Intricacies of Water Pricing & Non Revenue Water

"Agni & water are givers & sustainers of life, they are affectionate mothers, givers of all, givers of life, they possess healing power" - Rigveda

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11th September,2020

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Delicacies of Leh

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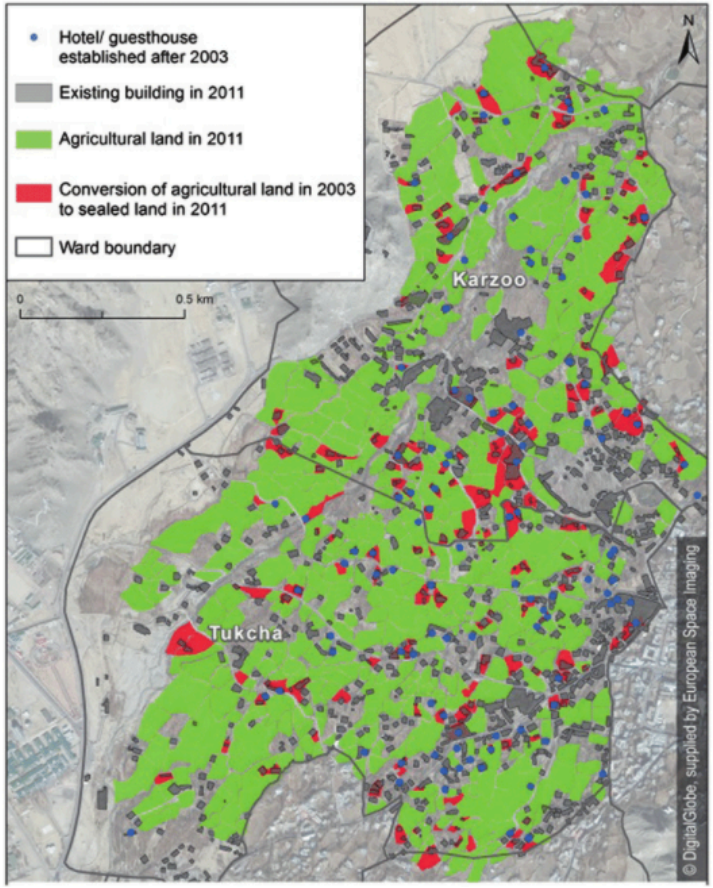
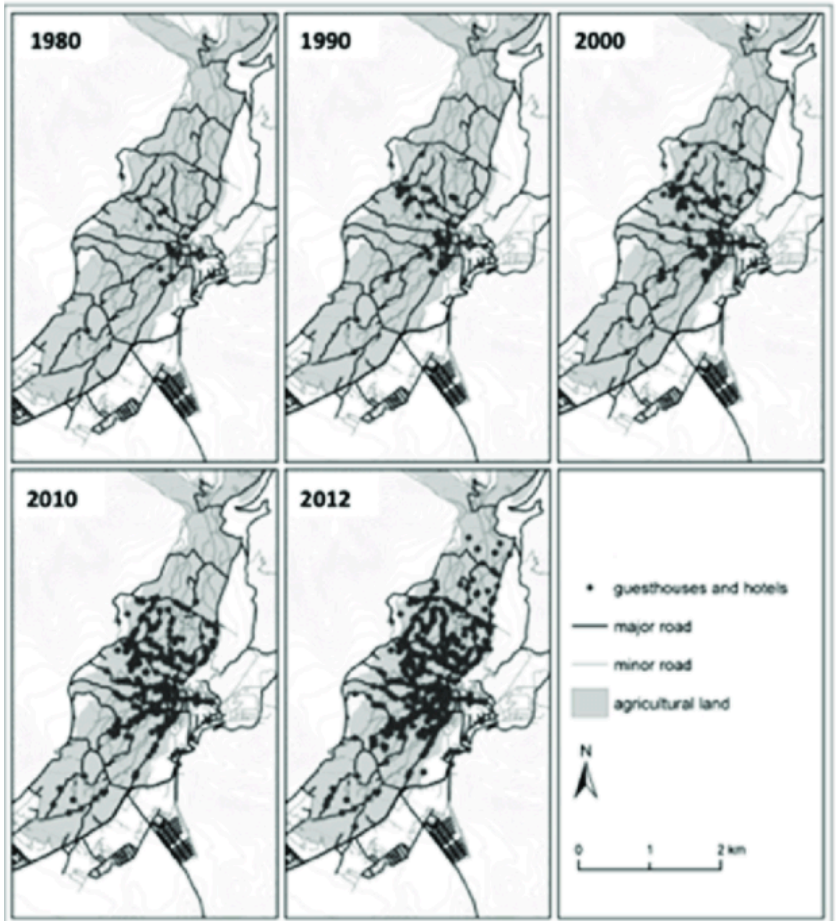


Barren land in Leh's rapidly urbanizing wards



Planning Under Uncertainty: Climate Change, Water Scarcity and Health Issues in Leh Town, Ladakh, India

Water Scarcity in near future

- Increased Ground Water Extraction

- Visitors increase 230,000 in 2016 from just 527 in 1974.

- Accommodation has also boomed. In the 1980s, there were just 24 hotels throughout Ladakh and today there are 670, some 60% of which are in Leh.

- A study by the Ladakh Ecological Development Group (Ledeg) found **that the average Ladakhi uses 21 litres of water per day, while a tourist needs as much as 75.**

- Each day, roughly three million litres of water is supplied to Leh from three sources: direct extraction from the **Indus river bed in the heart** of the town, **digging borewells in Leh town** and **upper Leh areas**, and through springs and diversion channels

https://www.thethirdpole.net/2017/07/26/ladakh-water-tourism-demands-india

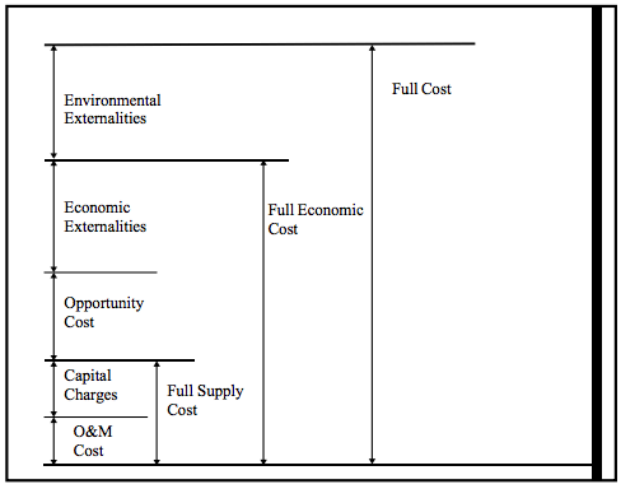
Why Water Pricing?

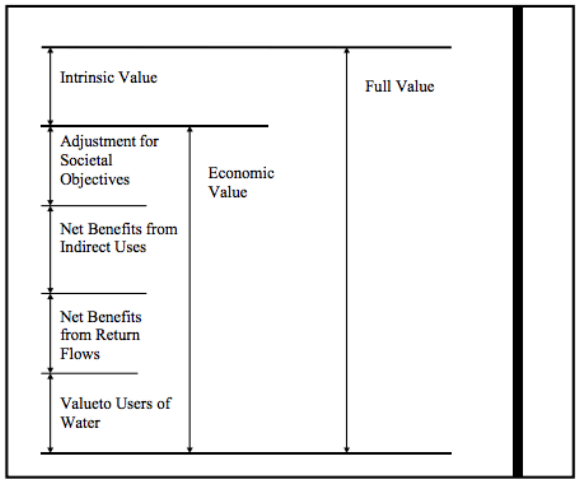
Principles of Non Rivalry & Non Excludability brings in the notion of ” Free riders” & it results in overutilization & exploitation, To regulate it, water pricing is need of an hour thus resulting in reduction of Non Revenue Water

Water Economics

Three important concepts from water economics

COST	O&M costs, capital costs, opportunity costs, costs of economics and environmental externalities
VALUE	Benefits to users, benefits from returned flows, indirect benefits, and intrinsic values
PRICE	Amount set by the political and social system to ensure cost recovery, equity and sustainability. The price may or may not include subsidies. Prices for water are not determined solely by cost





Peter Rogersa,*, Radhika de Silvab , Ramesh Bhatia 2002, Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. Water Policy 4 (2002) 1–17.

Determinants of Water Pricing

- Costs of supply i.e. service delivery, but also costs related to the scarcity of the resource itself (e.g. externalities and opportunity costs) It depends up source and type of use.

- Water pricing exists within social and political settings, where factors such as trust, power and status influence price formation, in addition to supply and demand. is means that even in competitive markets, a price is not necessarily a perfect or the only signal of scarcity.

- Willingness to pay is determined by the socio-cultural context as well as the level of information that is available to them (Beckert, 2011).

- For these reasons, there is commonly a gap between the users' willingness to pay for a good like water and the price necessary to achieve sustainable water management.

Water Pricing Classification

Administrative water pricing- The price is set directly by a public authority, usually a service operator or regulator. based on supply-related costs, as well as opportunity and externality costs from the water use. The price-setting process is almost always regulated by a government agency, or by political decisions.

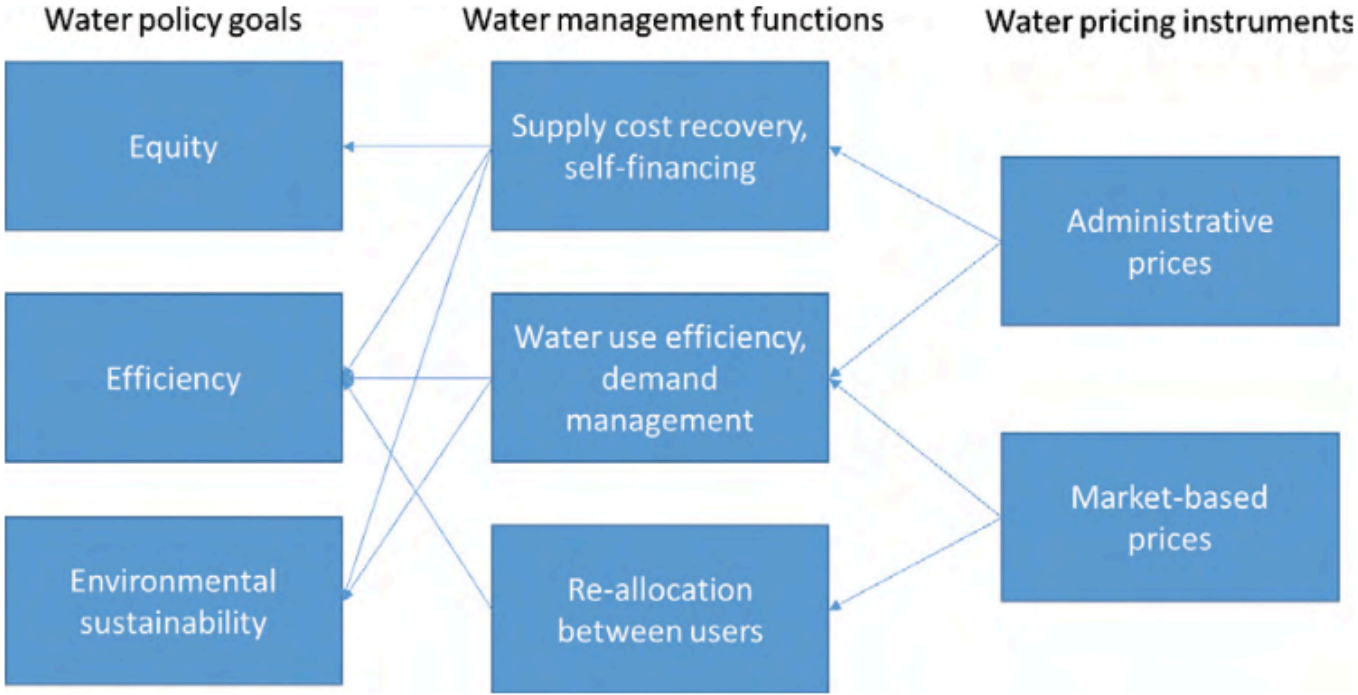
Market-based pricing- The prices are determined indirectly via a decentralised pricing mechanism (such as a market). price is determined by supply and demand, but may also be influenced by historical, social and political factors. One example is a market for tradable water permits

Typology of Water charges

Irrigation Tariffs: Related to Area Irrigated, using wastewater tariffs for cost recovery, economic instruments can be used to incentivise pollution prevention. Most commonly, liability rules for release of pollutants and related to collecting taxes according to the polluter pays principle. In Europe, this is being implemented in various ways, for instance ,in Germany, calculated in terms of units of damage based on equivalents of ten pollutants (Möller-Gulland et al., 2015).

Sjödin, J., Zaeske, A., Joyce, J. 2016, Pricing instruments for sustainable water management. Working paper Nr. 28. SIWI, Stockholm.

Interlinkages for Water Pricing



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Determinants of Water Tariff

- Setting up a Tariff is most challenging, morBoland (1997), OECD (1987, 1999a, c), Potter (1994), Howe (1997), and Wong (1999) have addressed few points for water tariffs

Deciding Tariff elements , (OECD,1999)

1. Connection charge
2. Fixed charge
3. Volumetric charge
4. Block charge
5. Minimum charge

Peter Rogersa,*, Radhika de Silvab , Ramesh Bhatia 2002, Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. Water Policy 4 (2002) 1–17.

Tariff structure systems

The two-part tariff system: Conventional Method

- Several OECD countries like Australia, Austria, Denmark, Finland and the United Kingdom have this system
- It has fixed and variable elements. In these countries the fixed element varies according to some characteristic of the user, and the variable element often uses average cost pricing (OECD, 1999a). This method can be improved upon by using an increasing block tariff system (IBT) for the variable part. The variable element charges the consumer according to his consumption level and therefore encourages conservation.

Peter Rogersa,*, Radhika de Silvab , Ramesh Bhatia 2002, Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. Water Policy 4 (2002) 1–17.

Increasing Block Tariff structure: Advanced Method

- Advanced form of the two-part tariff system.
- IBT provides different prices for two or more pre specified blocks of water.
- The price rises with each successive block.
- The utility must decide on the number of blocks, volume of water use associated with each block, and price to be charged for each block when designing an IBT structure (Boland & Whittington, 1998).
- While the first of these is more a management decision the second and third are political and social decisions.
- IBT is a progressive tariff. This allows the utility to provide lifeline to the poor at below-cost rate, and charge higher prices for use beyond this minimum volume.
- This subsidy allows the poor access to water and sanitation and promotes public health. Thus IBTs are acclaimed for improving equity. Under this system poorer households get access to low-rate water since they possess fewer water consuming appliances (Whittington, 1997), and allow for rich-to-poor subsidies and industrial-to-household subsidies as well (Boland & Whittington, 1998).

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Typology of Water charges

A price can be sub-divided into charges along the water management cycle, each part directly associated with the specific costs of providing some facet of service.

- **Raw Water Abstraction Charges**: Relates to Grown Water abstraction by Industries, levied on industries, Based on Opportunity cost & Environment cost, Volumetric Charges for Extraction. Example: Berlin, Zurich etc.

- **Household water tariffs**: Single rate volumetric prices are directly related to the amount of water withdrawn or consumed in use. Fixed rate, amount of water used & duration. Dual rate method, one for times of peak demand and one for times of low demand. is also commonly takes the form of increasing block rates (IBR), especially in developing countries (Whittington, 2002), where the marginal price increases for each user as their volume increases.

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Sjodin, J., Zaeske, A., Joyce, J. 2016, Pricing instruments for sustainable water management. Working paper Nr. 28. SIWI, Stockholm.

Real Intricacies for Water Pricing

- Rational Behaviour of Individuals
- Cultural & Social context
- Political resistance to reform

} Water Political Economy & Governance, (Diver,2000)

Dimensions for Institutional Capacity by Grafton et al (2011) are

- Recognition of multiple users
- Authority & resource for water management
- Coordination b/w public authorities at same level & different
- Definition of water rights
- Resolving water conflicts
- Institutional capacity
- Water Title Rights

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Sjodin, J., Zaeske, A., Joyce, J. 2016, Pricing instruments for sustainable water management. Working paper Nr. 28. SIWI, Stockholm.

Performance of Water Pricing

- South Africa developed a water policy framework highlighting “**equity above economic efficiency**”, Grafton et. Al (2011).
- European Union Framework directives from 2000, focused on achieving the supply cost recovery, to recover O & M cost, it varies from India’s 20 to 30 % O & M recovery to 75 % in Madagascar.
- European Environment agency, 2013 also talks about Economic Efficiency, it is more concerned with Volumetric tariffs rather than flat tariffs.
- In Europe, Household consumption elasticity was less responsive to price whereas for public assets, it was more responsive that eventually results in **more generation of Non- Revenue Water**
- In Australia, Water pricing was more instrumental towards scarcity of water, during drought water tariffs marked sky in juxtaposition to more availability of water.

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Sjodin, J., Zaeske, A., Joyce, J. 2016, Pricing instruments for sustainable water management. Working paper Nr. 28. SIWI, Stockholm.

Intricacies for Non Revenue Water

Estimates of worldwide Non Revenue water

	ESTIMATES OF NRW							
				Ratio		Volume (billions of m^3/year)		
	Supplied population (millions, 2002)	System input l/capita/day	Level of NRW (% of system input)	Physical losses (%)	Commercial losses (%)	Physical losses	Commercial losses	Total NRW
Developed countries	744.8	300	15	80	20	9.8	2.4	12.2
Eurasia (CIS)	178.0	500	30	70	30	6.8	2.9	9.7
Developing countries	837.2[a]	250[b]	35	60	40	16.1	10.6	26.7
				TOTAL		32.7	15.9	48.6

Sources: WHO and authors' estimates.

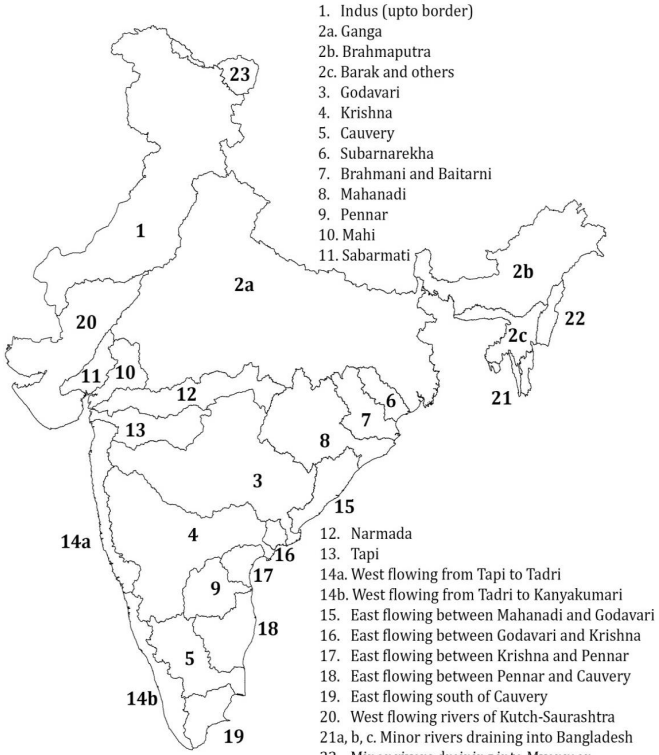
l = liters; m^3 = cubic meters

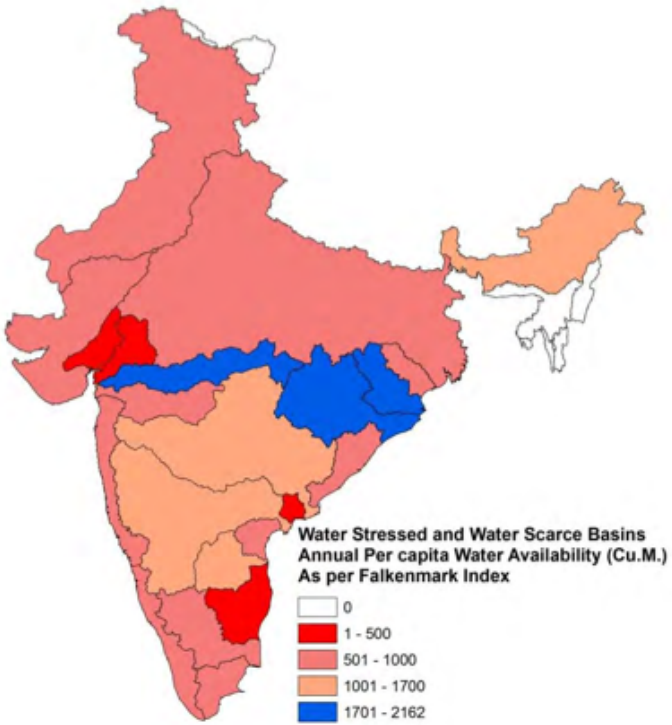
a. Based on a total population having access to safe water supply of 1,902.7 million people, with 44 percent of these receiving water through individual household connections.

b. This figure reflects a wide discrepancy among developing countries, from 100 l/capita/day for some utilities in the poorest countries or those experiencing severe water shortages to more than 400 l/capita/day in many megacities of Latin America and East Asia. The figure used in this calculation is a conservative average.

Source: (Bill Kingdom, Roland Liemberger, Philippe Marin The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries)

River basins and water stress





Source: IIHS RF Paper on Water Supply and Sanitation

Emerging water supply issues in developing nations

- Inadequate coverage
- Intermittent supply
- Outdated piping
- Low pressure and poor quality
- Chronic shortage of investments
- Inadequate operation and maintenance
- Metering errors
- Water theft and unbilled collection also lead to high levels of Non-Revenue Water (NRW).
- Water boards in India area able to recover only 30 to 35 per cent of the operation and maintenance (O&M) cost (HPEC, 2011).

Performance-based service contracting for NRW reduction

- **State of Selangor (Malaysia**): Large-scale contract for reducing physical and commercial losses has been in place since 1998 between the (at that time state- owned) water utility serving Kuala Lumpur and its surroundings, and a consortium led by a Malaysian company

- **Bangkok (Thailand):**Metropolitan Waterworks Authority (MWA) that sup- plies Bangkok outsourced physical loss reduction to private contractors from 2000 to 2004

- **São Paulo (Brazil):** SABESP, the water utility that serves the São Paulo Metropolitan Region, experimented with different contractual approaches for reducing commer- cial losses with the private sector

- **Dublin (Ireland):**Water Division of the Dublin City Council contracted in 1997 an international private operator to implement a two-year contract for reducing physical losses

Source:The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries :2016

Non Revenue Water: Definitions

- Non-Revenue Water (NRW) is defined as the difference between the amount of water put into the distribution system and the amount of water billed to consumers (ADB 2010).
- 40 to 70 percent of more water can be available to the urban households without any extra cost by reducing financial and physical losses. (World Bank,2012)
- To increase the supply capacity, investment in NRW reduction will be much cost effective than investments in new capital projects. (Liemberger, 2010)
- The per unit cost of reducing leakages is significantly less than the cost involved in creating additional capacity (PwC, 2011)

Hence focus on NRW management may be a sustainable model of urban water management.

NRW = System Input Volume — Billed Authorized Consumption

<table>
<tr><th colspan="6">The IWA/AWWA Water Balance</th></tr>
<tr><td rowspan="2">Volume From Own Sources (corrected for known errors)</td><td rowspan="11">System Input Volume</td><td>Water Exported (corrected for known errors)</td><td colspan="3">Billed Water Exported</td><td>Revenue Water</td></tr>
<tr><td rowspan="10">Water Supplied</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="8">Non-revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="6">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Unauthorized Consumption</td></tr>
<tr><td>Systematic Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to the Point of Customer Metering</td></tr>
<tr><td>Water Imported (corrected for known errors)</td></tr>
<tr><td colspan="6">NOTE: All data in volume for the period of reference, typically one year.</td></tr>
</table>

https://www.openintl.com/non-revenue-water-management-the-challenge-facing-water-and-sewage-companies

International Water Association (IWA) components

Physical (or real) losses

Leakages from transmission mains, storage facilities, distribution mains or service connections. They are majorly caused due to poor operation and maintenance and poor quality of underground materials (assets).

Commercial (or apparent) losses

Caused due to water theft, metering inaccuracies and poor data holdings. Significance of Non-Revenue Water in Urban Water Management.

Unbilled authorized consumption

Water which cannot be billed like firefighting purposes and free water services to certain groups. The level of Non-Revenue Water in India is extremely high, it is estimated that NRW in India range between 40 % - 60 % or even higher. Even this is a guesstimate, as majority of Indian cities do not have real accounting system for the water that is actually supplied to various consumers (HPEC, 2011, Planning Commission of India, 2011 and Mckinsey Global Institute, 2012).

Why is NRW not being addressed?

Very little interest and attention is shown in addressing the issue of NRW by the water utilities after knowing the potential benefits that NRW provides. Evidences of simple management and technical issues by some water utilities have resulted in dramatic results in reducing the water losses (e.g., Phnom Penh, Manila, Singapore) The major concerns resulting in NRW are

- Asset Management
- Capacity
- Funding
- Accounting
- Raw water pricing

Emerging Water Supply issues in developing nations

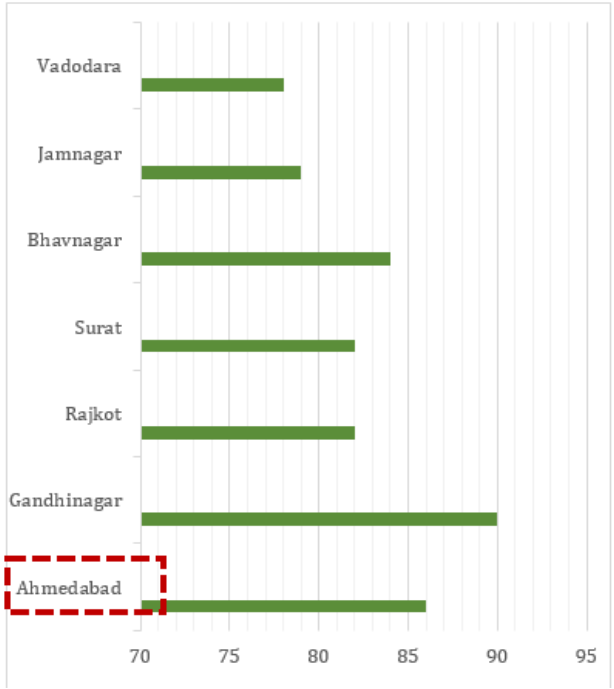
Ahmedabad has a population of 62 lakhs of which 78 percent resides within the municipal area. The rapid urbanization has led to overflow of population outside the city limits which has resulted in an increasing demand of water. The paper attempts to examine the non-revenue water in context of Ahmedabad it throws light on the present water supply in Ahmedabad and instigates the amount of non-revenue water which majorly include physical losses, commercial losses and unbilled authorized consumption. After instigating NRW, the solutions are recommended for the locations with higher percentage of Non-Revenue water.

Research Objectives

- To review the existing scenario of water supply in Ahmedabad
- To examine the Non-revenue water in the selected locations of Ahmedabad
- To provide a solution for reducing NRW in the selected locations with a higher percentage

Source: Peri-Urban Interface of Indian cities: Growth, Governance & Local Initiatives

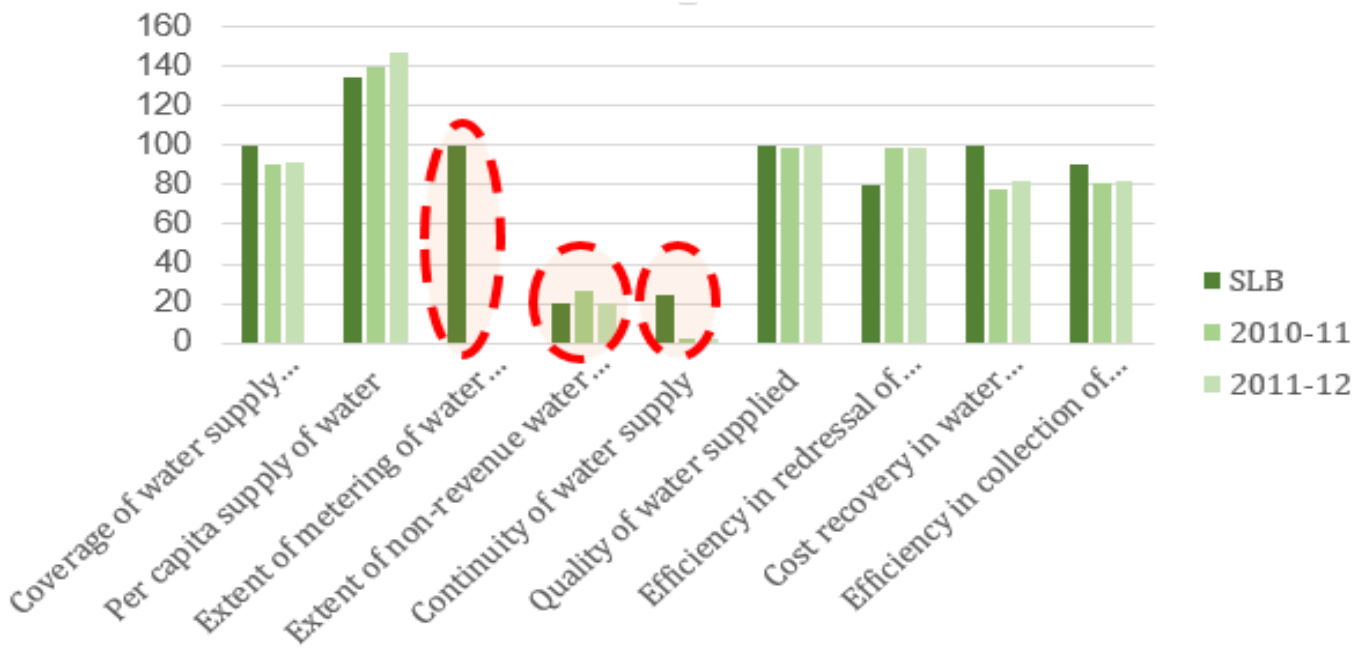
Water Coverage: Ahmedabad



Source: CSP Ahmedabad 2012

In terms of coverage of water supply Ahmedabad is doing well and is placed at second position as compared to other cities in Gujarat with a coverage of 86 percent household which is placed behind Gandhinagar that is one of the planned cities in India. Whereas in comparison other cities like Rajkot, Surat, Bhavnagar, Jamnagar and Vadodara are behind. Although coverage of water supply is good but if we compare all the indicators stated under Service level benchmarking for Ahmedabad “extent of NRW” have increased over the years

Service Level Benchmarking for water



Source: CSP Ahmedabad 2012

Evolution & History of Water Supply for Ahmedabad

1890

1931

1955

1979

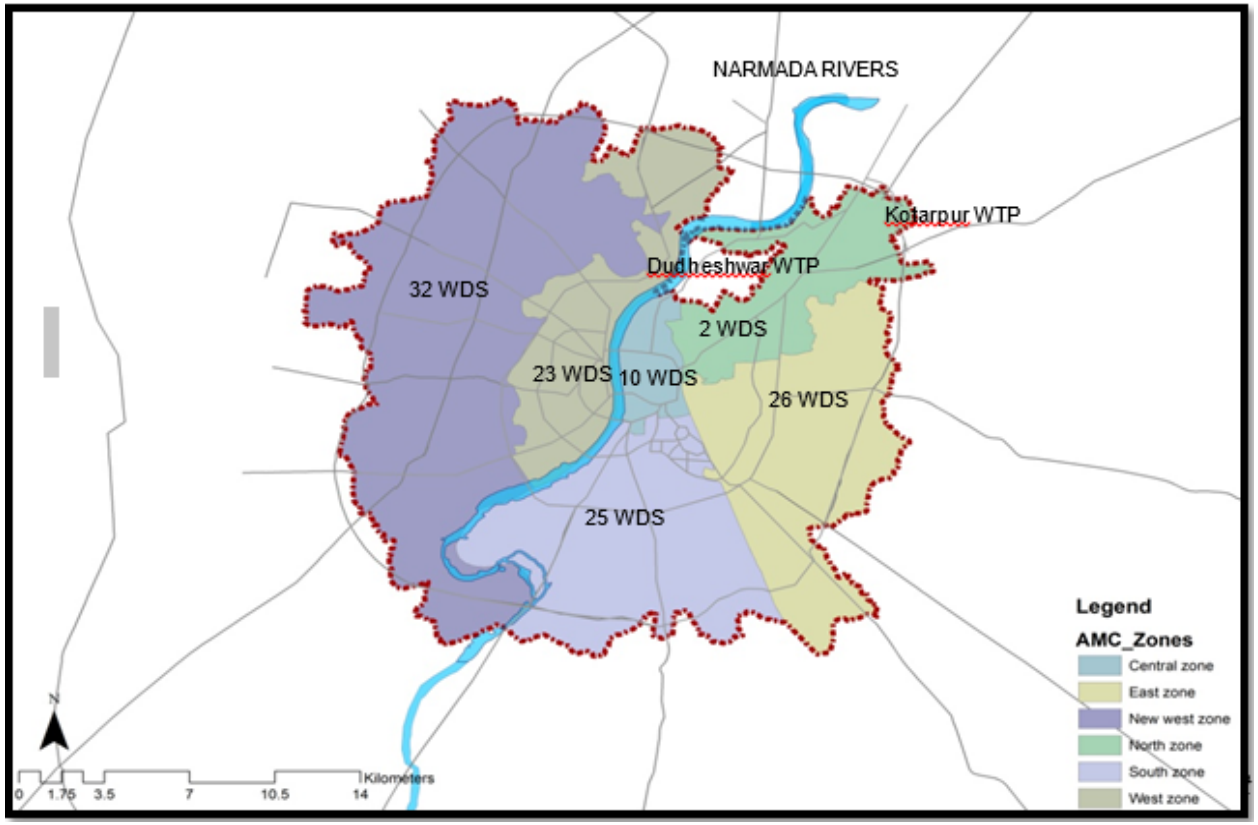
1997

2012

The origin of Ahmedabad's water network started from 1890 when water was tapped from Dholka branch of Sabarmati and Dudeshwar water works started in 1891 in which water from Narmada was tapped and the water network of city grew in east zone till 1931 and later on the water network expanded to east and west zone by 1955. As the population was increasing in east and west zone thus to cater the needs of people kotarpur water work started in 1970 which at present supplies water to majority of Ahmedabad population. The water distribution network further expanded to south zone by 1997 and later on after 2006 city's water distribution network grew in New west zone.

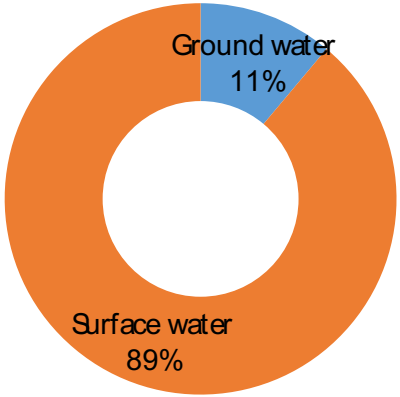
Source: CSP Ahmedabad 2012

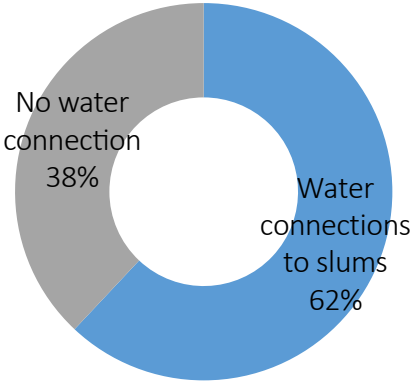
Water Distribution Zones for Ahmedabad

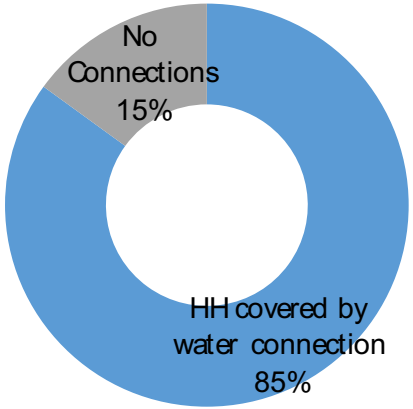


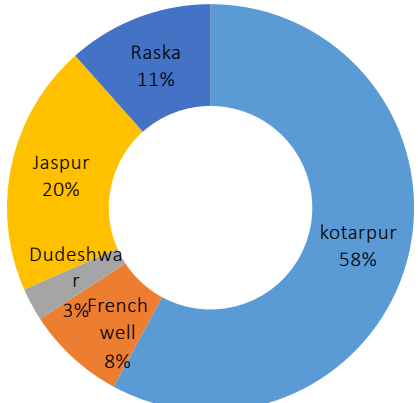
Ahmedabad Municipal Corporation has 139 water distribution stations across the city. There are six distribution zones, overlapping with the administrative zones. The distribution network of 3500 km covers entire city. The length of trunk main line is about 230 km. The average daily supply of water is around 1030 MLD. The average litre per capita per day (lpcd) is estimated around 148 LPCD. The coverage of water supply connection is reported to be 88.3 percent.

Water Source, Coverage, Connections & Treatment for Ahmedabad

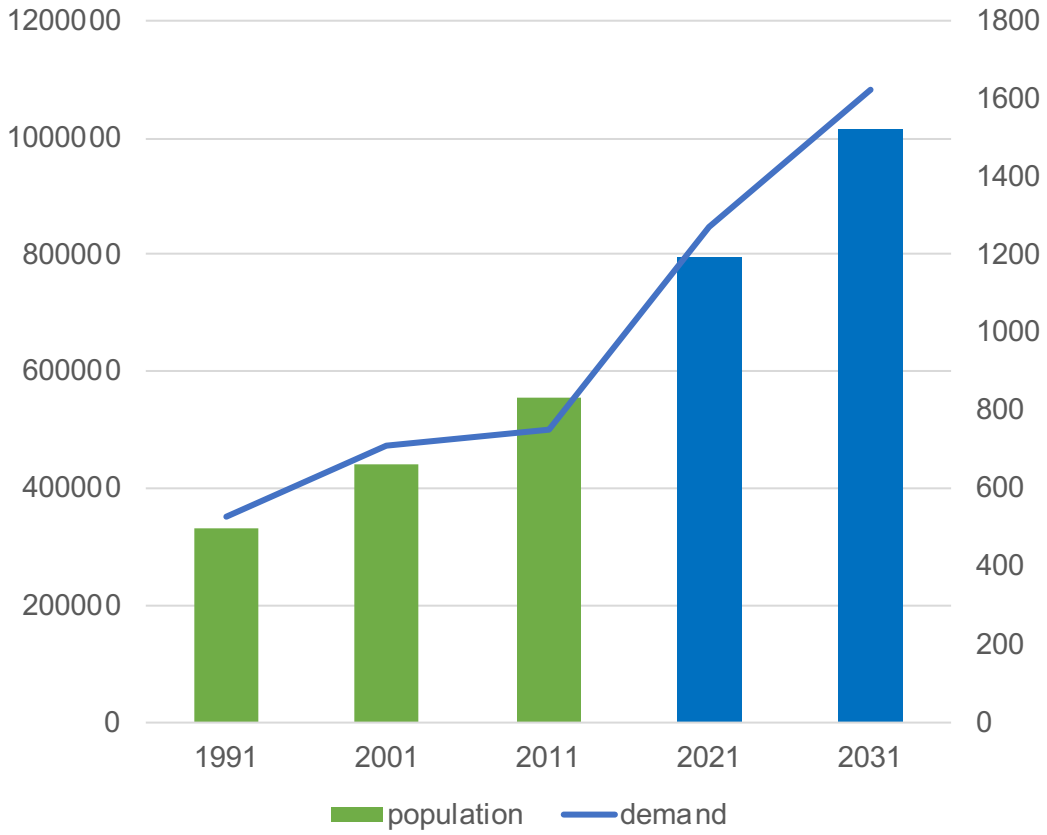




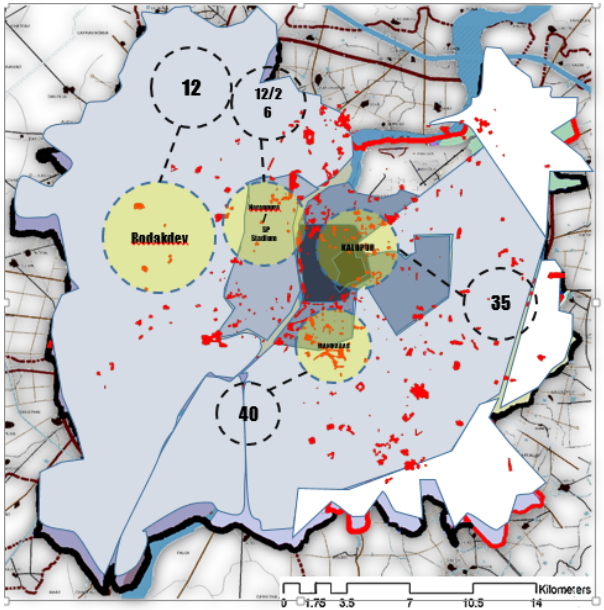


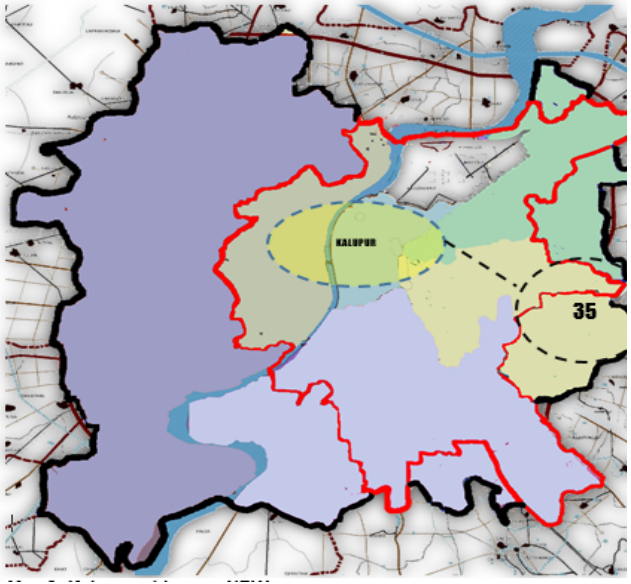


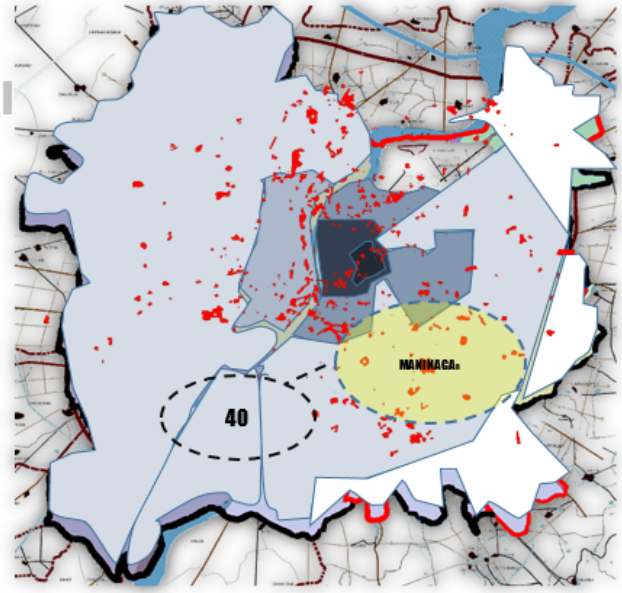
Population & Water Demand for Ahmedabad



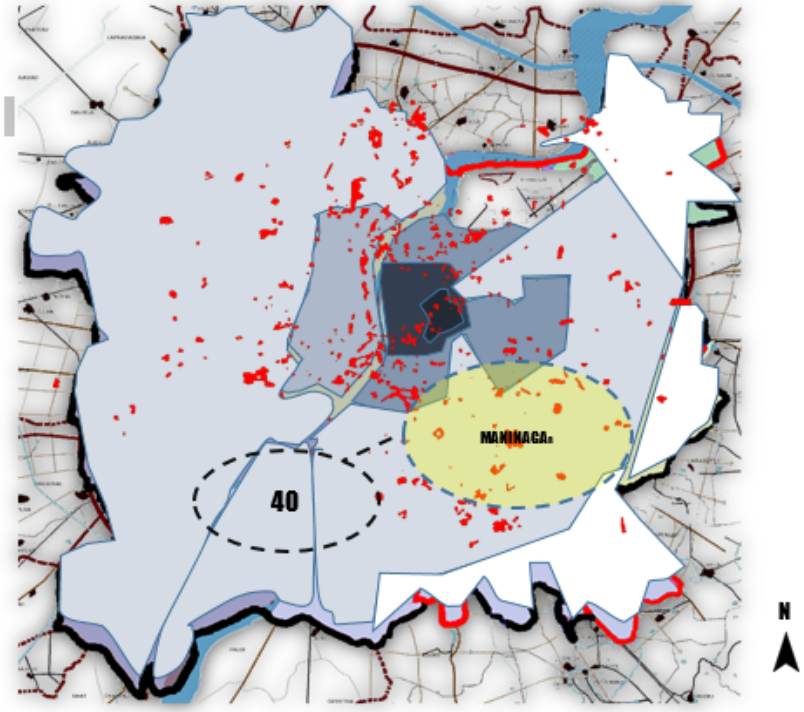
Water auditing for Maninagar & Kalupur Ward







Water auditing for Maninagar Ward

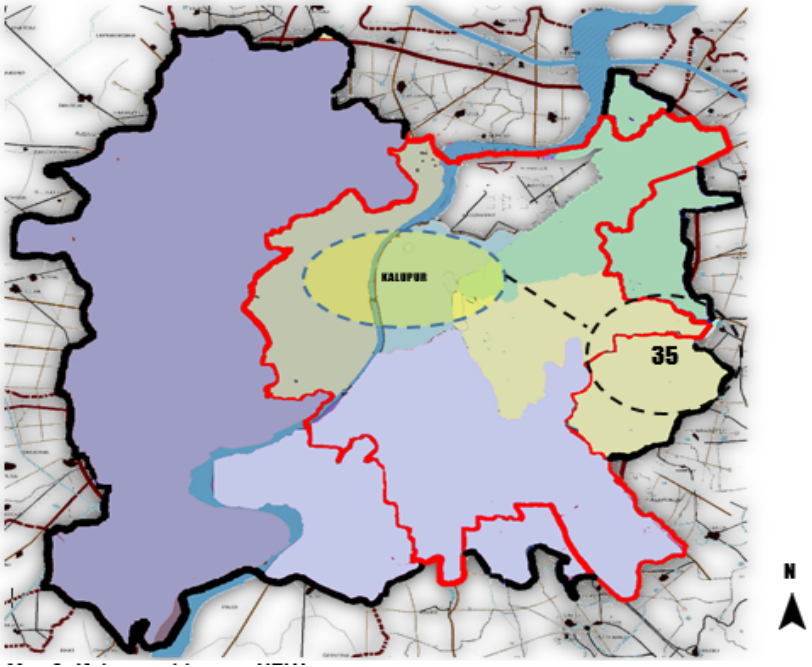


The pilot project of leak detection include different stages as described

- Selection of samples from MIG,HIG,LIG and slums which will require 11 days
- Availability of Isolation Valves which will require 12 days
- Pipe and valve survey which will require 25 days
- Checking of existing flow which will require 7 days
- Leak detection test which will require 20 days

Overall span of project is 75 days

Water auditing for Kalupur Ward



The pilot project of leak detection include different stages as described

- Selection of samples from MIG,HIG,LIG and slums which will require 14 days
- Availability of Isolation Valves which will require 16 days
- Pipe and valve survey which will require 29 days
- Checking of existing flow which will require 11 days
- Leak detection test which will require 24 days

Overall span of project is 94 days

Water Related Interventions

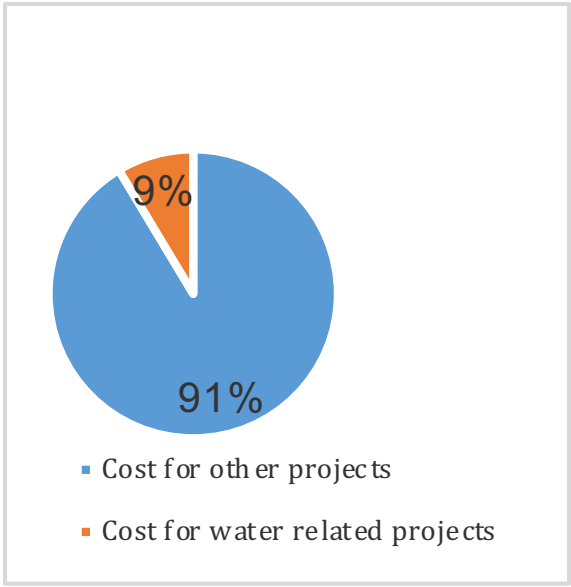
Out of 1000 crores sanctioned to AMC only 86 crores is sanctioned for water sector which shows that an important emphasis is given on all other sectors rather than water sector

Although 86 crores were sanctioned under JNNURM for water related interventions

40 crores for 24 * 7 water supply in Jodhpur, new west zone , Ahmedabad

13.58 crores 24 * 7 water supply at Navrangpura, Stadium, Juna Vadaj

33.3 crores for Automation (SCADA based) of the Water Supply System



THANKYOU

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