

# Challenges in the Water Sector and Wastewater Sector

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## 1. Introduction

Water is an essential element for the survival of mankind and 30% of world's population has no proper access to drinking water. According to the data given by Department of Censes & Statistics [Ref. 3] 40% of Sri Lankan population has organized water supply facilities and 59.4% is depending on other sources such as wells, tube wells, streams and rivers etc., including 10% on unprotected sources. Sri Lankan Government targets to provide safe drinking water supply for all by 2025 with 60% piped born water supply coverage by 2020 through, the national authority to provide drinking water, National Water Supply & Drainage Board (NWS&DB).

Several constrains have been identified in expanding the coverage of the water supply such as insufficient funding of capital; high purification and operation cost; deficiency in cost recovery; lack of awareness on real cost of water among stakeholders [Ref. 2]; lack of organized institutional mechanism to share water recourses among users; and indiscriminate pollution of water bodies. Therefore, it is essential to consider the Waste Management System as well. Organized wastewater and disposal systems are available in major cities with a 2.5% coverage which is target to increase up to 7% by 2020.

This paper describes the present status of the water and waste water sector in Sri Lanka and the major challenges which are to be faced by the water and waste water sector professionals and other professionals in the public sector. Special attention was given to assess the real cost of water and waste water service facilities.

## 2. The Water Sector

Major constraints on the expansion of water sector coverage are [Ref. 2],

- a) Lack of capital due to poor cost recovery where only 1/3<sup>rd</sup> of the total cost of water is recovered from the consumers.
- b) High (per capita) investment required for water resource development and due to distribution systems sometimes being laid in low density areas.
- c) All potential low cost water resources are already used and new water resource development requires huge investment.
- d) Water sharing issues.
- e) Pollution of water bodies indiscriminately.

Therefore, innovative methodologies are required to identify the cost of providing water supply facilities and to implement a cost recovery system in order to meet the challenges in the water sector. Cost of water consists of following;

- Capital investment required to establish water supply facilities
- Operation and maintenance cost of the water supply facilities
- Replacement cost and rehabilitation cost
- Environmental cost (cost of treatment of wastewater)
- Opportunity cost (cost of raw water)

In order to assess the real cost of water; all these elements are to be considered. At the moment, we carryout studies, but the current research is limited only to items like capital cost, O&M cost and rehabilitation cost; whereas it is essential to identify the environmental costs and opportunity costs as well.

Presently, NWS&DB produces 590 million m<sup>3</sup> of water annually and distributes to various parts of the country. Eventually a majority of drinking quality water supplied; is being used (and polluted) and discharged to the rivers and streams, thereby polluting water in existing water resources. The loss of opportunity for use of traditional water sources; due to said pollution; also needs to be considered. Therefore, waste water management systems are also required.

## **2.1 The Investments Required Achieving the 60% Water Supply Coverage in Sri Lanka**

As it is difficult to provide pipe borne water supply coverage to the entire Island, the government should at least make an attempt to supply water facilities up to 60% of the population within a reasonable period compared with other expansions (Road, Power, Telecom etc.) and maintain continuous economic growth and provide safe drinking access to a majority of the population. The investment requirement estimated is given below.

The present population (December 2012)	= 20 .26 Mn
Present coverage-Organised water supply facility	= 40%
Served population	= 8.104 Mn
The population in 2020	= 21.81 Mn
Coverage target in year 2020	= 60%
Total population to be served in 2020 (including the present served population)	= 13.08 Mn
The served population to be increased	= 13.08 – 8.104 = 4.98 Mn
Additional Water demand in 2020 (average day m <sup>3</sup> ) (See Table 2.1)	= 0.822 mcm

**Table 2.1: Water Demand Projection for Year 2020; Target Average = 60%**

Average monthly consumption for domestic sector (Kandy average consumption was used to represent the un-served area)	= 12.65 m <sup>3</sup> /month
Average family size	= 3.9 Nos
Per capita consumption	= $\frac{12.65}{30 \times 3.9} = 108 \text{ l/h/d}$
Allow for non-domestic demand	= 15%
Per capita consumption for all sectors	= 108 x 1.15 = 124.2 l/h/d
Allow for NRW	= 25%
Design per capita consumption	= $\frac{124.2}{0.75} \text{ l/h/d}$
Population to be served	= 165.6 l/h/d
Additional water demand in 2020	= 4.98 million
	= 4.98 x 0.165 mcm
	= 0.822 mcm

The total investment estimated for the coverage expansion is summarized below.

Investment per m <sup>3</sup> (medium cost schemes)	=	275,000 Rs.
Investment per m <sup>3</sup> (high cost schemes)	=	375,000 Rs.

<b>Investment required to provide water facilities to meet 60% coverage</b>		
Total supply requirement for peak day	=	0.822 mcm/day x 1.20
(peak day demand = 1.2 x average day demand	=	0.9864 mcm/day
	=	(say) 1.0 mcm/day
Assume 25% of supply could be provided from low investment water supply systems and balance is covered from high investments schemes		
Low investment		275,000 Rs/m <sup>3</sup>
High investment		375,000 Rs/m <sup>3</sup>
Total investment required	=	$1,000,000 \times \left[ (275 \times 0.25) + (375 \times 0.75) \right] \times 10^3$
	=	Rs. 350 Billion

Investment required to provide water supply facilities to meet the 60% coverage in 2020 is estimated as Rs. 350 Billion.

## **2.2 Constraints in Securing the Capital Investment Required to Achieve 60% Coverage Target in Year 2020**

There are numerous difficulties on obtaining the capital required and suitable institutional infrastructure to implement the said investment plan. Major critical factors are:

- i. Bilateral donors have gradually withdrawn due to cost recovery issues.
- ii. Commercial credit facilities are available; but their ultimate motives are not attractive to the water sector. They charge higher interest rates and promote their own products.
- iii. Government contribution for capital investment is very limited.
- iv. Lack of demand management strategies in order to contain the capital investment in water sector.
- v. Lack of water sharing mechanisms lead to higher investment for water resource development.

## **2.3 Demand Management Strategies to Reduce Capital Investment (For Water Supply Facilities)**

Capital investment to produce one cubic meter of water is around Rs. 300,000 to 400,000. In order to recover the capital cost and O&M cost, it is required to sell a cubic meter of water at the rate [Ref. 1] of Rs. 125 to Rs. 150. Therefore, it is essential to introduce demand management measures such as;

- i. Reducing water leakages; one of the main losses. It is mainly due to poor quality of water fittings, and substandard plumbing systems. Regulatory measures are required in order to procure quality water fittings and installation services.
- ii. Rain Water Harvesting is to be promoted as an alternative source of supply, and a special subsidy may be provided to identify areas where the population densities are very low, and distribution investments are very high.
- iii. Water saving equipment is to be available for the consumers at subsidised rates; and such technologies should be popularised.
- iv. Water conservation measures are to be introduced to the school curriculum in order to promote a water saving culture in our country.

## 2.4 Recovery of Capital Investments

The studies reveal that shows that investment of Rs. 250,000 to 490,000 m<sup>3</sup>/day (installed capacity) is required to provide an organized water supply facility. The selling rates per m<sup>3</sup> to recover the total capital investment within 30 years were estimated with various interest rates is presented in Table 2.2.

Assumed Capital investment is Rs. 250,000 m<sup>3</sup>/day for installed capacity and NRW component is 25%. Table 2.2 shows that at least to recover the capital investment; it is required to sell water at Rs. 80 to 115 /m<sup>3</sup>. At present, the consumer pays Rs.18, 000 to 23,000 to get the house connections (within 10 m from the distribution main).

**Table 2.2: Capital Recovery Component of Water Sector Investment [Ref. 2]  
Depending on Loan Interest Rate and Recovery Period (Rs/m<sup>3</sup>)**

Number of recovery years	Interest Rate				
	6%	8%	10%	12%	15%
20	79.62	93.02	107.27	122.26	145.90
25	71.44	85.55	100.61	116.44	141.28
30	66.35	81.12	96.88	113.37	139.09
40	60.70	76.58	93.39	110.78	137.50

Average cost of complete house connection is Rs. 18,500 (House Water Connection Pilot Programme, 2013). Capital investment per family to provide water supply infrastructure is Rs. 175,000 to 340,000 (0.7 m<sup>3</sup>/d/family). Therefore capital cost recovery from this (house connection) payment is only around 2% of the total investment per family.

## 2.5 Status Current Cost Recovery System in NWS&DB

**Table 2.3: Summary of (O&M) Cost NWS&DB 2012/2013**

Operating Expenses	2012 Actual	2013 Budget Estimated
Operation & Maintenance Cost (MRs)	12,046	14,602
Total Quantity Sold (Million m <sup>3</sup> )	359	374
<b>Selling Rate to Recover (O&amp;M) Cost (Rs/m<sup>3</sup>)</b>	<b>33.5</b>	<b>39.06</b>

Billing records of the NWSDB's Commercial section were analyzed in the paper on Investment Cost and Cost recovery - Water Sector Sri Lanka [Ref. 2] and summarized in Table 2.4 and Figure 2.1.

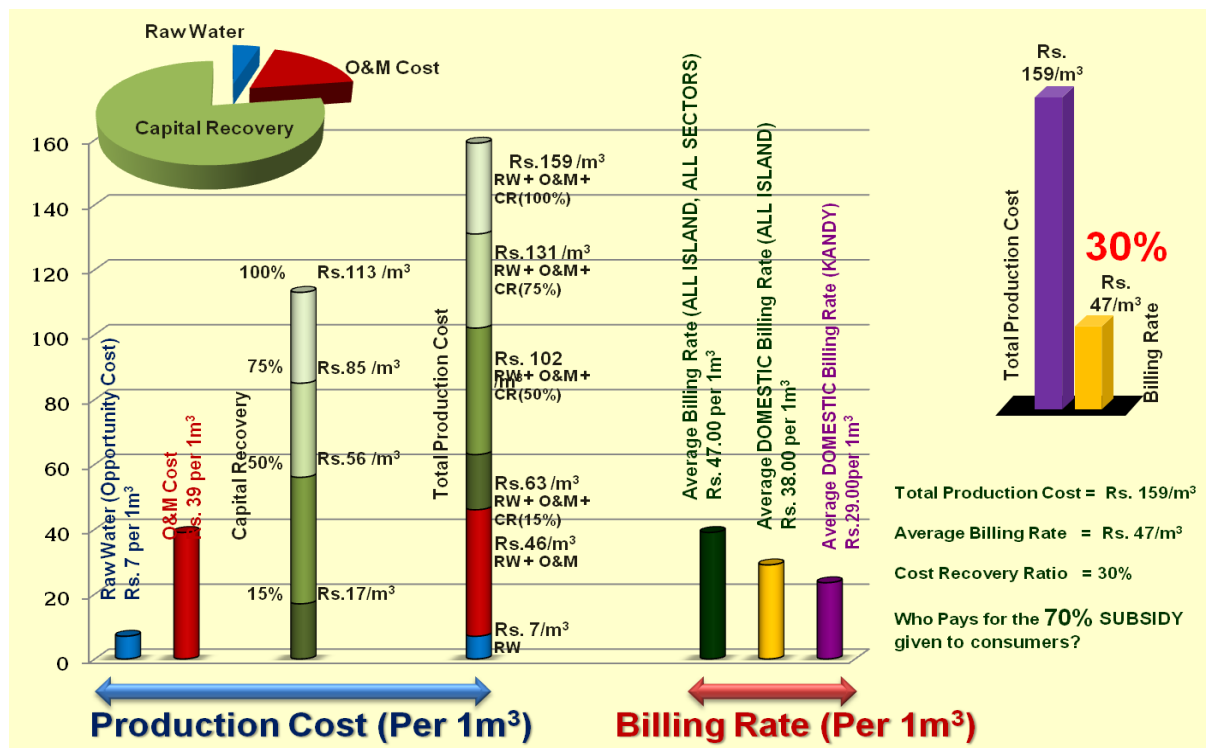
More than 70% of water is used for the domestic sector and it will reach close to 75% in 05 years. At the moment, domestic sector generates only 55% of the total revenue.

However, the domestic average billing rate has increased throughout the years as given below.

**Table 2.4: Tariff revision during last 10 years**

Average Billing Rate	Current (2012 Dec) (Rs. / m <sup>3</sup> )	Average (Rs. / m <sup>3</sup> )
Domestic	37.95	230%
Non-domestic	69.22	114%
<b>All Sector</b>	<b>47.00</b>	<b>149.5%</b>

Average billing rate in December 2012 (with latest tariff revision) is around Rs. 47/m<sup>3</sup>, and estimated sale units for the year 2013 is 374 MCM. The total billed value expected during the year 2013 is around Rs. 17,500 Mn. The total O&M expenditure is estimated as Rs. 14,600 Mn. leaving Rs.3.0 billion for capital repayments and expansion of coverage.



**Figure 2.1: Capital Cost Recovery Component for Different Recovery Ratios, O&M Cost and Present Billing Rate for a Typical Water Supply Scheme**

### **3. Wastewater Sector**

#### **3.1 What do we Mean by Wastewater? [Ref. 4: Pg. 2]**

Wastewater can mean different things to different people with a large number of definitions in use. However, this can be defined in a broad perspective as “a combination of one or more of domestic effluents consisting of black water (excreta, urine and faecal sludge) and grey water (kitchen and bathing wastewater); water from commercial establishments and institutions, including hospitals; industrial effluent, storm water and other urban run-off; agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter” (Adapted from Raschid-Sally and Jayakody, 2008).

Note: However, it shall be noted that NWS&DB does not operate combined sewer systems to collect all the above said wastewater flows, and excludes storm water, surface water or ground water into the systems.

#### **3.2 Sewage/Wastewater Treatment: An Economical Perspective [Ref. 4]**

A sustainable sanitation situation is a precondition for a country’s development as it relates to hygiene, public health and has a major impact on environment, health, economy and the social life. Cleaner environment makes the risk of diseases much lower in a society. A healthy person has more time availability for work and less medical cost, which has a good impact on the economic growth. Over half of the world’s hospitals beds are occupied with people suffering from illnesses linked with contaminated water and more people die as a result of polluted water than are killed by all forms of violence including wars.

Investments in improved sanitation and water treatment technologies pay dividends. On the other hand, investments in the rehabilitation and restoration of nature’s water purification systems—such as wetlands and mangroves— offer a cost effective path to cleaner water.

Meeting the wastewater challenge is thus not a luxury but a prudent, practical and transformative act, able to boost public health, secure the sustainability of natural resources and trigger employment in better, more intelligent water management.

#### 4. Sanitation Development in Sri Lanka: Goals [Ref. 4: Pg. 2]

##### 4.1 Sri Lanka Government Goals (Mahinda Chinthana)

By 2020, all the emerging metro cities such as Kandy, Hambantota, Trincomalee, Dambulla, Jaffna, Galle, Gampaha, Kurunegala and NuwaraEliya as well as large townships such as Vavuniya, Badulla, Matara, Anuradhapura and Ratnapura, which attract a substantial portion of the population and increase economic activities in coming years, will have centralized sewerage systems, which in turn will ensure environmental sustainability. The targets for these centralized sewerage systems will be;

**Table 4.1: Sri Lanka Government Targets for Pipe Borne Sewerage**

Year	2005	2009	2015	2020
Pipe borne sewerage coverage (%)	2.0	2.5	3.0	7.0

(Source: Ref. 1: Pg. 61 & 62)

#### 4.2 Sanitation Coverage in Sri Lanka [Ref. 4: Pg. 2]

##### 4.2.1 Status of Sanitation Coverage

**Table 4.2: Present scenario of sanitation coverage in Sri Lanka stands as (End of 2012);**

Type of Sanitation	Estimated Population Coverage	
	(Nos.)	(%)
Piped sewerage facility (off site)	486,329	2.4
Onsite sanitation facility	17,021,528	84.0
Other sanitation (includes sharing with another household, common/public toilet)	2,411,383	11.9
Unknown sanitation type (not using a toilet)	344,483	1.7

Sources: [Ref: 3]

##### 4.2.2 Population Coverage by Onsite Sanitation

Establishing the sanitation coverage under onsite sanitation is entirely based on the "Basic Housing Information" published by Department of Census and Statistics, Ministry of Finance and Planning and is as follows.

**Table 4.3: Island wide onsite sanitation coverage**

All Island	Population in 2012	Occupied Housing Units in 2012	No of Households with Onsite Sanitation	Benefitted Population with Onsite Sanitation in 2012	Safe onsite Sanitation coverage in 2012 (%)
All	20,263,723	5,188,047	4,358,432	17,021,528	84.00



### 4.3 Capital Investment required for the Implementation of Sewerage System in Major Cities

Public investment program on sewerage projects data was used in the following table. This tables shows that investment per family for providing waste water facilities is around Rs 0.5 to 2.0 million. (assumed family size is 04). In some areas, the invesment cost is exceeding Rs. 2 million per family.

**Table 4.4: Capital Investment Required Implementing Sewerage System**

Project	Population to be served	Total Estimated Cost (MRs)	Per Capita Investment (Rs/Connection)	Investment per housing unit (4.0 person per housing unit/Rs)	Status
Western Province Waste Water Projects	156,400	18,668	119,361	477,442	Ongoing projects
Kandy City Waste Water Management Projects	205,000	22,711	110,785	443,141	
Jaffna Kilinochchi Water Supply & Sewerage Project	80,000	18,328	229,100	916,400	
Jayawardenapura/ Kotte Wastewater Disposal Project	138,300	40,542	293,145	1,172,581	Projects in Bidding Stage
Negambo Waste Water Disposal System	86,700	8,916	102,837	411,349	
Maharagama and Boralessgamuwa Wastewater Disposal System	27,300	4,968	181,978	727,912	
Kurunegala Water & Wastewater Project	32,000	13,248	414,000	1,656,000	
Galle Waste Water Disposal Project	34,600	10,080	291,329	1,165,318	
Hambanthota Waste Water Disposal Project	30,400	11,519	378,914	1,515,658	
Kataragama Wastewater Desposal Project	26,000	2,040	78,462	313,846	
Kattankudy Waste Water Disposal Project	79,000	9,277	117,430	469,722	
Chlaw Wastewater Disposal System	4,700	3,937	837,660	3,350,638	
Puttalam Wastewater Disposal System	7,200	4,119	572,083	2,288,333	
Kelaniya/Peliyagoda Wastewater Disposal Project	76,827	23,182	301,743	1,206,972	Projects in pipeline
Matara Waste Water Projects	40,961	22,076	538,952	2,155,807	
Ratmalana-Moratuwa & Jaela/Ekala - Phase II Wastewater Disposal Project	49,600	9,276	187,016	748,065	
Kalutara Wastewater Disposal Project	20,847	7,523	360,867	1,443,469	

**Table 4.5: Total Investment required to achieve coverage up to 5.12% [Ref. 4: Pg. 36]**

Period	Status of the Project	Funding Requirement (Rs. Mn)
2013 - 2017	Ongoing Sewerage projects	59,707
	Sewerage Project in Bidding Stage	108,646
	Sewerage Projects in Pipeline	63,393

Accordingly total fund requirements for all the above projects is Rs. 231,746 million. However, the piped sewer coverage expected in the year 2020 will be only 5.12% which has to be increased to 7% by adding possible new sewerage projects to Public Investment Programme. 2012 Census on housing information are summarized below [Ref. 3].

Population without on site sanitation facilities	5,188,047
No. of household units without onsite sanitation in year 2012	609,886
Investment required to provide onsite sanitation facility to 5.2 million [Ref. 4: Table 9.1]	Rs.30,493 Million
Investment required to provide sanitary facility through organized public wastewater system for 1.2 million people	Rs.230 Billion
Total investment required for the wastewater sector	Rs.260 Billion
Average annual investment in wastewater sector	Rs.32.5 Billion

## 5 Conclusions and Recommendations

- i. Estimation of Cost of Water is difficult due to lack of a database on cost of goods and services. (This has a bearing on calculating the correct tariff).
- ii. Domestic customers are heavily subsidized and only 1% of consumers pay the average billing rate of more than Rs. 107 /m<sup>3</sup>, whereas total cost of water is more than Rs.160 /m<sup>3</sup>.
- iii. Cost Recovery System is to be changed drastically to improve the financial capacity of NWSDB; if the NWSDB is to borrow funds required to achieve coverage targets.
- iv. Due to technical complexity of water sector activities, it is difficult to estimate the investment required to expand the water supply facilities in future unless a national database of cost information is established.
- v. Repair maintenance cost is less than 6% of total cost. Operation & Maintenance budget estimations also should be reviewed (based on a O& M database) specially on maintenance of assets such as pump, generators, pipe & valves, water meters, house connection materials, water treatment equipment and civil structures (including life cycle costs and replacement costs). This will help in requesting a realistic budgetary allocation for maintenance material and personnel; to ensure the long term sustainability of the water supply system.
- vi. Water Conservation measures are to be implemented by procuring quality goods and services for the water sector. It is required to regulate the imports of water fittings and apparatus.

- vii. Water sector is required 350 Billion Rs and Sanitation sector is required 260 Billion Rs. within 08 years to achieve the target, which means 75 Billion Rs/year investments are to be secured. In order to repay the total cost within 20 years at 12% interest rate, 85 Billion Rs/year of revenue potential is required. In other words, average Sri Lankan family should allocate Rs. 16,000 for water and wastewater systems, in addition to the present loan repayment component.
- viii. It is essential to carryout awareness campaign to the entire population on cost of urban sector facilities such as water, wastewater management system, solid waste management, street lighting, surface drainage systems, road maintenance and improvement and cost recovery aspects in order to sustain the urban infrastructure facilities, in order to contain the rapid urbanization process.

## References

1. Department of National Planning, 2010, Ministry of Finance and Planning, Mahinda Chinthana, Department of National Planning, Colombo.
2. P H Sarath Gamini and D R I B Werellagama, *Investment Cost and Cost recovery - Water Sector Sri Lanka*, Sri Lanka Water Convention 2013.
3. Principal Source of Drinking Water, 2012, Census of population and housing, Department of Census & Statistics - Sri Lanka, viewed on 5<sup>th</sup> of February 2013, Online, <http://www.statistics.gov.lk/PopHouSat/CPH2012Visualization/htdocs/index.php?usecase=indicator&action=Map&indId=528>.
4. Public Investment Programme on Sewerage Projects 2012-2017 - Ministry of Water Supply & Drainage, National Water Supply & Drainage Board, March 2013.