Demand Supply Gap in Urban Water Supply and Sanitary Services- A Case Study of Mangalore City Corporation Area

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Today, some 1.1 billion people in developing countries have inadequate access to water, and 2.6 billion lack basic sanitations. These twin deficits were rooted in institutions and political choices, not in water's availability. Household water requirements represent a tiny fraction of water use, usually less than 5% of the total, but there is tremendous inequality in access to clean water and to sanitation at a household level. In high-income areas of cities in Asia, Latin America and Sub-Saharan Africa people enjoy access to several hundred litres of water a day delivered into their homes at low prices by public utilities. Meanwhile, slum dwellers and poor households in rural areas of the same countries have access to much less than the 20 litres of water a day per person required to meet the most basic human needs. Women and young girls carry a double burden of disadvantage, since they are the ones who sacrifice their time and their education to collect water.

Clean water and sanitation are among the most powerful drivers for human development. They extend opportunity, enhance dignity and help create a virtuous cycle of improving health and rising wealth. People living in rich countries today are only dimly aware of how clean water fostered social progress in their own countries. Just over a hundred years ago London, New York and Paris were centres of infectious disease, with diarrhoea, dysentery and typhoid fever undermining public health. Child death rates were as high then as they are now in much of Sub-Saharan Africa. The rising wealth from industrialization boosted income, but child mortality and life expectancy barely changed.

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Sweeping reforms in water and sanitation changed this picture. Clean water became the vehicle for a leap forward in human progress. Driven by coalitions for social reform, by moral concern and by economic self-interest, governments placed water and sanitation at the centre of a new social contract between states and citizens. Within a generation they put in place the finance, technology and regulations needed to bring water and sanitation for all within reach. The new infrastructure broke the link between dirty water and infectious disease. By one estimate water purification explains almost half the mortality reduction in the United States in the first third of the 20th century. In Great Britain the expansion of sanitation contributed to a 15-year increase in life expectancy in the four decades after 1880.

In rich countries clean water is now available at the twist of a tap. Private and hygienic sanitation is taken for granted. Concern over water shortages may occasionally surface in some countries. But that concern has to be placed in perspective. Children in rich countries do not die for want of a glass of clean water. Young girls are not kept home from school to make long journeys to collect water from streams and rivers. And waterborne infectious disease is a subject for history books, not hospital wards and morgues. The contrast with poor countries is striking. While deprivation is unequally distributed across regions, the facts of the global water crisis speak for themselves. Some 1.1 billion people in the developing world do not have access to a minimal amount of clean water. Coverage rates are lowest in Sub-Saharan Africa, but most people without clean water live in Asia. Deprivation in sanitation is even more widespread. Some 2.6 billion people half the developing world's population does not have access to basic sanitation. And systemic data underreporting means that these figures understate the problem. "Not having access" to water and sanitation is a polite euphemism for a form of deprivation that threatens life, destroys opportunity and undermines human dignity. Being without access to water means that people resort to ditches, rivers and lakes polluted with human or animal excrement or used by animals. It also means not having sufficient water to meet even the most basic human needs. While basic needs vary, the minimum threshold is about 20 litres a day. Most of the 1.1 billion people categorized as lacking access to clean water use about 5 litres a day one tenth of the average daily amount used in rich countries to flush toilets. On average, people in Europe use more than 200 litres in the United States more than 400 litres. When a European person flushes a toilet or an American person showers, he or she is using more water than is available to hundreds of millions of individuals living in urban slums or arid areas of the

developing world. Dripping taps in rich countries lose more water than is available each day to more than 1 billion people.

Not having access to sanitation means that people are forced to defecate in fields, ditches and buckets. The "flying toilets" of Kibera, a slum in Nairobi, Kenya, highlight what it means to be without sanitation. Lacking access to toilets, people defecate into plastic bags that they throw onto the streets. The absence of toilets poses particularly severe public health and security problems for women and young girls. In sanitation as in water, gender inequality structures the human costs of disadvantage. Access to water and sanitation reinforces some long-standing human development lessons. On average, coverage rates in both areas rise with income: increasing wealth tends to bring with it improved access to water and sanitation. But there are very large variations around the average. Some countries such as Bangladesh and Thailand in sanitation, and Sri Lanka and Viet Nam in water do far better than would be expected solely on the basis of income. Others such as India and Mexico for sanitation do far worse. The lesson: income matters, but public policy shapes the conversion of income into human development.

Water supply -The Indian Scenario

In accordance with the principles adopted at the International Conference on Water and the Environment (Dublin, January 1992), it was agreed that "fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment" Water is a resource which is absolutely necessary for the sustained development of a state. Regrettably, the statistics regarding the availability of fresh water in the world are staggering. It is estimated that 1 billion people do not have access to clean water, and 1.7 billion do not have sanitation.

In India, in spite of substantial emphasis on water supply sector, only about 82% of the urban household covering 85% of urban population had access to safe drinking water as of 1991. Against this over all coverage, estimates also indicate that in 1988-89, about 58% of the urban households had access to dinking water facilities within their premises and about 40% within a distance of 0.5km. Even this statistics does not reflect the true conditions as there exists substantial distribution inequity among the states, within the State between the cities and even between the different localities within each settlement. Against the National average target of 135 lpcd of water and 180 lpcd per capita in large cities, the per capita availability is low and ranges from 165 lpcd in a few larger towns to about 50 lpcd in smaller towns. The availability of water in urban slums is about 27 lpcd. In India although irrigation will

continue to be the major consumer of water even in future, its share in the total water use may reduce while the share of domestic, industrial and energy water use will rise due to the urbanization and industrialization. The tentative assessment for future water requirements for various sectors, as assessed by the Standing Sub-committee (Ministry of Water Resources) for assessment of the availability and requirement of water for diverse uses is as under:

Table-1: Projected Demand of Water (Billion cu.m)

Use	1990	2000	2010	2025
Domestic	32	42	56	52
Irrigation	437	541	688	910
Industry	-	8	12	23
Energy	-	2	5	15
Other	33	41	52	72
Total	-	634	813	1093

Source: ACPCB Publication entitled the status of water supply, wastewater collection, treatment and disposal in class I cities: CUPS/30/989-90

Water resources management is a State and concurrent subject under schedule VII of the Indian constitution. There are numerous institutions dealing with water resource management both at central and state level like Ministry of Water Resources, Ministry of Environment and Forests, Central and State Groundwater Boards, Ministry of Agriculture, Ministry of Industry, State Irrigation Department and Central and State Pollution Control Boards. India receives nearly 4000 cubic kilo meters of water annually through the seasonal monsoon rains and rivers that flow down from the snow capped Himalaya and other mountain ranges. Due to a large and increasing population, the amount of utilizable water available per person per year is only 1250 cubic meters and is likely to decrease further.

Water crisis in Mangalore City Area

Dakshina Kannada is endowed with rich water resources. Fourteen rivers criss-cross Dakshina Kannada and Udupi Districts. The rivers are rain fed and the magnitude of flow is related to rainfall. The estimated average annual flow of the district's rivers is 29,561 mcm. Yet every year, both the districts suffer acute water shortage. The coastal cities, Mangalore and Udupi as everyone feared, are today in the grip of acute water scarcity. The water supply situation in these cities, sad to say, are

grim and people are praying for an early onset of monsoon for it is only Rain who can save them from the present crisis.

The tragedy on the part of Dakshina Kannada is that the entire monsoon rainwater received in the high ranges flows down to the sea in less than 48 hours. The solution to arrest this phenomenon in the absence of adequate dense tropical forest cover is to take up watershed programs by constructing check dams in the high ranges and down streams in various points. But sadly, this has not been implemented effectively in the coastal belt and Malnad region of Karnataka.

Some of the factors that can be attributed to the present crisis are degradation of forest, shrinkage of wetlands, enormous draw of water from the rivers for area plantations, indiscriminate draw of water fro industrial purpose, faulty developmental projects and lack of far sight on the part of policy makers. Rapid urban development without appropriate town planning contributed innumerable problems. Multi-storied apartments replaced independent housing culture in the past decade. City's water bodies vanished quickly as the demand for land increased. The grand old demand for land increased. The grand old-bodies like Emmekere, Tavarakere, Gujjerekere and many other lakes are filled to reclaim land for commercial purpose. This has leaded to the ground water depletion, which in turn left, most of the wells dry and dead.

Presently, an ADB aided project of laying parallel pipelines aimed at providing safe drinking water for Mangalore city ands surrounding areas is underway in the city with the project implemented by KUDCEMP. But the tragedy is that the project facilitates everything for a drinking water project, but lacks the very source of water. The KUIDFC, the implementation authority for this project is spending over Rs 100 crores on it. But what is the use when the dam doesn't have enough water to be supplied through these pipelines during summer?

Mangalore city with a population of over six lakh requires 20 million gallons of water per day. The vented dam at Tumbay, which was built, by the Karnataka Water Supply and Sewage Board at a cost of Rs. One crore during the Chief ministership of M. Verrappa Moily, is required to store 2000 million gallons of water that is enough for 100 days. But Mangalore City Corporation officials say the dam can store not more than 600 million gallons of water, which is not enough even for 25 days. According to officials this was due to silt-up and to top it all, the dam is leaking, which is only 14 years old. The corporation has no money to repair the dam nor has money to build another.

Today, when the city is facing an acute shortage of potable water, the issue of construction of a second vented dam at Tumbay has become inevitable. The proposal for a new dam is estimated to be Rs. 40 crore, of which the state Government has offered Rs. 30 crores recently and the balance Rs. 10 crores to be raised by the Mangalore City Corporation. However, the debt-ridden Corporation finds it difficult to raise not even 10 percent of it. Mayor Ashraf made this clear in the MCC meeting recently.

Even the ADB project which has allocated over Rs. 100 crore just for laying parallel pipelines has failed to allocate another Rs. 20 to 30 crores for construction of a vented dam. The NEEDCO report prepared by the Netherlands based consultancy for the ADB aided project, way back in the early 90s had wrongfully estimated that the present dam at Tumbay was capable of storing 9650 milion gallons of water. But the agency failed to foresee the sustainability of the dam due to poor quality of work and silt-up. Moreover, the reports also failed to mention about the construction of a dm near Uppinangady under the same project for supply of drinking water to Puttur. What can be finally construed is that the ADB aided project, which is nothing but a typical government project with much of international flavor.

Another important factor that has to be noted is drawing water for industrial purposes. The Mangalore Refinery and Petrochemicals Limited (MRPL) draws several thousands of gallons of water everyday for industrial purpose and it has even constructed a dam at Sarapady, 18kms upstream of Tumbay, to store water for its use. The height of this 2.5 feet dam was increased by 1.5 feet last year, without due permission of the authorities. Toady, several large industries in the region consume thousands of gallons of water everyday at the cost of the ordinary man. Why is it that these factories, which need water in large quantities of water do not shut down during summer when there is acute water scarcity? The need of the hour is for the government to make it mandatory for large industrial units to shut down during times of water scarcity or find alternative arrangements as the water otherwise used by the large plant could be diverted for domestic purposes.

MRPL, two years back, shut down the plant following water scarcity, after an appeal made by the district administration. This year, it is yet to be seen if the company would follow suit. Another thing is that of drawing of water by farmers for irrigation purpose and this is in the peak during summer. According to MCC officials, an estimated total of 2500 HP IP sets draw water on daily basis form Netravathi River.

And last but not the least; the biggest spoiler is the highly improper, leaky, outdated and corrupt water distribution network in the city. It would even not be wrong to say that there is an absolute lack of water audit in the Mangalore City Corporation. Toady, everyone is gazing at the skies in search of dark clouds hoping and praying for an early shower. The taps are going dry every alternate day and it may be still worse. The authorities, on their part are pretending to be taking the present crisis much more seriously, that too when the situation is out of their control and has turned from bad to worse. Though construction of a second dam at Tumbay seems at the outset to be a good solution to the problem in the coming years, no one is sure if the project would be taken up. It is not known why the state government which spends crores and crores to ensure good water supply to Bangalore, is not thinking of making some arrangement for prominent districts like Dakshina Kannada and Udupi.

People are now slowly realizing that water problem would be a regular feature every summer and it is they who have to do something instead of waiting for the authorities to take some concrete measure. Lack of farsightedness on the part of the policyholders is only taking its toll on the ordinary man. Those at the helm of affairs seem or pretend to be on their toes only when things go out of hand.

Today, it would be much wise on the part of people if they opt for one of the best alternatives-rain water harvesting, as incorporation of this technique would definitely solve their water problem, which, it is feared, may even turn grave, in the years to come in the absence of proper remedial measures. They can also take hint from several families, which have already incorporated the Rain Water Harvesting (RWH) technique effectively. At the same time they should also not forget that presently, millions of liters of precious rainwater are drained into the sea every year in the absence of rainwater harvesting. This is being the case why not harvests each of this raindrop that is going waste and benefit from it?

Keeping in mind the above mentioned drawbacks the study was carried out to explore the demand supply gap of water supply and sanitation provisions in Mangalore city corporation area.

To collect the necessary field level data and information the following sample distribution was framed (see Table-2.)

SAMPLE DISTRIBUTION

Table-2: Sample Distribution

Respondents from Higher Level Reservoir (HLR)	200
Respondents from Lower Level Reservoir (LLR)	200
Respondents from Panambur Line (PL)	200
Hospital Respondents	60
Hotel Respondents	80
Industrial Respondents	60
Total	800

In total about 800 respondents (600 household's viz. 200 from region covering water supply from Higher level Reservoir, 200 from region covering water supply from Lower level Reservoir , 200 from region covering water supply from Panambur line and 80 hotel respondents, 60 industrial respondents and 60 hospital respondents) were surveyed to generate information at the field level. **Table-2, Chart-1**

Chart -1: Sample Distribution

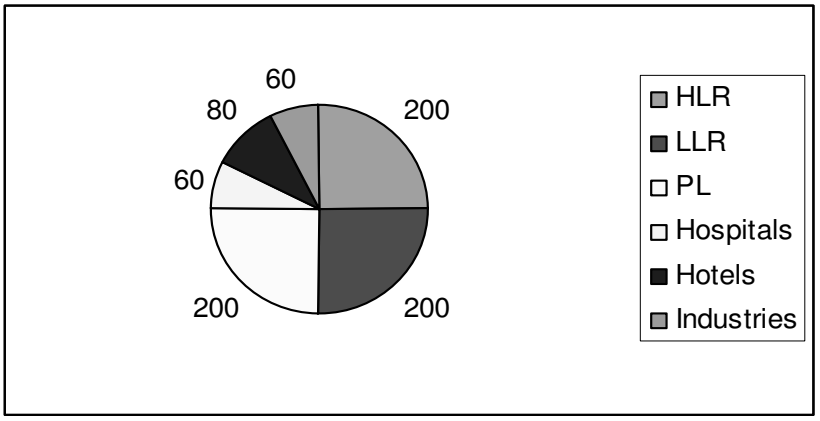

Table-3: Demand and supply of water in the study area 2001-2006

(in ltrs)

Demand and supply of water for consumers getting water supply from HLR					
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 200 household (per day)	56250	60875	62500	66500	67500

Water supplied for 200 household (per day)	57550	62875	65230	68300	68160
Demand supply gap :surplus /deficit	+ 1300 (surplus)	+ 2000 (surplus)	+ 2730 (surplus)	+1800 (surplus)	+ 660 (Surplus)
Actual percapita consumption of water is required	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita
Existing percapita consumption	127.89	129.11	130.46	128.38	126.22
Percapita consumption gap: Surplus/deficit	+2.89 (surplus)	+ 4.11 (surplus)	+ 5.46 (surplus)	+ 3.38 (surplus)	+1.22 (surplus)

Source: Authors calculation

From the above table-3 it is evident that during year 2001-06, sufficient amount of water was supplied by the Mangalore City Corporation to the consumers who were residing in the area which availed water supply from Higher Level Reservoir. Therefore it is clear that consumers were residing in the area which was availed water supply from Higher Level Reservoir, the percapita consumption having the mixed trend of increasing and decreasing but not below the minimum per day percapita consumption level and the total water requirement was having the increasing trend over the years.

Table-4: Demand and supply of water in the study area 2001-06

(in ltrs)

Demand and supply of water for consumers getting water supply from LLR					
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 200 household (per day)	60000	62500	66250	66875	68750
Water supplied for 200 household (per day)	59100	61300	65100	64700	67000
Demand supply gap :surplus /deficit	-900 (deficit)	- 1200 (deficit)	-1150 (deficit)	-2175 (deficit)	-1750 (deficit)
Actual percapita consumption of water is required	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita
Existing percapita consumption	123.13	122.6	122.83	120.93	121.81

Percapita consumption gap: Surplus/deficit	-1.87 (deficit)	-2.4 (deficit)	-2.17 (deficit)	-4.07 (deficit)	-3.19 (deficit)

Source: Authors calculation

From the above table-4 it is evident that during the year 2001-06, sufficient amount of water was not supplied by the Mangalore City Corporation to the consumers who were residing in the area which availed water supply from Lower Level Reservoir. It is also evident that, over the years (2001-2006) in the area of consumers availed water supply from Lower Level Reservoir the demand for water was increased. According to the demand the water was not supplied by the Mangalore City Corporation and there was water deficit over the years. During the period 2001-2002 to 2002-2003 the percapita consumption decreased to 123.13 ltrs to 122.6 ltrs and during the year 2003-2004 it was increased to 122.83 ltrs per day. Thereafter, during the year 2004-2005 it was decreased to 120.93 ltrs. Thereafter during the year 2005-2006 it was increased to 121.81. Therefore it is clear that consumers were residing in the area which was availed water supply from Lower Level Reservoir, the percapita consumption having the mixed trend of increasing and decreasing. But decreasing was below per day minimum percapita consumption level and the total water requirement was having the increasing trend over the years.

Table-5: Demand and supply of water in the study area 2001-06
(in ltrs)

Demand and supply of water for consumers getting water supply from PL					
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 200 household (per day)	61750	62500	65000	65250	67500
Water supplied for 200 household (per day)	60430	60200	63200	67500	66350
Demand supply gap :surplus /deficit	-1320 (deficit)	-2300 (deficit)	-1800 (deficit)	+2250 (surplus)	-1150 (deficit)
Actual percapita consumption of water is required	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita	125-200 ltrs/capita
Existing percapita	122.33	120.4	121.54	129.31	122.87

consumption					
Percapita consumption gap: Surplus/deficit	-2.67 (deficit)	-4.6 (deficit)	-3.46 (deficit)	+4.31 (surplus)	-2.13 (deficit)

Source: Authors calculation

From the above table-5 it is evident that during the year 2001-06, the demand for water was increased in the area of consumers' availed water supply from Panambur Line. According to the demand the water was not supplied throughout the years by the Mangalore City Corporation and there was water deficit over the years except during the year 2004-2005. During the period 2001-2002 to 2002-2003 the percapita consumption decreased to 122.33 ltrs to 120.4 ltrs and in the year 2003-2004 it was increased to 121.54ltrs per day. Thereafter, during the year 2004-2005 it was further increased to 129.31ltrs. Thereafter during the year 2005-2006 it was decreased to 122.87.

Therefore it is clear that consumers were residing in the area which was availed water supply from Panambur Line, the percapita consumption having the mixed trend of increasing and decreasing but below the per day minimum percapita consumption level except during the year 2004-05 (129.31ltrs) and the total water requirement was having the increasing trend over the years.

HOTELS

Table-6: Demand and supply of water in the study area 2001-02

(in ltrs)

Demand and supply of water for Hotels					
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 80 Hoteld (per day)	936630	979683	991172	1002630	1013000
Water supplied for 80 Hotels (per day)	913260	923460	932300	975300	976130
Demand supply gap :surplus /deficit	-23370 (deficit)	-56223 (deficit)	-58872 (deficit)	-27330 (deficit)	-36870 (deficit)

Actual percapita consumption of water is required	70 ltrs/capita	70 ltrs/capita	70 ltrs/capita	70 ltrs/capita	70 ltrs/capita
Existing percapita consumption	22.83	23.09	23.30	24.38	24.40
Percapita consumption gap: Surplus/deficit	-47.17 (deficit)	-46.91 (deficit)	-46.7 (deficit)	-45.62 (deficit)	-45.6 (deficit)

Source: Authors calculation

From the above table-6 it is evident that the percapita consumption having the increasing trend but always below the minimum per day percapita consumption level (70ltrs/capita) and the total water requirement was having the increasing trend over the years. The percapita consumption gap was filled by the effort of making alternative arrangements to cope with the water requirements of the Hotels by purchasing water from private agencies.

HOSPITALS

Table-7: Demand and supply of water in the study area 2001-02

(In ltrs)

Demand and supply of water for Hospitals (total 60 = 30 above 100 beds+30 below 100 beds)					
Above 100 beds	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 30 Hospitals (above 100 beds) (per day)	9814500	10236000	11130000	12260000	12330000
Water supplied for 30 Hospitals (above 100 beds)	9636000	9167000	10220000	12000000	12300000
Demand supply gap :surplus /deficit	-178500 (deficit)	-1069000 (deficit)	-910000 (deficit)	-260000 (deficit)	-30000 (deficit)
Actual percapita consumption of water is required	455 ltrs/capita	455 ltrs/capita	455 ltrs/capita	455 ltrs/capita	455 ltrs/capita
Existing percapita consumption	321.2	305.57	340.67	400	410
Percapita	-133.8	-149.43	-114.33	-55 (deficit)	-45

consumption gap: Surplus/deficit	(deficit)	(deficit)	(deficit)		(deficit)
Below 100 beds					
Actual water supply required for 30 Hospitals (below 100 beds) (per day)	463000	592000	613200	712300	722000
Water supplied for 30 Hospitals (below 100 beds)	422000	567000	602000	692000	701230
Demand supply gap :surplus /deficit	-41000	-25000	-11200 (deficit)	-20300 (deficit)	-20770 (deficit)
Actual percapita consumption of water is required	340 ltrs/capita	340 ltrs/capita	340 ltrs/capita	340 ltrs/capita	340 ltrs/capita
Prevailed percapita consumption	187.56	252	267.56	307.56	311.66
Percapita consumption gap: Surplus/deficit	-152.44 (deficit)	-88 (deficit)	-72.44(deficit)	-32.44(deficit)	-28.34 (deficit)

Source: Authors calculation

From the above table-7 it is evident that over the years (2001-2006) the water requirement for Hospitals was increased. According to the demand the water was not supplied throughout the years by the Mangalore City Corporation and there was water deficit over the years.

Therefore it is clear that the percapita consumption in case of Hospitals with above 100 beds, there was mixed trend of increasing and decreasing trend but always below the minimum per day percapita consumption level (455 ltrs/capita) and the total water requirement was having the increasing trend over the years. The percapita consumption gap was filled by the effort of making alternative arrangements to cope with the water requirements of the Hospitals by purchasing water from private agencies and making their own private arrangements like private tube wells, open wells etc. It is also clear that the percapita consumption in case of Hospitals with below 100 beds there was increasing trend but always below the minimum per day percapita consumption level (340 ltrs/capita) and the total water requirement was having the increasing trend over the years. The percapita consumption gap was filled

by the effort of making alternative arrangements to cope with the water requirements of the Hospitals by purchasing water from private agencies and making their own private arrangements like private tube wells, open wells etc.

INDUSTRIES

Table-8: Demand and supply of water in the study area 2001-2006 (in ltrs)

Demand and supply of water for Industries					
	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
Actual water supply required for 60 Industries (per day)	18900000	20250000	21600000	24300000	27000000
Water supplied for 60 Industries (per day)	4060000	6020100	8030000	10020000	16032000
Demand supply gap :surplus /deficit	-14840000 (deficit)	-14229900 (deficit)	-13570000 (deficit)	-14280000 (deficit)	-10968000 (deficit)
Actual percapita consumption of water is required	45 ltrs/capita	45 ltrs/capita	45 ltrs/capita	45 ltrs/capita	45 ltrs/capita
Prevailed percapita consumption	9.67	13.38	16.73	18.56	26.72
Percapita consumption gap: Surplus/deficit	-35.33 (deficit)	-31.62 (deficit)	-28.27 (deficit)	-26.44 (deficit)	-18.28 (deficit)

Source: Authors calculation

From the above table-8 it is evident that, over the years (2001-2006) the water requirement for Industries was increased. According to the demand the water was not supplied throughout the years by the Mangalore City Corporation and there was water deficit over the years. It is also clear that the percapita consumption was having the increasing trend but always remained below the minimum per day percapita consumption level (45 ltrs/capita) and the total water requirement was having the increasing trend over the years. The percapita consumption gap was very high in case Industries which was filled by the effort of making alternative arrangements to cope with the ever growing water requirements of the Industries by purchasing water from

private agencies and making their own private arrangements like private tube wells, open wells etc. Mangalore City Corporation was only able to meet the sum portion of water requirement of the Industries but not the entire water requirements. When we look into the trend of water supplied by the Mangalore Municipality Corporation then we can find a huge demand supply gap in the water supply.

SANITATION

Table-9: Types of drainage facility available (%)

Respondent consumers opinion	Number of Household respondents / %			Number of respondents/ %	Number of respondents/ %	Number of respondents/ %
	HLR	LLR	PL	Hotels	Industries	Hospitals
Closed drainage	78 (39.00)	46 (23.00)	52 (26.00)	65 (81.25)	3 (0.5)	55 (91.67)
Open drainage	122 (61.00)	108 (54.00)	148 (74.00)	8 (10.00)	12 (20.00)	3 (5.00)
No drainage	--	46 (23.00)	--	7 (8.75)	45 (75.00)	2 (3.33)
Total	200	200	200	80	60	60

Source: Authors calculation

From the table -9 it is observed that 23% of the consumers residing in the area of water supply from Lower Level Reservoir were not having any type of drainage facilities, and 54% of consumers were having only open drainage facility, very less percentage of consumers (23%) were having closed drainage connections compared to other two regions. Very highest percentages (39%) of consumers residing in the area of water supply from Higher Level Reservoir were having closed drainage connections compared to other two regions. The access to open drainage was highest (74%) in case of consumers residing in the area of water supply from Panambur line.

In case of non-domestic, commercial and Industrial consumers hospitals were having highest percentage of closed drainage connections compared to industries, the next highest was hotels. In case of industries the no drainage and open drainage case was very highest. (No drainage= 75%, open drainage= 20%). Because of this industries were discharging their waste water directly to rivers which ultimately leads to river water contamination. Open drainage system leads to several hazards like air pollution, spread of diseases, well water contamination etc.

Table-10: Types of toilet facility used (%)

Respondent consumers opinion	Number of Households respondents / %			Number of respondents/ %	Number of respondents/ %	Number of respondents/ %
	HLR	LLR	PL	Hotels	Industries	Hospitals
Individual sewered toilets	158 (79.00)	124 (62.00)	116 (58.00)	--	8 (13.33)	--
Shared toilets	36 (18.00)	70 (35.00)	84 (42.00)	80 (100.0)	52 (86.67)	60 (100.0)
Public toilets	6 (3.00)	--	--	--	--	--
Total respondents/percentage	200 (100)	194 (97.00)	200 (100)	80 (100)	60 (100)	60 (100)

Source: Authors calculation

In the table- 10 it is evident that highest percentage of consumers having individual sewerage toilets was from consumers residing in the area of water supply from Higher Level Reservoir (79%), the next was from Lower Level Reservoir and the last one was from Panambur Line. The highest percentages (84%) of consumers residing in the area of water supply from Panambur Line were using shared toilets. And 3% of the respondents both from water supply from Lower Level Reservoir and Panambur Line were not having any type of toilets.

In case of non-domestic and commercial and industrial consumers all hospitals and hotels were having shared toilets, most of the industries having

shared toilets (86.67%) and only 8% of Industrial respondents were having individual sewerage toilets.

Table-11: Access of drainage facility to different types of consumers (%)

Respondent consumers opinion	Number of Household respondents / %			Number of respondents/ %	Number of respondents/ %	Number of respondents/ %
	HLR	LLR	PL	Hotels	Industries	Hospitals
Yes	200 (100.0)	154 (77.00)	42 (21.00)	78 (97.5)	15 (25.00)	58 (96.67)
No	--	46 (23.00)	158 (79.00)	2 (2.5)	45 (75.00)	2 (3.33)
Total	200	200	200	80	60	60

Source: Authors calculation

From the table -11 it is observed that all respondents residing in the area of water supply from Higher Level Reservoir were having access to drainage facilities. In case of respondents residing in the area of getting water supply from Lower Level Reservoir highest percentage of respondents (77%) were having drainage accesses compared to consumers residing in the area of getting water supply from Panambur line i.e. 21%.

In case non-domestic, commercial and industrial respondents highest percentage (97.5%) of hotel respondents were having drainage access. The next highest percentage was from hospitals (96.67) compare to industries which were having very less number of drainage connections (25%).

Policy suggestions

- The rain water harvesting is indispensable for Mangalore City Corporation. Micro level and macro level rain water harvesting schemes are very essential activities to be undertaken by City Corporation and encourage the households in this regard.
- There would be a need for improving the pipeline system of water supply

- There would be a thorough check on the leakages of distribution lines. The leakage should be corrected immediately. If necessary more staff may be employed for watching and reducing the wastage of water in Mangalore City Corporation area.
- Up-gradation of distribution and treatment technologies should be taken up for efficient running of water supply schemes.
- There would be a urgent need to repair the Thumbe Vented Dam to stop water leakages. Water is already scarce and it is likely to become more and scarce in coming future. Rational use of water is essential for Mangalore City Corporation area.

- There would be a need to supply water equally to all regions.
- There would be a need for extending house connection system of water supply in Mangalore City Corporation area. The house connection procedure is very lengthily, time consuming and expensive in Mangalore City Corporation area.
- There would be a need for increasing the duration of water supply (1 to 2 hours) because the size of water supply tape is small and there is problem of low pressure and irregular supply.
- The community bore well concept has to be introduced in most of the Mangalore City Corporation area (with regulation of ground water use).

- There would be a need for installing indication boards which indicates the existence of underground water supply pipe line; so that it will guide the telephone cable laying workers when they dig the land for cable connections.

- There would be a need for restructuring institutions which participate in the provision of the services

- There would be a need to design the cost recovery approach and the efficient criterion for pricing of the urban basic services. (Realistic pricing for poor)

- In order to sustain urban water supply and sanitation, and to overcome the problem of water stress, efficient integrated public – private participatory strategy need to be revised.

- The water rates have to be increased to meet the capital cost of water supply schemes in Mangalore City Corporation. Further it was came to know from the

opinions of household consumers during the field survey that high income families are willing to pay more amount if additional quantity of water is supplied to them.

- The health care awareness program regarding water supply would be undertaken by the Mangalore City Corporation. Because going to the depth of the water supply pipe drilling holes and getting unauthorized connection was very common in the city. The rain water often gets mixed up with water supplied by the corporation. Water theft and unauthorized water use would be regulated immediately, regulating misuse of public taps would be very essential.
- Public awareness campaigns be started to conserve water i.e. make economic use of water.
- Keeping in mind the outcomes of the research study it was observed that it would be better to go for privatization (privatization of service) as long as it can be shown that the existing services can be made more efficient and that the costs can be reduced purely by increasing efficiency and reducing corruption
- It is one of the important policy guideline that, if reforms are not possible or not desirable for some reason, or if reforms cannot play a role in reducing the inefficiency of the public water distribution system or corruption in the system absolutely, then only one would go in for privatization of water. But this would be under a strict contractual arrangement operating on the basis that water as a public utility must be available to all, with no exclusions. Differentiated prices for water thus supplied can be permitted, negotiated and then decided.

A Practical Approach to Tackle the Problem: General Guidelines

The following general guidelines would be designed to a broad perspective to water supply and sanitation projects:

- To consult with and encourage community participation, especially women, to formulate objectives, and identify key health and hygiene issues, related to water supply and sanitation.
- To formulate clear objectives based on people's priorities and demands.
- To phase the project according to the needs, addressing immediate needs first and gradually attaining minimum standards with respect to water supply and sanitation.

- To coordinate and monitor projects, so that priorities are met and gaps are avoided and necessary adjustments are done.
- To involve community representatives and a gender-balanced cross-section of the community in all aspects of decision-making, design, layout, implementation, and operation and maintenance of projects.
- To adequately consider local conditions, local customs and practices, locally available materials and resources, while planning and in implementing projects.
- To be sensitive to the needs of the different social groups, ethnic groups, castes, and creeds, at the household level and the community level.
- To plan for immediate betterment of living conditions, with a long-term incremental perspective.
- To plan for provide equitable and efficient water distribution for all regions in the study area.

Essential steps needed for tackling water crisis

The main constrains that were faced in the water sector were inadequate trained personnel, inability to mobilize internal and external resources, inadequate project preparation, uncoordinated development approach, institutional weakness, technological shortcomings, poor quality of water resources itself, water losses through leakage intermittent services, haphazard garbage collection and disposal systems, inadequate drainage of surface run off, non involvement of community in project planning development, operation and maintenance activities, etc., The following suggestions for solving the water crisis would be considered as below:

- A large share of water to meet new demands must come by saving water from existing uses through comprehensive reform of water policy
- New strategies for water development and management are urgently needed to avert severe national, regional and local water scarcities that will depress agricultural production, damage the environment and escalate water related health problems.
- Major institutional policy and technological initiatives are required to ensure efficient, socially equitable and environmentally suitable management of water resources.

- In facing the enormous challenge of meeting the requirements of water supply for domestic, irrigation and industrial uses, it is natural to expect that the Rural Development and Urban Development authorities play an important role.
- Water management programs would be implemented in a systematic way with integrated coordination of all relevant government departments at State and Central level. There would be a need for revision of water legislation/ground water control regulation acts to maintain water table at a reasonable depth for sustainability.
- Clear-cut water rights system is indispensable for the sustainability of water use.
- Integrated watershed development actions have to be taken to use rainwater, soil water groundwater and run off water to increase production in rain fed areas.
- A database would be created among all water boards and corporations for effective transfer of best practices.
- The beneficiaries' role would be modified from passive recipients to active participants in water conservation activities. As women know better all the matters related to water, participation even from the selection of the site for water projects to the maintenance is important.
- Immediate steps would be taken for drastic reduction of wastage of water in all sectors and protection of water sources from industrial pollution.
- A strong political will of government to frame appropriate water policy and equally important indomitable conscience of water users to utilize water judiciously are absolutely necessary for sustainable utilization of water.
- There would be a need to implement a regulation to adopt rainwater-harvesting techniques in the stage of construction of houses and buildings.
- There would be a need to stop using sanitary devices which consuming high amount of water.
- Recycling of sewerage water for gardening purposes and for construction purposes is highly useful in conserving the water.
- There would be a need to give awareness about the cost of treatment and supply of water to the public through mass media communication system.
- There would be a need to adopt technical tools for ensuring good service provision, which include;

a) Systems of water pricing related to volume and timing, for all applications;

b) Periodic audits of the activities of the private and public sector regarding water resources management;
c) Transparent use of economic instruments;
d) Management systems which secure best practice use and reuse of water resources while minimizing off-site, groundwater, and downstream impacts on freshwater ecosystem services;
e) Technical innovations can include increased efficiency in storage, conveyance and distribution of water and techniques for waste minimization;
f) Effective regulation and clear government policies.

● There would be a need to provide training to build capacity in water professionals bacuase training of water professionals is an important tool for capacity building and is necessary across the full range of water organizations. The necessary change in approach can be achieved through specially designed courses, through modification of university courses and through on the job training programs. Specific ideas include:

a) Providing specific courses on participatory approaches and gender awareness;
b) Encouraging multi-disciplinary training involving all kinds of water practitioners, including environmentalists, economists, engineers, social scientists and business majors ;
c) Including water management in degree programs, in engineering and other faculties, such as economics, environmental sciences, biology, etc, or adding water as a major in such degree courses as the MBA ;
d) Developing modules for on-the-job training to keep practitioners' skills up-to-date;
e) Developing training of trainers modules in new approaches and techniques ;
f) Creation of short courses on water management for policy-makers, aimed specifically at senior managers without technical water backgrounds;
g) Once formal training is completed, the concepts can be reinforced through a range of training activities (e.g. on-the-job training, short courses, remote learning, sabbaticals, twinning arrangements, international short courses, etc,). The training of trainers is a specialist area, requiring an understanding of adult learning methods and the significance of the peer group (farming community, professional water community) in creating learning opportunities. Equally, training trainers in information exchange and communication requires significant input into education programs by water resources management agencies. Methods include in-service

courses, seminars and workshops. There is an increasing emphasis on electronic means of information dispersal and training techniques especially distance learning;

h) Many information exchange facilitators (such as extension officers, field guides and field agents) come from biophysical science and engineering backgrounds, and need a cross-disciplinary training in various skills in communication, group interaction facilitation, accounting and program management and counseling. Knowledge exchange systems like the GWP Toolbox provide valuable support for capacity building.

- There would be a need to utilize the benefits of Civil Society Institutions (CSIs), Non-governmental Organizations (NGOs) and Community-Based Organizations (CBOs) which can play an important role in developing and communicating integrated water resource management policies. The benefits of such organizations are as follows:

a) Advocate on behalf of nature and environmental protection;
b) Develop and test new models and tools in water management;
c) Increase awareness of the need for sustainable water management;
d) Mobilize local communities to get involved

- There would be a need to implement the integrated water management policies. The benefits of integrated water management policies are;

a) Collaboration between service providers and CBOs can strengthen community ownership' and build water management capacity at local level;
b) Similarly, working linkages between CBOs and local government provide a strong structure, allowing local water management issues to be scaled up and it strengthening local regulatory capacity.
c) It is important to think through which level is most workable and will create a portfolio of activities that justifies the existence of a permanent local organization. Micro-planning and resource mapping are useful instruments at CBO level.
d) Civil society organizations representing either professional categories or interest groups are most effective in societies where there is a commitment to participation and consultation.

Conclusion

Water is most essential for sustaining life in all its manifestations. With the rapid growth of urban population, the demand of potable water for domestic and other uses has increased manifold and generally speaking, shortage of water is becoming more acute in almost all cities and towns, specially the metropolitan cities in India and particularly in the study area. Large quantities of water are also required for industries and community activities, which are expanding at a fast pace and for parks, gardens and trees, which are integral part of urban development for a healthy living and for the greening of environment.

As water is a scarce natural commodity, an integrated view has to be taken to meet the total requirements both for urban and rural needs. Keeping in mind the issues associated with urban water and sanitary services the research problem for the study, i.e "Urban Water Supply and Sanitary Services in Mangalore City Area: An Economic Analysis of Investment, Pricing and Equity Patterns" was an effort made in order to trace the problems of different types of stakeholders in the study area and to give some policy suggestions to overcome such problems. Although sincere hard work had been made during the research an ultimate perfection is not argued due to the limitations of the study, which are mentioned earlier.

Finally, the needs to be emphasized that water supply and sanitation in urban areas would be considered as two sides of a coin and also inter-dependent. Maintenance and upgardation of sanitary system of clean drainage and sanitary latrines not only need day-to day attention from municipalities but also full cooperation of users who should be made aware of their responsibilities like participation in keeping cities clean with satisfactory sanitation all round for safe health. Once water supply arrangement is conceived and provided for, it is incumbent to devise and arrange for collection and disposal of waste water so as not to result in insanitary condition. Moreover, for conservation of water and overall economic considerations, re-use and recycling of waste water need to be organized. Often expansion of urban piped water supply is hindered on account of scarcity of finances which the local authorities and municipal bodies are unable to mobilize. It results in a large gap between demand and supply of water and causes acute scarcity of potable water in cities, on the whole, particularly in outer areas of cities inhabited by squatter and newly developed housing colonies and urban areas like Mangalore City Corporation area. Moreover, acute shortage of water may also occur in some parts of the city due to low pressure in the distribution system. These cause lot of hardships to urban dwellers. It is necessary for the urban people to activate movement and consciousness of ecology and environment of the surrounding areas with the involvement of government, Industrial and commercial establishments

and NGOs. Only environmentally sound techniques for water supply and sanitation that are affordable to people should be considered appropriate which need to be evolved and adopted.

Select Readings

1) Addoor Krishna Rao (2006), "For a Gulp of water -water scarcity grips Mangalore", Mangalore Today (April)
2) Arabi.U (2004a), "Pricing Urban Water and Sanitary Provisions in Developing counries" Nagarlok, Vol. 36, July-Sep, No.3
3) Arabi.U (2004b), "Urban Water and Sanitary Provisions; Pricing issues in India" in Urban Infrastructure and Quality of Life, (edited) by Dr.K.V.M. Varambally, Mr Sandeep.S. Shenoy and Shuhan Allied Publishers, Private Limited, Chennai.
4) Bahl R.W, Linn J.F, (1998), "Urban Public Finance in Developing Countries", New York, Oxford University, Press.
5) Bijalani H.V. (1998), "Safe water and Sanitation-The Future Outlook and Action", Nagarlok-Vol-31, (pp-68-82)
6) Bijalani H.V. and. Rao P.S.N (1989), "Role of Public Agencies in Planning, Funding and Development of Physical Infrastructure with Reference to Water Supply and Sanitation" Nagarlok vol-22
7) Chetan Vaidya (1995), "Urban Poor's Willingness to Pay for Water and Sanitation Services-A Case Study", Nagarlok, vol-27, (pp-60-71)
8) Chatterjee P.K. and Dutta A.K. (1982), "Water Pricing: With Reference to Calcutta Metropolitan District", Nagarlok, Vol-14, No-1.
9) Chambouleyron, A.: (2003), "Optimal water metering and pricing", Economics Working Paper Archive at WUSTL 0301013.
10) Debabrata Datta and Suparna Basu (1999) "Urban Water Supply: Some Reflections on the Issues of Pricing", Nagarlok vol-31 (pp-12-24)
11) Frank Gradilone, III and Mark R. Rothenberg (1993), "Seasonal Rates-The Pros and Cons: A Case Study," paper presented at the American Society of Civil Engineers Conference on Water Resources: Planning and Management, Seattle, Washington.
12) Gupta M.C. and Girish K. Misra (1997), "Appropriate Technology for Urban Water Supply and Sanitation", Nagarlok, vol- 29
13) George A. Raftelis, (1989), "Water and Wastewater Finance and Pricing", Chelsea, Michigan, Lewis Publishers, pp-3-7
14) H. A Mengers (1990), "Aspects of Privatization of Basic Urban Infrastructure Developing Countries", Nagar Lok, No. 5 (PP. 76-87).

15) Joyashree Roy , Subharup Chattopadyay, Sabyasachi Mukherjee, Manikarnika Kanjilal, Srujata Samajpat, Sanghamitra Roy, (2004), "An Economic Analysis of Demand for Water Quality; A case of Kolkata", Economic and Political Weekly, Jan (pp-186-192)
16) J. Brad Schwartzand Ronald W. Johnson (1992), "Maximizing the Economic Impact of Urban Water Supply and Sanittaion Investments", prepared for the Office of Health, Bureau for Research and delopment, U.S. Agency for International Development, under WASH Task No. 154
17) Jerome W. Milliam, (1963), "Policy Horizons for future Urban Water Supply", Land Economics, Vol. 39, May 1963, pp-109-132
18) John Anderson (2000), "Recycling to meet the World's Water Needs", Productivity, Vol- 41, No-3, Oct-Dec, 2000, pp-369-376)
19) Janice A. Beecher and Patric.C.Mann,(1990), "Deregulation and Regulatory Alternatives for Water Utilities, Columbus, Ohilo, The National Regulatory Research Institute, pp.1-19
20) Mulkh Raj (1998b), "Financing of Urban Infrastructure in India", Nagarlok, vol-25, No-1, Jan-sep (pp-38-57)
21) Mathur, M.P (1994), "Financing Urban Services: Strategic Options", Nagarlok, Vol-26, No-4, (pp-35-40)
22) Mariel Loente, Marie Helene Zerah (2003), "The Urban Water Sector: Formal Versus Informal Suppliers in India", Urban India, Vol. 22, No.1,
23) Nand Dhameja and Rakesh Gupta, (2000), "Urban Infratsructure Financing Innovative Tools", Nagarlok, Vol-32, Jul-Sept, 2000, No-3, (pp-12-20)
24) Odeyar D. Heggade (1997), "Finance of Urban Government in Karnataka: A Case Study of Mangalore City', Nagarlok, Vol-29, (pp-37-50)
25) Patric C. Mann and Paul R. Le Francois, (1983), " Trends in the Real Price of Water", American Water Works Association Journal, Vol-75, Sept. , pp-441-443

Reports

1) Expert Group on the Commercialization of Infrastructure Project (1996)-The India Infrastructure Report - Policy Imperatives for Growth and Welfare
2) Government of India (1995-2000) Tenth Finance Commission Report, Para 15.2, ibid, Paras-3.23;3.27
3) Human Development Report, (2000), United Nations Development Program (UNDP), New York, Oxford University Press.
4) Ministry of Urban Development, Government of India, Annual Report (1989-90), New Delhi
5) NIUA, (1998), "India's Urban Sector Profile" (Research Study Series No-6), Jan-(pp-290)
6) Report of the National Commission on Urbanization, New Delhi, Government of India (1988)

World Bank, "World Development Report" (1994), New York, Oxford University Press