Water Supply Engineering
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Lecture - 03
Water Uses

Hello friends and welcome back. So we have been discussing about some of the basic concepts in water supply engineering in this course and this is the first module. So in the last lecture, we discussed about the various water sources and the availability of water. So how much water is available, we did discuss about the global scale availability as well as the water availability in India and what is the level of stress and scarcity. In this lecture, we will be talking about water uses.

So water is used in different sectors for different purpose. So we will be discussing about what are the various applications of water? What are the various competing uses of water and how much water is used in which specific sector. So all those things we will be discussing in this lecture.

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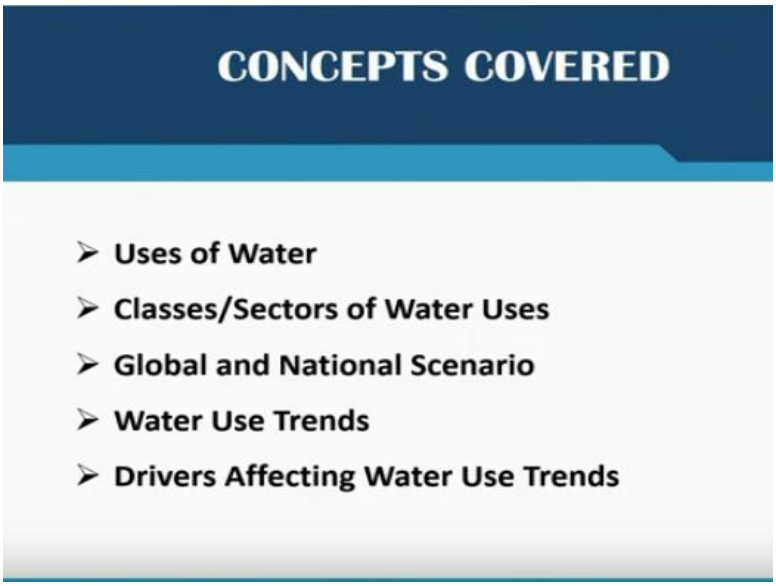

So the concepts that we will be covering is what are the various uses of water, then the various classes and sectors of water use. Of course, we will discuss the global and national scenarios of how much water is used for which specific or what kind of applications. We will see the trends in the water use. So if it is changing or if it is consistent and what are the drivers that actually affect the water use trends.

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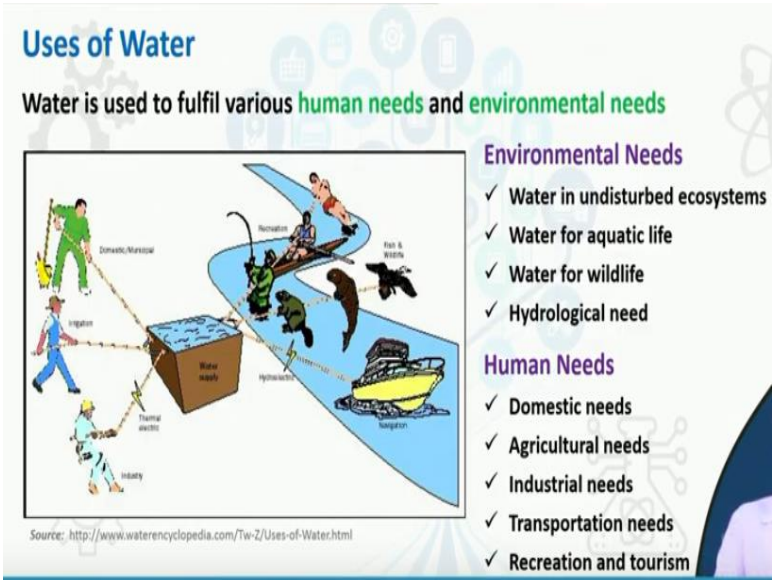

So this is what we are going to cover in this particular lecture. So when we talk about the uses of water it is actually to fulfill various demands. Now this demand could be demand from the human or demand from the ecosystem okay. So water can be used to fulfill the human needs as well as environmental needs. Now there are different applications under both of these classes.

So ecosystem demand or environmental needs is the water which is basically used for the aquatic life, water which is used for wildlife, plants, water which is used for hydrological needs means survival of the our aquatic system, survival of the river, pond, lakes okay and water which is basically used in the undisturbed ecosystems. That is actually the environmental need of water.

But what we are more concerned is what is the uses of water for development, for growth, for civilized societies. So that comes under the human needs and in human needs we use water for domestic purpose. So of course, you all understand that we use water for drinking, bathing, cooking, cleaning. So all those applications comes under the domestic need.

Then water is required for agricultural needs, primarily for irrigation purposes, so growing the crops, okay. Then industrial needs, so development of various kind of products and services in the industry. So that is the industrial need for the water. Then there could be the transportation needs, means water for the purpose of transportation.

So shipping and those kind of processes also need enormous amount of water and recreation and tourism purpose. So these are various human needs of the water.

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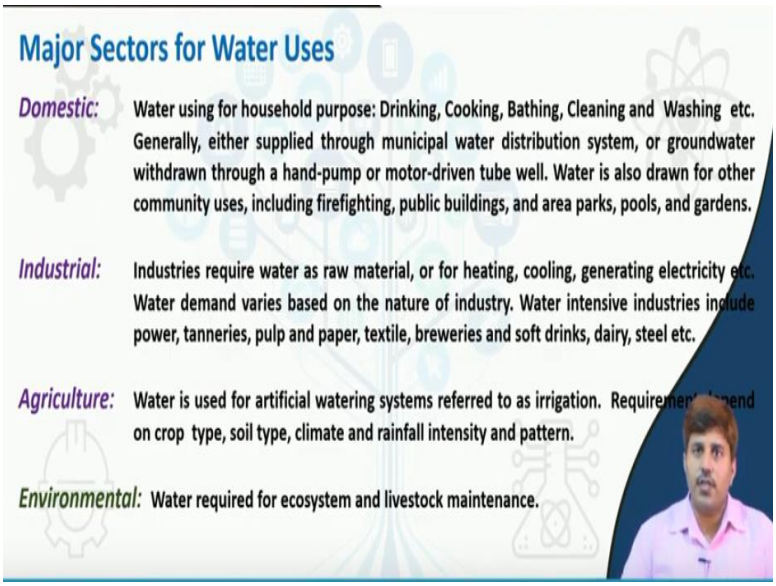

Now, if we see the major sectors for water uses, we can classify them into three primarily, three primary sectors where human needs are given due importance and there could be the fourth sector environmental when we talk about the ecosystem needs. So the environmental sector is for fulfilling the water required for ecosystem and livestock maintenance, okay.

Whereas, under the human needs, we can have three major sectors which is domestic sector where water is used for typical household purpose, drinking, cooking, bathing, cleaning, washing all those, okay. So this particular like water for this particular sector needs is either supplied through municipal water distribution system or the groundwater which is withdrawn through the hand pumps or motor driven tube wells.

Water mostly is supplied through the pipe system in urban space whereas the rural sector primarily use water through the hand pumps or tube wells or wells those kind of thing, okay. Water can be also used for the other community uses including firefighting and then in the public building, parks, schools, pools, gardens, those places.

So all that will also come under the domestic sector because it is for the growth of civilization, for the development of city or town. So that all comes under the domestic

sector. Then there is a industrial sector which they are basically industry required water. This could be requirement as a raw material, the requirement for various industrial processes which may include heating, cooling, generating electricity, those kind of applications.

The demand of water from industries varies based on the nature of industry. So there are various water intensive industries like power industry requires huge amount of water, thermal power or like whatever kind of power industries we are talking about. Then tanneries, pulp and paper, textile, soft drink industries, dairy products, then food industry, steel industry.

So these are some of the industries which require substantial amount of water. So we can call them as a water intensive industries. Then there is a agricultural sector which needs water. So water for the agriculture is primarily used for the irrigation, okay. It means artificially watering the plants or artificially watering the crops. Again the requirement will depend on the crop type, then what kind of the soil is, what are the climatic conditions, what kind of rainfall pattern is there in that place.

So all these in combination will basically set up the requirement for the irrigation. So domestic, industrial and agriculture are the three primary sector for water use for human needs and we can have ecosystem or environmental as the fourth sector.

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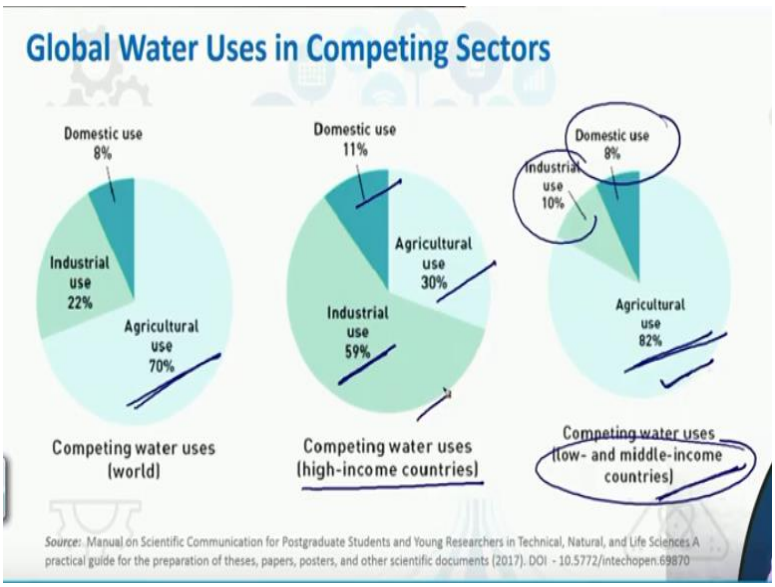

Now if we focus on these competing sector, the domestic, agriculture, and industrial sector, so there is a very interesting trend in water uses in the developed world and developing or low income countries, okay. So in the high income countries, the water used in the industries are maximum. So industrial use actually can go as high as around 60% in the high income countries, okay.

The agriculture sector uses around 30% of the water and rest like around 11% or 10% range goes to the domestic uses. But if we look at low and middle income countries, then this trend kind of reverses as we see the agriculture uses become much more dominant, because most of the low and middle income countries are agro based economies like in India. So our Indian economy is also primarily agricultural based.

So the uses of water is highest in the agriculture sector. So agricultural uses on an average in the low and middle income countries uses around 82% of the total consumption okay. The industrial uses goes around 10% and domestic uses of the same order. So industries and domestic uses are more or less of the similar order, whereas, agriculture is the sector that dominates.

Now, because if you see the word average, so the population or the area under these low and middle income countries dominate. So that is why on a global scale also we will see that agricultural uses are the most dominant type of water uses. So there are close to 70% water which is used for the agriculture purpose which is used basically for the irrigation.

Then industrial uses go around 22% okay, which are primarily driven by the high income countries and domestic uses is again of the similar order around 8 to 10% or that range. So this is how the water is used in the different competing sectors across the globe.

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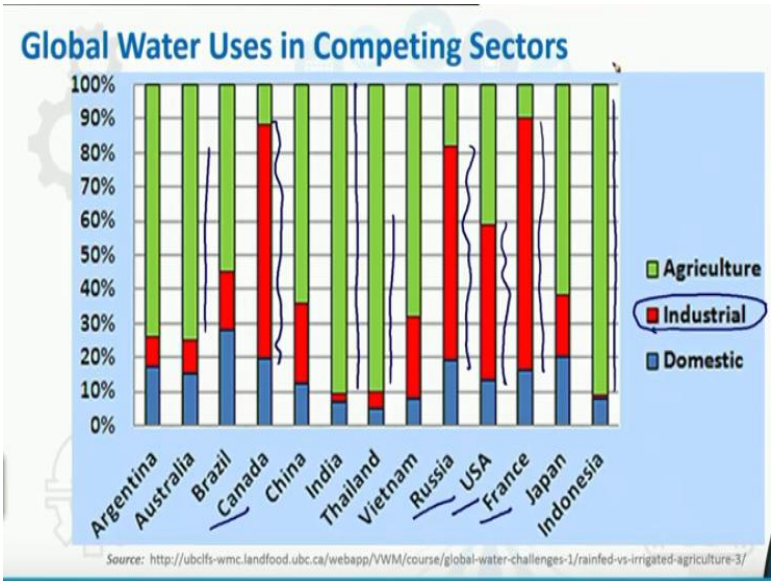

If we take an example from few countries, so interesting trends can be seen here, like if you see the Russia, USA, France, okay or Canada, or these kind of countries so you can see the red blocks which is for industrial uses is significantly dominating. You can see that France majority portion is this, US there is substantial agricultural activities because of the size but still the industrial uses dominate.

Russia, predominantly industrial uses. Canada very little agricultural activity, mostly industrial applications and agricultural activities are limited. Whereas, if you see the countries like India, you can see that agricultural activities around 90% okay. Thailand, again, very high agricultural activity. Argentina, even in the Australia agricultural activities is quite high. Indonesia, agricultural activities are very high.

So one can see from here that it is basically the agricultural activities that dominate in the countries India, Indonesia, Australia, or all these Argentina, Brazil, whereas the countries like Canada, Russia, US, France are predominantly the water is predominantly used in the industrial sector. Then domestic sector of course, it varies based on the population in percentage and those things but roughly it ranges from around say 6, 7, 8% to 10 or 15% generally in that range.

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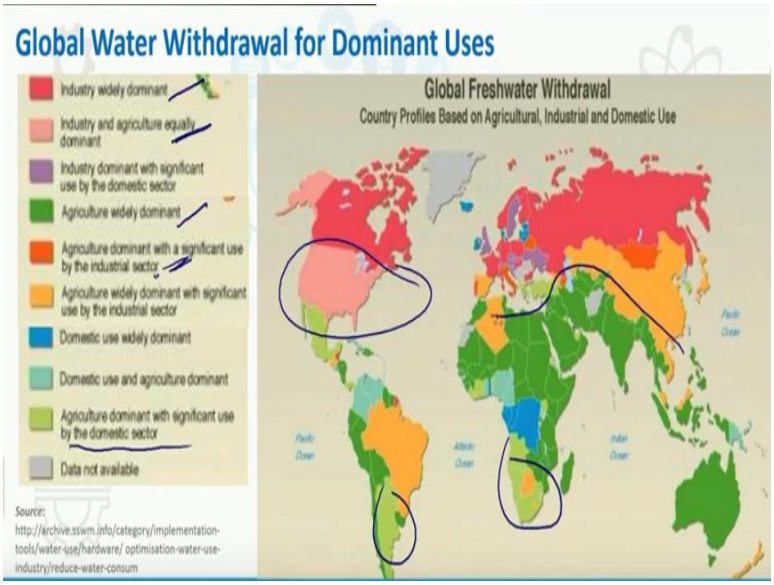

This is another kind of prospective of the global water withdrawal for the different dominant uses, okay. So if you see there are the different colors indicate different type of uses like this color is industry widely dominant okay. Similarly, green color is agriculture wildly dominant, okay whereas the blue color is domestic use widely dominant.

Now you will see very rare blue patches pure blue patches like somewhere here and almost other places very small some here or here. Otherwise there is generally the domestic uses never dominate in most of the countries okay. So what we are left with the country's either like their industry widely dominating uses or agriculture widely dominating uses.

Now the different states of color can give you an idea of the secondary uses as well like this color is industry and agricultural equally dominant. So as we were just seeing also in the part of US it is the agriculture and industry which equally dominates okay. Similarly, the blue, this violet patch is industry dominant with significant use by the domestic sector. Again domestic sector significant uses as very little okay.

Then this one is agriculture dominant with significant use by the industrial sector. So this also you can see in the various other parts where industry and agriculture both are predominantly used okay. This is agricultural dominant with significant use in the domestic sector, the green ones. So you can see that in the some portion near South Africa and those places.

Whereas in majority of this part, you can see it is all green. That means, it is practically the agricultural uses which widely dominate and widely dominate means almost over 80% of the consumption is from the agricultural sector.

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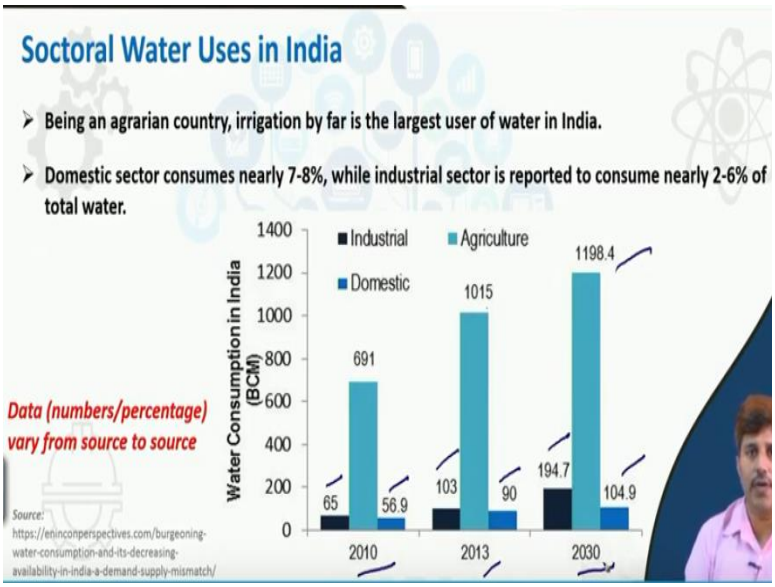

So that was a global perspective. Now if we see the sectoral water uses in India, so again, first thing is that the numbers or the data that we see on the screen may vary from source to source. So there is no absolute number available there is because these are all estimates and different agency may come with the different numbers.

However, these numbers are roughly close to each other or at least if we talk in terms of percentage and those things. So these estimates quite match with the different sources. However, again the exact number or percentage may not match from the different sources and may actually vary from source to source. So if we see the water uses in India of course we are agrarian country.

So our economy is based on the agriculture primarily and irrigation by far is the largest water using sector in India. Then domestic sector comes nearly around 7 to 8% while industrial sector is also reported to be around 2 to 6% depending on the source to source. This is actually estimate. So in 2010, it can be seen that the total agricultural consumption was 691 billion cubic meter.

Industrial consumption barely 65 billion cubic meter and domestic consumption around again 57 billion cubic meter. In 13, it is this has gone to 1015 billion cubic meter. This has gone to 103 and this has gone to around 90. Again in 2030 it is expected to be around 1200. This is expected to be further doubled around 194 and this is expected to be around close to 105 billion cubic meter. So that is one estimate.

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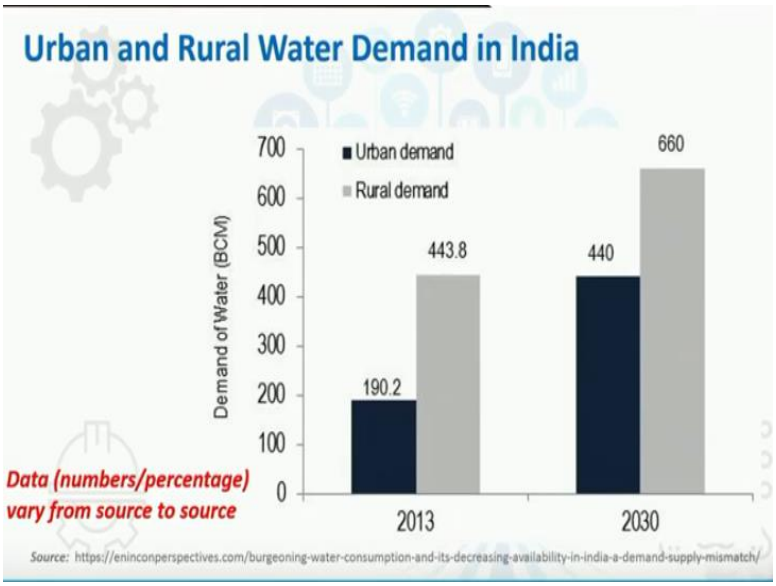

Similarly, we can actually have estimate from other sources as well. If we see the demand from the rural and urban sector, so because our majority of the population still lives in the rural areas and agriculture demand is predominantly comes from the rural areas. So that way we can see that the rural demand is much higher as opposed to the urban demand.

But because of rapid urbanization, the rate at which the rural demand is growing is not that high as opposed to the rate at which the urban demand is growing. So urban demand is likely to be around 440 by 2030 whereas rural will reach 660 and we are actually expecting more than 50% of our population will live in the urban areas by that time. So of course, the domestic demand is going to be higher in urban areas.

But it is shrinking of the rural activities as well and agricultural activities. That is why there is lesser enhancement in the agricultural or rural demand as opposed to the urban demand.

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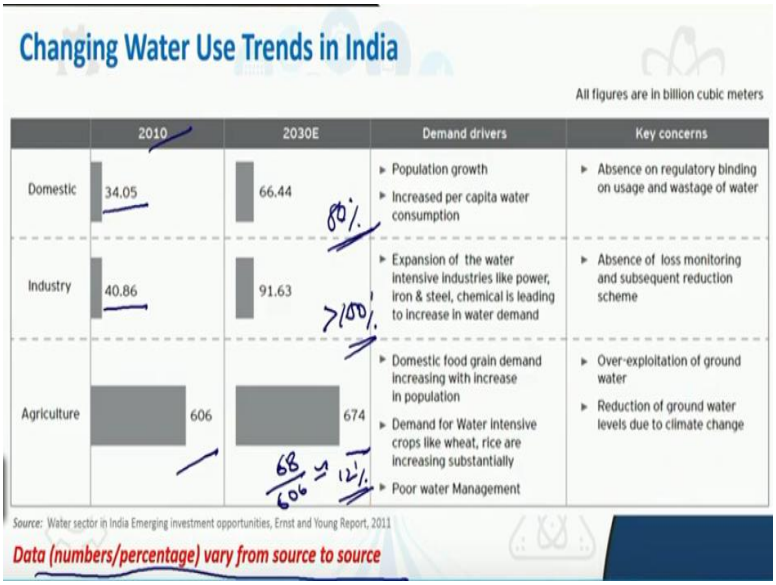

Interestingly, if we see the trends of the water use, how the water use is basically trending; so again this is another estimate, which is a report by Ernst and Young. In 2010 the estimated domestic demand was of the order of 34 billion cubic meters, okay. Again, I am mentioning that this number and percentage may vary based on source to source.

But still like if we take this number on its face value say so the domestic demand was 34 billion cubic meters, industrial demand 40 billion cubic meters, and agricultural demand 606 billion cubic meters. In 2030 it is estimated that agricultural demand will be around 674 billion cubic meter.

So if you see the rate at which it has grown is very little, around like in terms of percentage if you try to see, so this will be 68 divided by 606 okay. So close to around say 10% or 12% in that range, okay the growth would be in that range. Whereas, industrial demand is going to rise from around 41 to 91. So more than double, more than hundred percent increase.

And the domestic demand is going to be from 34 to 66. Again, close to around 80, 90% growth. So if you see the percentage growth, it is far more higher in case of industries. It is much higher in case of domestic but in agricultural it is the rate at which the agricultural demand is growing is much lesser as opposed to the industrial and domestic demand.

That is primarily because domestic demand is driven by the population growth. So population increasing domestic demand will increase and it is also driven by the increase in the per capita water consumption. So as our lifestyle is changing and as just we were discussing that we are expecting more than half of the population is going to shift in the urban areas.

So the requirement of water or per capita requirement of water is generally perceived to be higher in urban areas as opposed to the rural areas. So there is higher per capita water consumption and more number of people. So inclusively we see the rise in the domestic demand. Industrial demand is because the industrialization, so expansion of the industries and more so ever water intensive industries like power sector, iron, steel still those kind of industries.

So they are going to impose huge amount of water demand, okay. And as we see that in the developed countries, the industrial demand go as high as close to 60% of the total water consumption, we are still at around 6%, 8% or 10% that range. So this will actually increase substantially, okay. And that is why we see a huge growth is expected in the industrial water demand.

Agricultural water demand of course, if there are more number of people with population growth, so there will be more requirement of the food grains and that would require more water, but it is just not depend on the food grains we have the we have to have the area available for agricultural activities and that area is not going to increase, that area is rather shrinking.

So of course, we need to grow more food for more people, but so probably our food, our cropping pattern is going to change and all that. So there would be likely increase in the agricultural demand as well, but it is not going to be that high okay. And it will basically see like what kind of water management practices can be adopted in the agricultural sector, because right now, one of the challenges is that our water management in agriculture is not that great.

So the production of the crop per unit water consumed is not as high as in the various other countries. So there is a lot of scope of producing more food grains with almost

similar amount of water. So by enhancing the or by adopting the good water management practices in the agriculture. So there is a scheme from the central government more crop per drop, which actually targets this only.

So these are some of the like trends that we see in the water use and how the water use is going to change okay.

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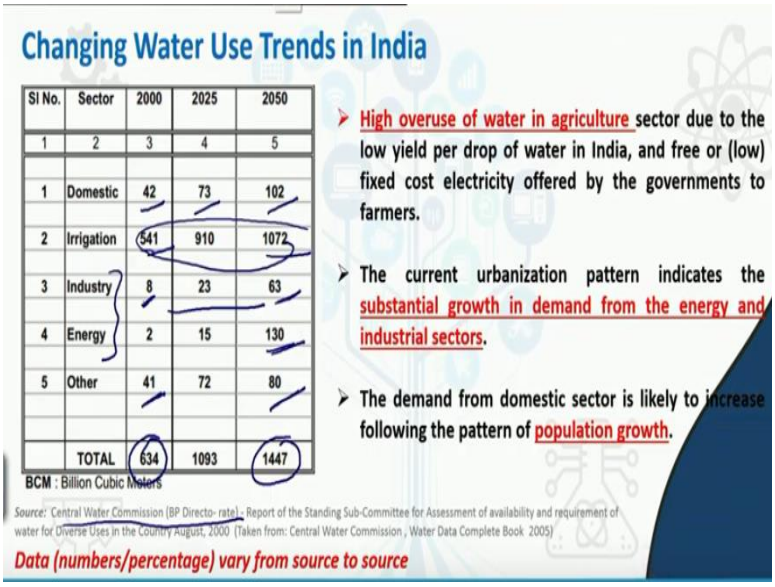

Similar kind of our Central Water Commission also believe similar trends. So the domestic this is actually the number from the Central Water Commission. Again, as we said that it could be, the numbers could be different from different sources, but what we see in 2000, the domestic requirement from 42 is going to be expected to around 73 by 2025 and 102 by 2050.

So if you see the growth rate, so it is actually like again by from here to here, it is more than 60% that way and then from here to here, it is more than 2.5 or close to 2.5 times. Irrigation again close to two times from 2000 to 2050. Industrial demand from 8 to 63, so close to around 8 times increase in here okay. Much more increase in the industrial demand as opposed to the agricultural or domestic demand.

Energy sector will also need huge amount of water. The power is one of, actually this can be clubbed with the industrial sector as well because energy is also one type of industry, okay but the power industry is also going to have huge amount of water

demand and all other water demand which is estimated at around 41 billion cubic meters will also rise to almost double okay.

So the total water consumption which is 634 which was estimated as 634 billion cubic meters in 2000 is going to of the order of 1500 close to that number by 2050. Some of the important points is that there is high over use of water in the agricultural sector as just we were discussing okay which is primarily because its water is free or very low priced in agricultural sector.

And the most predominant source for agricultural applications is groundwater. And because of the free or very low fixed electricity cost which government offered to the farmers, there is no cost of pumping as well not much cost of pumping. So there is no restriction on pumping, lot of water is pumped and our fields are irrigated.

And that is why we do not use the most irrigation efficient methods in many part of the country resulting in too much irrigation or very high overuse of water in the agricultural sector. Again, the urbanization pattern indicates that substantial growth in the demand will be from energy and industrial sector as just we were discussing.

And the demand from domestic sector is basically going to come from the population growth, predominantly population growth and to some extent, the per capita increase in the water consumption as evident from the living standards of the people.

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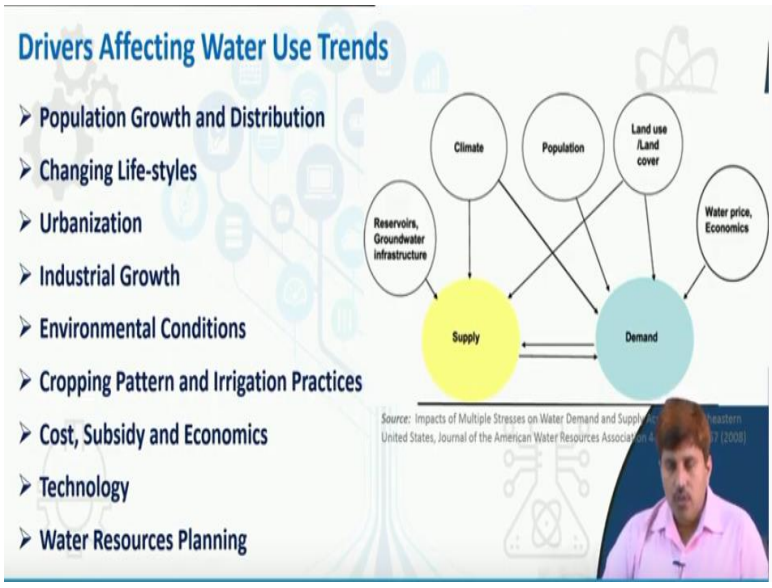

Some drivers that affect various water use trends. So we have been discussing some of these points, there is population growth and distribution. So how the population is growing and how it is getting distributed. Distributed in a sense that the overall if you see the population rate at which the population is growing is quite high.

But it is getting more and more concentrated towards the urban centers like in the metros, the population of Delhi if you see the rate at which the population of Delhi is growing or NCR is growing, as opposed to the rate at which population in say some district of Rajasthan or MP is growing, so they are going to be very different rates okay.

So overall population growth is there, but due to migration or due to other factors as well, the population is getting more and more concentrated towards the urban sector. And this urbanization or more people moving into the urban sector is going to create a lot of water demand from the domestic sector. This would have impact from the changing lifestyle as well okay because the kind of lifestyle which is adopted in the small town or rural sectors is quite different from the urban sectors okay.

People earlier used to take bath in the bucket, so maybe 20 liter water, but now if you open the shower and you stand there for some time for 5 minutes 10 minutes. So the amount of water consumed in the bathing is going to be quite different from that, quite different for a person taking a shower and for a person taking say bath in through a bucket okay.

Or for a person which is actually going to some bathtub or that kind of practices. The food style is changing so what kind of food earlier used to be prepared what kind of fooding practices are being adopted more in the urban centers these days. So all these changing lifestyle will have impact on per capita water consumption, okay. Then there is industrial growth which will actually lead to high water demand from the industrial sector. This we have already discussed.

The environmental conditions one of the most, if not most, but one of the very prime factor that affects the water use trends is the environmental conditions. We have been basically talking about the climate change impacts as well these days. So with the

climate change, the temperature is rising. So overall like the consumption of water by the ecosystem as well as by the humans is going to increase okay.

So of course it is going to affect the sources as well but we are not talking about sources here we are talking about water uses. So there is a impact of the environmental conditions as well. The rainfall is getting, the fewer instances of rainfall is coming. So the irrigation requirement would be high although the rainfall is getting more concentrated, so even though the amount there is a debate whether the net rainfall is decreasing or not.

But everybody believes that it is getting more and more concentrated. So we do not get rainfall spread throughout the year now and as a result the like the requirement for water for irrigation, horticulture or these purpose is going to be higher. Again as we said with the temperature rise the body requirement or ecosystem requirement of water is going to be higher. So all those factors will also count in.

Then cropping pattern and irrigation practices. So there are like water intensive crops. If there is more production, more requirement of rice, sugar, or all those things so that will actually require more water. So what kind of irrigation practices are adopted?

If there are like flood irrigation which use enormous amount of water, there are other alternate methods which save water like drip irrigation and those things which are very much efficient in water saving, but then there is a cost of installation and those things and still it is not that popular. So what kind of integration practices are being adopted in future or what kind of cropping pattern is adopted in future will also affect the water use trends. The cost subsidy and economics. So what is the cost of water?

What is the subsidies being provided by the government as we were just discussing the agricultural water is usually subsidized. There is no cost for water. The electricity is also subsidized or almost free. So anyone can pump whatsoever amount of water they want, there is no control that way. So this is like, if you, if these subsidies are phased out, so that will also have, that could have actually an impact on the water use trends, okay.

The what is the cost of water and how much investment is needed for basically ensuring the water reaching to its end consumer or industries or the agricultural fields. So those kind of thing. Of course, what kind of technologies is being adopted, that will also affect the water use trends and ultimately how things are planned and governed.

So that also will have a impact on how the water is being consumed under the different sectors and how this the demand from the different sector grow. So like there could be restrictions on the industrial water use so that might reduce the demand from the industrial sector but to what extent that would be justifiable. Similarly from the agricultural sector and then prioritization of the sector as well, prioritization of water use, in terms of finance, in terms of the societal needs, all those things.

So they like how the resources are planned and governed, that also could play an important role in the setting up the water use trends in the future. So with this we conclude the discussion from this lecture and in the next lecture we will then be discussing about what are the prominent issues and challenges in the water sector in India. So see you in the next class, thank you for joining.