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SUSTAINABLE DEVELOPMENT OF WATER RESOURCES, WATER SUPPLY AND ENVIRONMENTAL SANITATION

Policy Needs for a Sustainable Management of Groundwater Resources in Sri Lanka*Gemunu Herath and Uditha Ratnayake, Sri Lanka*

The demand for ground water in Sri Lanka has grown rapidly over the past few decades, mainly as a result of population growth, economic development, and shortages in rainfall. Recent estimate show that over 55 percent of the population now relies on it for there daily needs. As a free and easily tapped commodity, groundwater today is used in a wide variety of uses. Of the 300 urban and rural piped water supply schemes operating across the country, almost one – third of them rely entirely on groundwater. The volume they withdraw exceeds over 16 million cubic meters per year; which includes supply to many industrial zones and urban and rural centers. And the volume of groundwater abstracted by around 11 million individual domestic users (out of the 13 million people with no access to piped water) is estimated at around 400 Mm³/yr. In some parts of the country including many locations in Kandy and Colombo, high pumping rates have lowered the groundwater table, causing the wells to go dry and affecting the natural water courses including those used for drinking. If these situations get worse, water shortages could become severe, especially during the more frequent extended frequent dry spells being experienced, possibly due to climate change. Further, water pollution from domestic, agricultural and industrial sources is contaminating the surface water and groundwater and affecting the environment and further placing more pressure on the available water resource. Therefore in this paper identifies several critical issues as urgent challenges to be immediately addressed to achieve a sustainably managing groundwater resource in Sri Lanka.

Introduction

COMPETITION and water shortages are increasing in Sri Lanka because of high variability in rainfall and growing demand for water. In addition pressure from population growth is causing degradation of watersheds, resulting in soil erosion, sedimentation of reservoirs, landslides and more serious floods and droughts. As a result groundwater is being extracted excessively in most urban regions raising doubts on its sustainability in the longer run. Water pollution from domestic, agricultural and industrial sources is contaminating the surface water and groundwater affecting the environment and public health has further aggravated the problem. These concerns have demanded immediate counter measures and strategies for proper management of the available water resources.

Study Area: This study mainly focuses on groundwater management in two urban centres in the island. The selected for areas are Colombo and Kandy (Figure 1a & 1b). Of the two study areas, Colombo is located in the coastal plains of the western region of the country. The terrain in Colombo is of gently undulating plains with high density of drainage paths. Kandy city is a plateau in the central mountainous region and is around 500 to 700 meters above sea level. However the terrain in Kandy city area does not contain many steep, plunging slopes except in the surrounding mountains. The topography in this plateau consists of undulating plains with hillocks formed by drainage paths separating them.

Climate: In terms of the amount and pattern of the rainfall received, Sri Lanka can be divided mainly into three different climatic zones. These zones are referred to as wet zone, intermediate zone and dry zone. Rainfall in the island mainly occurs during the Southwest and Northeast monsoons and during the inter-monsoons. Both the selected urban areas are located in the wet zone, which receive an average annual rainfall of about 2500 mm. However with the recent climatic changes, the average rainfall iso-lines from 1911 to 1940 compared with the average rainfall iso-lines from 1961 to 1990 show that the rainfall has significantly reduced all over the country and specially around Kandy (Ratnayake and Herath 2005). Further it is revealed that the lengths of the dry periods have increased all over the country and the lengths of wet periods have decreased. This climatic change has directly affected the groundwater by reducing the recharge time corresponding to the lengths of the wet spells and increasing the exploitation with increased use during dry spells. However, according to the historical data, the Colombo area receives an average annual rainfall of 2376 mm (40-year average) while the Kandy study area, receives an average of 1841 mm (60-year average).

Socioeconomic condition: Regionally, Colombo and its suburbs accommodate the densest population in Sri Lanka. As of 2001, the total population living in Colombo study area was 4.3 million. The total population in 2001 of the Kandy study area was 1.27 million (Sri Lanka Data Sheet

2004 and Sri Lanka Department of Census and Statistics web page). The average population growth rates during the past 20 years in the Colombo and Kandy regions are 1.7% and 1.0% respectively. Here the Kandy average value is lower than the current country average of 1.2%. The GDP of the country at US\$879 in 2000 has increased to US\$1160 in 2005 (Central Bank of Sri Lanka web page).

Land use: The total land coverage in Colombo and Kandy case study areas are 1575.6 km² and 322 km² respectively. The land use changes during the recent past show that the major change in both the study areas is the rapid increase in built-up areas. Colombo shows an increase of 900% within the eleven years from 1987 to 1998. This increase replaces the domestic gardens, water bodies and marshes (a typical domestic garden in Sri Lanka mainly consists of mixed vegetation that surrounds the house). Also there is a significant decline in the extent of domestic gardens, mainly because of migration to commercial crops. Another, significant change in relation to this study is in the reduction of cropping efficiency of paddy that cover nearly 20% of the area. This change is happening in both study areas and usually is not reflected in the land use maps. The cropping efficiency

in the late seventies was nearly 200% with two cultivation seasons, while in the last decade, this dropped to an average of 140%. This has substantially restricted the amount of irrigation water in the paddy fields, thereby reducing the sub-surface flow and recharge, which in turn influenced the groundwater resources in the regions.

Groundwater Resources, Development and Related Problems

There are six main type of groundwater aquifers demarcated and identified in Sri Lanka. They are shallow karstic aquifers, coastal sand aquifers, deep confined aquifers, lateritic (cabook) aquifers, alluvial aquifers and shallow regolith aquifers in the hard rock region. In addition to these major aquifers, a large number of small groundwater pockets can be found throughout the country. These aquifers occur in either isolated patches of soil cover over the bedrock or in the fracture and weathered zones of the underlying metamorphic bedrock formation.

Colombo basin hydrology indicates that there is a fair amount of groundwater potential both in the alluvial aquifers and bedrock. The prominent aquifer bedrock types in the basin are quartzite and a few crystalline limestone (marble) bands. The secondary porosity of these formations provides excellent conditions for deep aquifers. The alluvial sand/gravel aquifers in the basin are recharged by rainfall and seepage from the rivers. High-potential porous residual laterites also contribute to groundwater supplies. During droughts, river water and springs recharge most alluvial aquifers in the basin.

Groundwater in Kandy exists mostly in the form of semi-confined aquifers in the first 100 meters of the bedrock. Groundwater storage exists as small pockets of underground reservoirs or as fissure groundwater. The available amount of water in these aquifers is not very well known and is limited as the recharging of these aquifers is very slow. In addition, there exists high-yield groundwater resources along the alluvial flood plains of the Mahaweli River and are mostly recharged by the river water.

The water demand in Sri Lanka is steadily increasing particularly for urban and rural water supplies, irrigated agriculture and in the industrial sector. This rapid increase in demand is exerting considerable pressure on the available groundwater resources. According to the WHO/UNICEF report on "Joint Monitoring Program for Water Supply and Sanitation-2000", only 76.1% of urban population was supplied with a piped supply compared to 11.4% in rural areas, while the urban and rural population using underground well-water was estimated to be 22.4% and 71.8% respectively. (Urban and rural populations in 1999 were 5.86 and 13.05 millions respectively.)

There are 93 urban and rural piped water schemes operating across the country that rely entirely on groundwater for their supply, accounting for 31% of the total. The total amount of annual groundwater abstraction from these 93 schemes

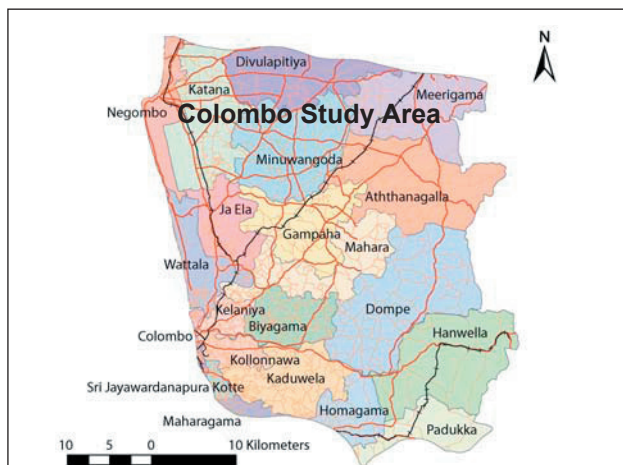


Figure 1a. Case Study Area - Colombo

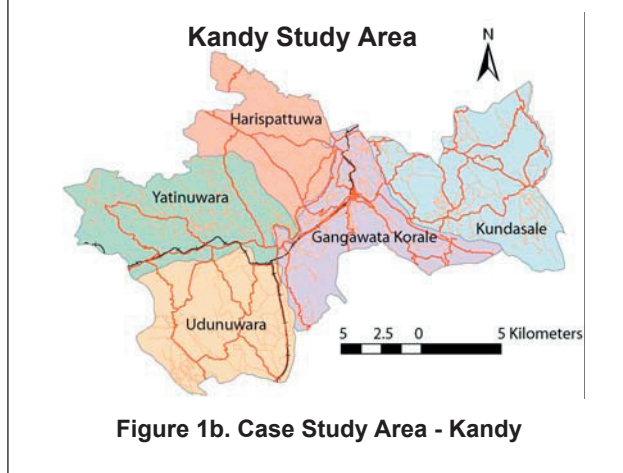


Figure 1b. Case Study Area - Kandy

exceeds 16 million cubic meters. In addition, the approximate amount of groundwater used in piped water supply schemes in the Gampaha and Kandy districts are 5859 m³/d (10% of the total supply) and 13,233 m³/d (30%) respectively (Panabokke and Perera 2005). There are no water schemes relying on groundwater in the Colombo district.

The total number of recorded deep groundwater abstraction wells in the Colombo, Gampaha and Kandy districts is 342, 890 and 1754, respectively. According to the Department of Statistics, the piped water coverage and population using groundwater in 2001 in Colombo was 64% and 33.5%. In Gampaha it was 22.2% and 73.4% and in Kandy it was 40% and 50%.

There are three main state agencies involved in groundwater studies, investigations and development in Sri Lanka. They are the Water Resources Board (WRB), National Water Supply and Drainage Board (NWS&DB) and the Agriculture Development Authority (ADA). In addition, a few private drilling companies and donor funded projects have also been engaged in the investigation and development of this resource. In terms of monitoring and data collection, these organizations collect data primarily for their own use, although some is shared with other agencies and some is released to the public. However, this collected data is limited only to deep wells. In most cases, the recorded information is restricted to the drill log, the initial water levels and the initial water quality. There is no information available on wells constructed by other private drilling companies.

Presently there are no legislative provisions available for the assessment planning or management of groundwater in Sri Lanka. Therefore, none of above agencies are responsible for the management of the groundwater resources of the country. Because of this there is no groundwater-related monitoring data available and there is no means of controlling the adverse impacts from the developments taking place in recharge areas.

Quantity-related issues: Most of the quantity problems experienced in the study areas occur either in the coastal aquifers, vesicular laterite aquifers or in semi-confined rock aquifers. In the coastal regions of Colombo, over exploitation is seen as a major threat to the sustainable use of its coastal sand aquifers. These thin, freshwater lens aquifers that float on saline water is often contaminated with saline water due to excessive abstraction, especially during prolonged droughts.

In regions of vesicular laterite aquifers, some are highly productive. So they are commonly used for medium-scale piped water supply schemes. Excessive abstraction that mostly occurs in the laterites located away from the flood plain results in the lowering of the water table. When these aquifers are used excessively, the aquifers themselves are subjected to localized groundwater table depletions affecting the groundwater wells in the surrounding areas.

The semi-confined rock aquifers are used in high-volume applications, such as industrial activities, and by water-supply schemes. However, according to the NWS&DB, in most

of these deep hard-rock abstraction wells have experienced either a rapid lowering of the water level or decreased yields or both. The causes for these failures are largely unknown due to the lack of information and instrumentation for proper investigations.

Quality-related issues: Both in Colombo and Kandy, there is no continuous monitoring of groundwater quality being done. Based on the quality measurements taken from many bore-hole wells constructed in Kandy during test pumping, have shown high levels of hardness, iron and nitrite. Hardness as high as 1125 mg/l has been recorded in these areas, with the total iron at 18 mg/l, nitrites at 128 mg/l and sulphates at 500 mg/l.

Apart from these initial water quality measurements, there have been a few quality measurements taken over the last few years. Although they have not been tested at regular intervals or at regular locations, most of these quality tests shows that the main quality concern in the shallow groundwater is contamination due to coliform.

Policy Responses, Future Challenges and Policy Recommendations

As discussed there have been a number of recent warning signals pointing to problems associated with the increasing groundwater use in Sri Lanka. Though Sri Lanka is blessed with good water resources when one considers the total aggregate water availability, the variations over space and time, from the historical perspective, demand a proper management strategy. It is clearly evident that unless appropriate policy initiatives are taken immediately, the long term sustainability of the water resource is highly uncertain.

As a means to address the groundwater issues, Sri Lanka proposed a Water Policy. The major deficiencies in the present groundwater management setup that have been identified under the proposed water policy are listed below (National Water Policy – Draft, 2000).

- Ownership, and therefore management responsibility, of the groundwater is not clearly defined in legislation.
- Responsibility for investigation into, development of and regulation of groundwater is not formally assigned to any agency.
- There is neither coordinated groundwater information program nor proper groundwater planning system.
- Even when a considerable body of information on seasonal behaviour and quality is available, there is no institutional authority for control or regulation of the resource.
- There is no legal basis for groundwater allocation.
- There is no public information or awareness program regarding groundwater.

Based on the above views the authors propose the following policy recommendations to be address immediately to protect the available groundwater resource.

- To achieve sustainable management of groundwater

resources, the unique characteristics of specific aquifers need to be recognized. In particular, the rate of aquifer replenishment and the sensitivity of aquifers to depletion and contamination need to be taken into account in groundwater planning and allocation. Therefore it is recommended to establish guidelines for proper groundwater management.

- Establish an authority to coordinate the management of groundwater related issues.
- Make authorized agencies responsible for planning and managing the groundwater resource developed by them.
- Issue guidelines for safe and sustainable exploitation and use of groundwater for all types of aquifers in this country. Disseminate the guidelines widely. Drilling technology needs to be improved and needs to set standards for drilling companies.
- Initially, start a registration program for heavy groundwater users. Thereafter, establish a well licensing program to track groundwater development.
- Areas sensitive to groundwater should be identified and demarcated with immediate effect.
- An integrated approach should be taken in the management of surface and groundwater. This may involve education and other means of encouraging water users to use surface water when it is available and to save groundwater for use during periods when there is deficient surface water.
- In most cases, the exploitation of shallow groundwater is through small-scale domestic and agricultural wells. While each of these wells use only a small amount of water, their cumulative impact can be considerable. It is considered impractical to regulate these small wells through water entitlements. Therefore steps must be taken to control the over-use of shallow aquifers and thus to safeguard the water supplies of existing users of shallow wells.
- Reliable information is essential for the sound management of water resources. However, information on groundwater availability and quality is currently very limited and it is necessary to enhance the collection of groundwater data and management of information.
- A strategic approach needs to be adopted in relation to groundwater information. Research, assessment and ongoing monitoring need to be undertaken both on a widespread, reconnaissance basis and more intensively, in priority aquifers and in areas of declared water management and areas sensitive to groundwater.

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