
Reduction of Non revenue Water in Colombo City

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ABSTRACT:

National Water Supply and Drainage Board provides about 290,000 cubic meters of water per day to the Colombo city. One of the major challenges faced by the Board is the high percentage of Non Revenue Water (NRW) which at present is around 48%. NRW reduces the income of Board while wasting scarce water resources. While the major reason for high NRW is the very old distribution network there are other factors such as free water supplied to about 40000 families living in low income settlements and stealing of water through bypasses and illegal connections. The Board took over the entire operation of water supply from Colombo Municipality in 2001 and since then many steps have been taken to reduce the NRW to an acceptable level. While these measures have succeeded to a large extent, large scale pipe rehabilitation has to be done at a huge cost in order to further reduce NRW. This paper will elaborate on steps already taken including pipe replacement in some areas and provision of individual connections in low income settlements, progress achieved so far and future plans. It will also highlight the difficulties to be encountered in this process and possible solutions.

1. INTRODUCTION

Colombo was one of the few cities in Asia that fortunate to get pipe born water supply in 19th century. Piped water supply in Colombo city has been started in 1886 with the construction of an impounding reservoir at Labugama about 40 km east of Colombo. Initially water supply facilities were restricted to central and northern parts of the city which had a significant population. Since then water supply facilities in the city has been gradually improving during the last 125 years. Water supply from Labugama was enhanced by constructing another impounding reservoir in Kalatuwawa in 1959. As those gravity sources were unable to provide the total demand for water, extraction of water from Kelani Ganga at Ambatale was commenced in year 1962. Treatment facilities as well as capacity of Ambatale has also been substantially improved during the last 50 years and at present all above three sources provides 600,000 million cubic meters of water per day to Colombo city and other surrounding areas.

2. PRESENT STATUS OF WATER SUPPLY IN COLOMBO CITY

Colombo city compasses the area of about 47 square kilometers coming under the purview of Colombo Municipal Council (CMC). Colombo city has a residential population of about 700,000 and a floating population of about 400,000 who visit daily to the city for employment and other needs. The average daily supply of water to the city is 290,000 m³.

At present city is served by four reservoirs located at Maligakanda(50,000 m³), Ellie House at Mattakkuliya (38,000 m³), Jubilee at Kotte (18,000 m³) and Dehiwala (16,000 m³).The total number of connections in the city is 127,000 as at the end of last Year. Quality of water is always up to Sri Lankan Standards and is available for 24 hours a day. However there are some higher elevated areas where they get water only for few hours a day. The number of consumers and amount of water consumed by various types of customers are shown in Fig (1) and Fig (2).

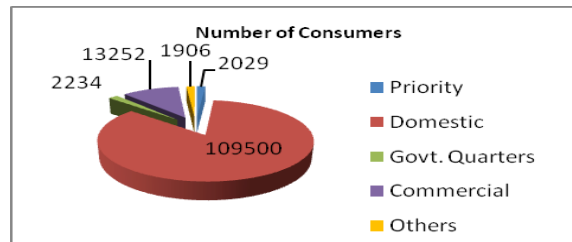


Figure (1) – Number of Consumers

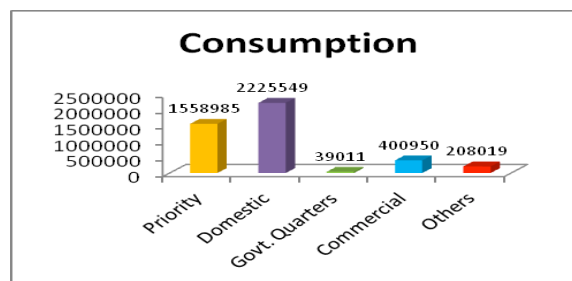


Figure (2) - Quantity of Water used by customers

3. ADMINISTRATION OF WATER SUPPLY IN COLOMBO CITY

Since the inception in 1886, water supply to the city had been managed by CMC like in other areas in the island. NWSDB was established in year 1975 to take care of water supply to the people of Sri Lanka. Although it was intended to take over all water supply systems operated and maintained by local authorities by NWSDB, Colombo water supply was continuously under the CMC. Only in 1980 Head works were taken over by the Board. Distribution system was continuously maintained by CMC and when NWSDB started water billing in year 1982, billing of consumers within the city was also initiated by the Board. Then in year 2001 the entire distribution system with all assets and staff were taken over by the Board on a policy decision of the Government. Since then all responsibilities of water supply to Colombo city lies with NWSDB.

The entire city has been divided into two Manager Areas for smooth operations in the city. Each manager area is further subdivided into two area engineers' Zone and four Officers in Charges' areas. Two Managers through an Assistant General Manager report to Deputy General Manager. There are some other sections like Non Revenue water reduction section, Metering unit, Priority section and Mapping unit which are providing some specific assistance for the water supply in city. The Figure (3) shows the areas covered by managers and fig (4) shows the present organization structure for the city. The direct staff employed for the city operations is about 430 while about 230 persons in other sections also provide specific supports. In addition to that, many works have been outsourced and private sector participation is also obtained.

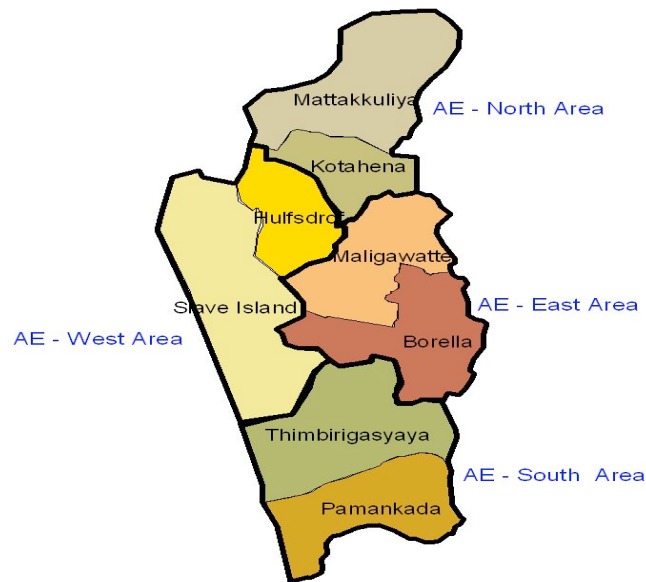


Figure (3) Administrative Areas

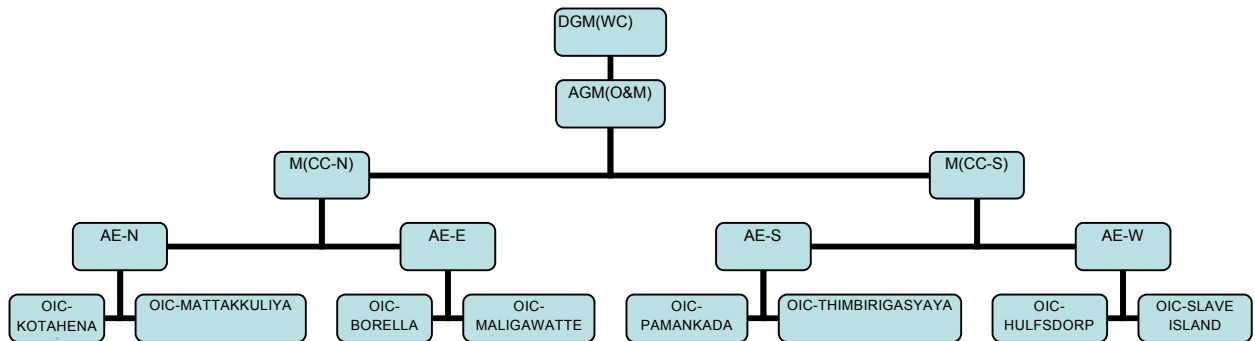


Figure (4) - Organization Structure for Colombo City

4. SIGNIFICANCE OF WATER SUPPLY TO CITY

Although the administrative capital is moved to Sri Jayawardenapura Kotte in 1978, Colombo is still the centre for many commercial and administrative functions. Furthermore many developments are coming up in the city. Hence a reliable water supply in quality and quantity is vital for Colombo city. As far as NWSDB is concerned the City generates 23% of the Total Board's income. The loss incurred by providing water to many parts of the island is cross subsidies by the income generated from Colombo. Hence water supply to the city is important for the Board as well.

5. NON REVENUE WATER

Any Water Supply entity encounters a certain amount of water losses in their transmission and distribution systems. Hence the quantity supplied to the consumers is always less what is produced. The lost water does not generate any income for the water supply provider. This is generally known as Non Revenue Water (NRW). It is measured as the percentage of the quantity not generating an income to the total quantity supplied. Depending on various reasons NRW figures vary within a large range for major cities in

the world. The following Table (1) shows NRW figures for some leading cities in the world. There are instances where correct NRW figures are not disclosed by the authorities due to various political and social reasons.

City	NRW (%)
Jakarta	51
Kuala Lumpur	43
Delhi	40
Karachi	30
Osaka	7

Table (1) - NRW Figures for some cities

6. NRW IN COLOMBO CITY

At present average daily supply to the city is about 290,000 m³ while only about 150,000 m³/ day is billed as per the latest records for Colombo city. This simply means that NRW for Colombo city is about 48%.

High NRW is clearly a heavy loss to the water authority. In addition to that there are many harmful effects of it as follows.

1. Leaking water pipes in transmission and distribution system damage public roads causing severe inconvenience to the public. Sometimes it may lead to road accidents as well. Then those pipes have to be repaired again causing traffic jams and water interruptions.
2. If the water pressure in the pipe system goes down, contaminated water may intrude the system causing severe health threat.
3. It will reduce the service level of consumers due to reduced pressure
4. It will lose the consumers' confidence on the water supply.

NRW figure is considered as a good performance indicator of Water Authorities in the world of today. Therefore it is very much important to keep the NRW status to a bare minimum.

7. CAUSES FOR NRW

There are number of reasons for high NRW in Colombo city. The major reasons are as follows.

7.1 Very old pipe system.

At present Colombo water distribution system consists of about 760 km of pipe of various sizes and materials. The Fig (5) shows the details of pipes.

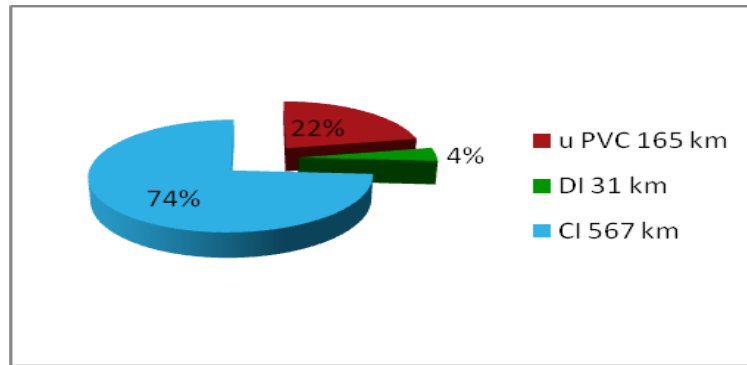


Fig (5): Details of pipes in Colombo city

Most of the cast iron pipes in the system are very old. The Fig (6) shows the age analysis of cast iron pipes.

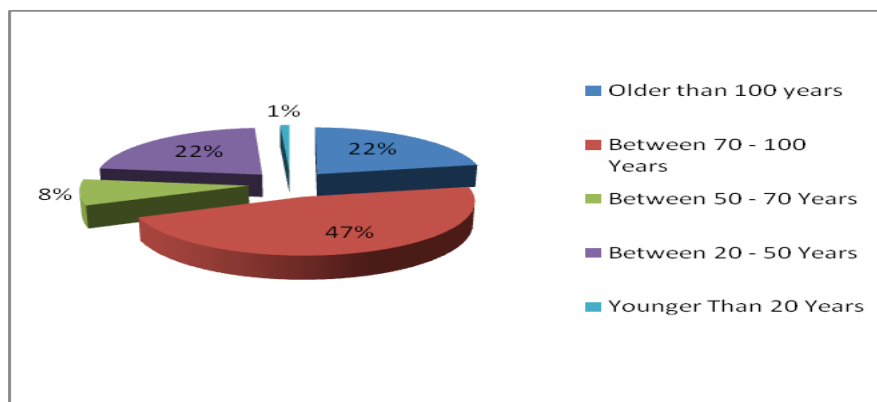


Fig (6) – Age of Cast iron Pipes

Due to aging of above pipes they tend to leak very frequently and encrustation in most of above pipes have considerably reduced the carrying capacity of pipes. Although pipe leaks are repaired regularly it is not successful as they start to leak from another point within a short period. Valves and other apparatus fixed to the pipes are also in bad situation and hence causing many water leaks.

7.2 Free Water Supplied to underserved settlements

There are about 1500 underserved settlements (US) in the city. The number of families living in those US is about 40,000. They have been living in for several generations and mainly consist of daily wage earners working in the city. They have obtained their water needs from common water outlets for several decades. Generally there are three types of such common water outlets. They are public stand posts; common bath taps and taps in common toilets. The number of common water outlets was about 5500 when the water system is taken over by NWSDB in year 2001. Water supply through common outlets is totally free from the beginning. In addition there is very heavy water wastage from above and it has been found that the total quantity flown through above outlets is about twice the actual requirement of water.

7.3. Water thefts and Bypasses

It is believed that there are a fair number of illegal connections and bypasses in legal connections.

7.4 Losses due to Administrative Problem

Like in many other water supply systems, there is a considerable amount of NRW is caused due to the following administrative problems.

- Issue of water bills based on estimated consumption instead of actual meter readings due to defective meters, lack of meter readers, unmetered premises and poor performance of meter readers etc.
- Deficiencies in the billing systems
- Under reading of water meters

8. COMPOSITION OF NRW

It is quite difficult to find the exact composition of NRW. Several pilot studies have been carried out during the past and as a result approximate composition of NRW has been established as shown in Figure (7).

Factor	NRW Percentage
Leaks in pipe lines	30
Free water in US	10
Water thefts	4
Administrative errors	4

Figure (7) – Composition of NRW

8. VALUE OF NRW

High NRW is used to criticize the Board activities in many instances. The loss due to NRW is exaggerated at many times without any scientific background. The financial loss for the Water Board due to the NRW is a debatable issue. The financial loss depends on the possible use of saved water. If adequate water is already there, when losses are prevented production at the water treatment plant may be reduced. However if there is a water shortage in the system saved water may be sold. Even in this case expected revenue may depend on the type of customers and their water use pattern due to the prevailing tariff structure. By considering all above scenarios a tentative value of NRW may be produced as shown in Table (2).

Average daily supply of 290,000 m³ and 48% NRW is assumed.

Effect of NRW Reduction	Average cost/revenue per m3 (Rs)	Total cost saving/ revenue increase per year (Rs m)
Reduction of Production	5.00	256
Sale of water for domestic consumers	10	512
Sale of water for domestic consumers	65	3328

Table (2) – Value of NRW

In reality effect of NRW may be a combination of all above and it must be understood that bringing NRW to zero is also not practicable.

9. ACTIONS TAKEN TO REDUCE NRW

High NRW in Colombo city is considered as a serious matter. The need for reducing NRW was strongly felt after the taking over of water distribution in year 2001. Although no correct measurements were available, NRW in year 2001 is believed to be about 60%. During the period from 2001 to 2011, NRW has been reduced up to about 52%. Although number of measures were taken to reduce, reduction was marginal. Therefore it may be reasonable to assume that the steps taken to reduce NRW have contributed largely to control the increase of NRW. Having learnt from the past, number of new steps were introduced and further strengthened the ongoing efforts since June 2011. These steps could be summarized in to three main categories as follows.

9.1 Short Term Measures to Reduce NRW

Under the above category following steps were taken.

- Prompt attention for leak repairs – Leak repair works has been strengthened. Private contractors are employed full time (day and night) for leak repairs in addition to Board staff. Additional two gangs from the Board staff have been employed exclusively for night works (from 16.00 hours to 8.00 hours) for all 7 days of the week.
- Night leaks surveys – Every week a night survey is carried out in one part of the city to find water leaks and repair them
- Call Centre – A 24 hours toll free call center is functioning at Maligakanda to receive complaints on leaks and consumers' service break downs. A night gang is employed to attend such leaks immediately
- Following activities are in progress to reduce administrative errors.
 1. Replacement of defective water meters promptly
 2. Metering of all unmetered premises
 3. Checking of premise where water supply is disconnected but not yet reconnected
- A programme (known as "Randiya Programme") was launched in year 2001 to provide individual house connections to people living in US and reduce the common water out lets. Under the above programme house connections were provided at a very concessionary terms. During the last ten year about 21,000 house connections have been provided and about 2000 common water outlets were disconnected. This programme is still continuing.
- Checking of suspicious premises as well as on information received is continuing to trace illegal water users. A separate unit headed by a chief Engineer has been established for this purpose. Five working gangs are regularly attending to this task. During the last 10 years more than 30,000 premises have been inspected and 16,000 number of premises have been detected for illegal water use. The revenue collected through this process is about RS 320 m.

9.2 Medium Term Measures

- All consumer premises were renumbered in order to facilitate easy monitoring of meter readings and NRW activities.
- It is very important to measure NRW correctly if it is to be controlled effectively. Therefore action was taken to meter all incoming points and outgoing points in city boundaries.
- Administrative structure for the city was completely changed. Earlier officers had been appointed subject wise and they are supposed to work everywhere in the city. Now the officers have been appointed area wise so that all activities in a particular area come under a single office. This has increased the accountability of the officers.
- In addition to the normal programme funds were obtained to provide 1000 connections for US under Greater Colombo Water Rehabilitation Project and another 2000 connections to be provided under Kaluganaga Project before the end of 2013.

- About 5km of badly corroded Cast Iron pipes in selected areas are being replaced using funds provided by the Board.
- A comparison of voters register with Water Board consumer data base was carried out to find illegal water users. 365 Number of illegal water users was detected under this activity.
- There are under served settlements where individual house connections cannot be provided due to various social and technical reasons. As water from common outlets has to be continued for those US, consumer societies were established to take care of such facilities. Water bills for common outlets are issued in the name of the society and consumers have to pay it. A special tariff (RS 3 per m3) was introduced for those committees. This programme is continuing and about 400 committees have already been formed.

9.3 Long Term Measures

- As stated in previous chapters, the main reason behind the high NRW is very old pipe network in the city. Although many studies have been carried out in the past, no major pipe replacement programme was implemented. Having understood the above situation Board has taken several steps to replace old pipes during a short period. In this connection following programmes are already started.
- 56 km of cast iron pipes in Fort and Pettah areas are being already replaced. Another 25km of pie lines are being identified to replace under the same project
- Asian Development Bank (ADB) has agreed to fund a project for improvements in Colombo city. The main objective of the project is to reduce NRW by replacing of about 90 km of pipe lines.. Project preparatory activities are in progress.
- The ADB project will address only a part of the need due to limitation of funds. Hence another proposal has been prepared to address the remaining issues including old pipe replacements and other activities. The proposal has already been forwarded too National Planning Department and External Resources Department to find a suitable funding source.
- Half of the water supply to the city is consumed by priority consumers. Hence in order to monitor their consumption as well as possible leaks installation of an automated meter reading system is being considered.
- Arrangements are being made to revise the specifications of water meters, pipes and fittings to ensure the use of high quality materials in future.
- A very positive step taken in relation to the NRW reduction is very close monitoring of NRW activities. Every week NRW status and activities are monitored by the top management since June 2011 and that has remarkably improved the interest in this special task.

10. Progress achieved

Due to the comprehensive steps taken during the last one year, NRW has been reduced to 48% from 52%. The Figure (8) shows the monthly NRW variation from Last June.

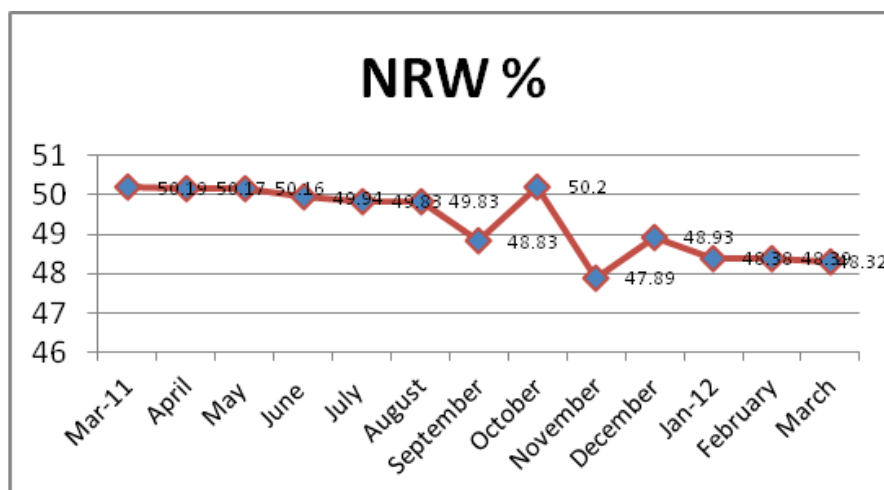


Figure (8) – NRW Variation since June 2011

11. CHALLENGES

Reduction of NRW faces with many challenges. Main challenges and measure taken to address them are given in Table (3).

Challenge	Measures Taken
Lack of funds for pipe replacements	Seeking the assistance from world lending intuitions
Difficulties encountered in Construction	Seeking the possibilities of adopting newer technologies like pipe bursting instead of open cut method
Lack of commitment from Board staff	Awareness and motivation of Board employees for their contribution in NRW reduction
Inadequate support from politicians	Improved awareness

Table (3) - Challenges and Remedial Measures

12. CONCLUSIONS

Reduction of NRW is a difficult task. Especially with a pipe network of about 100 years old, it is quiet difficult. However if the above steps are implemented, it is expected that NRW in Colombo city could be brought down to a bearable amount within next few years.

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