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Lecture -62
Case Studies and Practice Problem on Water Pricing

Welcome friends, so we are now officially at the last lecture for this course; which is the week 12. And as in earlier couple of classes we have talked about the water pricing, what are the concepts of water pricing. And in just previous class we discussed the different water tariff models. In this class we are going to see some case studies and practice problems on the water pricing.

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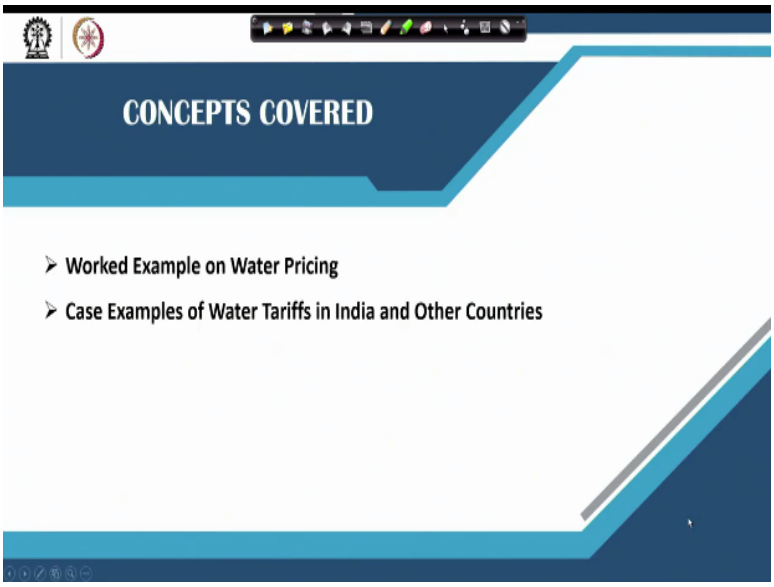

So practically we will see a work example on water pricing, water tariff designs and we will see some case examples of water tariffs in India and other countries.

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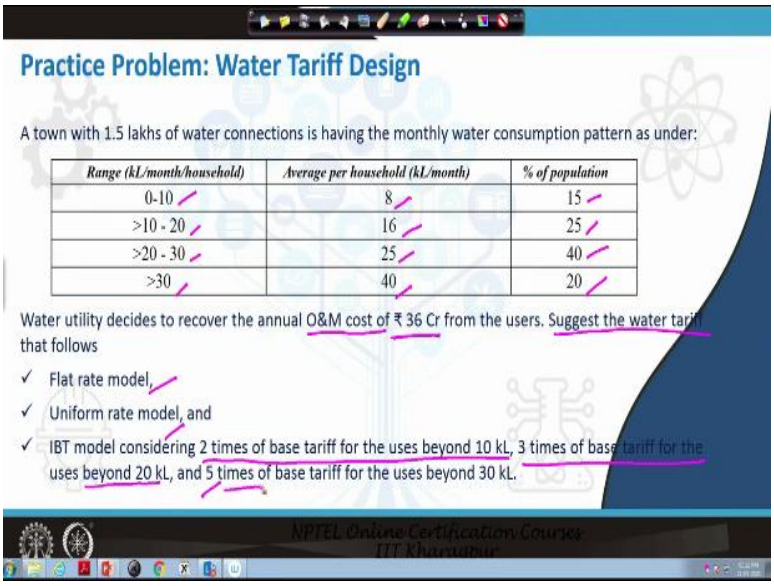

This is the problem that we are going to discuss a town has a 1.5 lakhs of water connections and is having monthly water consumption pattern as under, so monthly water consumption pattern is given. The consumption in the range of 0 to 10 kilo liter per month per household the average value per household is 8 kilo liter and the percentage of population is 15% which are consuming in this range 10 to 20 is with the average consumption of 16 kilometer per month 25% population is consuming in this range.

And 20 to 30 average consumption 25; 40% population is consuming in this range and greater than 30 with average consumption 40. 20% of population is consuming in this particular range. So water utility decides to recover the annual operation and maintenance cost which is estimated as rupees 36 crores and we need to suggest the water tariff structure that follows the flat rate model, uniform rate model.

And IBT model considering 2 times of the base tariffs for the uses beyond 10 kiloliter 3 times of the base tariff for the uses beyond 20 kilo litter and 5 times of the base tariff for the uses beyond 30 kilo litter per month. So this is the problem statement, now we have to practically design the water tariffs following the flat rate model, following the uniform rate model and following the IBT model. So let us see how we can do that.

The basic information what has been given to us the population is, we do not know population but there are 1.5 lakh households and these 1.5 lakh consumers you can say that way and the amount that we need to recover is 36 crores.

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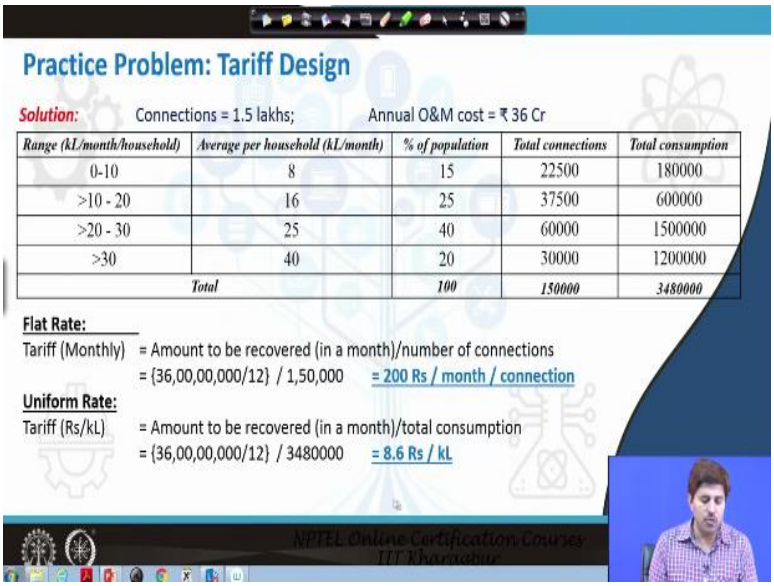

So let us see how we design this; now the connections that we have is 1.5 lakh and annual operation and maintenance cost which needs to be recovered is 36 crores. This is the information given 0 to 10, 10 to 20, 20 to 30, 30 to 40 with average consumptions in this block. And percentage of population using that total 100% population of 1.5 lakhs is connected to this server.

So if we see the total connection like 15% population, means 15% connections will be how much? So total is 1.5 lakh, so 1,50000 and we have to take 15% of that so we multiply this with 0.15 we got this number. We multiply that with 0.25 we got this number and then similarly we multiply this with the 40.4 we get 60,000 we multiply with 0.2 we get 30,000, so total we have one 1,50000 connections.

So 15% means 22500 households are using average water 8 kilo liter per month all right? So total consumption will be like, this is 8 kilo liter per month per household, its average per household. So we have 8 kilo liter water per month per household. Now there are this many

number of households which are using average 8 kilo liters we multiply 8 with this, we get the total consumption this many kilo liters per month.

So we get total consumption this many kilo liters per month similarly for the 25% population that means 37,500 households are consuming 16 kilo liter per month water average, like average on an average they are consuming 16 kilo liter per month water. So we multiply this with 16 and we get 6 lakhs kilo liter per month as consumption from these 25% households. Then the 40% households which is basically 60000 households are consuming 25 kilo liters per month average in the range of 20 to 30.

So we multiply 60,000 with 25 and we get this 1500000 lakhs kiloliter per month. So here we have 180000 kiloliter, 6 lakhs kiloliter and 15,00,000 lakhs kilo liter per month water is being consumed by these 40% households. And remaining 20% households which are 30000 consumes on an average 40 kilo liter water per month so multiply 40 with this and we get 12,00,000 kilo liters per month.

So if we sum up all the consumption the total consumption it is going to come out as 34,80,000 kiloliters per month is being consumed. So the total water which is being consumed in a month is 34,80,000 kilo liters. Now we have to recover the 36 crore rupees from a tariff system, so for flat rate as we have discussed flat rate is independent of consumption we do not need any consumption data for flat rate.

Because every household will be charged with the same amount irrespective of whatever volume they are consuming somebody is consuming 8 somebody is consuming 40, still they are going to be charged at the same rate in a flat-rate model. The flat rate tariff would be like the amount that we need to recover in a month and number of connections because each connection has to contribute equally.

So the amount what we need to recover, if we divide that with number of connections we can get the monthly tariff, so total amount which needs to be recovered is 36 crores in a year, so 36 crores in a year that means 36 by 12, so that means 3 crores in a month. So we have to recover 3

crores in a month and we are having 1.5 lakh connections. So 3 crores means 300 lakhs divided by 1.5 lakhs.

So this is this many lakhs rupees is to be recovered and this many lakhs connection we have, so we cut it down it will come 200 rupees per month per connection. So that becomes our flat tariffs. So if you just want to go for a fixed tariffs or flat tariffs model we will ask each household to pay 200 rupees a month, so somebody using 8 will also pay 200 somebody using 25 will also pay 200 someone using 40 will also eventually pay 200 rupees in a month.

Then let us go to the uniform rate model if we want to design a tariff in the uniform rate, so uniform rate tariffs are not monthly they are basically rupees per kilo liter based. So they will see like how we price? Because the rate is going to be fixed per unit water consumed rate is going to be fixed per unit water consumed, how much water is consumed 34,80,000 kilo liters of water is consumed.

So this 34,80,000 kilo liter water has to generate it is in a month, so has to generate the 36 crore by 12 that is basically 3 crore, so has to generate 3 crore revenue in a month. So eventually we will divide 3 crores by 34,80,000 so that will basically so 3000 divided by 348 which will be coming as 8.6 rupees per kilo liter. So in in a uniform tariff rate we will set tariff as 8.6 rupees per kilo liters rate.

So we have a fixed rate tariff, fixed rate means the rate is fixed not the amount respects the difference between flat rate and uniform rate in flat rate the amount is fixed, everybody is going to pay 200 rupees a month whereas in uniform rate the rate is fixed so everybody is going to pay at a rate of 8.6 rupees per kilo liter irrespective of whatever volume they consume. So somebody consuming 8 will pay 8 into 8.6.

And somebody consuming 40 will pay 40 into 8.6, so that is going to be the monthly bill of these two different people this people this guy and this guy so this will be paying somewhat around say 70 rupees or so and this guy would be paying much larger amount, almost 5 times of this. So that way we will we can basically set up a uniform tariff rate as well.

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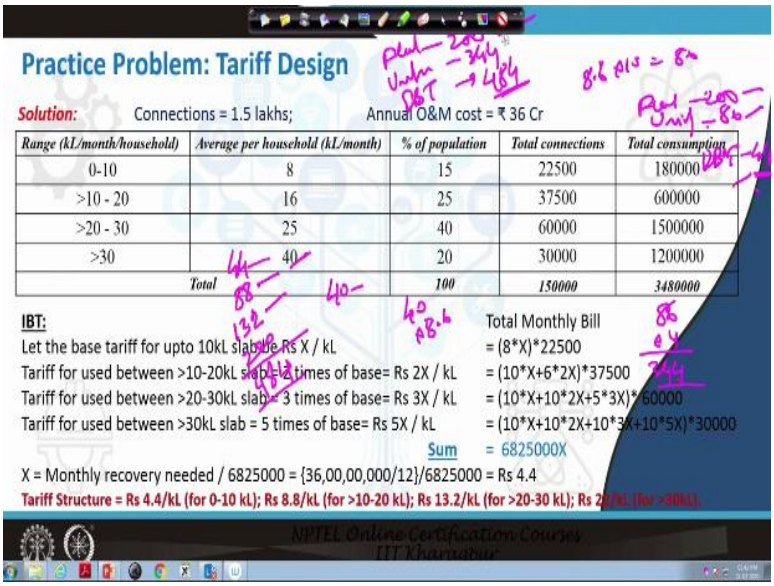

Now the most or the more complicated relatively is the is the IBT model; increasing block tariffs so if we need to set up increasing block tariffs based on the data which is available to us. So how we are going to set up in increasing block tariffs in this case? Now we know that the number of connection 1.5 lakh and 36 crore is to be recovered, we already have analyzed this like what is the consumption in the different ranges.

Now let us see X is the base slab for IB T we have given we have been given a criteria that the 10 kilo liters is the base slab and then from 10 to 20 the price is 2 times the base slab. So basically if this is say X, so this is going to be 2x then 20 to 30 price is 3 times. So this is going to be 3x and then greater than 30 the price is going to be 5 times, so this is going to be 5x. So let us say we have this X as a base tariff.

So for 10 kilo liter slab there are like 22500 connections which are consuming on an average 8 kilo liter per month, so basically the total consumption is this so this is the number of households 22,500 and this is the amount they are consuming and they will be basically paying at a rate of X because for all these households the consumption is between 0 to 10. So since consumption is between 0 to 10, nobody is going to cross that slab and as a result everybody will be paying at a rate of X.

So they will be paying at a rate of X with the average consumption of 8 and number of households so total amount total revenue which will be generated will be this much if we multiply 8 into X into like this is going to be average revenue from one household and we have 22500 households. If we multiply this with 22500 we get the total revenue. For tariffs between 10 to 20 kilo liters slab which is basically two times of base tariff.

So we have 2X here, now as the IBT is let us see this way we have 10 20 30 are the slabs for first slab we let us say have this as X so for next slab this is going to be actually 2X this value is 2X 4 next slab it is going to be 3 X and for higher slabs, it is going to be 4 X. So those who are consuming somewhere in this range they will also be pay for first 10 kilo liters at a price of X. So that means their average consumption is say 16 so out of 16, 10 will be paid at a rate of X.

And the remaining 6 will be paid at a rate of 2X, so 10 into X plus 6 into 2X this is going to be an average build from each household and there are 30 7500 such so we multiply with the 37,500 in order to get total revenue collected from these group of users. So total revenue collected from the first group of users is 8x into 22,500, total revenue collected from the second group of users is 10X + 6 into 2X into 37,500.

Similarly for 3rd group of users who are further using so again for these group of users with 25 average connections so out of 25, 10 will be charged at a rate of X another 10 will be charged at a rate of 2X while 5 will be charged at a rate of 3 X. So they will be paying 10 at a rate of X 10 at a rate of 2X and 5 at a rate of 3x; so average monthly bill and then number of connections is such connections are 60,000.

So we multiply that 60,000 this will give us the revenue from this particular people who are in this slab, and then last set is the 40. Now for 40 again here 10 will be charged at a rate of X, 10 will be charged at a rate of 2X, next 10 will be charged at a rate of 3x and anything other than this 30 so that means there are still 10 remaining, so this remaining 10 will be charged at a rate of 5x. So total revenue from one household on an average is going to be 10x for first slab.

10 into 2x for 2nd slab 10 into 3 X for 3rd slab and 10 into 5 X for the fourth slab and this is going to be the average revenue from each household and there are 30,000 such households so you multiply this with 30,000 we get the total amount here. Now this total amount whatever is there has to be equal to the monthly recovery because this is the total amount which is going to be generated in a month.

And this much amount should be equal to the amount that we need to recover and which is basically 36 by 12 that means 3 crores in a month, so if we sum all these this is coming out to be 68,25,000 X because 8 X straight away then 10 X + 6 X becomes 22X and this becomes 10 X + 20 X means 30 X + 15 so 45 X into 60000 it is the same way. So if we do all these calculations the after summing this because everything is in the terms of X.

So what eventually we are going to get is say 6825000 X and this 68,25,000 X has to be equal to the 3 crore; 36 crore by 12 so that means this is equal to 3 crores and then we can determine X from here as 3 crore divided by this number 6825000. So we solve this and we get a number 4.4. so that means X value is 4.4 so that our base tariff we can keep at 4.4 and we can design our IBT like say this; so this is 4.4 rupees for first 10.

And then for next 10 it is going to be 8. 8 and then for next 10 it is going to be 13.2 3 times of 4.4, and for any higher tariff it is going to be 4 times; so that is basically going to be 22 rupees per kilo liter, 5 times sorry so this is 5X, so that means 22 rupees per kilo liter so this is our IBT structure the first at a rate of 4.4, 2nd at a rate of 13.2 and last round at a rate of 22 so that way we can basically design a IBT model as well.

So this is how we can design these pricing models, and if we know IBT particular IBT let us say if we know that this is the different prices then again we can calculate similar way how will what will be the monthly bill? So far say under each of these models, now let us take another exercise that under each of this model what is going to be the bill of a household which is consuming say 15 or say 25 kilo liter water.

So consider two household one consuming 10 kilo liter water and another consuming 25 kilo liter water so for 20 kilo liter water this IBT will give you 4.4 rupees per kilo liter for the first 10 kilo liter. So that means it is just using 10, so 10 into 4.4; so 44 rupees the flat price 200 rupees and the, so this is 44 that way flat price is 200 and the uniform rate was 8.6 so uniform rate was 8.6 that means with uniform rate 8.6 into 10 so that is 86.

So with flat price 200 with uniform it is 86 and with IBT it is just 44 rupees, so you can see that for low consumers IBT maybe a better model because the first rate or first slab is usually subsidized in a IBT model. For a user which is say consuming high let us take 40 instead of 25 so a user which is consuming 40 so again for a flat tariff 200 for a uniform, so that is going to be 40 into 8.6 so that is that means 86 into 4, so 344 will be paid here.

And then IBT if you calculate by IBT, so IBT will have for a 40 the first 10 will have 44, for the next 10 will have 88 2 times, the next 10 will have 3 times so that means 132 and the last 10 will have 5 times, so because rate is 22 so that means 220 of this. So you sum up all this so this becomes 4 and 5 +1; 6 +10, 8 and 4. So he will be paying basically 484. So you see the IBT model penalized the user which is consuming high whereas facilitate low tariffs for the people who are consuming low.

And that is why it is considered as a model which is with the strong signal of water conservation. so you when a user which is consuming ten he will be paying 200 if flat rate is on if uniform rate is on 86 and if IBT is on just 44 where as a user which is paying which is consuming 40 will also pay 200 if flat prices on 344, if uniform tariffs is there and 484 if IBT is there so you can see the how the trend has reversed.

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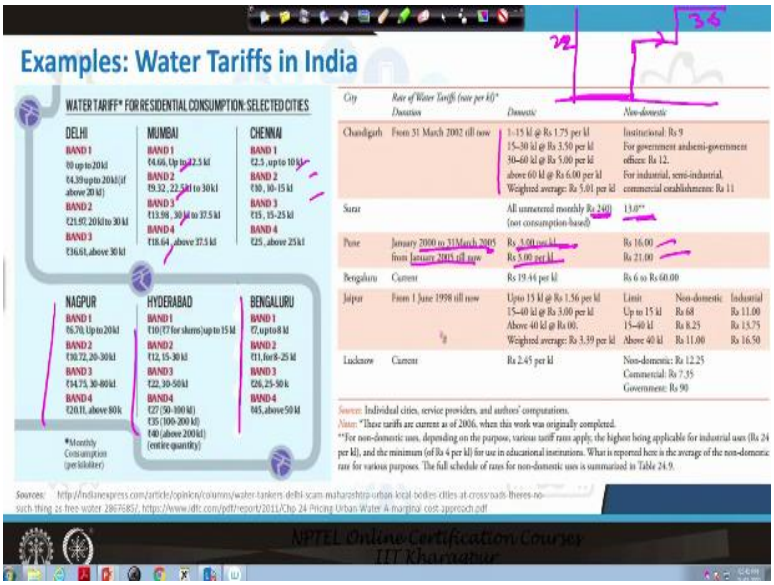

It so this is how the pricing strategies work, now let us see some examples of water tariffs in India this is just a few examples in Delhi there is a IBT kind of system where band 1 is 0. So Delhi system is unique because there is a free water for first and 1st 20 kilo liter. So you will see IBT structure where there is no charge for first 20 and then from 20 onwards you go to the band 20 up to 30, so there is 21.97 rupees per kilo liter.

So almost like 22 rupees per kilo liters charge is there for consumption beyond 20 and then consumption beyond 30, is its 36.31. So that kind of IBT is there in Delhi in Bombay again IBT structure with 1st band as 4.66, 2nd band ends 9.32, 3rd band is 13.98, 4th band is there in Chennai also we have structure. So these are the rates again some of them might have revised also.

So in Nagpur, Hyderabad, Bangaluru where basically the IBT model is there in, Chandigarh again similar IBT model is there, Surat in all unmetered monthly consumptions pay rupees 240 and non-domestic it is 13 rupees per kiloliter. Pune is a basically seasonal tariff from January to 31st March rupees 3 per kilo liter January 2005 no sorry not a seasonal tariff it is basically from this date to till 2005 it was rate this and then again it is here but industrial area if it has been increased Jaipur, Lucknow. So, there are these kind of practices from the in the different cities.

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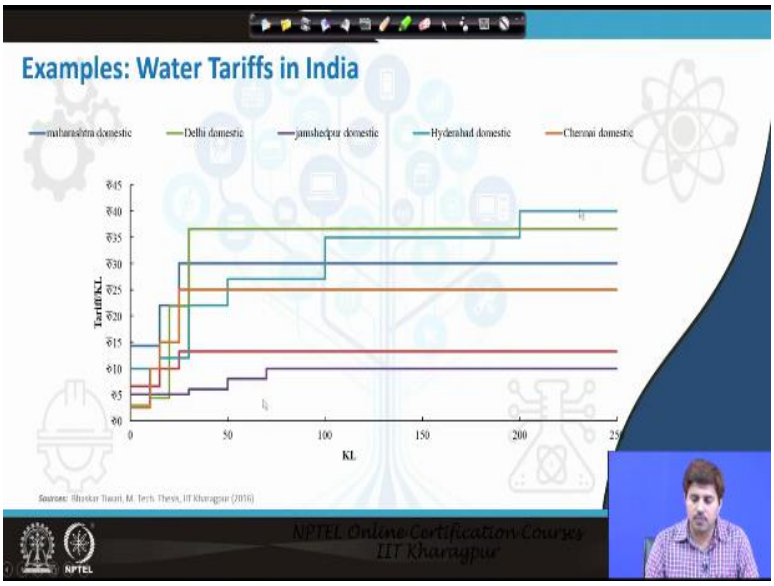

This is another example how the overall like in the Maharashtra and Delhi, Jamshedpur Hyderabad, Chennai domestic consumption, how it varies? So you can see that Hyderabad is probably charging at a higher rate as opposed to one other places.

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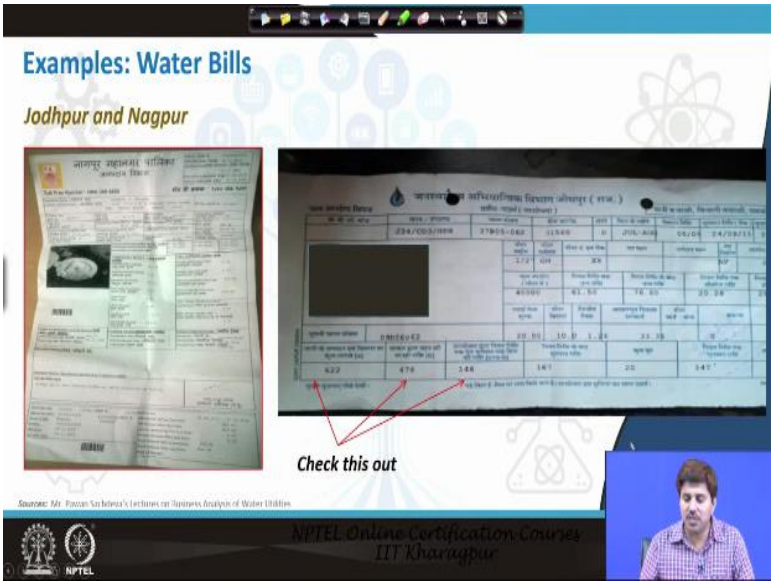

Now these are some of the example bills, so this is how the bills come from Jodhpur this is a bill from the Nagpur. So you can see that like the previous reading new reading then this is new reading and then a subsidy no it is not reading its subsidy so this is interesting actually this is a quite interesting bill. You can see that the total cost is this the government subsidy is this and the consumer has to pay this. So it tells that your water which we are getting is subsidized;

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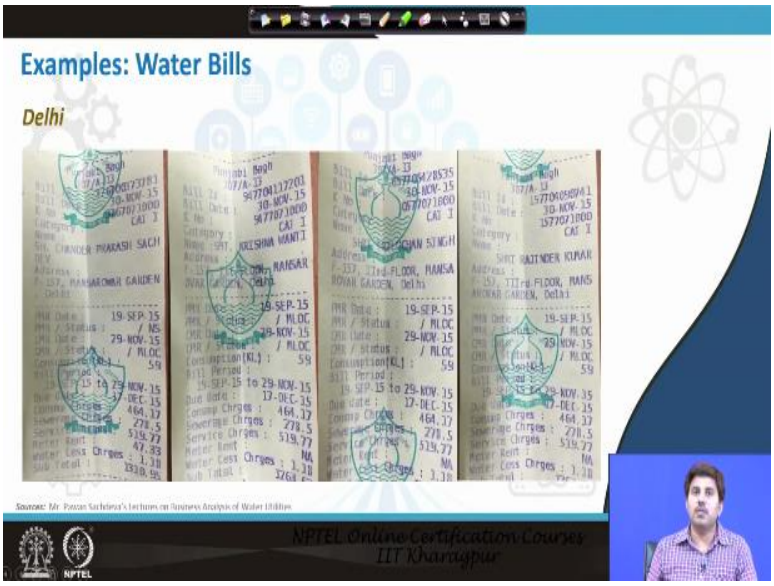

And this is the amount of subsidy which is being paid this example from Delhi water bills.

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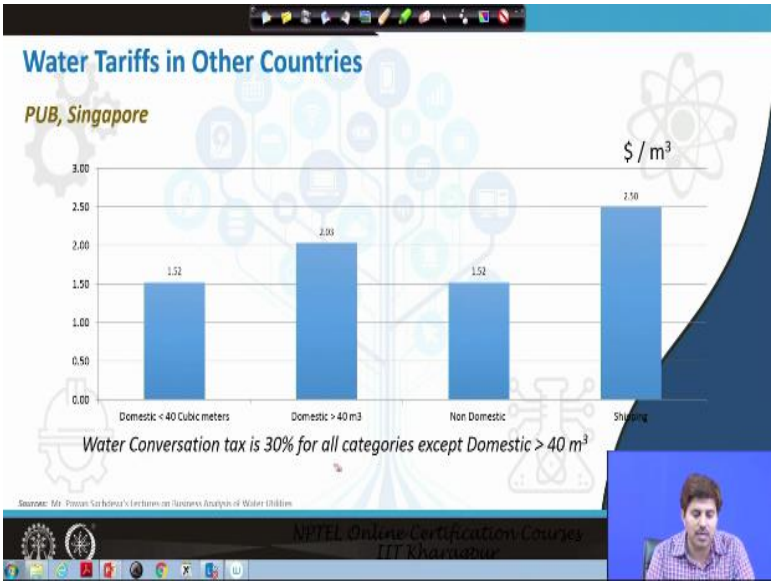

This is the water tariff in the Singapore PUB Singapore, so for domestic less than 40 cubic meter consumption it is 1.5 $ per meter cube Singapore dollars 2.0 3, 1.5 2 and 2. 5 2 for sipping purpose non domestic purpose domestic greater than 40 are charged at 2.03 and then water conservation takes as 30% is charged on all categories except domestic.

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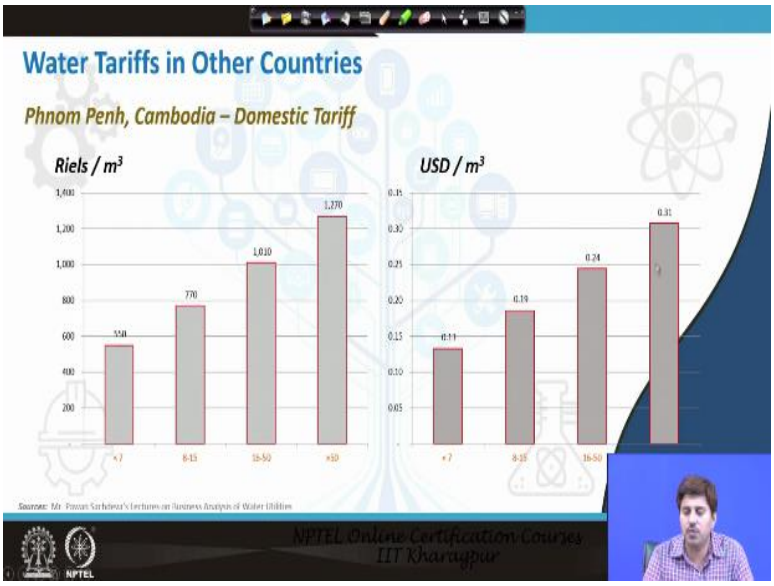

This is the case in the Phnom Penh, Cambodia so in US dollars they charge around say 0.13 for less than 7 kilo liters 8 to 15 meter cube 0.19. 16 to 50; 0.24 and greater than 50 meter cube at a rate of 0.31 so again a block tariff. So block tariff is worldwide the most popular tariff model in fact.

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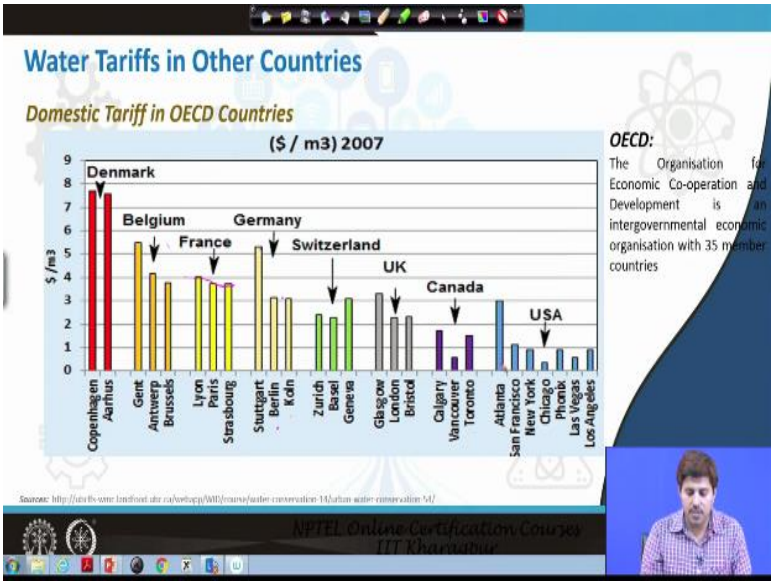

This is the domestic tariff in various OECD countries which is the Organisation for Economic Cooperation Development. So you can see somewhere it is high somewhere it is low, so in Switzerland it is in this range; like 2 to 3 dollars, in UK again similar range, in Denmark it is quite high 7 to 8 dollars, Belgium 4 to 5 dollars range, France in the range of 4 dollars, Germany Stuttgart is quite high more than 5 dollars.

Whereas Berlin and Klon is in the range of 3 dollars, in Canada it is less than 2 dollars US also for most places it less than 1 dollar in fact in Atlanta it is higher in the range of 3 dollars

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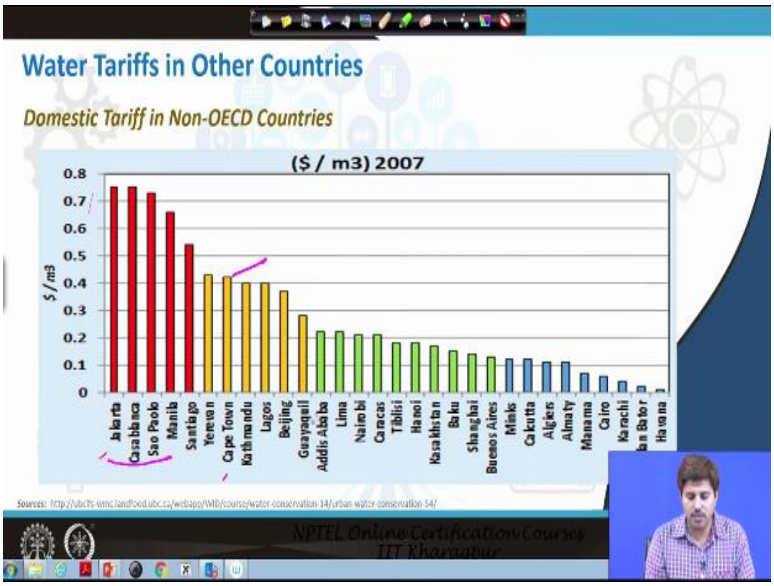

Then similarly like if you see the Non-OECD countries, so these are some Non-OECD countries average, well this thing so for say basically many of the African countries it is quite high Cape Town South Africa again 0.4 dollars per meter cube it is not though highly but it is it is always less than 1 in most of these cases whereas in developed countries it is more than 1. So that is how there are price disparity between the developed countries and developing countries.

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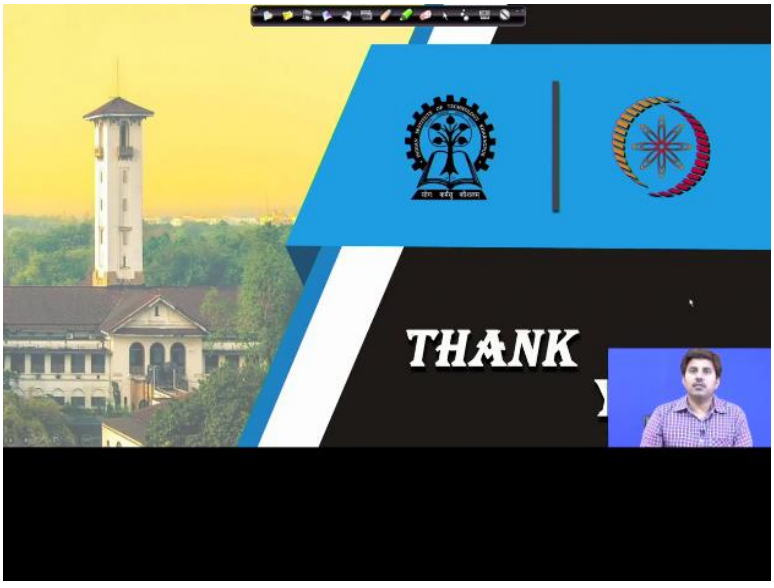

In developed countries people pay more so utilities are more equipped with the financial resources to take on the various projects various aspects whereas in low income countries since the tariffs are low so utility always run in the financial crunch situation and they are not able to upgrade to the newer technology or better systems. So now with this will conclude the discussion this has been a long journey and we have completed all the 12 weeks so this is finally the last lecture.

In these twelve weeks we have discussed all more all the possible aspects related to water we did talk about the I started from the availability then we did talk about the demand estimation or the consumption pattern we talked about the abstraction of water storage of water then purification systems supply systems we talked even the advanced purification systems as well. Then supply systems it once is in supply designing smart grid systems 24/7 systems.

The metering and monitoring so all were discussed and lastly like this week we talked about the financial aspect of the water services as well so I hope, it was a fruitful journey I hope that I was able to infuse some new information and knowledge in the viewers. So thank you for being with us for this entire 12 weeks it has been pleasure communicating with you all thank you stay blessed and we will see you some other time. Thanks.