treated wastewater again go back to the ground instead of going to some surface water bodies from where recharge becomes very difficult? Can there is a possibility of direct recharge? There could be a possibility of direct recharge, but there comes the quality aspect that if one is planning to replenish the groundwater from the treated wastewater. The treatment should ensure that the adequate quality of water is entering into the subsurface. It is not that we just provide partial treatment and put it into the ground, that may actually deteriorate the source quality and in terms of the volume in terms of the amount our source may be sustainable, but in terms of quality our source may not be sustainable there, because the quality might deteriorate.

So, sustainability ensures both in terms of quality and quantity as we have been basically discussed earlier also. So, that needs to be ensured. So, that is what is basic the sustainable practice in terms of water.

So, we will end this session here and in next class we will talk about the more in depth on to the water sustainability and primarily we will talk about the Dublin statement which arises for a from a conference in Dublin that how it recognized the various aspect of water and what kind of suggestion or action agenda it proposed. So, that will be discussed in the next lecture.

Thank you.