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Issues, Challenges and Prospects of Water Supply in Urban India

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Abstract: *Increasing population and climatic variation driven by climate change has led to water scarcity across world. As cited in United Nations Environmental programme 2002, by 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity about two-third of the world population, mainly in developing countries will face moderately to high water stress and half of the population will face problem due to water scarcity. Ongoing mismanagement of resources and wasteful behaviour in India has led to the overexploitation of water resources, particularly groundwater. A large part of India fall under the category of physical water scarcity where availability of natural water resources is not enough to ensure the future water needs hence they need to increase their efficiency of water use and wisely maintain their available water resources. The concentration of water related problems will be more in urban settlements where quantity of available water reducing day by day. The potable water as a commodity is highly delicate and vulnerable to pollution and contamination. As such it has to be handled with a high degree of care. This paper focuses on issues and challenges associated with urban water requirements and suggest pragmatic solutions and policy measures to ensure clean, continual and convenient access to drinking water supply to all the residents of urban settlements.*

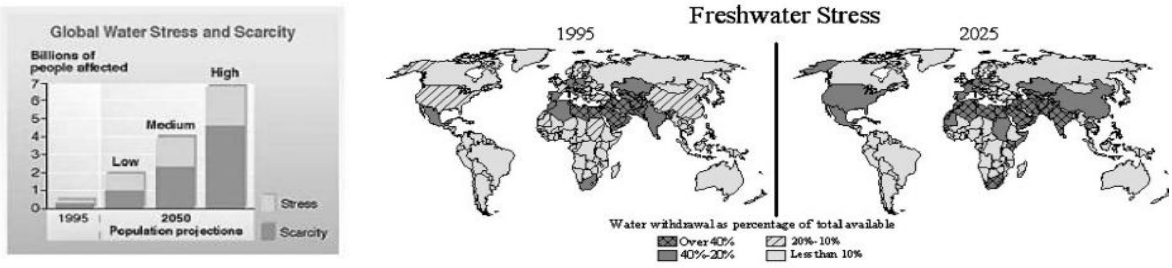
Keywords: *(Potable water, Water stress, urban Settlement, pragmatic solution)*

I. Introduction

Most of the world countries are facing the problem of fresh water scarcity mainly due to increasing population and climatic variation in rainfall is driven by climate change **(Image 1).** About two-third of world countries mainly developing countries will face moderate to high water stress water and half of the total world population will face real water constraints by 2025 **(United nations environmental programme 2002)**. Many of the European countries in the temperate zone having plentiful of fresh water resources are also facing the shortage of water supply due to successive water droughts driven by climate variations lead to drying of many water resources and water level in aquifers have reached to the critical point **(V. Lazarova et. al. 2001)**. Large part of India also fall under the category of physical water scarcity where availability of natural water resources is not enough to secure their future water needs hence they need to increase their efficiency of water use and wisely maintain their available water resources **(Seckler et al. 2008; Christine L. Moe et. al. 2006)**.

In India, right to fresh water for personal and domestic uses is not mentioned explicitly in Indian constitution but clean and affordable water is essential to life and one of the fundamental human rights protected under international human rights law. Freshwater is a finite resource and is also a basic requirement for human body. Water is used mainly for domestic, agricultural and industrial purposes and also food production are essentially a function of water level at farm and industrial levels **(FAO 2008).** The greatest demand of fresh water resources is in agriculture for food production as about 70% of the developed water supplies used in irrigation **(Seckler et el, 1998; Christine L. Moe et al , 2006)**. About 300 to 3000 litre water required to produce 1kg of food grain and that food production for a balanced diet requires 1300cubic of water per person per year **(Siwi et al, 2004)**.

Image1: Fresh water stress across world



Source: Christine L. Moe et al, 2006

In the case of pipe water connection in households, water use demand rises from 60 to 100 liters which can vary with climatic variation and food requirements **(Gleick, 1996)**. When pipe connections are not available, quantity of water used per capita is affected by the distance travelled and time taken for the collection of water particularly in the case of hygiene. Where People walk farther than 1 km to take water, then there is drop in the quantity of water use by 5-10 liters per day **(Howard et al, 2003)**. WHO recommended a minimum of 7.5 liters/capita/day of water to meet the potable requirements of most people under most conditions. Provision of potable water supply is important for socio-economic development of a country and also one of the main indicators of the development **(WWAP, 2009)**.

II. Issues Related To Water Supply In Urban India

Demographic, social and economic developments are the factors which increase pressure on water resources. Water availability, management and waste water disposal are three major issues related to water supply in the urban settlements.

2.1 Water availability

Only 1% of the total water available can be used for human consumption. Most of the Indian cities depend upon underground water to meet their urban water demand. All the cities with pumping locations around the city face steep decline in water table. Chennai in 2005 faces severe drought so large amount of underground water extracted to cope up their urban area water demands so water table fall to 8 to 10 metres **(Veena Srinivasan et al, 2010)**. The fall in ground water table has been recorded for the pumping location on seasonal and perennial rivers e.g. water table in Haryana, along Yamuna river, is also going down speedily due to intensive use in agriculture and supply for urban areas. There are many such examples in Punjab and across India. Cities, the concrete jungle, are characterized by impervious surfaces or surfaces with very high runoff coefficient. So, water which should percolate in earth in form of rain also get drained off very fast which increases the depletion of available water resources. Due to climatic variation, there is change in rainfall pattern and also rainfall availability is reducing.

2.2 Water Supply infrastructure

It is expected that majority of urban growth in India will take place in small and medium sized towns. Such towns do not have enough revenue to maintain the speed of infrastructure development with increasing demand and least capacity to manage such services. Unplanned Peri-urban areas are most prone to it having low pace of infrastructure development **(Anna Norstrom et al, 2009; UN Habitat, 2006)**.

Table 1: Water supply situation in India with comparison to other world countries

% of total population connected with households connection and stand posts		
1.	India	64
2.	China	91
3.	South Africa	86
4.	Brazil	80
Comparison of Duration of water supply		
1	India	1-6
2	Brazil	24
3	China	22
4.	Vietnam	22
Per capita water supply litre per capita per day (lpcd)		
1	India	37-298 lpcd (limited period)
2	Mexico	150 lpcd continuously
3.	Paris	171 lpcd continuously

Source-I .J Ahluwalia, 2011

2.3 Waste Water Disposal

Indian cities lack sewerage treatment plants. Industrial and domestic waste water is discharged in rivers, ponds and in wells resulting in pollution of natural water resources. There are few examples of waste water reclamation and water reuse in indian cities but people still hesitate to use reclaimed water for potable uses hence need to make some effort to aware people about the benefits of water reuse. Water reuse also helps in underground water recharge, restore water cycle and protect natural ecological environment.

III. Challenges Associated with Water Supply

3.1 Water Quality

Like water quantity, water quality also has been a matter of political agenda across the world and India, Delhi is the best example of the same. In the absence of strong regulation, industrial and domestic waste water is discharged in rivers, canals and underground water sources. About 70% of underground and surface water resources in India have been contaminated **(Sudhakar M.Rao et al, 2004).** High levels of pollution of the groundwater has been caused by the printing and dyeing units in Pali and Jodhpur in Rajasthan, Jetpur and Rajkot in Gujarat, Tannery industry in North Arcot district in Tamil Nadu. Printing and dyeing units in Panipat and Sonipat in Haryana are among other examples.

3.2 Financing of Infrastructure for Water Supply

Lack of finance in the urban water supply system is one of the biggest challenges in Indian urban water supply system. In India, most of urban local bodies/municipalities have to depend on the state government to get investment in water supply system. They do not have enough sources for revenue generation to maintain water supply infrastructure. In India, water supply is responsibility of both state government and urban local bodies. Unequal distribution system is also a big challenge where poor people do not have access to potable water system so effort should be done for equitable distribution of water.

Political will is also a big hindrance in equitable water distribution system because there is always nexus between politicians and bureaucrats. Large fraction of state grants does not reach to its end and become the black money of these politicians.

3.3 Lack of Regulatory Framework

There are no clear-cut distribution of responsibilities to different urban agencies in different urban areas and most of time they overlaps causing in the delay of almost all water projects. Lack of accountability and regulatory framework for core and peri-urban areas is not proper so each responsible agency can't do their duty properly. Lack of initiative taken for public participation in decision making to improve water supply system is also a major hindrance for its improvement.

3.4 Water Utilization and Infrastructure Management

Intermittent water supply is faced by almost all Indian cities in India. No Indian city provides 24x7 water supplies except some public private partnership systems. Inadequate water supply is a big problem in India as only 64 % of households are connected and stand posts. Average duration of water supply is found between 1-6 hours **(I .J Ahluwalia, 2011).** A large fraction of population does not have access to public water facilities hence they have to depend upon the private water suppliers and have to pay more charges in comparison to public water supply. Poor people are more vulnerable to this system because they have least participation in public water system management **.**The brunt of the burden of poor quality of water delivery is borne by the poor. Lower-income households without access to public networks typically have to rely on market sources to access water at a higher price Water utilities in India are typically able to recover only 30-35 per cent of the operations and maintenance (O&M) cost. In the Philippines and Cambodia, most water utilities recover the full O&M cost. Even in Bangladesh, water utilities recover about 64 per cent of their O&M cost **(ADB 2007).**

Problems related with water quality in the piped water distribution system is more prominent and serious in urban India, especially in middle income groups and weaker section, because they does not have enough resources to maintain their water supply infrastructure and disinfect residual. Rapid urbanization in developing countries is often accompanied by overwhelming demands on existing water systems and illegal connections to distribution systems in poor neighbourhoods. Many systems have cracks and high leakage. In 1991, an international survey of water loss as a percentage of water supplied reported that in industrialized countries water loss ranged from 8% to 24%. However, in middle income or newly industrialized countries, water loss ranged from 15% to 24%, and in developing countries like India water loss was estimated at between 25% and 45% **(WHO 2001)**. Frequent power outage too contributes to low or negative pressure in the pipes which allows contaminated water or wastewater surrounding the pipes to be drawn in through any cracks. Equitable distribution of water supply is also major problem as only prestigious people have access to potable water supply and poor people does nor receive minimum clean water requirement.

Unmetered water supply cause increase in extravagantly use of water by consumers. Due to this Municipalities/responsible authorities are unable to recover costs causing lack for further investment in expansion and maintenance of water supply infrastructure **(Mclntosh, 2003; Water and Sanitation Program – South Asia 2003)**. This erodes the consumer confidence, reliability and willingness to pay for billed water. Due to low fraction of households connected to piped water supply remains low, leading to declining financial

viability **(Singh et al, 1993; Rogers et al, 2003).**Aging of the water supply infrastructure is also a big problem facing aging of water supply infrastructure by Indian municipalities as they do not have enough revenue collection to replace them.

IV. Pragmatic solutions for efficient urban water supply

We know there are many techniques to increase the availability and better management of the water resources in the urban areas like rain water harvesting for underground water recharge and for storage in tanks. Water reuse or water from waste water after appropriate treatment can be used for non potable uses like flushing, cloth washing, plant irrigation, agriculture and also for potable uses after latest treatment technologies.

4.1 Rain Water Harvesting

Chennai faced severe drought in 2003-04 resulting in shortage of potable water supply in urban areas, since than water harvesting is mandatory and compulsory for all building plans to get approval. Before this, about 9% of rain water percolates and mix with underground water and remaining runoff in to the ocean but now 27% of rain water is utilized. Here, this approach also applied at community scale by rejuvenating all old water tanks and ponds as infiltration structures **(Veena Srinivasan et al. 2010).** Here rain water is not used only for no potable uses as in cisterns as end product also to recharge water aquifers directly. Also water is stored in tank built inside house basement and after appropriate treatment used to drink when required.

This technique is being adopted, encouraged and promoted in many countries like China, Australia, Brazil and India. Rain water harvesting is an efficient, promising and sustainable way to increase and supplement the availability of underground and surface scarce water resources in areas where the people are facing the problem of shortage of potable water supply and existing water supply systems are inadequate and failed to meet the adequate demand of potable water supply **(O. O. Aladenola, 2009)**. India is located in the region of monsoon climate where rainfall variation is most prominent in different months of year also imbalanced by climate change. Most of rainfall in Indian subcontinent occurs in monsoon months. Also there are many regions in world are facing variation in rainfall, more rainfall in some specific months. Due to increase in water demand rainwater collection has become an important technique to collect water for agriculture, underground water recharge and non potable uses **(Leggett and Shaffer 2002; 2005; Peters 2006)**. In New Delhi, Chennai and some parts of Haryana (India), it is mandatory and compulsory to have a rainwater harvesting system in building plan for its approval and clearance from local authority. Rainwater use is found in public facilities in Japan **(Zaizen et al. 1999)**, Millennium dome in London **(Chilton et al. 1999; Hills et al. 2001)** and Berlin in Germany **(UNEP 2002)**. Benefits of rainwater harvesting have been found effective by many researchers so should be explored more in other Indian settlements too.

4.2 Water Reuse or Water from Waste Water

Many of the urban settlements in world are facing inadequate water supply and scarcity of water resources in the absence proper water management techniques and policies. To overcome this short water supply, reclaimed has become a prominent reliable alternative water source, which can be sold as new product. Recycling of water is also an important aspect of water resource and environment management policies which help in the reduction of environmental pollution and help in achieving a more sustainable form of development especially in urban areas **(V Lazarova et al, 2001)**.

Water reclamation is the process of make waste water useable and water use is the process of using treated water for beneficial purposes such as landscape irrigation and industrial cooling. Direct water use requires the development of pipe water supply infrastructure or other water conveyance facilities to deliver reclaimed water on indented location while indirect water reuse is discharge of an effluent to receiving water for assimilation and withdraws downstream is important but not a planned direct water reuse. In contrary to direct water use, water recycling is the process where water is used for single use and effluent from the user is captured again and redirected back in the water use scheme. **(Asano, 1998)**

4.3 Conservation of Supplied Water

It is also an important strategy to improve efficiency of water supply system. In large urban settlements, a large fraction of supplies potable water is used for landscape and plant irrigation. Also the water demand increases in dry season when there is need for more irrigation like playground, golf course, parks etc. By reclaiming waste water, the demand of potable water can be reduced because recycled water can be used for landscape and plant irrigation in big urban settlements. Water metering with slab system has been identified as an effective tool for encouraging public for conservation of water.

4.4 Improving Water Distribution System and its use

By reducing water loses in pipe distribution system, low flush, dual flush or vacuum flush toilets water can be conserved in urban areas. With the help of efficient irrigation system like drip irrigation water can also be conserved in urban settlements. Recycled water can be used in industries instead o f potable water.

4.5 Ground Water Recharge

By replenishing underground fresh water aquifer we can improve water supply efficiency. Bio swales creation along transportation corridor for underground recharge is being applied in many countries. Reclaimed water can be directly percolated in natural water aquifer to improve water level. Rainwater harvesting is also technique by with underground is charged and termed as artificial aquifer recharge.

4.6 Public private partnership

There are some examples in India where private water suppliers with contract with municipalities are working well and the revenue collection is about 100% of total investment and expenditure and also they are earning profit. A pilot project for supplying water 24x7 in the three cities of Hubli-Dharwar, Belgaum, and Gulbarga covering a population of 200,000 (about 10 per cent of total population in each city) has successfully transformed the water supply scenario in the five demonstration zones of these cities from about one to two hours every five days to water round the clock (**I .J. Ahluwalia et al, 2011).**

V. Conclusions

Almost all of these are technical factors but we should also consider about socio-economic aspects i.e. willingness to pay, human perception, assessment of monetary and non-monetary benefits, as well as environmental aspects. All these aspects should be studied in harmony with economic, social and environmental sustainability. Saving water using metered connection will lead to less consumption in urban settlements of India. Water reuse will increase water availability and check environmental pollution through sanitation disposal programme too. As urban settlement with due course of time have evolved from villages which were dependent on natural reservoirs, so, we shall also try to replenish and adopt measures for replenishing the reservoirs in Indian cities. A strong need of regulations to recharge ground water is highly required. There is dire need of private investment for improvement in water supply efficiency, provision of new physical infrastructure, revenue collection by adequate water charging that help in capacity building and O & M of water system, reduction in leakages and theft of water, efficient monitoring system.

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