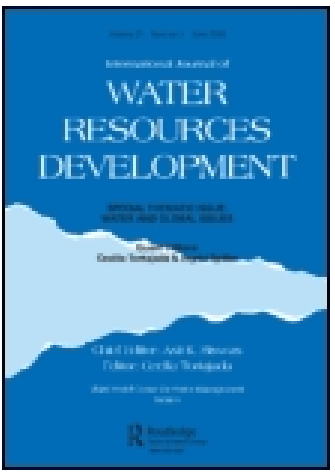

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Challenges to Urban Water Management in Sri Lanka

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ABSTRACT *Sri Lanka has an urban population of 22% of the national population living in 1% of its land area in 1985. Coastal lands in the wet zone are thickly populated and demand for water supply is increasing for pipe-borne safe drinking water. Surface drainage and shallow groundwater are purified and distributed for domestic connections and public standposts. Municipal Councils, the National Water Supply & Drainage Board and the Irrigation Department control water resources for the benefit of the residents. Annual new domestic connections are around 100 000 under new projects and the plan is for 100% completion by 2005. The institutional and funding issues are discussed in this paper.*

Introduction

Sri Lanka has 18 million population in 65 519 km^2 of land area, out of which the urban population was 3.8 million in 1998. The main urban population is concentrated in the Greater Colombo area. The high east density of population is concentrated in Western Province which contains one-third of the population. The coastal area also has one-third of population owing to its productivity. The high-density districts are Colombo, Gampaha and Jaffna because of their the productivity in agriculture, industries and commercial ventures. Second-level density is recorded in Kalutara, Galle, Matara, Kegalle and Kandy districts as a result of their water resources and productivity. Jaffna lies in a limestone region, which has groundwater resources rather than surface water. The wet zone relies on surface water runoff, and shallow groundswells provide drinking water to households. Traditionally this water is utilized for drinking, bathing, cooking and washing, covering a wide range of water supply. The Jaffna limestone region uses deep wells with 'andia' leverage for all activities.

At present 76% of the 3.8 million urban people are provided with a water supply. Those who live within Municipal Council, Urban Council, and former Town Council limits are considered as urban and others are considered as rural. Many urban areas are situated in the coastal belt where the supply is mainly from the perennial rivers, which originate in the central mountains. Coastal cities risk the hazard of recurrent flooding and many areas have been abandoned as low-lying areas without permanent housing. Safe areas were traditionally occupied but due to the population explosion unsuitable areas are becoming residential with a high demand for drinking water. Only 1% of the total land area is considered as urban but it supported 22% of population in 1985. Greater Colombo has the highest demand for future residence as the big markets,

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schools, hospitals, state machinery and banks are located there, together with a main seaport for loading and unloading of containers. Many businessmen live in Colombo. The present trend of partitioning land and selling it off for new residential blocks is increasing the population.

Water Supply, Sanitation Methods and Limitations

Wet-zone towns rely on stormwater, which collects in a supply reservoir. Few towns directly tap water from the main stream. The gravity system helps in distribution but otherwise pumps are used to elevate filtered water from the deep well under the riverbed. This purified water is then aerated and flocculated using alum. Water is then chlorinated and filtered and lime is added to attain low acidity. This water is pumped to a distribution tank and finally released to consumers. The coliform count is reduced to 10% of samples. Domestic effluent is added to groundwater and people do not use it.

About 40% of the urban population use public standposts provided along the roads. People collect water in pots and also use these areas as bathing places. This free supply encourages the residents to expand any housing unit in the vicinity. The supply tank is designed for a finite capacity and daily output is limited. In all towns maximum capacity is reached before the expected date. This was quite marked before 1991 when water meters were not installed. In 1998 all domestic, commercial, industrial and subsidy connections were metered but bulk meters are still in place and illegal tapping is continuing. The wastage has now been arrested and consumers are monthly billed. During dry periods the supply is limited to a few hours. In Galle project salinity is mixed with water at the intake. Bowser supply is used to meet any urgent or difficult situation. Isolated towns have different water strategies to meet the need. Puttalam water supply has a high degree of hardness and people use a tubewell to obtain drinking water. Wet-zone storm water is soft and people migrate to coastal towns to get good quality water. Dry-zone water has excess fluoride but people drink it because there is no alternative.

Water Supply and Sewerage Responsibility

With the development of Municipal Councils in Sri Lanka legislation was enacted to form elected councils of residents. These councils collected revenue and effected the supply of many facilities to the resident: water provision and removal of sewage were two main duties of such local bodies. Removal of garbage, construction of roads and street lighting were other issues. Flood control was under the control of the Irrigation Department.

Municipal Councils in the past operated with foreign labourers but today the workforce is localized and manual removal of sewage was not continued after 1965. Colombo Municipality had about 98 000 land plots and a population of around 0.98 million in 1998 but it also has a migratory population of 0.5 million. The main city may not increase population beyond the normal rate of 1.7% but the Greater Colombo area is urbanizing fast at a higher rate.

A sewerage system to pump sewage into the deep sea at two outlets is presently operated for Colombo. This system is very old but effectively functions except in a few places. Beira Lake vicinity is not connected to the system but it will soon be connected. The distance from the coast is 2 km at the outfall. The

Municipal Council is a government office and hence loans and aid cannot be accepted. Thus, under the provision of NWSDB, projects are gazetted for sewerage system improvements. Septic tanks are widely used in the urban area and Kolonnawa and Dehiwala areas operate a sewerage delivery system run by the NWSDB concurrently. It is expected to connect more houses in future. A connection charge is lessed only for sewerage but no operation cost is charged. Hence the product is added as a nutrient to the fish life in the sea.

Kandy is situated in the mid-river position and the Municipal Council therefore has a duty to treat the effluent and release it to the river. The Municipal Council controls the water supply project, but the Operation and Maintenance staff are under the NWSDB. Galle Municipal council in the South functions in the same manner as Kandy. Galle has no sewerage project. After 1965 septic tanks were introduced. The NWSDB has sewage treatment plants for small-scale housing projects. The Gin River supplies water to Galle Municipality but runs dry in the dry months and tastes of salinity. The Puttalam Mannar region has groundwater and groundwater projects are operated in this area. The refugee problem causes more demand in this area.

Water Supply Planning and Issues Related to the Water Sector

Investigations

The Presidential Task Force on Housing and Urban Development has identified the following goals for the development of the water supply sector in Sri Lanka, in response to the call from global organizations regarding fresh water problems in the Asia Region, in order to provide a minimum (lifeline) supply of safe drinking water to all people at an affordable price:

(a) to meet the demand for water supply services from economic sectors such as industry, tourism, commerce and other related uses and to maintain a 24-hour supply level;
(b) to facilitate investment in the water supply infrastructure through alternative financing sources including the private sector and community;
(c) to encourage local government institutions to undertake distribution of water supply services, operation and maintenance, and to participate actively in capital financing through cost financing with the Government;
(d) to plan sustainable extraction of existing and potential water sources for present and future uses through research and investigation and incorporation of appropriate technologies in the design, construction and operation of water utilities.

Present Water-pricing Method

Currently there is no mechanism by which water tariffs are annually adjusted according to a price-adjusted mechanism (PAM). The present tariff-approval process involves NWSDB formally submitting a request for tariff increases to the Ministry of Housing & Urban Development (MHUD). The ministry considers the submission and makes a formal submission to the Ministry of Finance & Planning for its concurrence. The process takes a very long time and the revisions are adjusted to the national requirements of a democratic society. The

subsidy is the main factor that affects state budgetary control, and as long as state funds are available urbanization will continue in Municipal Council areas of Sri Lanka.

Features of Water Pricing

The salient features of the water pricing policy are:

(a) water prices must be sufficient to ensure that each year the total revenue from water sales is sufficient to meet total recurrent expenditure including depreciation and interest on capital and to meet a proportion of new investments for development of the water supply structure;
(b) water-tariff revenue must be sufficient annually to earn an acceptable return on fixed assets. The indicators are to be (A) return on fixed assets and (B) debt service coverage rate;
(c) water prices are to reflect broad social objectives such as supplying water at a relatively low price to reduce customers using less than a stipulated amount of water each month;
(d) water pricing is to support water conservation objectives and wastage reduction.

Water-pricing Issues

In working out a tariff policy for water, the following issues need to be considered:

(a) the rising scarcity of water;
(b) a socially affordable tariff;
(c) cross-subsidization;
(d) capital investment requirements;
(e) the financial viability/efficiency of NWSDB;
(f) the regulatory body; and
(g) the reservoir cost of water from the Irrigation Department (ID).

Rising Scarcity of Water

Water scarcity occurs when the supply of water of required quality is unable to meet the demand. Only about a third of the overall resource can be economically harnessed to supply human needs because many potential water sources are located too far from the major water users, while closer sources are already tapped. In many parts of the region, misuse of water resources and poor water resources management practices have already resulted in depletion of aquifers, falling water tables, shrinking inland lakes and stream flows diminished to ecologically unsafe levels. Pollution of water, originating mostly from human activities, is occurring more frequently, spreading over large areas and causing a sharp decrease in the amount of water suitable for use. Many wet-zone streams and much shallow groundwater have been ruled out as potential water supply sources.

A threshold for water adequacy is around 1600 m^3 of renewable fresh water per person year. When water resources are less than 1000 m^3/person year

Table 1. Existing water availability and projected demands for Greater Colombo

Item	Total demand (day maximum) in 000 m^3/day					
	Year					
	1995	2000	2005	2010	2015	2020
Total demand, m^3/d	473.3	559.2	646.8	734.5	825.2	915.8
Existing capacity, m^3/d	546.9					

countries are considered as water scarce, and the shortage of water adversely affects their socioeconomic development and environmental quality.

The present water demand (1997) of the Greater Colombo Area of Sri Lanka is 559 240 m^3/day. The water availability as at today is 546 909 m^3/day. However, according to the forecasts the water demand in the year 2005 will be 646 800 m^3/day, resulting in an almost 20% water shortage. The existing water resources and the projected demands for Greater Colombo are listed in Table 1.

Socially Affordable Water Tariff

Pricing of water is different from that of any other commodity since there is no market price decided by demand and supply. Therefore in setting a water tariff the concept of 'willingness to pay' or 'affordable to pay' is used. A water tariff for domestic customers should be set that is socially acceptable. It must allow the poorest group in society to meet their basic need for water. In principle a socially affordable tariff (SAT) is the upper limit of a tariff. Current socioeconomic data are used to evaluate the SAT. By international standards Sri Lanka's domestic water bill per income is low and broadly in line with the level of developed countries (Table 2)

Table 2. Annual household expenditure on water services as a percentage of average household income

Country or city	%
Sri Lanka	1.8
Colombo	1.0
Developing countries:	
Dhaka	3.5
Jakarta	3.5
Manila	2.0
Hungary	2.5
Czech Republic	6
Developed countries:	
Kuala Lumpur	1
Bangkok	2
Singapore	1
France	1.4
UK	0.5
Tokyo	1

Table 3. Status of water supply by hours served in 1997

Service hours distribution	Number of schemes	Percentage
0–6	79	29
6–12	56	20
12–18	42	15
18–24	12	4
24	86	32

Cross-subsidization of Tariff

Currently tariffs for commercial, industrial, government and institutional customers are set high enough to recover all their related costs and to create a surplus. On the other hand, domestic tariffs are set well below cost-recovery levels and are substantially cross-subsidized by non-domestic customers. The danger of high non-domestic tariffs is that the commercial customers could seek other sources of water than pipe-borne water. Another threat of a high tariff gives encouragement to illegal connections.

Therefore the tariffs of commercial, industrial, government and institutional customers should not be increased except for annual adjustments. Domestic cross-subsidization should not exceed 1:5 at any time.

Capital Investment Requirements

At present only 20% of the urban population receive a 24-hour water-supply service. Of all the water-supply schemes only one-third have to the capacity to provide a continuous supply as given in Table 3.

The Government has set a target to achieve the goal of providing safe drinking water for all by the year 2010. At present 62% of the total population has access to safe drinking water. However, the coverage of pipe-borne water supply in terms of the regional distribution is inadequate and heavily skewed to a few districts in Sri Lanka as shown in Table 4.

The demand for reliable and adequate pipe-borne water supply services shows a rapid increase from all user groups: domestic, industrial, commercial and other sectors. The piped water supply has been growing at an average annual rate of 5.5% for domestic use and 4.5% for non-domestic use during the past 12 years.

Investment projections of the water sector show that annual investment should increase threefold the present level of allocations, if it were to meet the present demand. Based on four scenarios for water coverage up to 2010, the projected investments up to 2005 are given in Table 5. As per projections, the required cumulative investment in the year 2005 to cover 90% of the urban population with a pipe-borne water supply is Rs64 billion. At present the Government of Sri Lanka (GOSL) provides the entire local component as a grant to NWSDB, and from the foreign loan component 50% is given to urban projects as a grant. Funding requirements are to be given by careful considerations owing to the scarcity of available finance. The proposed subsidy components are given in Table 6.

On the present estimates it could reasonably be assumed that the GOSL and donor funding is likely to remain at present levels for next six years. On this

Table 4. Status of water supply in 1997

Supply duration and number of schemes in districts District	No.	Supply hour range
Colombo	14	15–24
Gampaha	22	3–24
Kalutara	14	8–24
Galle	8	8–24
Matara	16	7–24
Kandy	30	2–24
Nuwara eliya	4	2–24
Matale	6	6–24
Kegalle	9	24
Ratnapura	8	10–24
Kurunegala	18	1–24
Badulla	35	2–24
Dry zone areas:		
Hambanthota	19	2–24
Anuradhapura	13	5–24
Polonnaruwa	6	6–24
Moneragala	6	1.5–24
Puttalam	7	3–24
Ampara	8	2–12
Batticaloa	2	1.5–12
Jaffna	15	1–6
Kilinochchi	1	2
Mannar	7	2–5
Trincomalee	6	4–24
Vavuniya	1	24

basis, Rs24 billion could reasonably be estimated as available from GOSL/donor funding sources. Through the tariff-setting process, internal efficiency gains and through capital recovery cost the NWSDB should target receiving over Rs4 billion over the next six years for capital investments. This will give a balance deficit of Rs36 billion to be raised through alternative financial sources including the private sector and community projects.

Private Sector Participation

The private sector is attracted to participate in water supply to achieve growth and profit objectives. Government and other stakeholders in the community need to be reconciled to profits being earned from water services. Companies

Table 5. Proposed investments for water supply

Scenario	Pipe-borne urban coverage (%)	National coverage (%)	Projected capital investment (Rs billion)
1	90	100	63.29
2	80	100	59.23
3	75	90	54.65
4	70	85	51.57

Table 6. Subsidy components for consumers

Category	Loan (%)	Grant (%)
Commercial urban	70	30
Residential urban	30	70
Urban poor (tenements)		100
Rural small towns (2000–6000)	100	
Rural large town (6000–20 000)	15	85
Villages <2000		100
Sewerage		100

have to provide a reasonable return for their shareholders, and will also be cautious about negative cash flows in the early years. They will look for stable government, stable economic conditions, and fiscal and regulatory regimes, which prevent future changes adversely affecting profitability. Since large capital outlays are required, the prospective private sector bidders will wish to ensure viable payback periods, economies of scale etc. before committing large capital funds. The better PSP projects will refocus the sector on the service standards to be achieved, and will establish a financial and regulatory framework to ensure sustainable delivery of those standards.

Financial Viability and Efficiency of NWSDB

For financial viability it is necessary to generate profits. The Board must recover its operating costs, the capital costs, investments, debt service costs associated with its capital costs from the tariff and also be able to get a targeted rate of return on its assets.

Efficiency

This objective covers two types of efficiency: productive efficiency and allocative efficiency. Productive efficiency is essentially the cost per unit of treated water consumed. It is vital that the Board increases its productive efficiency but it is difficult to do so through tariff setting. A requirement for an annual increase in internal efficiency for tariff-setting purposes should be established. Surface water resources are gifted by irrigation reservoirs in dry-zone areas. Achieving allocative efficiency means ensuring that people use water whenever, and only when, the value of water to them exceeds the cost of producing the water. This requires that consumers are correctly charged according to the volume of water consumed, and that the price per unit of water reflects the cost of producing and additional unit.

The low-tariff structure has been a major contributory factor in the Board's weak financial performance. Profitability fell from 1991 to 1998 and it is now running at a loss. The weak financial performance is not only due to the low tariff, but also to the high level of non-revenue water, which means that 50% of water is not billed. The Board and ID pay for production costs, and have high operating costs. Inefficiencies are magnifying the costs. Staffing levels are well above those of best practice, with 23 staff per 1000 connections. A few projects

Table 7. Current water tariffs

Consumer category Domestic categories Unit: cubic meter/month	Current water tariff (Sri Lanka Rs)
Direct connections (1):	
1–10	0.00
11–20	2.50
21–25	7.50
26–30	15.00
31–40	18.00
41–50	20.00
Over 50	35.00
Standposts	5.00
Bulk	8.00
Religious/schools	3.00
Service charge	30.00
Non-domestic categories:	
Commercial/industrial	27.50
Shipping	110.00
Service charges	200.00
Connection charge initially	5000.00

have had a low staff level if the area is thickly populated. Colombo had seven staff per 1000 consumers.

Regulatory Body

It is necessary to establish an independent regulatory body to monitor tariff setting and performance measurement. There are many stakeholders in the water sector. Agriculture needs 70% of available water and dry-zone areas traditionally use all water in the reservoirs to the best benefit of the civilization from generation to generation. The community-based projects can solve all the issues in that sector. But in the wet zone, meteoric water of very pure quality drains to the sea. The state sector, NWSDB, donors and consumers and polluters all deal with water, so tariff setting should be done in harmony with all stakeholders. Water-pricing actions should not disturb water rights of farmers.

The regulatory body should set tariffs through a price adjustment mechanism (PAM). There are two main requirements in designing a PAM: it must be designed to ensure that real tariff levels are maintained; and the weightings used in the computation of a PAM's inflation factor must match the weightings of NWSDB's cost structure. The profit target and efficiency target should be reviewed annually. Any change in the tariff or services must satisfy national requirements, as most of the colonial laws are anti-national.

Tariff Structure

Domestic customers currently face a rising-block structure and pay a small service charge. The present tariff structure is shown in Table 7. The rising-block system promotes equity but causes problems in administration. Any body can consume more water at a higher cost.

Tariff Structure Summary

Water supply is a state duty, and 50% of the supply cost is passed on to the urban consumer. The balance is supplied by the state. The commercial sector, i.e. industries and hotels, pays a higher rate while the domestic rate is limited to 1% of the per capita income (US$650) with exponentially increasing slabs for water use. The water subsidy is 85% for rural schemes. Charity organizations and state services get it free. The annual increase is proposed to meet the operation cost and interest on the debt component but the Ministry of Planning decides the increase according to state policy. This situation encourages rapid urbanization. Illegal tapping is also recorded in many areas. The capital cost is obtained from foreign sources. New projects are undertaken with foreign funding, as the local funds are limited. When house connections are made, groundwater wells are abandoned. To meet interruptions a storage tank is necessary for every house.

Rainwater harvesting will be necessary in future to meet water demand.

Discussion and Conclusions

About 76% of the urban population receive a water supply and 40% use a public standpost supply. Only 20% are fortunate enough to get a 24-hour supply. The consumer constructs his own storage and distribution system, which needs the application of demand-management practices. The present sanitation system uses more water, which has to be modified by new methods and practices. Treated water is used for gardening purpose but rainwater is wasted down the drain. Rainwater tanks must be erected to cater to non-drinking needs. This will be a definite issue in the next few years. If water rates are increased, people will automatically reduce treated-water use. Rainwater contains nitrates, phosphates and carbon dust which need purification through sand filtering. Abandoned wells are poisoned with leptospirosis and many other bacteria. Pollution takes place due to chemicals released by residents and small industries. Septic tanks should be used to avoid water pollution.

The projected demand for 2020 in the Greater Colombo area alone is 0.915 MCM/day (90% of domestic capacity) and present capacity is 0.546 MCM/day, which will be equalled in the year 2000. The financial requirement for domestic supply alone is Rs63 billion. The NWSDB can earn Rs4 billion with Government and donor funding of Rs24 billion over 6 years. The balance of Rs35 billion will be left for private sector investments and NGO mediation.

The tariff structure will be modified from the present subsidized level to a viable level by incorporating the following slabs: the life-line slab (10 units) to look after the poor for basic water needs; two volumetric tariff slabs for a regular scale for consumption (10 units and 10 units); and a higher slab to discourage over-use.

The Government has a policy to provide safe drinking water to all in the year 2010, and the present level is at 62%. The wet zone has no facility to store water in dry periods as the storage reservoirs are limited. The construction of upstream tanks is badly needed to provide water in the months of February and August to all wet-zone cities. It would be very easy to convert the saline lakes into freshwater lakes in the coastal belt owing to their location close to the sea with a sand bar formed annually. This sand bar is usually cleaned seasonally to evacuate and drain water to control upstream inundations. Presently paddy

lands have been abandoned because of problems with salinity and low income but it would be useful to build a freshwater tank to cater to domestic use using the same stormwater.

The Gin and Nilwala Rivers are controlled by flood evacuation using low-lift pumps. This water is now drained to the sea. Using the same pumping an abandoned area can store water for future drinking purpose. The abandoned paddy tracts suffer from excess acid sulphate, which developed after control of floods. This defeated the purpose of flood control and now flooding is necessary to flush out the acid sulphate. Conjunctive use of groundwater and surface water will maintain the quality of the water in the future.

The Water Board has to improve efficiency by reducing excess staff and undertaking many more small-scale water-supply schemes. Illegal tapping of water and non-payment of bills must be controlled effectively using awareness programme. The wet zone has gravity storage potential in each valley and pipelines are easily fitted to supply water to villages in the command areas. Traditionally villagers travel long distance in search of water in the lowlands. The private sector, community-based organizations and non-governmental organizations can take the lead in this task as such schemes are profitable.

Rubber-dam reservoirs are suitable for riverbed storage under flood discharge situation in all wet-zone rivers. This is planned together with irrigation authorities.

Demand management through public teaching is essential in urban areas and presently wet-sanitation equipment wastes drinking water at 28 litres per flush. Most of these units were designed without proper research data. This quantity is to be reduced to 8 litres.

Rainwater tanks can supplement water needs if properly constructed. Release of raw sewage to open water bodies in cities will be prohibited. Dry-zone privy vaults are not creating problems and spread of cholera is due to drinking of canal water. Beira Lake in Colombo is polluted by raw sewage entry.

Methods to prevent urbanization are needed, to be formulated as state policy decisions. Regional development will be planned, to include the improvement of Galle Harbour.

The dry zone needs selected wells for reduction of fluoride in drinking water. Rainwater has a low fluoride level but villagers drink groundwater. All residents bear symptoms of fluorosis, especially in their teeth.

The NWSDB has to reduce staff and increase the number of connections to cover every house and reduce the wastage now recorded as 35% for leaks and illegal tapping. Meter readers can read electrical bills as well. Authority has to be decentralized to reduce costs. Bill arrears have to be carefully reduced through awareness programmes.

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