Urban Utilities Planning: Water Supply, Sanitation and Drainage
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Module – 02
Urban Water Supply
Lecture – 10
Cost of Water Supply

~~Welcome back.~~ In lecture 10, ~~we will talk about~~ Cost of Water Supply is discussed.

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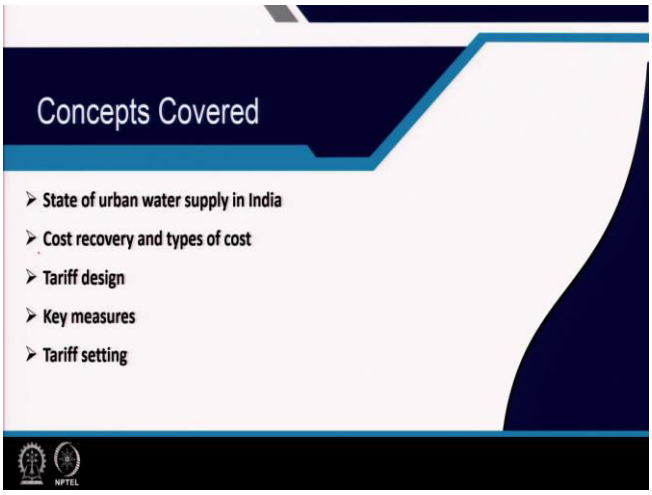

Concepts covered

~~So, the~~ The different concepts that would be covered in this ~~particular~~ lecture are state of urban water supply in India, cost recovery and types of cost, tariff design, some key measures and ~~finally~~, tariff setting.

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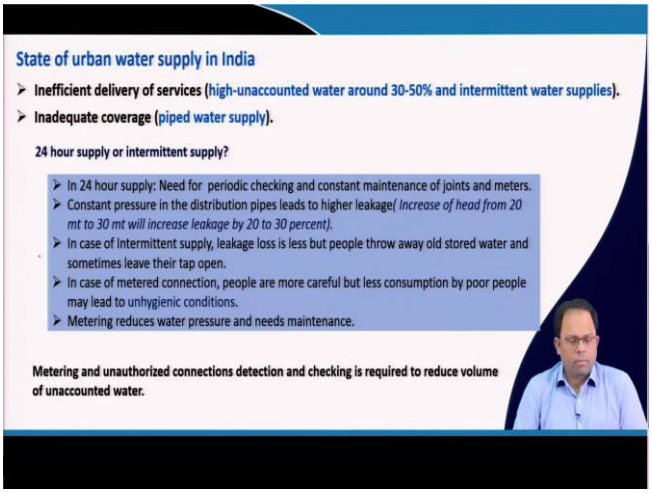

State of Urban Water Supply in India

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~~So, when we talk about~~Regarding the state of urban water supply in India, ~~the first thing we would like to say that the water supply in India is being,~~ even though it ~~just~~ is provided by several corporations/ municipal corporations in ~~some~~ cities, ~~some cities it is being done by the municipal corporations. But still in most cases we have seen the~~ delivery of services has been largely inefficient in most cases.

~~And we call it~~ It is inefficient because of two reasons.~~,~~ ~~one~~ One ~~is there~~ is ~~lot of~~a large amount of ~~highly~~ unaccounted water which is around 30 to 50 percent. ~~; that means, unaccounted~~ Unaccounted water is ~~basically~~ the water for which ~~we cannot say exactly that what is happened with that particular water~~there is no trace of its usage. ~~So, for example, that water~~ It could have been lost due to leakage, ~~this water could have been~~ stolen, ~~this water could have been~~ or used by someone~~body, but there is no trace of that particular who has used that particular water~~. Intermittent supply is another reason. This is not being supplied continuously for 24 hour period, but only for certain time periods.

~~So, this is lot of highly unaccounted water. So, 30 to 50 percent of water is unaccounted and intermittent water supply. That means, intermittent water supply means we are not able to provide supply for 24 hour period, but we are supplying it only for certain time periods. And usually we see that municipalities will provide either for a couple of hours in the morning or in the evening or maybe during two time periods either in morning and evening. So, that is what we see and its.~~

~~So,~~ ~~intermittent~~ Intermittent water supply ~~in general it~~ is ~~a~~ inefficient ~~service~~ because ~~you have to take care of water, to~~water needs to be stored ~~the water you have to first store it~~ in ~~a~~ underground reservoir, then ~~you have~~it has to be ~~to~~ pumped ~~it~~ to ~~over a~~a tank and then it is used~~use it~~ in ~~your~~ a building. ~~So, in it inefficient in that particular way.~~ Usually, municipalities provide the water for few hours in the morning or in the evening. ~~And it is a highly unaccounted water means it is a another inefficiency, but it is the inefficiency~~The system is inefficient ~~at the level of the company which is actually undertaking this utility provision or this water supply provision. So, this is one major thing.~~

~~And then of course, most~~ Most ~~of the~~ Indian urban areas do~~es~~ not have piped water supply in its entire area. ~~So~~Thus, inadequate coverage is ~~the~~ another issue. ~~And so, piped~~ Piped water supply is ~~still~~ yet to ~~be~~ reach~~ing~~ many of the parts, ~~and some of the~~especially poorest sections of the city ~~like~~ such as slums ~~and all, they do not have water supply~~. One of the reasons of inadequate water supply in slums is because ~~this the some of this slums are, the some of the slums~~these are not registered and ~~so~~ thus the ~~government~~ Government is unable to provide water supply to those particular slums. In addition, lack of the space for laying water pipes ~~from door to door~~ is also one of the reasons.

~~And because of the provision thus the space is also not there to taking the water pipes and then provide water supply from door to door as well. So, this is the status of urban water supply. Now, when we talk about~~Regarding the system of water supply in case of a developing country or a poor country, i.e., intermittent water supply and continuous water supply (~~or for a~~ 24 hours supply) ~~in case of a developing country or a poor country~~, ~~we really have~~one has to be very careful about ~~which to~~ which method needs to be adopted~~, right~~. ~~So, sometimes we say that well in~~Though 24 hours supply ~~is obviously,~~ seems better~~,~~ but there are some pros and cons to both of these systems~~is~~.

~~So, for example, in~~In case of 24 hours supply, ~~we need to~~ periodically checking of the functioning of ~~, and we need to see that~~ all the joints and meters ~~are proper if~~should be ensured to detect ~~the~~ leakages ~~they are not leaking~~. ~~And so, this~~ This kind of frequent periodic checking ~~has to be done which~~ is not required in an intermittent supply ~~to that extent,~~ but ~~of course, we need to~~ checks for leakages ~~and other kind of issues in~~needs to be done for pipelines in all cases.~~,~~ ~~but particularly, in~~ In case of 24 hours supply, the

checking should be ~~we have to be very~~ done carefully~~ done~~. Furthermore, in 24 hours supply,

~~Then,~~ constant pressure in the distribution pipes lead to higher leakage. ~~And what we see is increase~~ Increase of head from 20 meters to 30 meters ~~will~~ increases leakage by 20 to 30 percent. ~~So, that you can understand; that means, because there~~As the pipe is continuously under pressure because of 24 hours supply~~ then automatically~~ , the leakage volume ~~will~~ increases~~ by manifold~~.

~~And in~~In case of intermittent supply, though leakage loss is less, but people throw away old stored water when water is supplied and sometimes leave their taps open. ~~So, in case of intermittent supply what people do is they sometimes store the water because in the intermediate time period when there is no water supply they will use this stored water, and when new water comes in they will just throw away the old water. So, this is some big problem. And in~~In case of 24 hours supply, water supply is metered~~ connection~~, and thus people are usually more careful ~~and that and 24 hours supply also means that the water supply has to be metered, right~~about the water use because the volume of water consumed per day is being measured. This results in unhygienic conditions in the poor families where they use less water because they cannot afford necessary volume of water.

~~That means, it has to be we have to measure how much amount of water is being consumed all throughout the day. And so, there in case of metered connection even the people are careful to use less water, but sometimes in case of poor families where they cannot afford that much amount of water. So, they will actually use less water which may result in unhygienic conditions. And similarly, metering~~Metering also reduces water pressure and the maintenance requirement~~ is~~ also increases~~ because of metering~~.

~~So, these are the different things, even~~Even ~~though metering is not directly connected with 24 hours supply, intermittent supply, but it~~ but ~~is it has to be there if there is 24 hour supply~~should be done. ~~So~~Thus, these are the different issues one should considered while determining which ~~sort of~~ system should be adopted. ~~But primarily~~ Primarily, 24 hours supply is a ~~of course, a~~ better level of service or a better quality of service~~,~~ but ~~it is also going to cost or it also requires more amount of what to say more amount of~~

~~maintenance, more amount of cost and so on~~the maintenance and cost requirement is also high.

~~So, and in~~Thus, ~~for unaccounted water, also because we are talking about metering,~~ metering and unauthorized connection detection and checking is required to reduce the volume of unaccounted water ~~and that is also one~~which is one of the biggest challenge in Indian urban areas.

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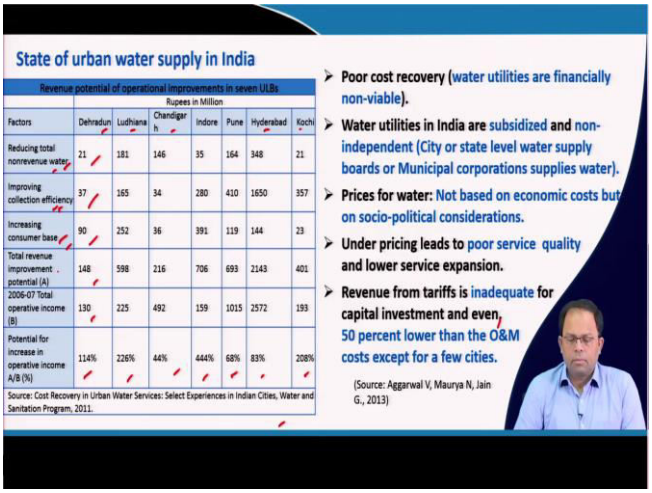

State of urban water supply in India

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~~So, in~~ In addition to the ~~that in this~~ two main challenges, i.e., inefficiency~~,~~ and coverage, there are other challenges ~~and so on, we see other kinds of challenges. Like for example, poor~~also. Poor cost recovery is one such challenge. The ~~and poor cost recovery means we the water utilities or the~~ companies which ~~actually~~ are charging for water ~~or they are trying to get some amount of cost, some amount of money because of this~~ for their services ~~services by different ways we will discuss that later.~~

~~But, usually they~~ are able to only recover a small part of ~~it~~ the cost. This ~~and that~~ is the reason why in most cases they are financially nonviable on their own and they have to be subsidized. ~~And in~~ In India, most of the water utilities are subsidized~~, and they are because they are subsidized they are~~ and non-independent~~; that~~ which means, city or state level ~~this~~ water ~~supply~~ boards or municipal corporations ~~are the ones which usually~~

supplies water and they are directly under the control of the governmentGovernment. The decision is taken based on

So, based on government's suggestion they have to also decide. So, if If an independent entity maybe aor a private company was supplying supplies the water, they would have, they were they should be able to you knowcan charge their own tariffs, and they would be able to propose improvement into the supply without any consideration of other interventions. So, independence is also not there. So, becauseBecause of subsidy, this particular corporations are also cannot take that kind ofnot able to take this kind of independent decisions. So, this is which is another challenge in India.

So, the The prices for water that is being charged in India are charged or recovered in India isin some other way in India this is also not based on the actual cost or the economic cost of water, instead it is based on socio political considerations. High water charges may lead to unfavourable political consequences.So, that means, it depends on because if you charge too much then people will be angry and the government empower will lose a lot of political capital and usually will probably lose its next election.

So, thatThat is another reason why water prices are artificially kept low. And this under pricing itself has got lot of other problems. For example, this The under pricing leads to not only poor service quality and there is also abut also lowers the chance of expanding the network because you are not do not have money for expanding the networkof lack of funds. So, coverage remains as it is, right. So, these are some of the challenges.

Then,The revenue from tariffs is inadequate for capital investment, and even 50 percent, and for an even in some cases 50 percent lower than the operation and maintenance cost except for a few cities. So, of course, whenever we are talking aboutFor expansion of the network, ; that means, it requires the amount generated is less than the capital investment in the scale that , but in the amount of money that we can actually generate is actually even lower than the total, you know not only the capital cost, forget capital cost we can barely operation and maintenance cost is barely managed to fulfil, the operation and maintenance cost.

And in some cities it is even 50 percent of the operation and maintenance cost, right. So, these are the different challenges that are there in India. And in the table you can see that this is sort of an estimate made by this particular in this particular report it was estimated

~~that for this particular~~This Table shows ~~teh~~the revenue potential of operational improvements in cities like Dehradun, Ludhiana, Chandigarh, Indore, Pune, Hyderabad and Kochi. It shows that ~~,~~ there is chance of improving the revenue potential through improving the operations ~~of course, in; that means, there is chance to improve the revenue to a large extent.~~.

For example, ~~we~~ in case of Dehradun, there is chance to reduce total non-revenue water ~~and~~ that could lead to around 21 million rupees improvement in revenue. ~~in case of Dehradun, then~~ ~~by~~ By ~~i~~Improving the collection efficiency ~~;~~ , ~~i.e., that means, to making the bills and all proper and to actually~~ recover the ~~charge~~s from the ~~people that could~~can lead to revenue improvement of around 37 ~~you know~~ million rupees. ~~you know that would be their improvement. And then,~~ By increasing the consumer base~~; that means, by increasing consumers you can add another~~ revenue of 90 million rupees~~, right.~~ ~~will~~ can be~~be~~ ~~improved~~achieved. These add up to

~~So, overall if you add these all these a bit comes to~~ around 148 million rupees whereas, the current revenue is around 130 million rupees. ~~So~~Thus, ~~this is actually around~~there is a 114 percent increase in the potential ~~to~~ for increase ~~income for this particular you know water supply agency~~in operative income. Similarly, potential for increase in operative income is estimated to 226 percent for Ludhiana,

~~So, similarly for Ludhiana it has been estimated at 226 percent that is twice it is improve that increases around 2.2 times more, then~~ 44 percent for Chandigarh, 444 percent for Indore, ~~for Pune~~ 68 percent for Pune, ~~for Hyderabad~~ 83 percent for Hyderabad and, ~~Kochi~~ 208 percent for Kochi.

~~So~~Thus, there is potential~~, there is chance~~ to improve the amount of revenue that is collected in urban Indian urban areas. ~~And for that you have to~~ To increase the consumer base, ~~we have to~~there is a need to improve the collection efficiency and ~~we have to~~ reduce the amount of non-revenue water.

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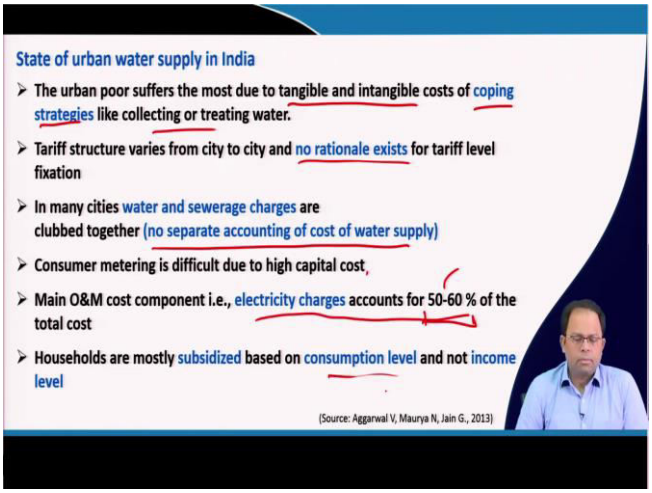

~~So,~~ ~~some~~Some ~~other~~ additional issues that are~~we~~ faced in India are described as follows. ~~the~~ The urban poor in India ~~suffers~~suffer the most ~~the reason is that there is something called~~due to tangible and intagible coping cost ~~or the~~ /coping strategies ~~you can say~~. ~~So, there are lot of the urban~~ Urban poor in slums ~~and all they~~ do not get water directly to their homes and they need to travel a given distance and then wait to get the ~~,~~ water. Moreover, the amount of water they get is very less that leads to diseases.

~~So, they have to go travel a certain distance, then they have to wait for the water to come, then they will actually bring the water back and because of this the amount of water consumed is less, the quality of water is poor and that leads to lot of diseases and all.~~

~~So,~~ ~~there~~There are lot of cost which gets added upon because they are not getting a good ~~water supply or good~~ quality ~~and good~~ /quantity of water supply. ~~So~~Thus, this tangible and intangible cost ~~this which actually~~ results because of ~~you know this~~ coping strategies like improper collecting or treatment of water ~~that because those are not you know proper~~. ~~So~~Thus, these are the extra costs that the urban poor ~~has~~have to pay even though they do not pay for the water directly. This coping cost or coping strategies increases the cost for the poor as compared to people who pay taxes or water charges.

~~So, even though they do not have to pay money as such for the water, but they have to pay money for other cost. And that actually is where you will see that~~Sometimes, it is seen that people are ~~actually~~ willing to pay more ~~in many cases for what~~ for water in many cases ~~and this kind of services~~ in urban areas, but that is usually not considered.

Tariff structure varies from city to city and there is no rationale for any kind of tariff level fixation. Different cities have adopted different kind of tariff structure.

~~So, people are, because they have understood that if I get water then these are the other costs that I would avoid.~~

~~So, this coping cost or coping strategies actually increases the cost for the poor compared to the normal people for or compared to the richer people or people who pay taxes or people who pay water charges. So, tariff structure varies from city to city and as we have seen in India there is no rationale for any kind of tariff fixation. So, that means, in different cities has adopted different kind of tariff structure, different kind of levels at which they are fixed a tariff and there is no rationale for any one of them.~~

~~And in~~In many cities, ~~what we see is~~ water and sewerage charges are clubbed ~~together. So, the~~together. The amount of money that is being charged is ~~basically~~ not only for water supply, but both for water and sewerage charges ~~which are put together~~. ~~And~~ These are usually ~~these are~~ not taken in form of taxes~~, maybe it is~~ based on the volume consumed. It can be a fixed charge based on ~~your~~ annual rental value of ~~your~~ the property, based on the size of ferrule, ~~based on many things, right~~etc. In cases where there is ~~a~~ measurement of amount of water consumed, 50-60% charge constitutes sanitation charges.

~~So, it is a fixed charge and usually we assume that a certain proportion of the charge that is there for water based on the volume of water that is being consumed, in case of you know where there is measurement of amount of water consumed we assume certain percentage like 50 percent or 60 percent of that particular charge which would be taken for sanitation. And accordingly, we divide the amount of money.~~

~~So,~~ Now, as there is no separate accounting for cost of water supply, ~~which is required because then only you can understand how much is~~ the cost of actual service provision cannot be determined and ~~actually you can recover that~~the amount of money cannot be recovered. ~~So, this is one another, this is another problem.~~

~~And then consumer~~Consumer metering is also difficult due to high capital cost. ~~Many of the you know utility~~Various utility providers ~~themselves say that it is not only the people who will is~~are reluctant to use meters~~, but also this the this utility providers they also say~~

~~that there is a~~ because a huge amount of capital cost ~~is~~ involved to provide these meters ~~initially~~.

~~And there is no money to go to spend this much amount of money in provision of meters and so on. So, these are the other challenges. Then, main~~Main operation and maintenance cost component, ~~the one major cost component is~~i.e., electricity charge accounts for around 50 to 60 percent of the total cost. This cost is incurred by utility providers ~~; that means, out of all the different cost that this utility providers actually has to pay~~ for provision of ~~services or~~ water supply services.~~,~~ ~~the main cost is electricity charge and that accounts for around 50 to 60 percent of the total cost~~.

~~So, if this amount could be saved there could be a lot of savings as well. So, households~~Households are mostly ~~subsidized and another issue that we see in India is households are mostly~~ subsidized based on consumption level and not their income level which is another challenge in India.~~ So, that is again another challenge that we have to all, that is another point that we have~~ All these costs needs to be considered ~~when we~~to determine future tariff revisions or future tariff settings.

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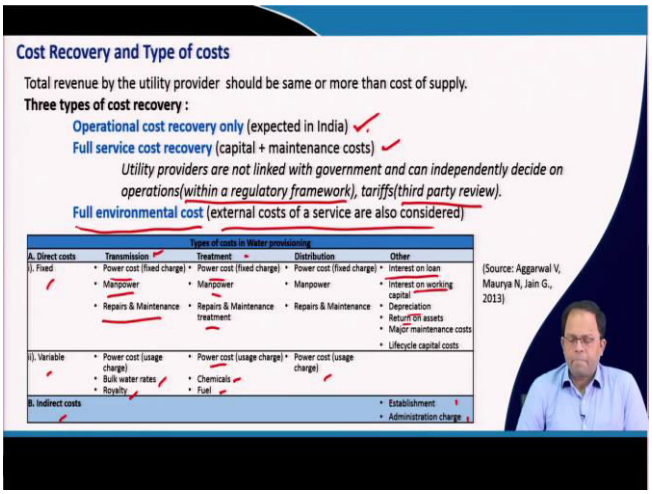

Cost recovery and type of costs

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~~So, now that we have talked about different types of costs, like we have to saying that the power is the most you know~~Apart from 50 to 60 percent ~~of the total cost~~total costs ~~is~~

because ofthat constitute power requirements, but there are other additional costs as well. SoThus, total revenue by the utility provider should be same or more than the cost of supply. But However, in India what we see is there are 3 three types of cost recovery models in India.,

so out of that theIn operational cost recovery only model;-, only the operational cost is recovered by service providers. that means, we are not concerned about theThe capital cost is not recovered which is .

Capital cost would be a one- time cost that would beis given as a grant by the state government or by the central government. Whereas, the operational cost recovery part has to be taken care by the service providers and thisThis model is expected in Indian conditions. Whereas, it is as per the SLBs you have seen that 100 percent cost recovery, but that is for operational cost recovery.

But forIn full service cost recovery model, which includes both the capital and maintenance cost that is the eventual targetare recovered. And many Various developing countries and many governments usually they target to not only operate and maintain those particular this infrastructure, but also expand/replace the infrastructure and so on or replace the infrastructure and so onfor which eostfinance is needed. So, ifIn this case, the operations of utility providers are not linked with government and, they can work independently (within a regulatory framework) decide on operations. In this way, they are free to expand their services and set their own tariffs. In India, is tThis model needs to be implemented,also requires –regulatory frameworks for determining the service delivery also needs to be setlevels. In addition, third party review of tariffs would also be required.

And so, this is another issue that comes along; that means, if utility providers totally separate from the government; that means, they have to provide both for capital expenditure as well as maintenance cost. And then they are also free to expand their services and not only expand their services they are also free to set their own tariffs. But of course, this cannot be without any kind of oversight.

So, even when they are setting determining what kind of operations, what kind of service levels they would provide then they have to set all this within a regulatory framework. So, in eventually, in India also if we go for this full service cost recovery model we have

to have regulatory frameworks determining what sort of service delivery has to be provided and also there has to be third party review of tariffs.

That means, there has to be a third Third party review which determines if the tariff setting for this by this particulara given private entity/ or this company which would provides water supply services this is right or wrong, right. So, or whatIt helps in deciding the kind type of subsidies. could be given, so that would be determined by this third party review. So, this is what the full service cost recovery model would look like eventually. This model, however, cannot be implemented without any kind of oversight.

And then, there is another model which is aIn full environmental cost model, which is not only full service cost recovery is considered, but also external cost of a service arecosts of a service are also considered. That means, environmental cost maybe certain other you know external cost, which were not like pollution cost and all these things are also considered as a part of the service. But anyway, so this is where we areIn India, services are being targeted for this modeloperational cost recovery model -now targeting service right now in India and then eventually in future we have to target full service cost recovery can be adopted.

So, let us look at theThe different types of cost that is are usually there forassociated with the provision of water supply services are. There are fixed cost and then there are variable cost.; that means, certain cost are would be there which should notFixed costs depend on the volume of water supply connection type that has to be supplied, but there are certain costs which while variable dependscosts depend on the volume of supplied water that has to be supplied. In addition, costs are also categorised as direct costs and indirect costs.

And then there are both direct cost and then there are indirect cost. Direct cost is related with the water that is being supplied and indirect cost is like related with establishment charges, administration charges which arethat are indirectly indirect cost, but which are also a part of the overall cost structure. So, let us look at the different kind of costs like fixed cost, we have forThese costs are involved in different stages of different parts of this water supply like transmission, treatment, distribution, and other aspects.

We see that in Within direct cost for the transmission stage, there is cost of power which is fixed there is cost of manpower which is also fixed and then there is cost of fixedfixed

cost includes power cost, manpower and repair and maintenance~~. Whereas,~~ whereas variable cost depends on power cost~~,~~ (usage charge)~~.~~~~, so~~ ~~some~~ Some amount of power cost would be variable based on more amount of water being consumed ~~more~~ because the pump ~~has~~ needs to run more. In addition,

~~Bulk~~ bulk water rates~~; that means,~~ is also included in variable costs. ~~it depends on the in~~In most cases~~, this utility providers has~~utility providers have to buy the water from state boards~~, right. So, this buy the water means, they have to buy the water from other departments, so in~~ as per bulk water rates ~~and they have to you know pay that money to those particular departments~~ and ~~this bulk water rates~~these bulk water rates changes as per the consumption volume. ~~And royalty, that they have to provide.~~Royalty is also included in variable costs.

~~And then for~~For treatment stage, ~~again we have got~~fixed cost include power cost, manpower cost, repair and maintenance cost. Similar is the case for ~~And same for~~ distribution ~~as well~~stage as well. ~~Whereas, for treatment the~~ The variable costs for treatment stage include ~~is~~ power cost, chemical cost, and fuel cost ~~this will~~ (vary as per the volume of water). The variable costs for distribution stage include ~~And for distribution~~ power cost because the pump draws ~~the horsepower of pump will has to be~~more power for ~~more for~~ higher amount of water to be distributed~~, so power cost also varies~~.

~~So,~~ ~~in~~In addition to all ~~this~~ these charges, there are some other costs ~~like~~ such as interest on loan, interest on working capital, depreciation, return on assets, ~~which we will discuss in the next page, in the next slide~~major maintenance costs, and lifecycle capital costs.

Indirect costs include establishment and maintenance charges.

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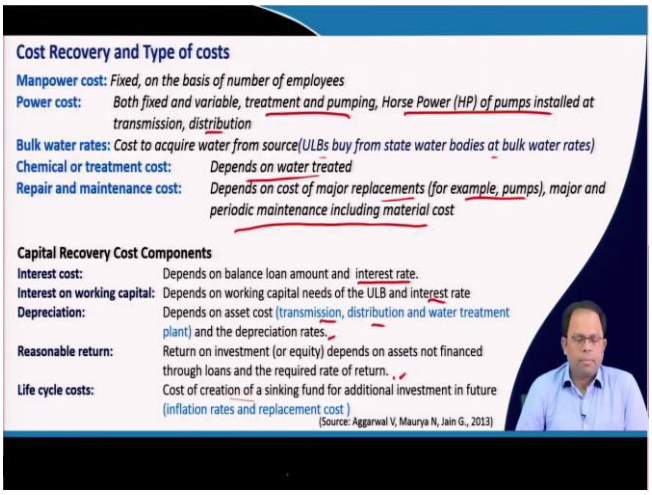

~~So, when we talk about the different types of costs and cost recovery we see that manpower~~Manpower cost is ~~mostly~~ usually fixed and decided on the basis of the number of employees. One has to pay for it according to the consumption. ~~, so it is a fixed cost that you have to pay whatever the consumption is. And power~~Power cost ~~is~~ could ~~be~~ both be fixed and variable. Fixed cost include minimum power requirement whereas variable costs include treatment and pumping cost, horsepower of pumps installed at transmission, and distribution. These costs depend on the consumption.

~~So, some of the cost is fixed like this, amount of minimum power requirement would be there whereas, some amount depends on the consumption. So, like treatment and pumping, horsepower of pumps installed at transmission, distribution. So, some of these cost are both fixed and variable.~~

~~And then bulk~~Bulk water rates ~~as we are discussing~~include cost to acquire water from source by ~~-~~ULBs/municipal ~~buy from~~corporation from state water bodies at bulk water rates. ~~So, this is the water that ULB or a municipal corporation has to buy while supplying water.~~ Chemical or treatment cost, depends on water treated. ~~repair and maintenance costs depends~~Repair and maintenance costs depend on cost of major replacement (replacement of pumps)~~, for example, pumps,~~ and major and periodic maintenance including material cost. ~~So, all these things becomes part of the cost structure.~~

And some other costs which we are discussing which we are mentioning in the last slide like interest costCapital srecovery cost components include interest cost, interest on working capital, depreciation, reasonable return, and life cycle costs. So, these are other costs, and these are capital recovery cost components where you see that interest Interest cost is basically depends on the balance loan amount and interest rate. in and of course, for For any kind of execution of any kind of project, or any kind of work it may a loan if loan it is taken, then interest cost also needs to be paid. for a particular project then we have to pay interest for at for that. So, this is the interest cost.

Interest on working capital is depends on the working capital needs of the ULB and interest rate. ; that means, sometimes to If a ULB takes a loan for /working capital for a yearly operation, then ULB takes a loan or the working capital and for that they have to also pay interest ratethis cost is incurred.

Then, depreciationDepreciation is theycost depends on value of different kind of assets/equipments are involved such as transmission equipment, distribution equipment, water treatment plants, etc and depreciation rates. The values of these assets continuously depreciate over years and And because these are equipments this kind of assets hasneed to be replaced once it reaches its end of life., so and because of you know use their values depreciate over different years. Thus, the overall cost of the asset needs to be divided over a different period.

So, this depreciation rates are considered; that means, every year. Some amount of money is being deducted because we are using this particular asset. And then once the you know it reaches its end of life we have to buy a new asset, right. So, we divide the overall cost of the asset over a different time over different years. So, that is what depreciation is all about.

Then, reasonableReasonable return, or return on investment or equity depends on assets not financed to loans and then andthe return on this the required rate of return. So, in case, it As it is based on my one's own invested, there is a return on that amount which needs to be considered. resources; that means, I have invested that money, so there has to be some return to that. So, in case you know I am trying to recover the entire cost. So, that also is considered. Lifecycle cost is cost of creation of a sinking fund for additional investment in future;. that means, in future I need to invest or increase my cov

~~erage.~~

~~So, I will increase you know I will save some money now for future. So, this kind of you know~~ ~~inflation~~Inflation rates and replacement cost of equipment ~~all these things~~ are ~~thought of, and this requires~~considered for creation of a sinking fund ~~and for that we have to also consider money~~. ~~So~~Thus, these are the different costs that are involved in water supply system ~~. And not only water supply system even in the sewerage~~and sewerage network design ~~and all, similar kind of costs are also there~~.

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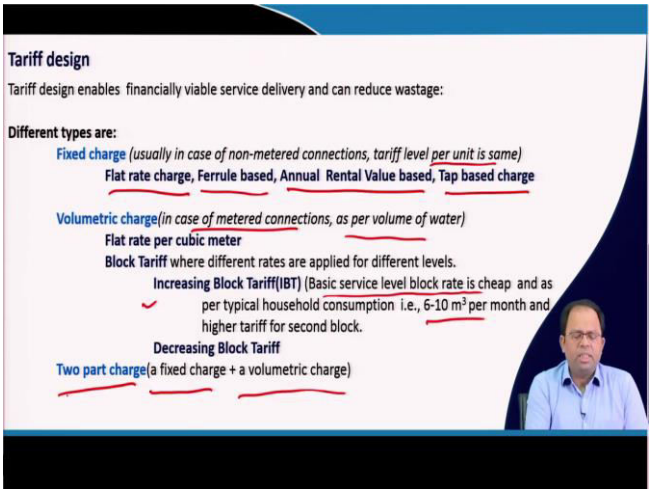

Tariff design

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~~So, next we come to tariff design tariff~~ Tariff design is the ~~basically that~~ rate which is charged ~~for the~~ from the people for supply of water. ~~And tariff design~~It enables financially viable service delivery and ~~this~~ can ~~actually~~ reduce ~~wastage. If~~wastage. Absence of necessary tariff can lead to ~~there is no tariff then people will~~ wastage of~~e~~ water. ~~If there is some amount of tariff people will be aware of that and then they will conserve water~~Tariff make people aware about water conservation~~. So~~Thus, ~~that is the idea objective behind you know setting of tariffs.~~ Different types of tariff design include fixed charge, volumetric charge, and two-part charge.

~~And then, different types of charges are there. These are fixed charges. For example, when we said this tariffs there could be different types of tariffs. One is based on~~

~~fixed~~Fixed charge~~s that~~ is usually applicable in case of non-metered connections~~,~~. In this case, the tariff level per unit is same. ~~is value is same and we use a there are could be different ways we can charge this value, it~~ The charges could be a flat rate ~~charge~~ for each ~~household, it could be a ferrule~~household, ferrule based ~~charge.~~, annual rental value based, and tap based.

Ferrule is the connection ~~given~~ provided to a ~~particular~~ given household to ~~take~~ receive water from a municipal supply line. Ferrule size diameters ~~are~~ could ~~be~~ vary as per the requirement of ~~that particular~~the household/consumption. The price needs to be paid ~~You have to you know spend some money~~ to ~~actually~~ get a ferrule connection ~~and the money that you have to also spend~~that depends on the diameter of ~~that pipe that you would get a~~the ~~connection~~ferrule. ~~And that diameter of the pipe determines how much amount of water will you will be able to get, right.~~

~~So, that is a ferrule based connection. So, if you have a higher ferrule size you have to pay more water, more charges, right. Then annual rental value of property; that means, based on the property tax. Usually property tax is set based on the annual~~Annual rental value of the property~~,~~ is based on property tax and a certain portion of the property tax is taken as fixed charges for water supply, and sanitation.~~, and just maybe also for water supply. Or~~ ~~tap~~ Tap based charged based on the number of taps that are being supplied.

~~So, these are the different ways fixed charges could be set, and then there are volumetric charges. For example, volumetric~~Volumetric charge is applicable in case of metered connections. In this case, the tariff is set based on the volume of water consumed.~~s means for as per the consumption; that means, if you consume more volume of water you will be charged more. So, to make sure that there if there is volumetric charge there has to be a metered connection and of course, depending on the volume of water with the charge, the charge is being set.~~ The volumetric tariff could be a flat rate per cubic meter or block tariff.

~~And then there could be different ways this volumetric charge could be set or this volumetric tariff could be set such as~~ For flat rate per cubic meter~~; that means~~, the charge is based on~~, for~~ each cubic meter of water ~~you can we can set a charge~~consumed. ~~So,~~More the amount of consumption more would be the charge. ~~more the amount of consumption more would be the charge.~~ For instance, 10 units are charged for ~~So, if I~~

take 10 cubic meters of water and 20 units are charged for , I will spend suppose example 10 rupees. So, if I spend 20 cubic meters of water., they if I consume 20 cubic meters of water then I will spend 20 rupees. So, it is a flat charge.

Or it could be something like a block tariff. In Block tariff means where, different rates are applied at different levels/blocks. So, it is a block. We create separate blocks of tariff, right. So, for certain consumption volume we create some tariff. If the volume is increasing in increased then we for the next block we have a different tariff. So, there could be different ways we can set that. It can be an Increasing Block Tariff (IBT) where

So, it could be like an increasing block tariff; that means, the initial block rate (basic service level) is fixed at a value which is a lower rate as per typical household consumption which increases for the next block if the consumption is increased after a given volume.; but if the rate is more than this; that means, you consume more than so many kilo litres of water or (Refer Time: 28:57), so many cube of water then the next block rate is higher. If you even consume further you falls on that is block rate after this then your tariff would be even higher, right. For instance, initial block rate is fixed for 6-10 meter cube per month for a household of 4-5 members. The rates increase if the consumption is increased beyond 10 meter cube per month. Similarly, it

So, usually when we set a increasing block tariff or IBT which is the popularly known as IBT, so we keep the basic service level block rate cheaper as per and usually it is as per the typical household consumption, maybe a household or family of 4 or 5 we assume that so many kilolitres of water would be consumed.

And we based on that kilolitre consumption which is around 6 to 10 meter cube per month and we set our tariff which is of reasonable volume; that means, for so many meter cube you for each meter cube we have to pay so much amount of money.

But anybody who is consuming more than 10 meter cube, we can pay, we can ask for a higher tariff; that means, for the rate of money that you have to pay per meter cube would be much higher compared to the first block. So, this is the increasing block tariff. Similarly, there could be a decreasing block tariff where the first block rate is higheris higher which decreases if the consumption increases., then the more you use it is not that high.

~~So, it depends on in, you know in case of India increasing~~ Increasing block tariff is more viable in India since water needs to be supplied at affordable charges to ~~because we have to provide for standard~~ poor families. On the other hand, ~~and then for larger consumers we have to charge more and usually~~ for commercial consumers or the ones who consume large volume of water can be charged with ~~we usually charge much~~ higher amounts. However,

~~And, but in cases,~~ in places where ~~you know~~ water supply is adequate and not an issue, ~~there is a adequate supply and all then they can have a~~ decreasing block tariff can be applied., ~~right. So, that is also possible. So, initially it is a high, then for more use they do not charge that much extra.~~

~~So, two parts, so both of this volumetric charge and fixed charge that we are discussing a single part charges. So, similarly there could be a two~~Two part charge ~~where there could be a portion which is~~include a proportion of fixed and a volumetric ~~; that means, you~~charge. One has to pay a given minimum amount ~~have to pay a certain amount of money which is the minimum amount plus a part which~~ in addition to ~~is~~ volumetric charge ~~for~~. ~~And then portion of the money which is based on the volume of water you charge.~~

~~So, these are the 3 ways or not 3 ways actually volumetric charge could be again of different types, but broadly these are the 3 ways in which we can or in which tariff is actually designed.~~

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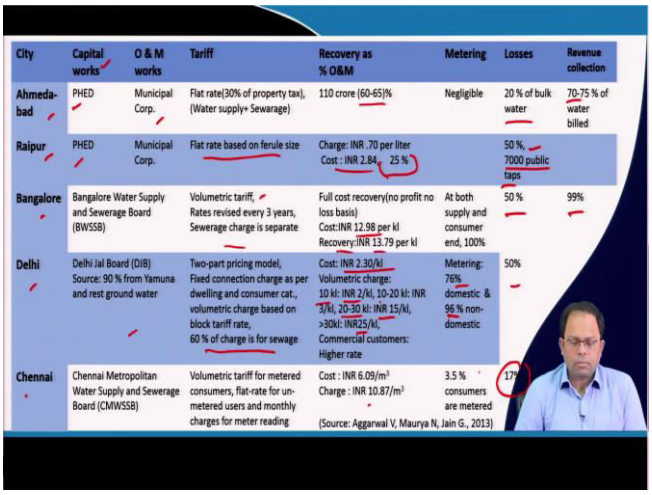

City	Capital works	O & M works	Tariff	Recovery as % O&M	Metering	Losses	Revenue collection
Ahmeda-bad	PHED	Municipal Corp.	Flat rate(30% of property tax), (Water supply+ Sewarage)	110 crore (60-65)%	Negligible	20 % of bulk water	70-75 % of water billed
Raipur	PHED	Municipal Corp.	Flat rate based on ferule size	Charge: INR .70 per liter Cost : INR 2.84 25 %		50 %, 7000 public taps	
Bangalore	Bangalore Water Supply and Sewerage Board (BWSSB)		Volumetric tariff, Rates revised every 3 years, Sewerage charge is separate	Full cost recovery(no profit no loss basis) Cost:INR 12.98 per kl Recovery:INR 13.79 per kl	At both supply and consumer end, 100%	50 %	99%
Delhi	Delhi Jal Board (DJB) Source: 90 % from Yamuna and rest ground water		Two-part pricing model, Fixed connection charge as per dwelling and consumer cat., volumetric charge based on block tariff rate, 60 % of charge is for sewage	Cost: INR 2.30/kl Volumetric charge: 10 kl: INR 2/kl, 10-20 kl: INR 3/kl, 20-30 kl: INR 15/kl, >30kl: INR25/kl, Commercial customers: Higher rate	Metering: 76% domestic & 96 % non-domestic	50%	
Chennai	Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)		Volumetric tariff for metered consumers, flat-rate for un-metered users and monthly charges for meter reading	Cost : INR 6.09/m^3 Charge : INR 10.87/m^3 (Source: Aggarwal V, Maurya N, Jain G., 2013)	3.5 % consumers are metered	17%	

~~So, this shows you know sorry case study of few cities like Ahmedabad, Raipur, Bangalore, Delhi and Chennai, where we see that T~~this Table shows ~~actually gives a snapshot of you know~~ the status of water supply in cities like Ahmedabad, Raipur, Bangalore, Delhi and Chennai~~this particular cities.~~.

For Ahmedabad and Raipur, ~~where you will see that~~ the investment for capital works ~~for~~ of water supply.~~.~~

~~That means, new projects, new investment~~ is done by the Public Health Engineering Department (PHED)~~,~~ ~~this is the public health engineering department, for this particular state. And then,~~ and the operation and maintenance work is taken care of by the municipal corporation~~ in both the cities, right, in Ahmedabad and Raipur~~.

~~And in case of~~ In Ahmedabad, a flat rate (30 percent of property tax) is being charged ~~and~~ for both water supply and sewerage~~. is being done together, and total~~ Total recovery is ~~around~~ 110 crores which is~~ about~~ 60 to 6~~5~~0 percent of the overall ~~over operation and~~ maintenance cost.

~~And metering~~Metering is ~~not there its~~ negligible ~~value, negligible amount. And~~and losses are around 20 percent of the bulk water~~ is lost. And revenue~~Revenue collection is~~,~~ ~~around~~ 70 to 75 percent of the billed~~uild~~ value~~ is being actually obtained as revenue~~. ~~So~~Thus, ~~we are~~the collection efficiency is ~~around~~ 70 to 75 percent.

~~Similarly, for~~ In Raipur, ~~you see that it is~~ a flat rate is charged based on ferule size ~~and the charge is something~~ which is around INR 0.70 paisa per litre. ~~Whereas,~~ ~~T~~the cost of production of this water is around INR 2.84 per litre which roughly ~~comes to around~~constitute 25 percent of the ~~amount of water~~ operation and maintenance charge ~~is being recovered in this particular case~~.

~~And we see that losses is~~Losses are around 50 percent. ~~Why this 50 percent, so high loss? Because~~This high loss is attributed to the provision of 7000 public taps ~~are being provided which actually you know there is~~which results in huge ~~lot of~~ loss of water. ~~in this public taps.~~

~~Then,~~ ~~in~~In Bangalore, ~~we have~~ the investment for capital works and operation and maintenance is done by Bangalore Water Supply ~~And~~and Sewerage Board (BWSSP). ~~And as you can see that in this they do both capital works as well as the operation and maintenance. And here in~~ Bangalore is the one of the only cities where volumetric charge tariff is being set and rates are revised every 3 years ~~and~~. The sewerage charge is separate.

~~So,~~ Thus, Bangalore is ~~pretty~~ advanced in ~~that way and~~ a way that full cost recovery is being undertaken ~~, no,~~ at no profit and no cost loss basis ~~and~~. The total cost of services is ~~around~~ 12.98 per kilolitre whereas, recovery is around 13.79 per kilolitre. Because of volumetric tariff, metering is

~~So, Bangalore a you know, in case of Bangalore because it is a volumetric tariff we see that~~ 100 percent ~~is being metered both~~ at ~~the~~ both supply and the consumer side. ~~That means~~It means that~~,~~ the consumer ~~has got a~~has meter whereas, at the supply end meters are installed at treatment plants (or wherever applicable) to determine the ~~wherever you are supplying water from the treatment plants and all, we also have meters to determined how much~~ amount of water is being supplied. ~~So, loss~~Water loss, however, is still ~~around~~ 50 percent. Revenue collection is 99 ~~is lost and around 90~~ percent. ~~is their revenue collection.~~

~~So,~~ ~~in~~In case of Delhi, ~~Delhi is~~ water is supplied by the Delhi Jal board. 90 percent of ~~this~~ the water comes from Jamuna and~~,~~ rest from the groundwater~~,~~. Tariff is based on ~~and it they have got a~~ two part pricing model, where fixed connection charge is as per the

dwelling and consumer category and volumetric charge based on block tariff rate~~, right~~. ~~And~~ 60 percent of the charge is for sewage~~.~~.

~~So, you see different you know flat rate, volumetric, and different parts of the city different part, different parts of the country different kinds of charges are being set. So, in case of Delhi you see the~~ The initial cost of ~~a cost of~~ water provision is INR 2.30 per kilolitre~~, INR 2 rupees 30 paisa per kilolitre.~~. Regarding volumetric charge, the charge is INR 2 per kilolitre for first 10 kilolitres, INR 3 per kilolitre for the next 10 to 20 kilolitre, INR 15 per kilolitre for the next 20 to 30 kilolitre, and INR 25 per kilolitre for volume greater than 30 kilolitre. After 20 kilolitre, there is a massive jump in the price and thus, the commercial consumers are charged at a much higher rate.

~~And the charge that they set, this is sort of a volumetric charge where for the first 10 kilolitres the charge is INR rupees 2 per kilolitre, for the next 10 to 20 kilolitre it is INR rupees 3 per kilolitre, for the next 20 to 30 kilolitre it is INR rupees 15 per kilolitre.~~

~~You see a massive jump there. And greater than 30 kilolitre it is INR 25 per kilolitre. So, commercial customers are even charged at a much higher rate. So, metering~~Metering is around 76 percent~~,~~ for domestic and ~~domestic consumers, and~~ 96 percent for non-domestic consumers. ~~and 50 percent of the water is lost.~~Water loss is 50 percent.

In case of Chennai, ~~water is supplied~~ capital work and operation and maintenance and ~~capital work~~ is ~~both~~ done by Chennai Metropolitan Water Supply ~~And~~and Sewerage Board. Volumetric tariff is applied for metered consumers where the monthly charges are based on meter reading~~,~~ while ~~they have got both volumetric tariff and~~ flat rate is applied for unmetered users~~. and monthly charges for based on meter reading that is also being charged; that means, because of the meter reading charges.~~

~~And cost~~Cost is around 6.09 INR per meter cube whereas, charge is around 10.87 INR per meter cube. ~~And~~ 3.5 percent consumers are metered and 17 percent of the water is lost. ~~So, at least the~~In the case, the ~~loss~~ volume lost is ~~very very~~comparatively less. ~~So, this actually shows you the status of water supply in many urban areas.~~

~~And~~ This analysis shows that while proposing water supply ~~when you propose in your particular~~in an urban area~~,~~ ~~if you propose water supply, you have to also think similar kind of~~ tariff pattern, ~~similar kind of you know, similar kind of you know~~ recovery,

losses, revenue collection, ~~and or similar kind of you know~~ management structure ~~or different kind of be like will you do the both the~~, capital works and ~~or just the~~ operation and maintenance works ~~and so on~~needs to be considered.

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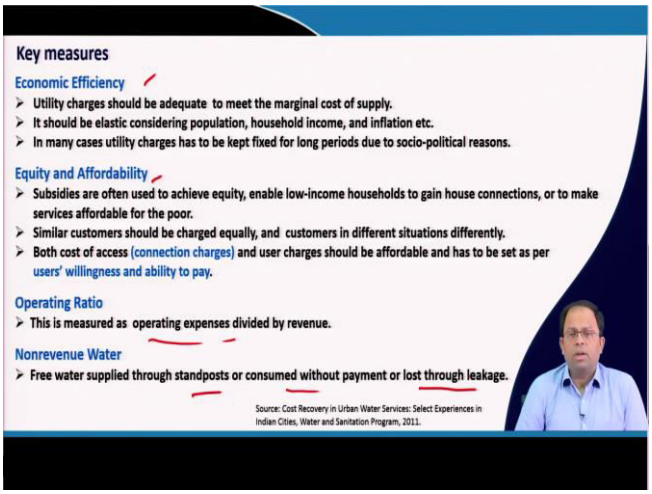

Key measures

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~~So, next we will talk about some~~ Some of the key measures based on which ~~usually~~ water supply system is being evaluated or ~~rather when we decide on the~~ tariff structure is decided are discussed below.~~, we usually take into consider this kind of key measures.~~

- ~~The first one is economic~~Economic efficiency:~~.~~ ~~So, what it means is T~~the charges that would be collected by the utility provider should be adequate to meet the marginal cost of supply. It means that

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- ~~So, that means,~~ the cost of supply should be ~~actually made by this utility charges and it~~which ~~should be~~ elastic~~, as we have already learned that water supply charges are bit inelastic, but it has to be elastic~~ considering population, household income ~~and~~, inflation, etc. Thus~~So~~, the charges ~~will~~ vary as per these different ~~you know~~ situations~~, in case of~~, i.e., ~~different~~ population groups, ~~in case of different~~ income groups or ~~in case of~~ inflation.

- In many cases, utility charges ha~~s~~ves to be kept fixed for long periods due to socio political reasons. ~~in~~In ~~many cities, which it is also not ideal like in Kolkata, the~~

charges are not there at all. So, in equity and then comes this. So, these are the different economic efficiency considerations.

Then, the equity Equity and affordabilityAffordability: considerations, this is where subsidies Subsidies are provided and they are often used to achieve equity and enable low income households to gain house connections or to make service affordable for the poor.

So, that It means that, even though maybe they people are able to pay the operation maintenance charges,, to get a new connection, there has to be some amount of subsidy. And so, orIn addition, to make the service available for the poorest of the poor, so there has to be subsidies are provided, so this has to be looked into. And , similarSimilar group of customers should be charged equally; that means, similar group of customers should have similar kind of charges whereas,whereas; the other groups of customers with different characteristics should have different charges.

And bothBoth cost of access the (connection charge) and user charges should be affordable and has to be set as per user's willingness/ability to, and willingness and ability to pay. So, if people are not able to pay for those charges, but still, that means, it has to be subsidized. So, that is why equity and affordability is considered while setting the tariff, right.

- So, it is Thus, not only about economic efficiency, it also about equity and affordability both also has to be considered when we set thewhile setting the water tariff structure for a particular given urban area for water supply of course.

- Then, operatingOperating ratio: This also needs to be considered while setting tariffs this iswhich is measured as the operating expenses divided by revenue.

- And then for Nnon-revenue water: we need to understandNon-revenue water free water supplied through, this is basically the free water/unaccounted supplied through the different standpost or like the public taps and then the different amount of water for which people do not pay or is lost ; that means, because of theft and then last due toand leakage. This has to be reduced which helps to

improve the overall tariff structure or the services can be provided at a lower tariff structure.

~~So, these are the different non revenue water or unaccounted water. So, this has to be reduced and then only you can improve the overall tariff structure or you can provide the services at a lower tariff structure.~~

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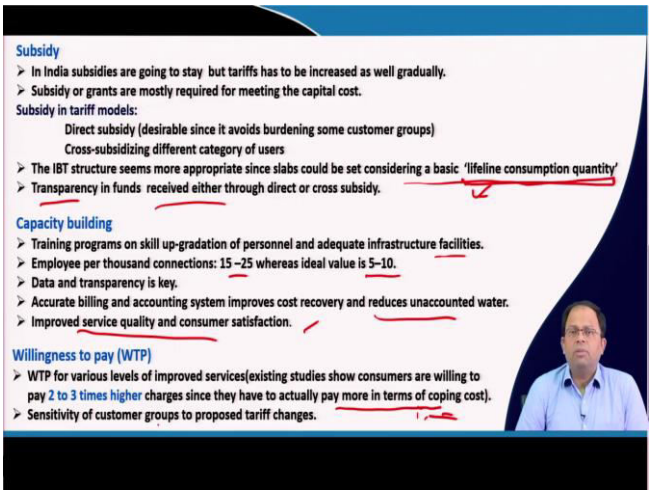

~~Then, subsidy~~Subsidy~~,~~ ~~:~~ ~~we already discuss subsidy when we were discussing equity. Like I~~in India, subsidies are going to stay~~,~~ but tariffs also has to be increased as well gradually. ~~So, it is not only about the subsidy, but gradually the even though subsidy is going to stay the tariff still needs to be increased a little bit, gradually over time.~~ In addition,

~~And~~ subsidies~~y and~~ or grants is mostly used for supporting capital ~~cost that we discussed earlier. And there~~cost. ~~are two~~Two models of ~~subsidy that could~~subsidies c~~ould~~an be provided ~~one is a~~that include direct subsidy and ~~the other is~~ cross subsidy.

~~So, what is direct subsidy? This~~ Direct subsidy is where certain customer groups are directly given some amount of money by Government ~~whereas,~~whereas; other customers are not given that amount of money or ~~that amount of~~ subsidy. ~~So, it is a direct subsidy from the government directly to~~Direct subsidy is provided to that

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group ~~which is~~ which cannot afford to pay ~~certain things, right, or which is actually facing the problem~~for certain services. On the other hand,

~~But~~ cross subsidy is ~~like~~ taking the money from one group and giving it to another group. ~~So, and this cross~~ Cross subsidy varies between the different groups. In this situation, there can be discontent from people and ~~may not willing to pay where and this is where sometimes people gets angry, like they are not willing to you know like you know if you take money from the~~ higher income groups ~~even though they are~~ consuming less water ~~and giving it to~~may not be willing to subsidize another person who is consuming more water~~., but from lower income; obviously, there will be you know discontent, right.~~

~~So, that is why cross out~~Out of cross subsidy and direct subsidy, it is better to ~~go~~ adopt ~~for~~ direct subsidy models in case of water supply. The IBT structure seems more appropriate~~, this increasing block tariff that we discussed earlier and where more appropriates, this is more appropriate in~~ considering India.

~~And we could set the initial~~Initial blocks or ~~this~~ initial charges could be set by considering a basic lifeline consumption quantity charge and then subsequent blocks could be charged at higher rates. ~~So, this lifeline~~Lifeline consumption quantity is the basic quantity that is required by all families. ~~So, we can create our first block based on that and then subsequent blocks would be charged higher rates, right. So, this is the basic amount of water that has to be supplied.~~ Subsidies

- ~~Then, when we talk about subsidy we also has to be very~~ need to be transparent ~~exactly how much~~about the amount of fund is being received, ~~either through~~whether it is for direct subsidy or cross subsidy ~~and where we are utilizing them, right~~. ~~So, this transparency is also key when we talk about subsidy.~~

~~Capacity building: Then, other things that also influence or other things that are also plays a role is the capacity~~ Capacity building ~~of that particular utility service provider~~include ~~.~~

~~Training~~ training programs on skill up-gradation of personnel/service provider and adequate infrastructure facilities. This helps to ~~actually~~ reduce~~s~~ cost. ~~.~~

~~Employee~~ For instance, number of employee per thousand connections ~~we have to bring down the number of employees, usually we find around~~is 15 to 25 employees ~~whereas,~~whereas; ideal value is around 5 to 10 and thus it needs to be decreased.~~, right. So, that is per 1000 connections. So, that is in case of India it is around 15 to 25. So, we need to bring it down.~~

Data and transparency should also be considered because~~, so the~~ if more data ~~we can save and~~is saved, the processes will be more transparent ~~the processes we will be able to make~~and thus the better estimates can be determined. It helps ~~and we will be able~~ to avoid losses~~, right~~. ~~So, based on fluctuations we can actually supply that amount of water that not send extra which will be lost.~~

- ~~Then, accurate~~ Accurate billing and accounting system ~~improves~~improve cost recovery and reduces unaccounted water. ~~So~~Thus, ~~the more better~~better the accounting system or the billing system ~~is~~, the better is this parameter~~s~~. Improvement of service quality and consumer satisfaction also needs to be considered.

Willingness to pay (WTP): Willingness to pay (WTP) is one of the crucial factors that needs to be considered. ~~So, overall when capacity is better~~ Better capacity building~~,~~ results in better service delivery, and more people are more satisfied and ~~. So, and then if they are more satisfied they~~thus, they will be willing to pay more.~~, right. So, willing to pay or WTP is the next dimension that has to be also considered.~~

~~And what we see is~~ WTP for various levels of improved services ~~we need to talk with people and find out that~~discusses about how much ~~they~~ people are willing to pay and what kind of improvements they want.

~~So~~Thus, these are the key to service water supply service delivery in urban areas. ~~And existing~~ Existing studies show that consumers are sometimes willing to pay even 2 to 3 times higher charges since they have to ~~actually~~ pay more in terms of coping cost. ~~So, this~~This is ~~particularly good you know true for~~applicable mostly for ~~poor consumers~~people of low-income group. ~~So, they are willing to pay more because now they are paying actually even though they are not paying any taxes or charges, they are paying more because of coping cost, right.~~

~~And sensitivity~~Sensitivity of customer groups to proposed tariff changes include the aspects which people want to change~~. That means, which are the things~~ if ~~I change my tariff or if I change my service quality which are the aspects which people want to change.~~tariff or service quality is changed. ~~So~~Thus, the sensitivity of different customers groups should be ~~also different this needs to be also looked into~~considered. ~~So, these are the different aspects that we need to consider when we set our tariff.~~

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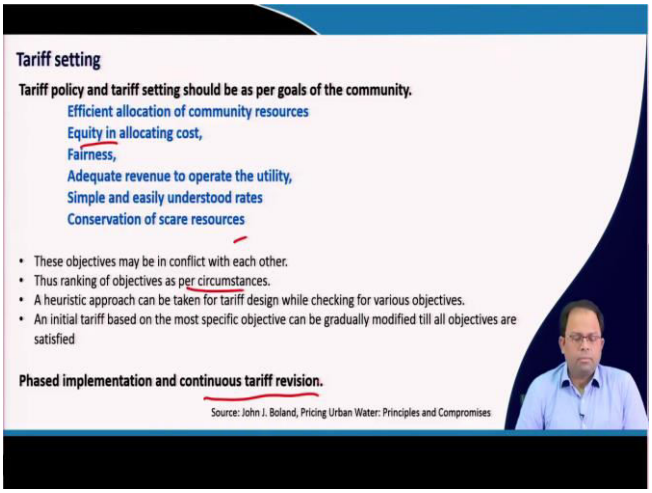

Tariff setting

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~~So, tariff~~ Tariff policy and tariff ~~setting should be a part of you know as per the goals of this particular~~a ~~given community~~. ~~The~~ goals for a community ~~and this goals are~~should be in terms of ~~this~~ efficient allocation of community resources, equity in allocating cost, fairness, adequate revenue to operate the utility, simple and easily understood rates, and conservation of scare resources. ~~So, T~~these ~~are the different~~ parameters ~~that has~~need to be considered ~~when you~~while setting ~~set~~ a tariff for a water supply for a particular community according to the user's needs. ~~And it has to be as per what the community wants.~~

~~So, community~~ Community is willingness to pay for different service aspects or like if ~~they are interested in~~value water conservation~~, they will pay more money for conservation or you know pay more money for water.~~ The structure should be very clear

and easy to understand ~~Then simple and easily understood rates it has to be the structure has to be very clear adequate revenue, so that~~and ~~means, to make sure~~ the utility ~~can~~should operate~~s~~ independently. Also, there has to be adequate revenue ~~, so may be the community would like to have that. So, that the~~and the service remains more professional.

~~And you know, so these are and the other thing efficient allocation equity these already we discuss. So, these are the different things that are considered when tariff is set. Now, some~~ Some of the~~se is~~ objectives ~~that we are discussing, this~~ may be in conflict with each other~~; that means, if you you know in like~~. For instance, equity and efficiency may conflict with each other. ~~So, what we need to do is we need to do a~~Thus, ranking of objectives needs to be determined for this particular community as per ~~that circumstances or for this particular~~ context and ~~what is prioritized, what is more important that should be taken at the first~~degree of importance. A heuristic approach can also be applied where tariff is first designed based on the most important objective and then,

~~And we can always take a heuristic approach where we can first design the tariff, you know for because there are several objectives what we can do is we can initially design the tariff based on the most important objective. And then,~~ it can be gradually modified as per the secondary objectives~~by making sure that all the other objectives are also met~~.

~~By of course, making some adjustment some compromises without compromise that is not possible. But still we first set the tariff based on the primary objective and then modify the tariff as per the secondary objectives, right.~~

~~So, this is how using a heuristic approach we can actually set the tariff level for a particular community. So, and not only that we have to do~~ Apart from phased implementation of ~~this particular~~ tariff, ~~and then also~~ continuous tariff revision is also required~~,~~ so that people are aware ~~of that tariff has to be revised~~about the tariff revision and they do not express anger ~~and they do not get irritated or angry~~ when ~~suddenly there is a you know~~ there is a ~~huge~~ sudden change in the price. ~~So~~Thus, ~~that it has to~~the change should be gradual over time. ~~So, this~~This is the way of ~~how~~ tariff setting ~~has to be done~~ for an urban water supply.

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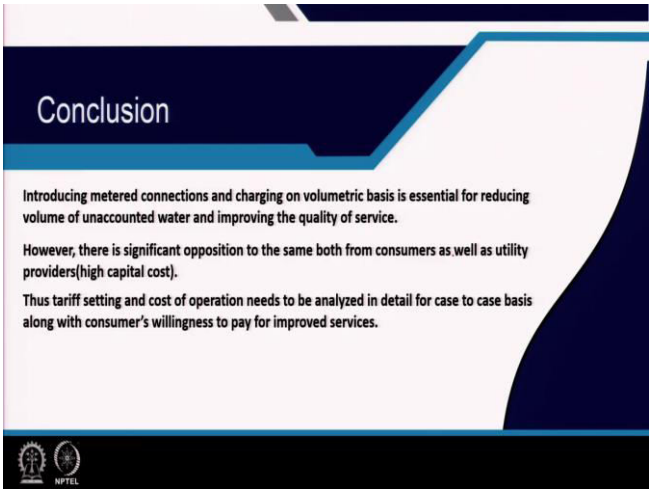

Conclusion

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~~So, to~~ To conclude, introducing metered connections and charging on volumetric basis is essential for reducing volume of unaccounted water and improving the quality of service. However, there is significant opposition to the same both from consumers as well as utility providers because of high capital cost~~, there, and both consumers as well because of high capital cost~~ of provision of this meter. ~~So, there is sometimes opposition from the utility providers as well.~~

~~And thus~~ Thus, tariff setting and cost of operation needs to be analyzed in detail for case to case basis along with consumer's willingness to pay for improve services. ~~So, this~~ These are the ways of ~~is how we should~~ setting tariff for a particular urban area for water supply.

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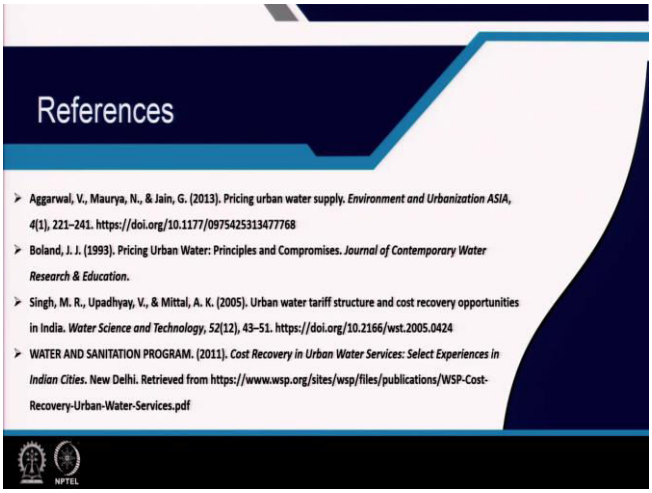

References

Formatiert: Schriftart: Fett

These are some of the references you can study.

~~Thank you.~~