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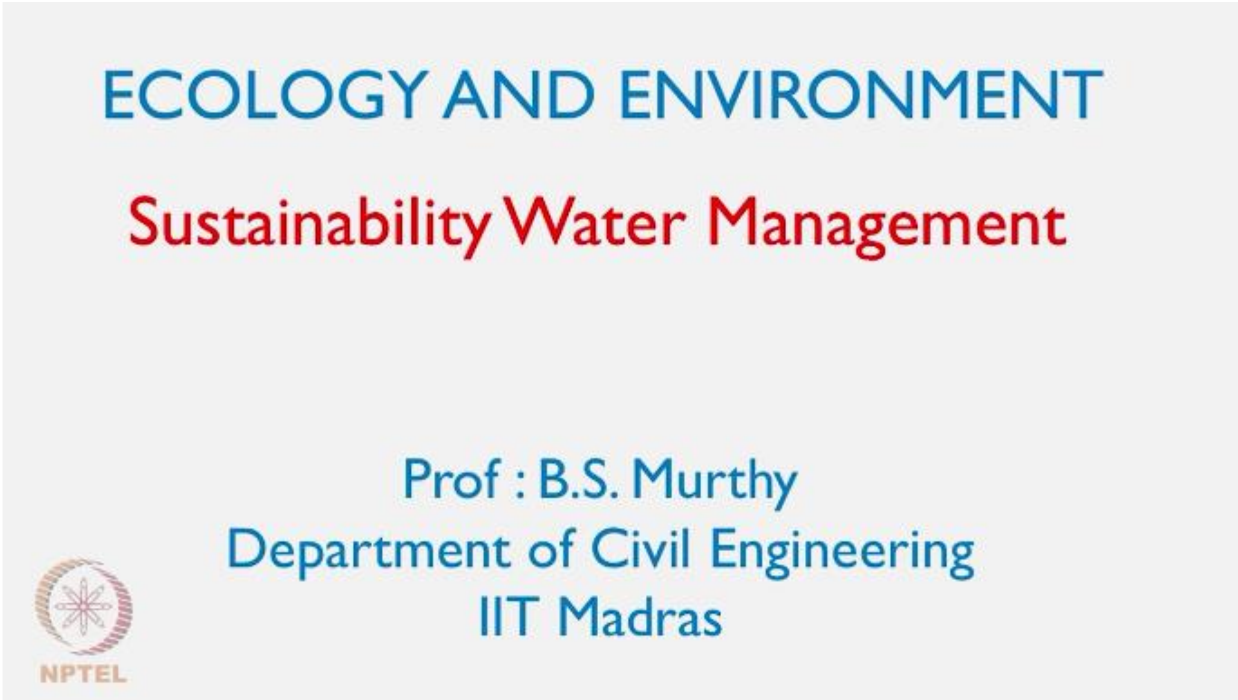
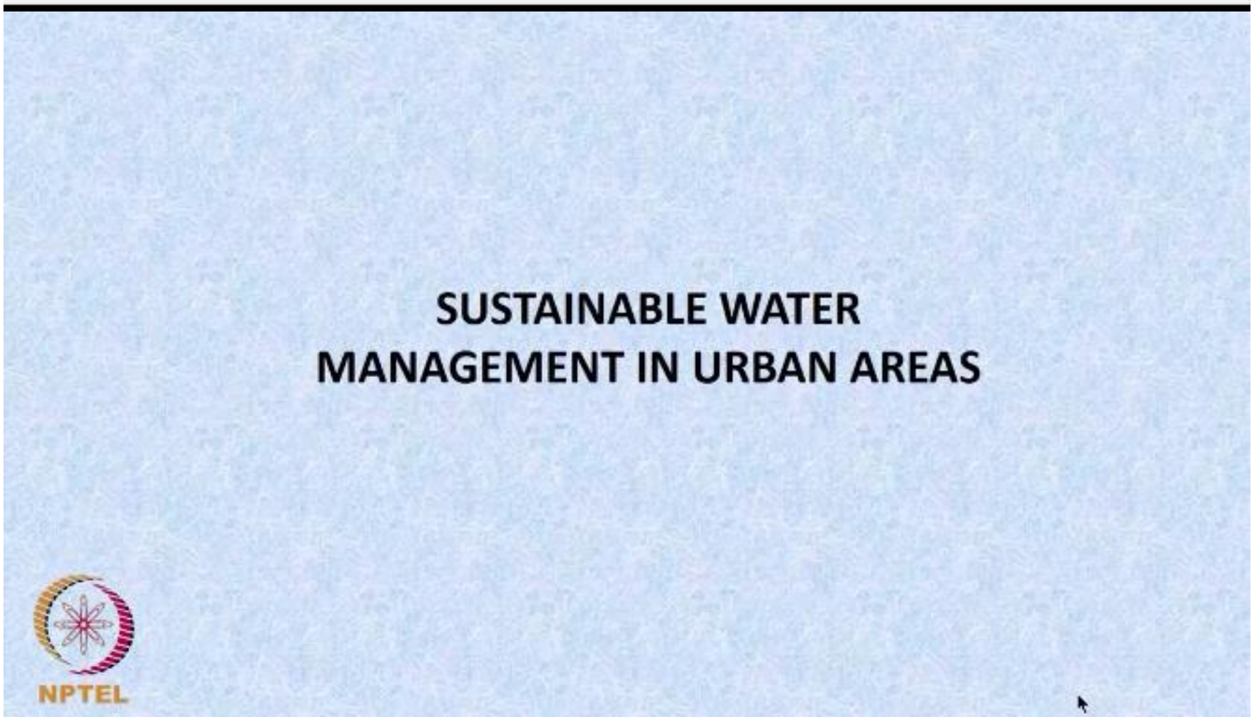
ECOLOGY AND ENVIRONMENT

Sustainable Water Management (Part A)

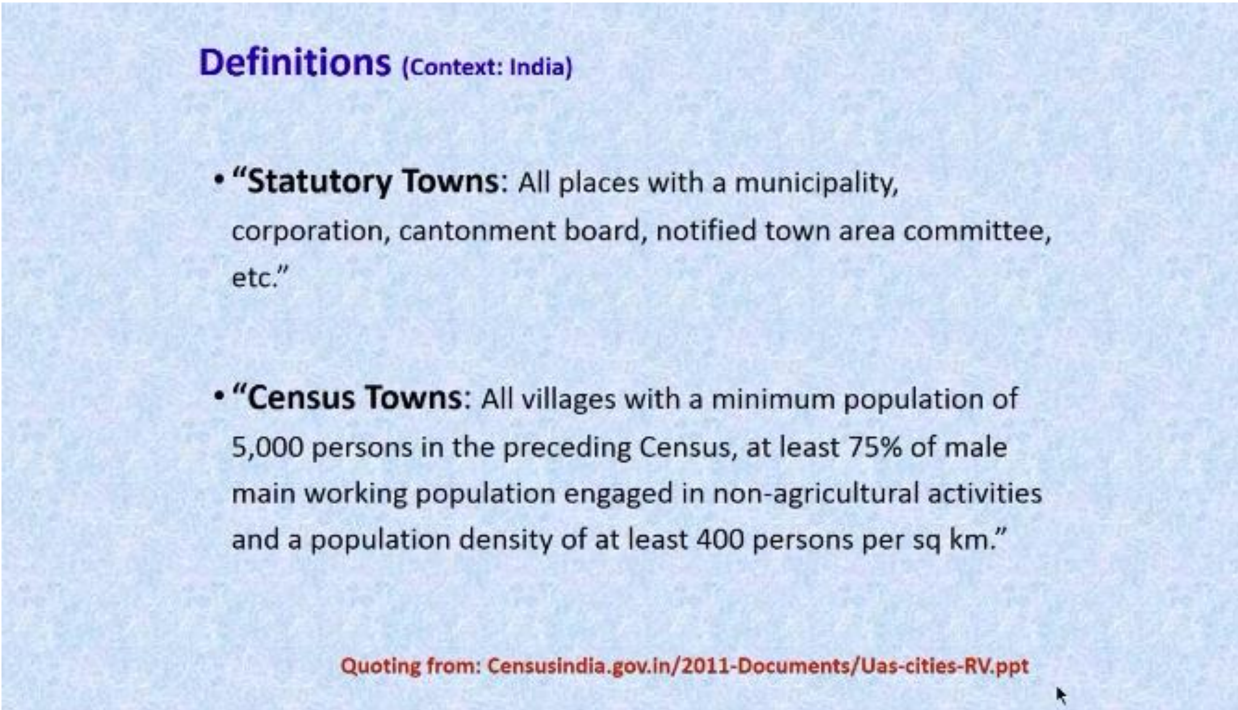
Prof. B.S. Murthy
Department of Civil Engineering
IIT Madras

SUSTAINABLE WATER MANAGEMENT IN URBAN AREAS (Part A)



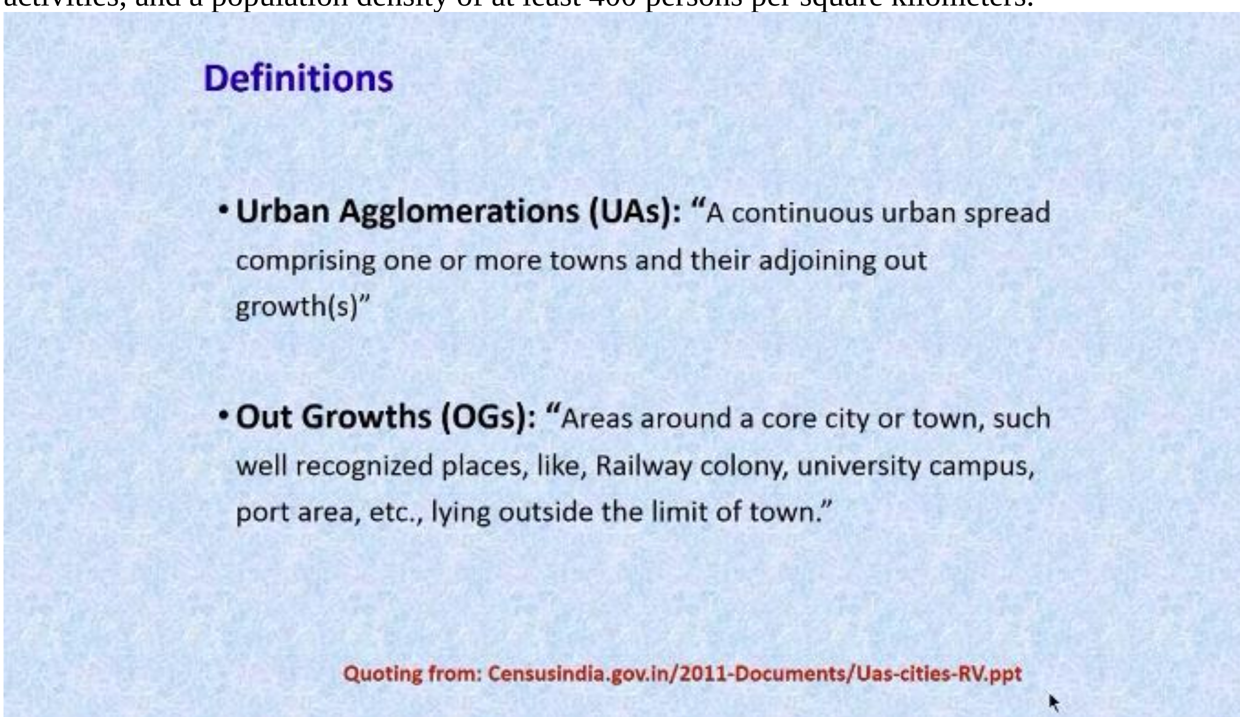


Welcome back to our lecture series on the course Ecology and Environment, in this lecture we will discuss issues related to Sustainable Water Management in urban areas.

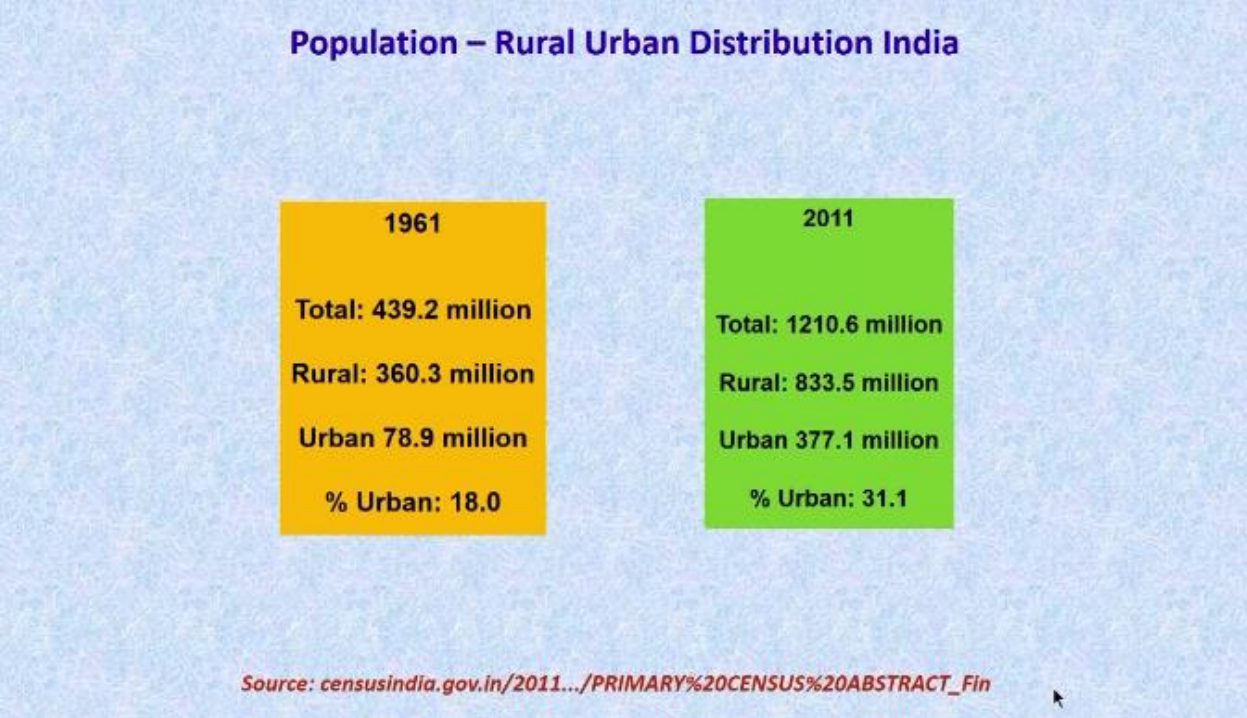


First, some definitions regarding what is an urban area in the context of India? Statutory Towns are defined as all places with a municipality, corporation, cantonment board, notified town area committees, etcetera.

A Census Town is defined as all villages with a minimum population of 5,000 persons in the preceding census, at least 75% of male main working population engaged in non-agricultural activities, and a population density of at least 400 persons per square kilometers.

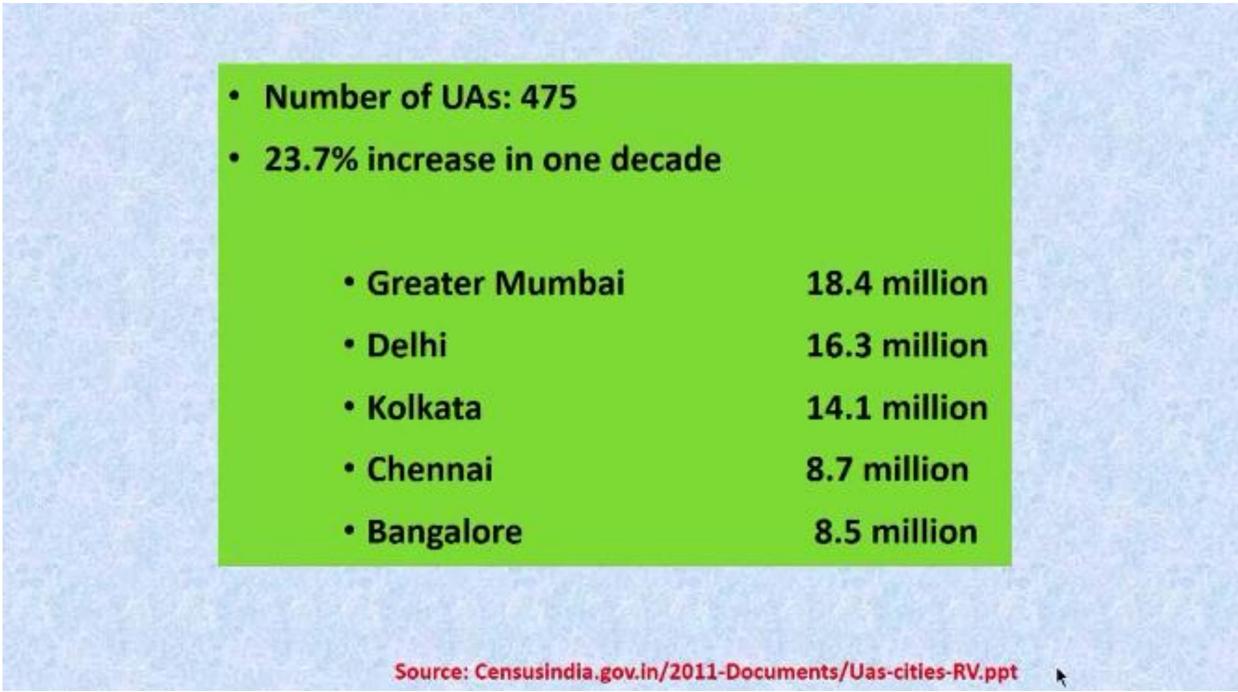


An Urban Agglomeration is defined as a continuous urban spread comprising one or more towns and their adjoining outgrowths. An Outgrowth is defined as area around the core city or town, such well-recognized places like railway colony, university campus, port area etcetera, lying outside the limit of town. Here, we are concerned with the water management in urban agglomerations and urban areas.

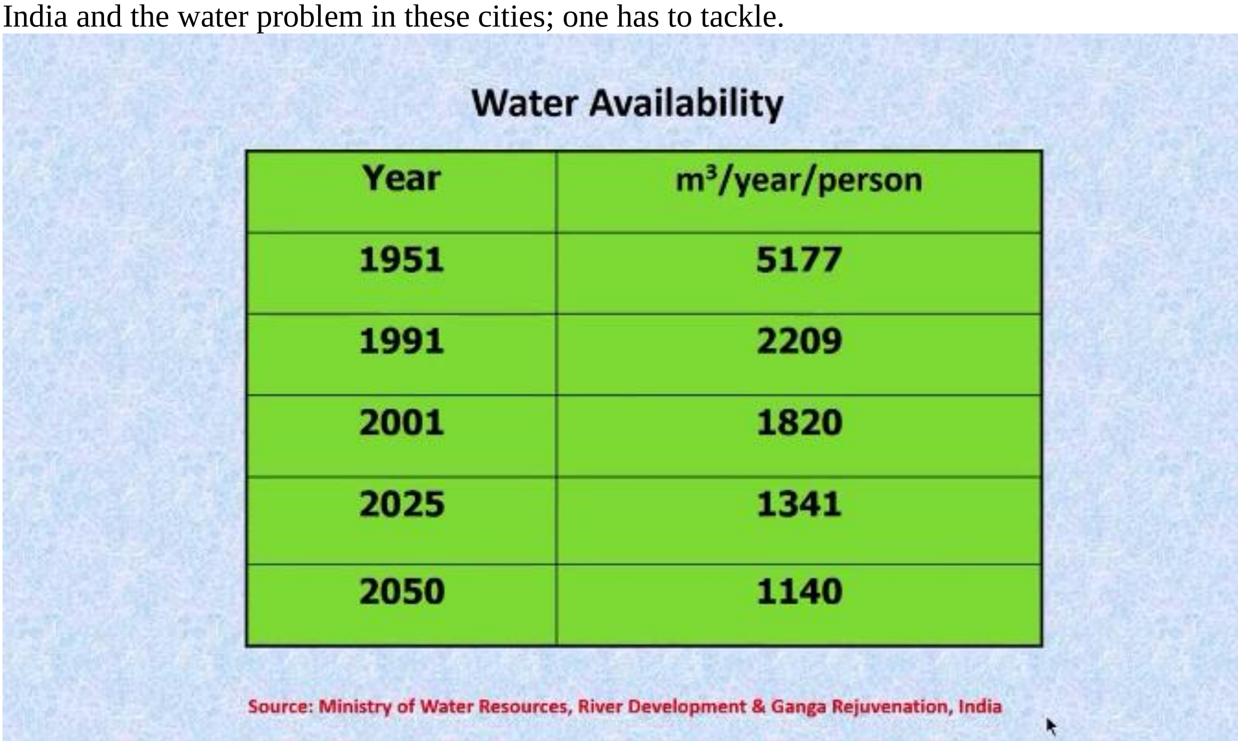


Now, if you look at the population that is the rural-urban distribution of population in India. In 1961 the total population was 439.2 million people, out of that 360.3 million people lived in rural areas and 78.9 million people lived in urban areas. Basically, urban population amounted to 18% of the population. And in 50 years that is 2011, the total population has increased to twelve ten point six; 1210.6 million, out of that 833.5 million are living in rural areas whereas 377.1 million people are living in urban areas.

Now, the percentage of urban population is 31.1%, so it has increased from 18% to 31.1%, and it is expected to increase much more in the years to come. So, this is going to put some kind of a stress on our water resources in urban areas, and we need to tackle that.



There are 475 urban agglomerations in India as per 2011 census; this is 23.7% increase in one decade. In the last one decade that is 2001 to 2011, there has been an increase of 23.7% in the number of urban agglomerations. And the largest urban agglomeration in India is Greater Mumbai which has 18.5 million people living in it, followed by Delhi were 16.3 million, Kolkata 14.1 million, Chennai 8.7 million and Bangalore 8.5 million. These are the five largest cities in India and the water problem in these cities; one has to tackle.



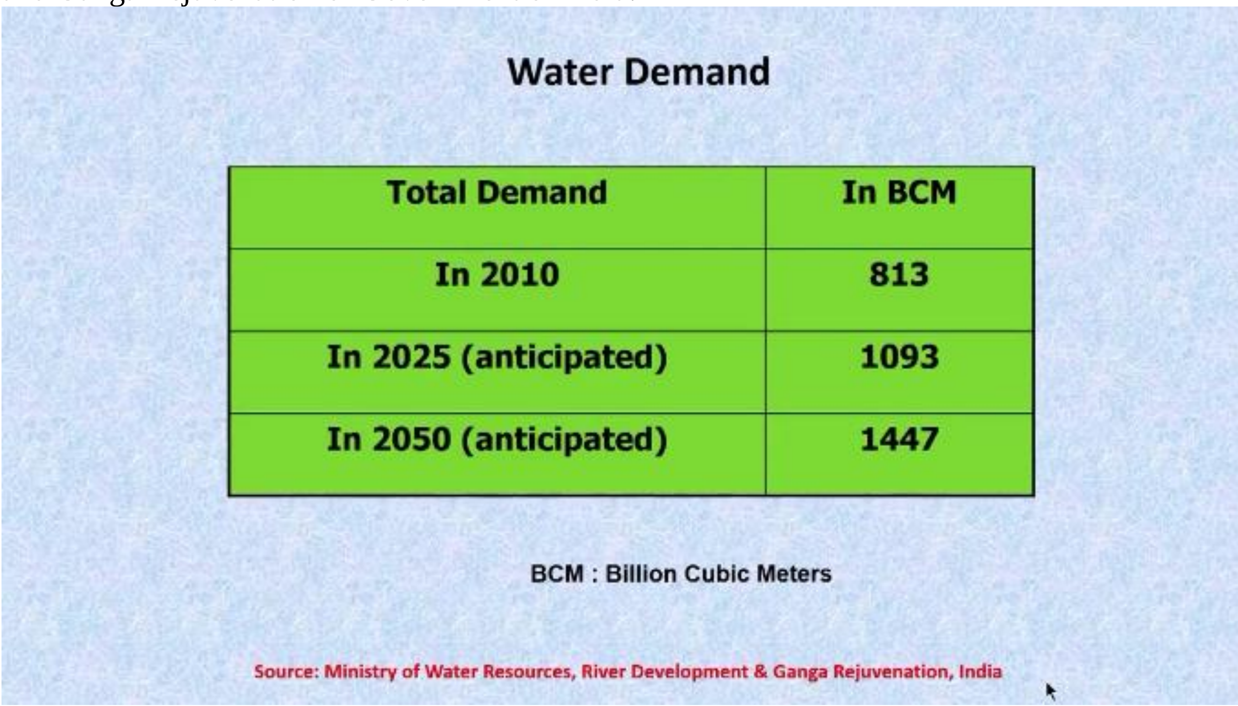
Water Availability

Year	m^3/year/person
1951	5177
1991	2209
2001	1820
2025	1341
2050	1140

Source: Ministry of Water Resources, River Development & Ganga Rejuvenation, India

If you look at the water availability in India, in 1951 we had 5,177 meter cube of water per person per year, and that has reduced to 1820 meter cube per year per person by 2001. And it is expected to decrease to 1341 meter cube per year per person; it is because many of the water resources are dwindling as well as the population is increasing.

By 2050, the water availability is going to be expected to be 1140 meter cube per year per person; this is as per the estimates made by Ministry of Water Resources, River Development and Ganga Rejuvenation of Government of India.



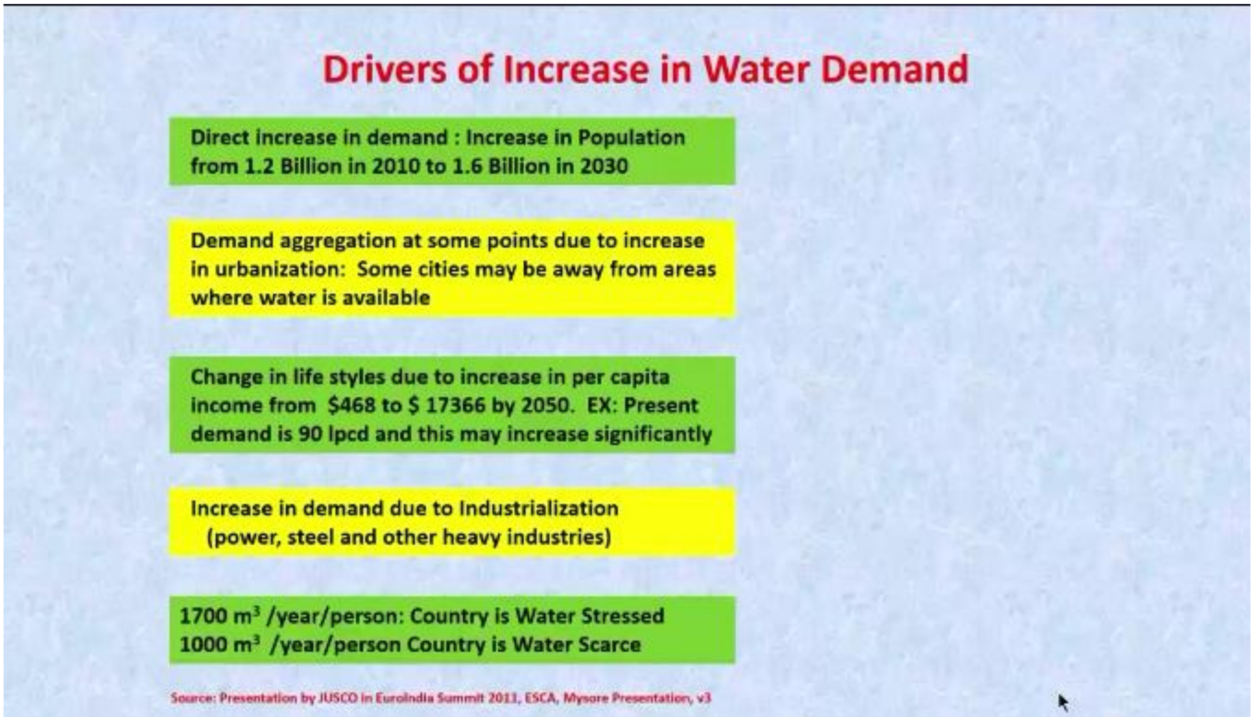
Water Demand

Total Demand	In BCM
In 2010	813
In 2025 (anticipated)	1093
In 2050 (anticipated)	1447

BCM : Billion Cubic Meters

Source: Ministry of Water Resources, River Development & Ganga Rejuvenation, India

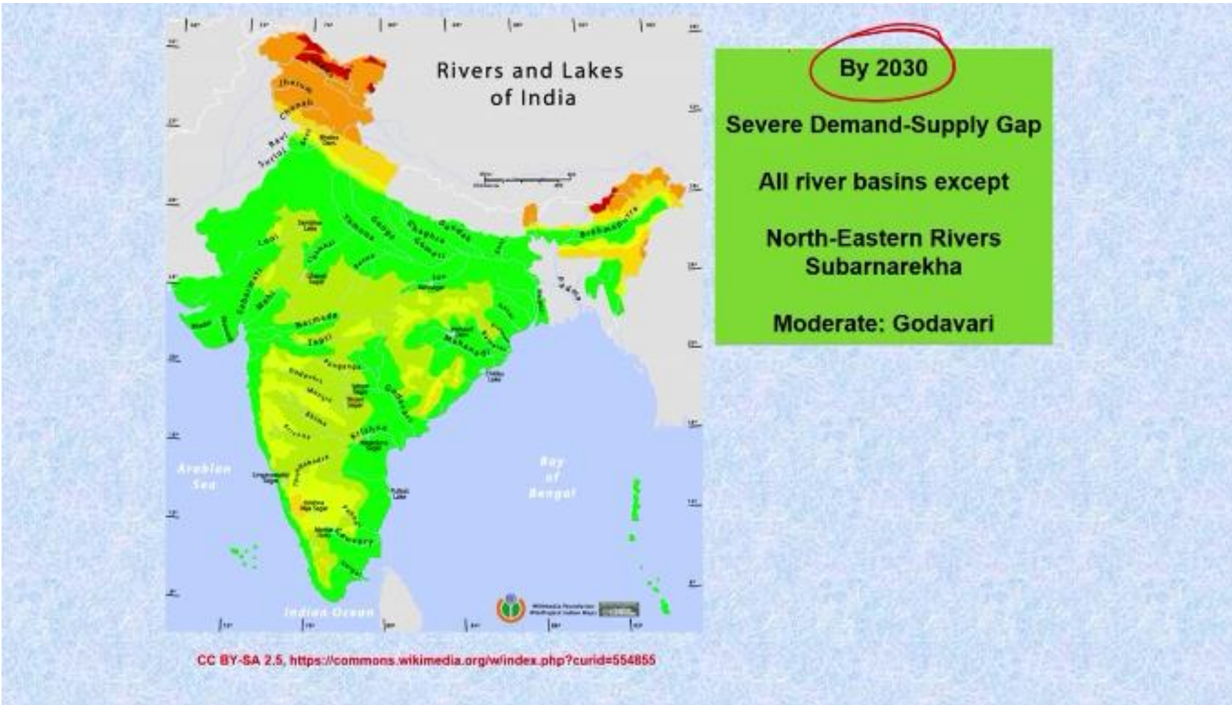
If you look at the demand in billion cubic meters, in 2010 the demand was 813 billion cubic meters, and in 2025 the demand is expected to increase to 1093 billion cubic meter and 2050 the anticipated demand is 1447. It is again the estimates made by the Ministry of Water Resources, River Development and Ganga Rejuvenation of Government of India. On the one hand, the demand is increasing, and per-capita availability of water is decreasing.



Now, what are the drivers of increase in the water demand? First and foremost there is a direct increase in demand due to increase in population. The population is expected to increase from 1.2 billion in 2010 to 1.6 billion in 2030, so this increase in population definitely is going to increase in the water demand. Then in some places, there is a demand aggregation, as the cities grow, the more and more people are coming to the cities, more and more places are getting urbanized, so there is a demand aggregation at some points because of this urbanization.

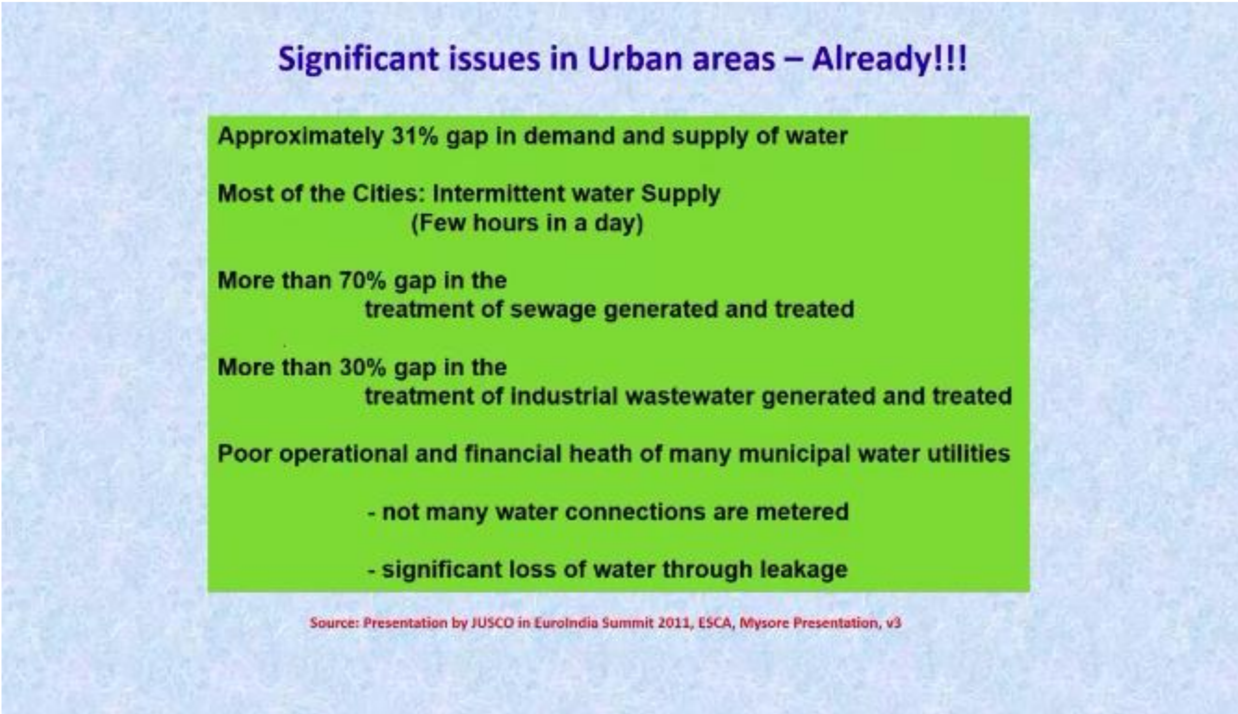
And some of these urban areas or cities are quite far away from areas where water is available. So, we need to transport water over a large distance, a long distance like for example, Chennai city in Tamil Nadu the water gets transported all the way from Krishna through canals from Krishna river, and again from South from Cauvery it gets transported through pipes. There is a long distance because the available water in Chennai city itself cannot meet the demand, so there is a demand aggregation. There is a change in lifestyles also due to increase in the per-capita income from $468 to 17,366 by expected to be by 2050. So, this increase in per-capita income or increase in wealth will definitely put make people demand more water, for example, the present demand is only 90 liters per capita per day, which is almost five times less than what they use in the United States of America. With the increase in the per-capita income, so the demand per person per day will also increase significantly. So, that is another driver for the increase in water demand.

Now, there will be an increase in demand due to industrialization as more and more industries come up, particularly power, steel, and other heavy industries require lot of water. So, there is going to be increasing water demand because of industrialization. We will compare based with how much water is available, but before that, 1700 meter cube per year per person, if a country has less than that 1700 meter cube per year per person, then it is designated as water-stressed country. If it is less than 1000 meter cube per year per person, the country would be designated as water scarce. Let us see, what is the gap in the demand and supply in our country, in India.



Here, I am showing the map of India, the river valleys, I mean river basins. By 2030, there will be severe demand-supply gap in almost all river basins except the Northeast and then maybe this, there is one river basin here Subarnarekha, there also we will not have that much of demand-supply gap, and some paths here we will not have demand-supply gap, but in all the other river basins we are going to have demand-supply gap.

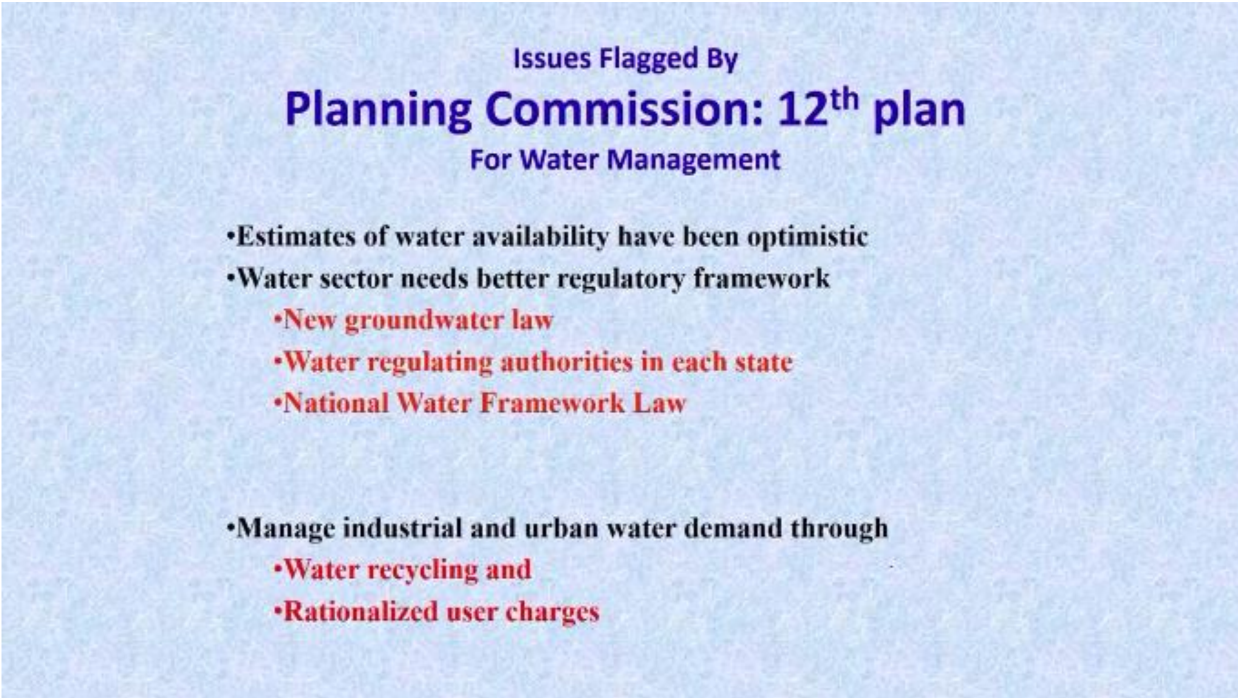
Some river basins like the Godavari would have moderate, but other places, other river basins will have a very severe demand-supply gap. And we have to consider that in our planning. Even before that, the situation at present itself we have lot of issues as far as urban water supplies concerned.



We have 31% gap in demand and supply of water and most of the cities we have only intermittent water supply. In fact, majority and more than 90% of the cities, India have intermittent water supply, where the water is supplied only a few hours in a day. And in some places, in fact, it supplied maybe few hours in 3 or 4 days. Very, very few locations we have 24/7 water supply. Now, this is an important point to be considered because we would like to in near future, actually supply water around the clock that is 24/7, how do we make this transition? That is something we have to think about. Then more than 70% gap in the treatment of sewage generated and treated. Now, this is also a very important point because if the wastewater that is generated, the domestic wastewater that is generated is not treated and let into the environment, it is going to pollute our surface water sources as well as groundwater sources. So, water will not be available, if the present scenario of not treating 100% the domestic sewage goes on.

There is a more than 30% gap in the treatment of industrial wastewater generated and treated, there we are doing better than the domestic wastewater, but still, there is a gap. We are not treating all the industrial wastewater that is being generated. Other than this, we have poor operational and financial health of the utility companies, the urban water bodies, I mean urban local bodies we call ULBs, who are in charge of supplying this municipal water. Not many water connections are metered, so we are not even knowing how much of water we are supplying, so we will not be able to collect the money from them, you know the people, for the water that is supplied to them because not many water connections are metered.

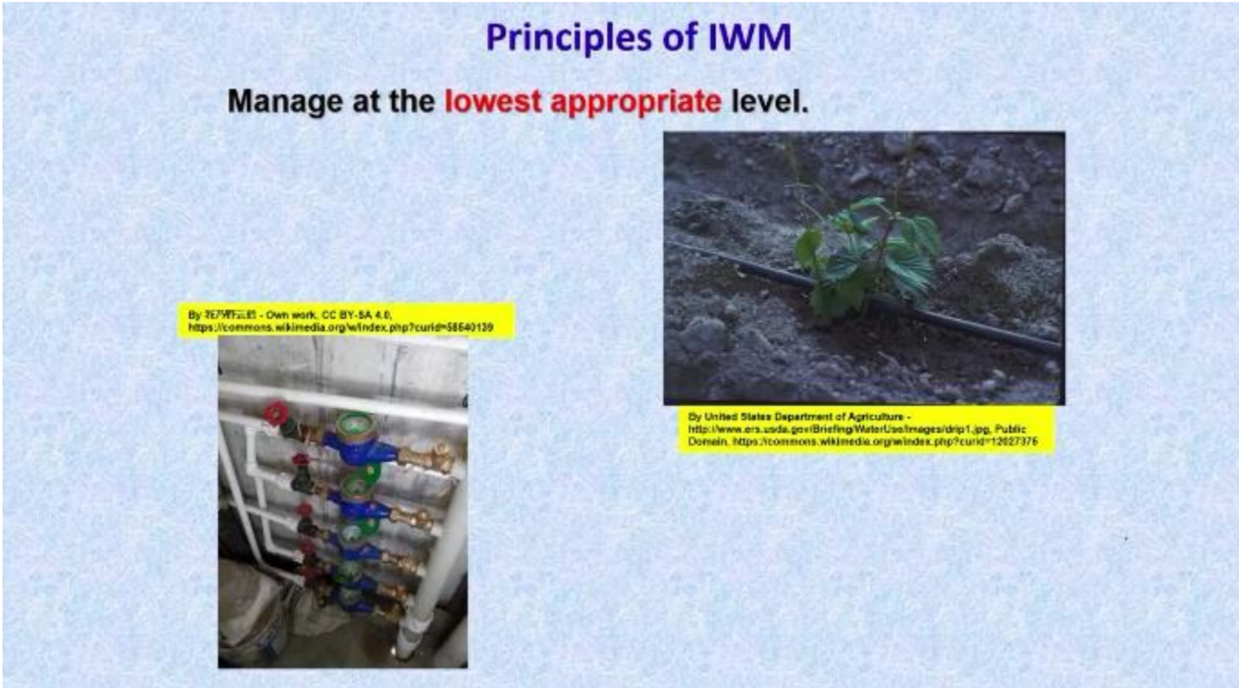
And there is a significant loss of water through leakage, as much as it is estimated that as much as 30 to 40% of water that is put into a distribution system is being lost, they are unable to account for that. So, these are some of the key points which should be addressed if you want to do a sustainable management of water in urban areas at least in India.



So, there were quite a few issues flagged by planning commission, the erstwhile planning commission in the 12th plan for water management. These are very important points; it has been said that estimates of water availability, these estimates themselves are quite optimistic. And another important point is water sector needs better regulatory framework, there is a need for passing new groundwater laws, and there is a need for setting up water regulating authorities in each state, and we have to pass national water framework law, these are something we need to do.

And now, that is what they said in 12th plan; we have to manage industrial and urban water demand, this is a very key point, manage industrial and urban water demand through water recycling and reuse and rationalized user charges. These two need to be implemented for sustainable water management in urban areas.

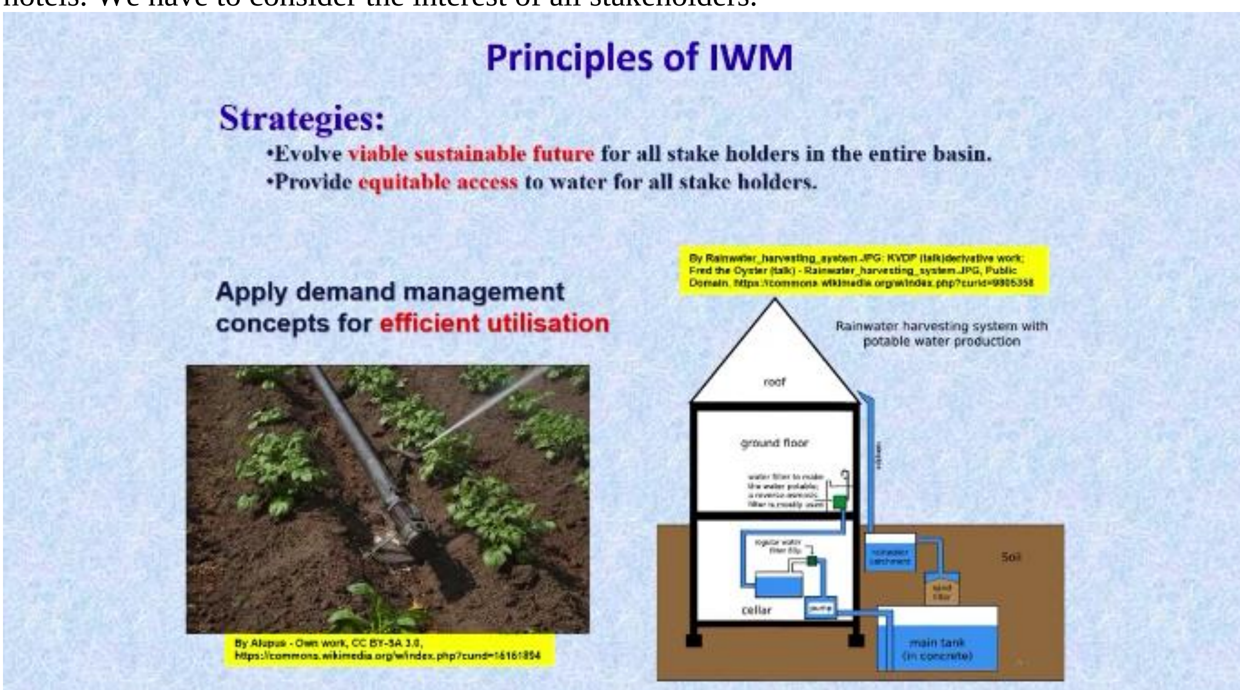
In this context, I would like to introduce to you the concept or principles of Integrated Water Management or IWM. The objectives of an Integrated Water Management are manage water in an integrated way recognizing that it has multiple uses. Water can be used for many purposes, for example, water is required for, large amount of water is required for carrying on agricultural activities, for food production. In fact, in India, more than 80% of the water is used in the, for irrigation or agriculture. Then water can be, I mean needs to be provided for drinking or domestic water supply, although it is only about 6%, but this is a must, we need to provide this 6%, I mean we need to provide water supply to all the people, both urban and rural areas. Then we need water for running our industries, particularly power and other heavy industries. At the same time we should not take out all the water that is available in a river and then make it dry, we need to make some water run in the rivers, there is a minimum amount that needs to be left in the river itself, for it to survive, these are minimum ecological flows that need to be maintained in the rivers, for maintaining the ecology. So, there are multiple uses of water, and one has to recognize that while doing the management of water in any large catchment area or integrated water management in a basin. And we have to manage at the lowest appropriate level.



When I say at the lowest appropriate level means, for example, when the water is taken for agricultural use, it is not just that we worry about how to operate a reservoir, but we also need to intervene at the field level, at the field level, at the lowest level, that is, we may go and then say how best to utilize the water in a farm or in an agricultural field by going for better water delivery system to the plant zone, I mean root zone of the plants. Like, here I am showing a picture of a drip irrigation system here, which probably has a better water use efficiency than the regular or conventionally followed flood irrigation system or other surface irrigation systems.

Or we have to go and then intervene at the household level and then probably monitor how much of water is being used for what purpose and then how to improve the efficiency of water use at the household level itself. Here I am showing how to put the meters; this is important because as I mentioned earlier in many of the urban areas in India, we do not have metered connections. So, you have to manage at the lowest appropriate level.

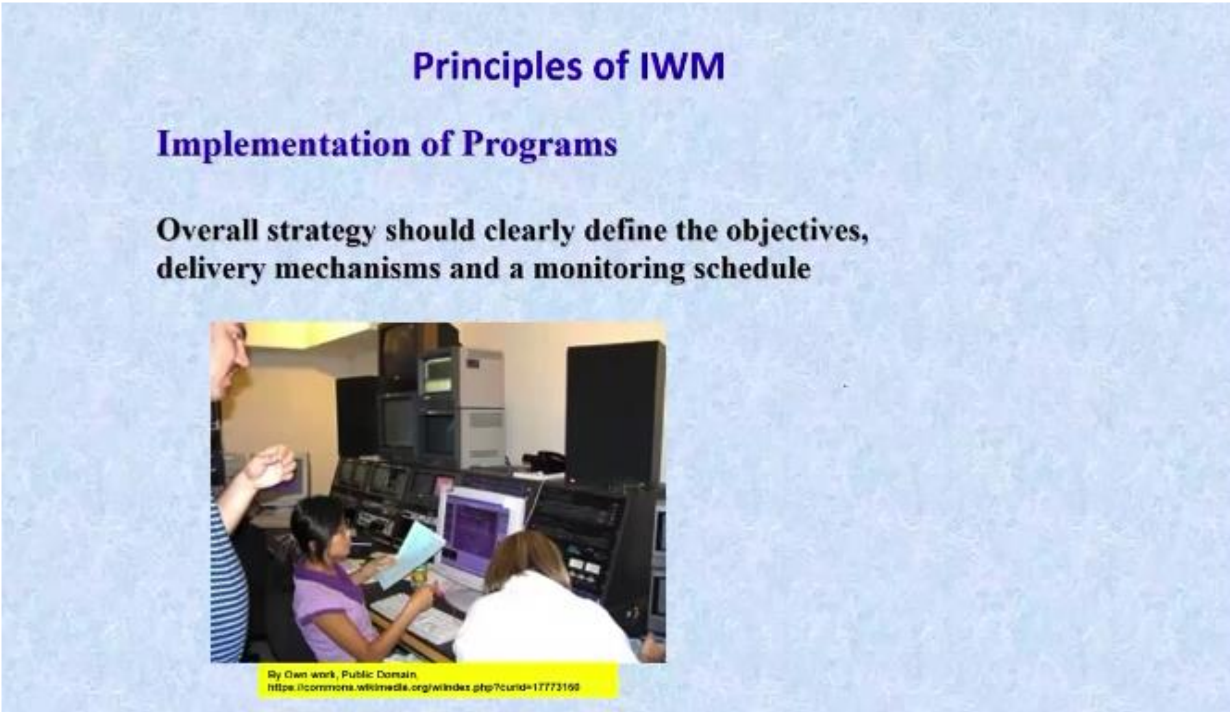
We also have to consider the interest of all stakeholders, this is the picture from one of the towns in India during summer and people do not have piped water supply coming to the houses, they go to the nearby public tap and then queue up their water pots. What I am trying to tell is, we need to supply water to underprivileged communities in urban areas as well as in peri-urban areas and of course in rural areas, as well as we have to supply water to probably to swimming pools in star hotels. We have to consider the interest of all stakeholders.



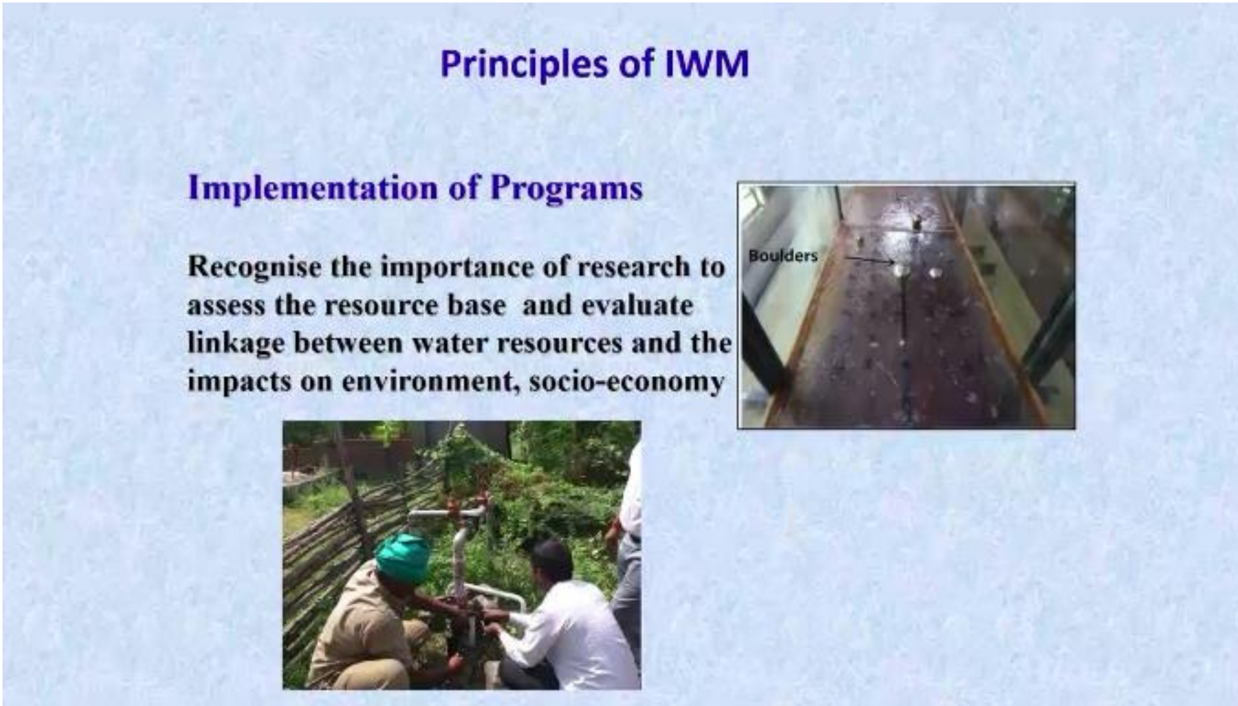
The main issue is, the main point here is, water should be recognized and treated as an economic good if you want to follow the principles of IWM. And what are the strategies that one can adopt, we have to evolve viable and sustainable future for all the stakeholders in the entire basin not just part of the basin and not for only few stakeholders and not just for now, but for the future also. Viable, sustainable future for all the stakeholders in the entire basin. And this is very important, provide equitable access for water for all the stakeholders, for this we need to do some demand management, particularly demand management for efficient utilization. For example, right now in India, the water use efficiency in the agricultural sector is very low, is less than 30%. Now we need to change, our ways of irrigation and how we deliver water to the root zone of the plants, and we need to increase irrigation application efficiencies. So, that for the same amount of water we can grow more crops or for growing the same amount of food we require less water, this is absolutely necessary.

So here we are showing a sprinkler system as an example for demand management. Another picture I am showing here is schematic of a rainwater harvesting system for a house. Whatever the rain falls on the roof of the house, we can take it through the pipes and then we can send it through some a sand filter and then store that water in a concrete tank underground. When the rain falls, we can store that water and then use that water, pump that water back to the house through a treatment system and then we can use it for even drinking. If you do that, then this particular household would not demand water from the utility, would not demand as much water from the utility company. So, that way, the demand, we can reduce the demand, so that whatever that is available to us with the city, it can be used more fairly and more efficiently. So, there is a demand-side management one has to implement.

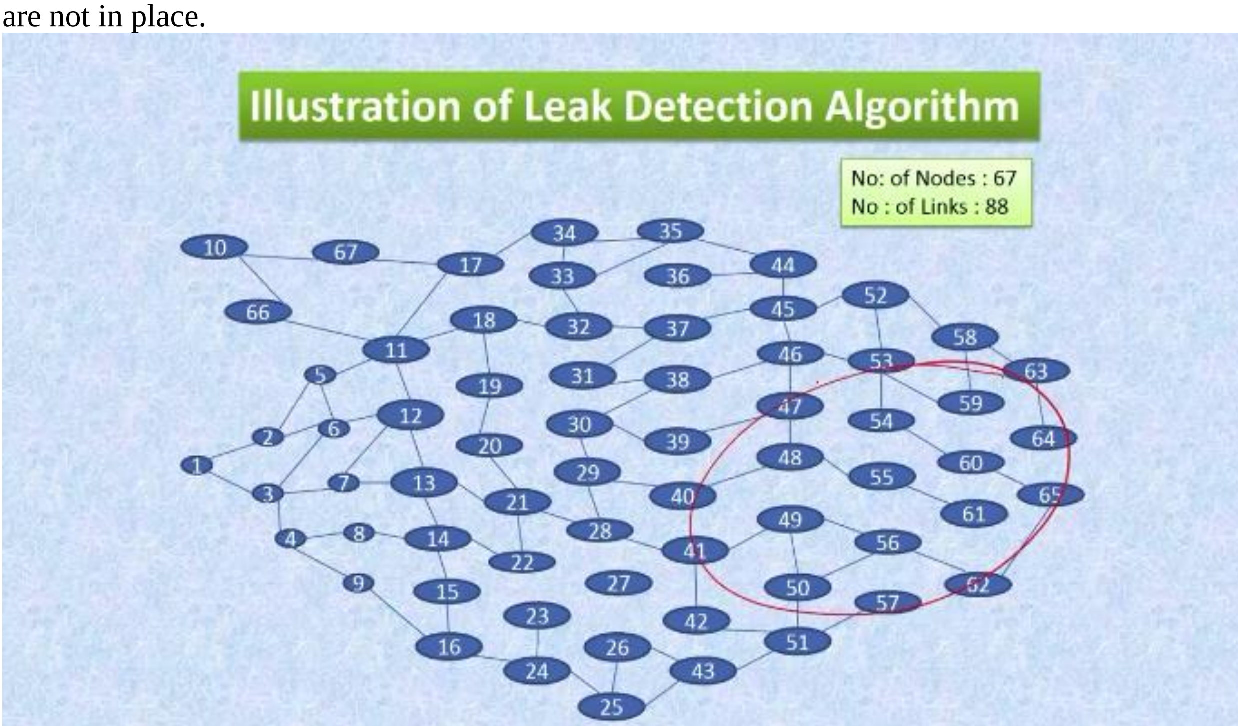
We need to prevent further environmental degradation. There are some, not all the rivers are bad or dirty or having poor quality of water, there are some rivers which are clean, which are pristine, we have to make sure that there is no further environmental degradation. We have to prevent pollutants moving into the river and then we have to regulate the activities in the nearby zones so that the river does not get polluted. We also have to restore degraded water resources, this picture I have shown earlier also in one of my lectures, very bad quality river in Chennai and we have to restore such rivers, restore degraded water resources.



And implementation of programs, certain principles have to be followed. The overall strategy should be very clearly defined, should very clearly define, what are the objectives, any new water resources project that is coming up in the urban areas, it should clearly define the objectives, what are the delivery mechanisms and very important, a monitoring schedule. That is once you put in this system, we have to monitor that and to see whether it is functioning properly or not. So, the planning is a crucial step for all these big water resources projects in urban areas. And not only planning, of course, after they are put in put in the place we have to properly monitor, in fact, most of the water distribution networks these days is mandatory to have this data, that is supervisory controlling data acquisition system which tells you how this system is performing.



We have to recognize, the importance of research to access the resource base and evaluate the linkage between water resources and the impacts on environment and socio-economy, this cannot be overemphasized. The research is very important, and the research needs to be carried out in the laboratories as well as in the field to get a better understanding of the linkage between water resources, the environment, and the socio-economy, more research needs to be done. Like for example, I just give you an example of a research that we are carrying out in terms of leak detection in large water, already existing water distribution networks but where the instruments are not in place.



And we are interested in finding out the areas where the leakage could be much more than the areas, maybe this area in water distribution network is having lot more leakage of water compared to some other area. If you can find out the answers to such questions then probably we can prioritize our maintenance probably if this area is leaking more, I would go and then change the pipes in that area rather than change the pipe somewhere else. How do we do this? If it is a large water distribution network, as I mentioned we do not have any instruments already there in place in the system, and we have to go and then make measurements and this measurements cost lot of money and then take lot of time. So, what is the kind of the measurement schedule we can have to detect the areas where the water is leaking more? We need to do research in such, I mean we need to research to find such, answers to such questions.

Thank you