Rural Water Resources Management
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Conversion of Rural water bodies to urban
Week 06 - Lecture 04

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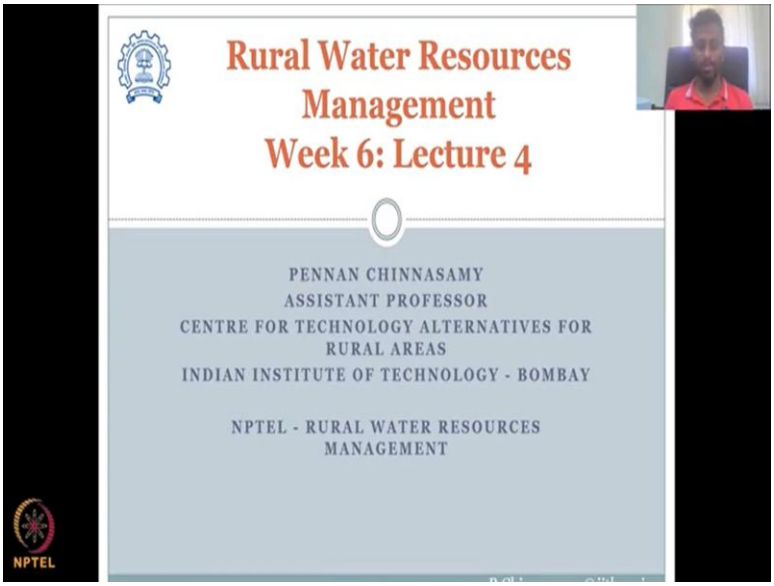

Hello, everyone welcome to NPTEL course on rural water resource management, this is week 6 lecture 4. In this week, we are looking at the surface water storages for rural water resource management and we also are looking at the different types and issues. In the last three lectures, we looked at the different types and how water can be brought from a one unique system into the farm level. In today's lecture, we would look at the issues and concerns on it.

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First very major issue is the rural to urban conversion of these water bodies made lakes or tanks. It is such a big problem that a lot of the international bodies for example the UN water has stressed on the need for water while you urbanize urbanization cannot be stopped because everyone wants to be living in a sophisticated city with better amenities and facilities. However, the water takes a hit when you convert a region from rural to what water guzzling urban cities.

Let us look at some of the issues, urbanization can be very important for understanding the rate of which the population is migrating and also how water and other resources are going to be shared. For example if you look at this graph at the bottom right you could see that by 2030 there is a tip where the rural population is going to dip which means or both the populations are increasing from your 1950s. And you could see that while it increases the population urban and rural around 2020 which is now and 2030 you would see that the rural population is going to come down and your urban populations keep on increasing.

Which is frightening because once that people come out not the area is not enough in urban, so what happens is the land is being used from rural to be converted into urban, so when that happens what are the negative aspects that can happen to water. Let us look at some physical expansion of urban areas is going to happen as I said the boundaries are going to be pushed wherein rural areas are going to be converted into urban. Then majorly caused by migration or concentration of peri- urban areas, so the peri-urban is a location between the urban and the rural.

So, you have urban area and then when you come out of urban area you have a peri-urban area and a rural area. So, majorly caused by migration or concentration of these peri-urban areas, which will be converted into urban areas. It affects the environmentally sensitive water bodies because lot of land is going to be encroached, land would be converted from a water body into a land for building houses. And there will be scarcity of water resources, because there is lot of consumption industries that may come. Lakes and tanks are already under tremendous decline due to urbanization I will show a case study in the next slide.

And understanding of issues which is due to urbanization could be if you have a better understanding you could do better management of water bodies and preservation of the ecological balance, which is taking a big hit. Ecological balances it is not only humans that have to live in this planet other organization organisms also have to live for example trees, birds, insects, animals and is there water for everyone is the question. When you start to expand and you can have a pump to access groundwater, but how can a bird take ground water. So, these kind of thing thoughts have to come while you do this urbanization.

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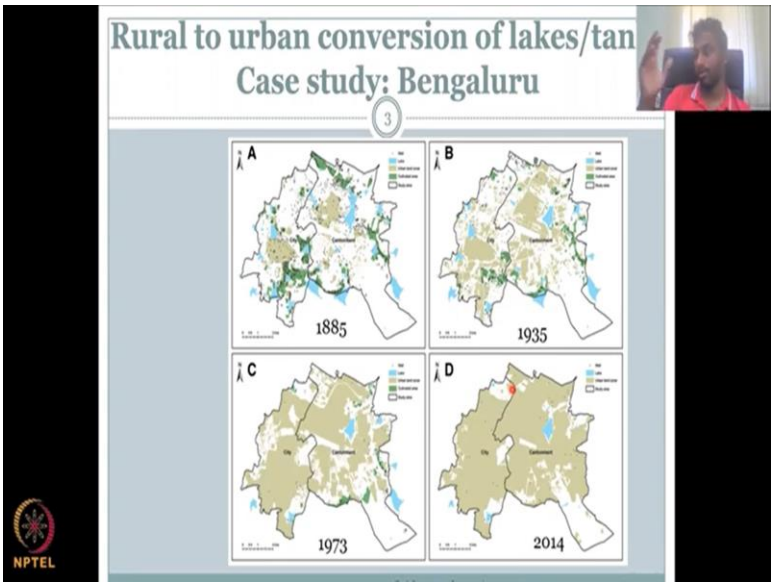

Let us look at the case study as I promised, we are going to look at rural to urban conversion of lake or a tank with a case study of Bangalore. So, Bangalore is one of these cities which were very beautiful and it was called the land of lakes, land of water bodies because lot of water bodies were there. In fact the Britishers used to build all these big parks and stuff in these areas,

because they loved the climate and the amount of water that were present naturally without man-made lakes however, it has declined.

Let us look at the timeline in 1885 you can see the blue color as the water bodies and urban is brown and then you have the green catchment areas or forests etcetera and you have this is a study area by the study by V Krishnan. It is striking to understand that when these mega metropolitan cities were there it was only four, when I was in school for example it was Delhi, Mumbai, Calcutta and Chennai. And these were predominantly based by the Britishers, because they had a port except Delhi, Delhi was the kind of a capital place where they ruled everything.

But the ports were very important Calcutta on one side whereas Mumbai on the other coast and then Chennai right on bottom where it can travel to any other location, so these were the major cities because of the British. However, due to some infrastructure change after independence after this IT boom a lot of urbanization has happened. So, let us look at how that has compromised the water bodies and the green cover in Bangalore.

So, 1885 a lot of forest lot of green cover and you also had in between there was a lot of good vegetation and forested cultivated areas both agriculture and non-agriculture in green and you saw a lot of water bodies which is very healthy. In 1935 what has happened is the city began to expand the urbanization picked up which is the light green or brown color. In 1973 it just boomed so all this land was taken up apart and then most of the lakes are already gone. So, these small tiny lakes that you see have been converted from a rural setting into an urban setting because initially these were in the you know there is a city and continent these regions were rural areas that is why you have cultivation which is green.

However, when the cultivation line was converted to an urban land which is happening here in small pockets but here totally all the cultivated land is gone you have left only with urban and the water bodies shrunk. So, only some it was pushed the agriculture was pushed to the outskirts of the city. Now, in 2014 in the current era you would see that totally all this agriculture is gone, so only very small pockets not it is very negligible and the size of the lake has shrunk because the land under the lake has been used for urbanization.

Just look at this lake for example, I will put my pointer, this lake for example you could see that it was a big water body and then when urbanization starts to happen or this rural area the

cultivated land changed into urban land slowly the lake size came down and here it is totally gone. More bad is that the land has been converted into a urban setting a house for example or an industry a mall building etcetera.

So, this is not sustainable this is what we are trying to say that because you did this now the water volume is less how much water is stored is less and it affects the ecological balance because birds, fish, animals are not going to come and the trees are not going to grow.

So all these have been disturbed by the unsustainable urbanization you could have organized part of the city and part of it could have still been kept like how the Singapore model is. However, it was not planned well and it just went in.

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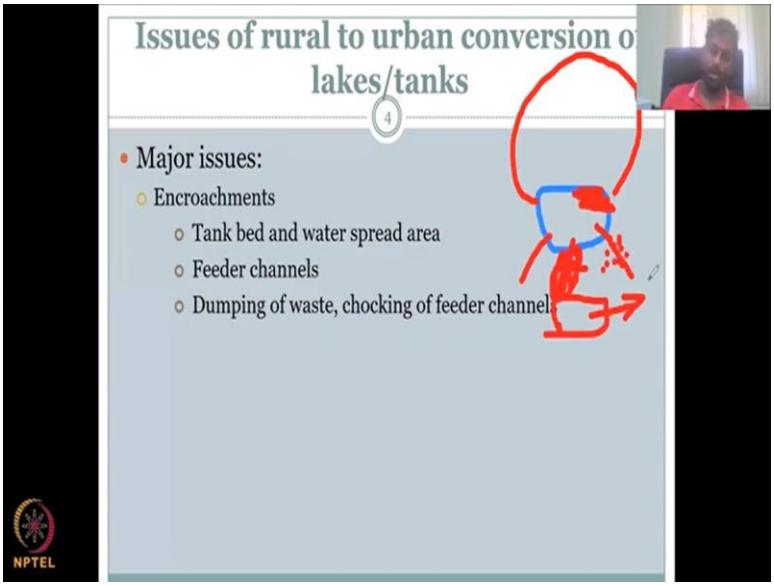

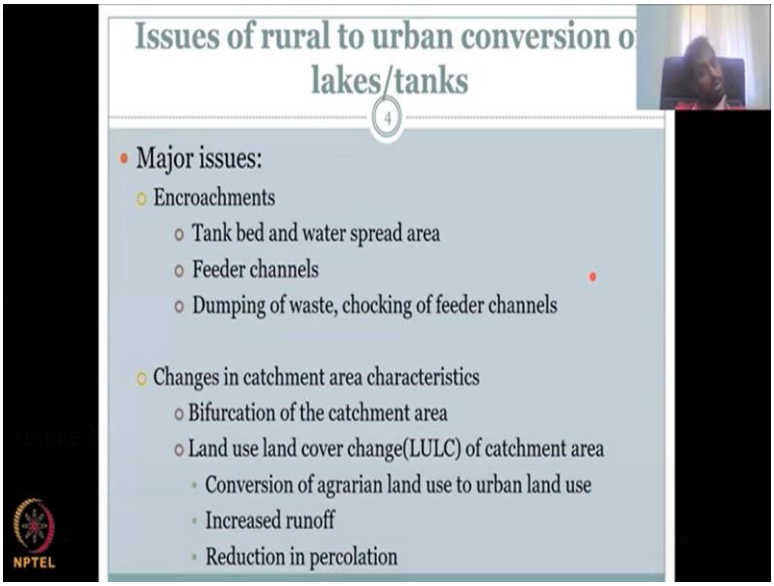

Moving on, so what are the major issues because of this. Continuing with the issues statement a lot of issues is not just because of un-proper planning, but lot of illegal activities starting from encroachments. The water bodies like tank bed and water spread area are encroached which means the tank bed where the water is to be coming and stagnating or kept as a storage is drained and that land is converted into a house or a flat for example. So, when you take that land where would water go and water will not even stay so just it will just run off. So, the tank bed and water spread area has been shrunk and converted into an urban land.

The feeder channels the channels you remember where from a lake from a water body there is water feeder channels where it takes the water to the agricultural field all those are being blocked now. So, it is inadvertently like when you block these water sources, then the agriculture cannot happen I also be happy to draw it for you so we had for example this is the water spread area and then we had the other area, which is the catchment area on the top. And then the feeder networks which come and give water to the land below due to gravity for example and these are the land which are getting the water for agriculture.

So, if I encroach this land first you are encroaching this land so you cut down the water already tank bed etcetera is taken away. Now, what you do is you stop and encroach the feeder channel so for example, I build a house right along or on top of the channel I just put sand in because those land are no one's land government's land. So, if you stop this water and then build all this with house then this farmer will have no water. So, the farmer what will happen he or she will wait for a couple of years and then sell it for urbanization and leave migrate.

Dumping of waste choking of feeder channels also happens, if I put all the waste here and then choke the channel then there is no water coming down for the agriculture. All this is to be avoided and stricter rules and regulations have to come but it is not happening.

Changes in catchment area characteristics, so how does this change the characteristics bifurcation of the catchment area is changed the line which says this is the water spread area is very not strict. Because, the water can go up and down based on the rainfall, and the water coming in, so that line has been pushed and encroached.

Land use land cover of catchment area has seen considerable change, because of urbanization especially conversion of agrarian land used to urban land use. The agricultural land has been converted to urban land increased runoff when that happens when you convert an agricultural land to a cultivation to a urbanization land what happens is the runoff increases, because you are covering cement on top of a soil and when water hits all of the water goes as runoff floods etcetera.

And there is no water to go into the ground water and recharge and come back into the water bodies. Reduction in percolation, so as I said if you cover it with cement water does not go in and does not go into the aquifers all these are covered and led by the urbanization.

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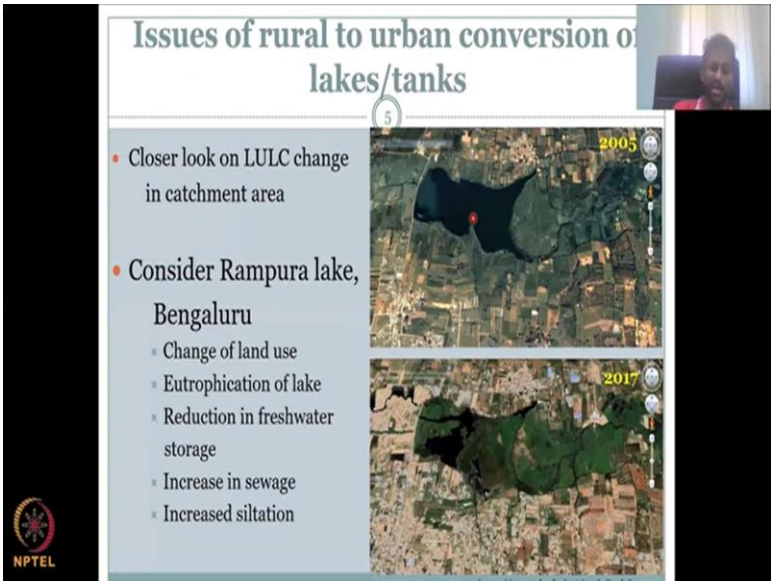

Let us take a data for example, I am putting together a map to show you where exactly these changes happened for Bangalore we will stay with Bangalore this example also. So this is the

images from the Google earth where it is a composite of images from satellites the best image will be shown by Google earth. It is free so anyone can use it please go ahead and see how things are for this lake, so let us take this link.

And in 2005 this is the water spread let us not care about what was before because maybe we do not have the data to look at it just let us look at 12 years how it changed. The land around it is partly agriculture and you have some urbanization here some organization here. But within that 12 years what has happened is all these lands have been converted from agriculture to urbanization.

So, you are converting from rural to urban and this water body which was supplying water for agriculture is now converted to an urban lake, an urban lake has its own problems. If you look at the catchment area on top you see that all this area has also changed which means the water quality coming into the lake will change. The water use is different and you could see that a lot of impurities are coming into the water.

Consider the Rampura lake, so this is the Rampura lake in Bengaluru, the land use change has happened already you could see all this land which where agriculture and stuff has changed into urbanization. And also along the sides, where the water is used for agriculture. So, now if there is no use for agriculture domestic you do not need such a big lake what they do they just cut down the lake into a smaller size and then remaining size remaining land of the lake is sold as urbanization.

Eutrophication of the lake has happened, because a lot of impurities have come in a lot of fertile nutrients have come in and so the plants inside the water have started to grow uncontrollably. When you had this agriculture the water would refresh fast because you pump it out you then have another rainfall which brings fresh water. But here eutrophication happens the water turns green in color, so you can see how the water is turning green. No one is going to manage it they do not care because they are happy with the groundwater recharge from the lake which is at a better quality than the lake water however the water quality on top is getting bad.

Reduction in freshwater storage the lake area has come down, let us see that because of the Eutrophication and urbanization increase in sewage disposal in the water people have started to use these as sewage disposable things. Because when you build an urban area in a rural land

there is no pipe connection to take the sewage out, so what do they do, they just put the sewage into these lakes. And if you look at even big cities like Chennai, look at the Coovum river the river was supposedly a good clean river. But when the urbanization happened too much when too many houses and etcetera were built sewage started mixing into these rivers.

And this is a common in many cities in India if you go and see the surface water in Mumbai, Calcutta, etcetera it does not look good. And increase siltation because you increase the runoff there is more sand and sediment which is picked up by the fast water and deposited into this lakes. So, at the whole what has happened is the lake size has reduced and the land that has been used once for agriculture has been converted to urban. Both because of greed and also because there is no water to supply and maintain these agricultural lands, so the lands have been converted.

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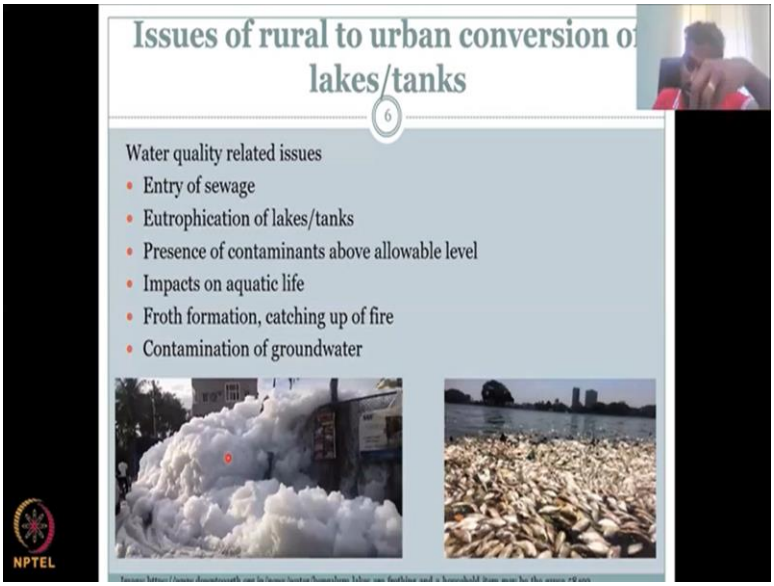

Let us look at specifically the water quality issues because of urbanization. So, as I said when you have urban setting there is other type of runoff which will come. In an agricultural field when rainfall happens it goes on top of the crop and then some fertilizer soil is washed into the lakes.

But now think you can cover the land with cement and cars and industry is present when that happens and sewage is mixing when rainfall happens all these impurities on the road is now washed into the lake. And that is not good correct, because the lake was not supposed to be

taking all these bad chemicals. For example the car oil is carcinogenic, so all the oil spills you see on the road lot of oil spills because of traffic all this now is washed into this lakes.

So, let us look at the water quality issues entry of sewage is happening both legally in terms of you have a legal connection and from the legal connection there could be a spill into the lake. And illegal is more important more permanently doing because people just take the water switch water and push it into these lakes. Eutrophication of lakes and tanks eutrophication is the place where a lot of too much of plants and water species grow and deplete the oxygen content in the water. And all the rest of the living organisms like fish and insects die.

So, once these chemicals get into this water some plants grow very fast and too much when they grow fast and too much eutrophication happens. The quality of our water body is so bad that the plants will survive for some time it kills all the other organisms and the plant will also die. Presence of contaminants above allowable level if you look at the central pollution control CPCB data most of these lakes the urban lakes have really bad water quality.

So, those lakes which are initially for swimming and drinking etcetera, now is reduced to nothing. You cannot do anything with this water, same for the water river waters I have mentioned. Impacts aquatic life you could see the fish all dead. Froth forming catching up fire etcetera so this froth is because of the chemicals that are mixed into this like collect water which is fresh water and with agitation and stuff the froth forms up.

So all these are bad and eventually it even impacts the contamination of groundwater because groundwater is recharged from the lakes. At first some instances it would not affect the groundwater why because the sand under the lake the sediments etcetera will filter the water.

But for how long the filter has to be changed and that does not happen natural setting you cannot take the lake out take the sand put a new sand and then the water is clean. So, eventually with 5 to 10 years the pollutants will start to move inside to the ground water and pollute the groundwater for good.

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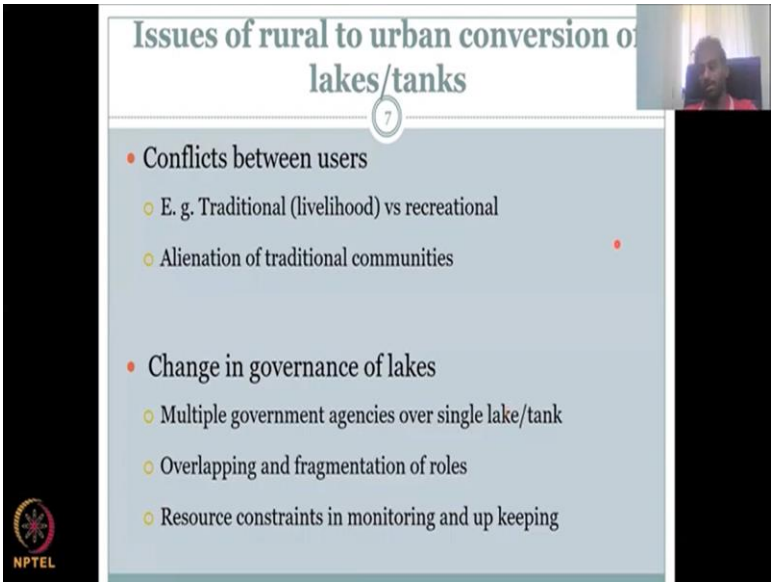

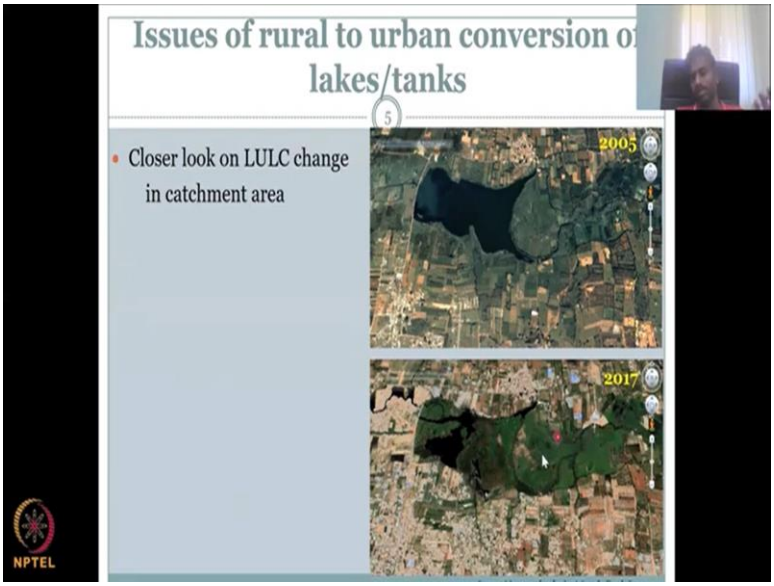

More issues are conflicts between users which is traditional livelihood versus recreational for example when you convert a rural area lake into an urban lake part of it is still rural. Let us take this example from Rampura, you could see that yes all this adjoining areas have converted into urban, but there is some area still using the water for agriculture. So, there is a conflict between the traditional water uses and the new water uses which is urban where they use it for recreational boating, fishing and walking those kind of things. They would not allow the water to be taken out for agriculture.

Alienation of traditional communities and because the urbanizing power has money and influence they start to push the rural people out and traditional communities out of this system. So, the same water which led to the organization now would lead to pushing the farmers out and cutting down the supply to their agricultural fields. Thereby, them selling the water and land at a cheap price and leaving the leaving the space.

Migration change in governance of lake is very important so initially the lake was governed by rural lose rules like agricultural irrigation department. But now since it is urban it comes into the urban department, so one lake is now going to be managed by multiple agencies such as the urban industry or the agricultural irrigation department.

Overlapping and fragmentation of roles how many people can manage one lake, so there will be overlaps and then there is issues in sharing this duty between the government officials. And at least two resource constraints in monitoring and up keeping. Because when there is overlap no one will do it, it is not like two people are going to solve the water body issue. So, when one person says why you into this because I am from rural and you are from urban both of them would not work on it. So, there is resource constraint and monitoring and also up keeping. Data on this water like quality area is very limited and there needs more research.

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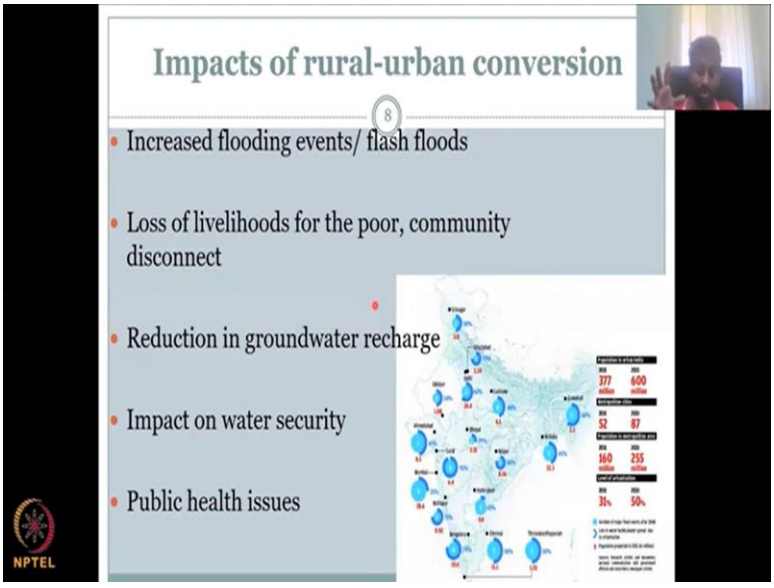

This is not in only one location which is Bangalore it happens across India. With urbanization the water qualities are going bad and look at the population of urban in India you could see that

in 2011 it was 377 million and by 2031 which is in 20 years from 2011 it almost doubles itself 600 million. The number of cities also expands from 52 to 87.

And the level of urbanization is from 31 to 50 percent of the country. And if you look at the water quality issues in all of these areas it is not good because all these lakes and rivers are polluted you can just have it for watching which means recreational you just go there put a boat maybe sit and watch the water that is it. It is not for consumption and it is not for agriculture.

So, look at the loss in water bodies water spread due to urbanization and the worst case is Delhi with 24, 62 percent loss and projected population is in 24.4 million because of the increase in population the area of your water bodies are coming down.

As we saw Bangalore is the most highest with 79 percent along with Surat sorry Surat is 95 much more higher than in Bangalore. And then we have Kolhapur, Mumbai etcetera Mumbai is different because Mumbai already it is it is fully expanded there is no more lakes. So, when you look at from 2011 to 2031 it is not going to happen much difference because it is already fully urbanized in terms of taking away the lakes.

And that has a correlation with the number of floods that happen look at how many floods which are happening in this part of the urban cities you could see that the major floods are in places where they have converted these local lakes and tanks into urban. Because you do that the flood water cannot stay in one location it floods the entire city. Chennai is noted as also so Chennai a lot of floods have been recently visited.

But more important it is Mumbai every single year it floods the drains are there the urban situation is there to tackle however because of depleting all your water bodies there is no space for water to go. You can have drains but the drain has to take the water out of the cities which happens at a very slow time.

So, there is increase of flash events which is flashy means instead of water hitting the surface and slowly converting it to runoff it happens at a very fast pace, there is loss of livelihoods for the poor community who are disconnected they do not have access to water. And so they do not have their livelihoods it could be even fishing for example who depend on fish.

Reduction in groundwater recharge if you cut down the lakes and water bodies the amount of water recharge is also going to be cut. And the impact on water security is also bad because the water security means certain amount of water is available for everyone which is now lost. So, this all combines to say that the issues are multi-pronged it is not only one lake which is only looking at agriculture or water demand, but there is other things which are lost like livelihood groundwater and water security most importantly the public health issues.

When you pollute these urban lakes then it is a breeding ground for dengue, malaria, mosquitoes it is a breeding ground for VBDs vector-borne diseases. So, it is very important to make sure that you convert into urban very sustainably keeping all these agricultural entities and water bodies as pristine as possible. Which means you do not disturb those ecosystem, keep the water coming into the lakes keep the water using it for rural areas and then have a balance. In those days urban cities had all the environments so for entertainment etcetera. So people prong and then came down to the cities but now everything is available your TVs, malls etcetera.

The quality of life is good but still that urban craze is there the price of land is there, so everyone wants to come and stay in the urban cities. Good schools are also available in villages now good hospitals are available but still the migration happens. And that is leading a considerable impact on the natural resources and of the natural resources water takes the biggest hit. Because not only the area is shrunk now the water whatever is shrunk has to cater to the public domestic use which is not going to be enough.

And when it is not enough what happens from the urban more water is procured from the rural areas we do not say that you do not have water we have just with something at the end of the day water is brought from rural areas into the cities. For example Mumbai when Mumbai big water crisis happens we have to take water from the neighboring districts especially rural districts of Pune. So, these things are not sustainable for the long run we have seen how water starts from rural and you capture it from rainfall put it in these storage structures.

And then slowly it can convert from rural to urban setting and then actually disturb the entire system. So, there is need for data for monitoring there is need for data to look at the areas and how they change and these things we will look at in the next class. With this I will stop today's lecture.

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Thank you.