There is a clear understanding at national and regional levels that insufficient political attention has been paid to ensuring water security in the Caribbean. Furthermore, there are growing concerns over the ability of governments to ensure the good management and provision of water without jeopardising economic growth and the maintenance of social well-being. Of concern are: the impacts of climate change, tariffs and the financial sustainability of service provision; the need to upgrade existing water infrastructure and improve the efficiency of resource use; the prevention of pollution of water sources; and the management of resources and services in the face of natural hazards.

This article provides an outline of water resources in the Caribbean focusing predominantly on the major factors influencing water security; the state of water resources; and service provision and factors affecting supply and demand in the region. The potential impact of future changes, such as demographics, climate change and economics, are explored.

Background

Water security is seen increasingly as an integral part of human security and central to the achievement of other rights, such as the right to life, education, health and adequate housing. Thus, access to enough safe water at an affordable price is necessary for a person to lead a healthy, dignified and productive life. This needs to be balanced against the need to maintain the health of ecosystems that provide water (Watkins et al., 2006).

The Global Water Partnership has defined a water secure world as one that ‘integrates a concern for the intrinsic value of water together with its full range of uses for human survival and well-being … harnesses water’s productive power and minimises its destructive force … where every person has enough safe, affordable water to lead a clean, healthy and productive life,’ and ‘where communities are protected from floods, droughts, landslides, erosion and water-borne diseases’ (GWP, 2012).

Considering the various definitions of water security, of which the above is but one, there are common elements that provide a framework within which to examine the Caribbean situation.

Figure 1 provides a proposed listing of drivers that may be associated with water security, though it does not necessarily capture the overlapping nature of some.

Adequacy of resources

Climate change projections for the Caribbean have indicated increases in temperature of between 0.7°C and 4°C depending on the emission scenario chosen (Campbell et al., 2010). In one scenario used in recent modelling work (Hall et al. 2012) a 2.5–3°C rise in temperatures is projected for the northern and southern Caribbean, and a 2–2.5°C rise for the eastern Caribbean for the period 2075–99. Further work by Hall et al. projects a decrease in annual precipitation of between ten and 30 per cent by 2080, and for the months of the wet season a 30 per cent decrease in monthly precipitation for the northern and 20 per cent for the eastern Caribbean is projected. However, over Belize and Guyana increases of between 20 and 30 per cent during the wet season are projected. The projected significant reduction in wet season rainfall across most of the insular Caribbean is particularly problematic and suggests that there is the potential for a major reduction in freshwater flows and groundwater recharge. Anecdotal evidence from Dominica appears to suggest that this may already have begun, with decreases in stream flows having been observed.

The projections are particularly troubling given that there are already serious gaps between available supply and demand in many Caribbean countries. Belize and Guyana, however, are faced with a different set of problems to those of the insular Caribbean. These countries have more than adequate water resources but are more prone to the effects of drought, flooding and, in the case of Belize, hurricane activity. The situation across the region is
compounded by high levels of unaccounted-for water loss, which results in a loss of, for example, 67 per cent of water in Jamaica, 40 per cent in Trinidad and 50 per cent in Barbados. The paradox is that many of these countries have sufficient water resources to meet demand, but lack the infrastructure or institutional frameworks to close the supply–demand gap.

The impact of climate change on infrastructure in the Caribbean can be considered to be twofold. Firstly, existing infrastructure may be ill-equipped to cope with changes in the hydrological regime and water quality. Secondly, it is anticipated that there will be an increase in category four and five hurricanes and, given that existing hurricane activity impacts water infrastructure through landslides and other damage, the increased activity is likely to have a more detrimental effect, see box: ‘Risk factors’.

Countries such as Trinidad and Tobago, Grenada, St Vincent and the Grenadines, Saint Lucia and Dominica use surface water for the majority of their freshwater supplies; whereas countries such as The Bahamas, Barbados and Jamaica rely heavily on groundwater.

A major challenge facing water resource managers as well as service providers is the difficulty associated with being able to determine the safe yields of aquifers and to undertake regular assessments of the yield–demand balance. Often, the required hydrogeological data, the models and the skilled personnel to do this are all in short supply.4

Changing population dynamics and rising incomes have been identified as two of the underlying drivers of water demand (WWAP, 2009). In the Caribbean region the effects of population growth are less significant than the impact of rising standards of living, changes in the age distribution of populations and urbanisation. Levels of urbanisation are increasing; already 65 per cent of the population live in conurbations. A feature of most Caribbean countries, especially the islands of the Lesser Antilles, is that the majority of urbanisation has taken place around the coastal fringes, with up to 70 per cent of the population living in coastal areas, of which 40 per cent live within 2 km of the coast (Bueno et al., 2008; UNEP, 2008). Urbanised populations tend to consume more water per capita than rural populations.

Tourism and tourist facilities are also large consumers of water, with visitors consuming up to three times as much as the local population on a per person basis (Charara et al., 2011).

Governments across the region remain keen to encourage growth in tourist numbers and though in some instances hotels are responsible for their own supplies, many are supplied from municipal distribution systems and can account for between ten and 15 per cent of all water supplied.
Access to services

For many Caribbean countries, improved water supply and sanitation coverage exceed 90 per cent of the country. The problems are not so much associated with the provision of or access to water services (though this does remain an issue) but with the quality of service and the maintenance and operation of the infrastructure.

In Barbados in particular, underreading by domestic and bulk production meters as well as pipe bursts and leakages contribute to high levels of unaccounted water loss (Halcrow Inc, 2010). Across the region, countries have an ageing water infrastructure and tend to focus their efforts on the maintenance and extension of supplies to customers. Investment in mains replacement programmes as well as in leakage management has not received much attention. This is partly due to management efforts focusing on ensuring that new developments are serviced and supporting economic activity.

Water is intrinsically heavy and requires energy to be transported through transmission and distribution systems. As a result, many water utilities are big consumers of electricity. Electricity generation in the Caribbean relies heavily on imported fossil fuel, paid for in hard currency, and represents a burden on many countries’ balance of payments. Energy costs in the Caribbean are among the highest in the western hemisphere. It has been estimated that savings of between 30 and 40 per cent could be made by installing energy-efficient devices and optimising pumping equipment (ECLAC, 2010). Little use is made of renewable energy sources, other than of hydropower.1

The provision of infrastructure for waste water services lags behind drinking water services. It has been estimated that 85 per cent of waste water entering the Caribbean Sea remains untreated.

Sewage discharges into the marine environment are considered to be one of the main factors causing the degradation of coral reefs, eutrophication and harmful algal blooms. A cost-benefit analysis of a proposed sewerage scheme in Barbados (BWA, 2008) demonstrated that, despite (relatively minor) public health benefits, costs arising from tourism-related losses and deterioration of the marine environment were in the order of US$260 million, giving rise to benefit–cost ratios of between 1.3 and 1.6. Moreover, advanced wastewater treatment would allow for an augmentation of scarce water resources and increase water availability for agriculture and industry.

Management for affordability

Arguing that water and sanitation are essential social services, it is common for politicians and politically influenced regulators to keep tariffs below cost. In a report by the World Bank (2005) it was argued that ‘the fact that many Caribbean water utilities are demonstrably inefficient helps rationalize this decision’.

Poor management, lack of investment and inadequate water services have led some Caribbean states to consider addressing the problems through forms of franchise or private sector involvement (this has occurred in Guyana, Trinidad and Tobago, Saint Lucia and Belize). For a variety of reasons, these initiatives have not been successful and have been opposed by trade unions and citizen groups. An emerging alternative has been to encourage co-operation between service providers both within and outside the region, as well as benchmarking the performance of water service providers. However, a lack of agreed standards of performance, confused and ineffective regulation of utilities (World Bank, 2005) and an absence of water policies (Cashman, 2012) has allowed poor performance to continue to place security of supply and effective water management at risk.

There are, after all, two sides to affordability: first, the affordability of water management and services to the consumer/customer/citizen, which revolves around determining willingness and ability to pay for services; and second, the costs associated with the provision of services and how these are to be afforded by the provider. While there are many instances of affordability being largely determined by political considerations within the Caribbean, probably only Jamaica has an independent and functional regulatory regime through which such matters can be resolved (World Bank, 2005).2

A development that appears to be emerging as a result of the current economic challenges is that of off-balance sheet financing mechanisms such as public–private partnerships. To date, such arrangements have been used in the provision of desalination plants, but there is no reason why the approach cannot be extended to other aspects of service provision and management, such as that of waste water facilities. Some of the successful delivery models from Jamaica and Haiti include water services being provided by small companies, community-based organisations and non-governmental organisations.

Risk factors

Hurricane Tomás, which affected the Caribbean in 2010, highlighted the impact of extreme events on maintaining accessibility under emergency situations. In Saint Lucia, as a result of the impact of Hurricane Tomás, the principal storage reservoir was silted up by a landslide, which damaged the electricity supply and pumping facilities. Consequently, some 80 per cent of the population had to cope with limited water supply. The siltation blocked the lower intake significantly, reducing the available storage supply volume. Hurricane Tomás highlighted the multiple facets to maintaining accessibility; water systems cannot operate without electricity and water becomes non-potable if it cannot be properly treated. This suggests that greater attention needs to be paid to scenarios where risk and uncertainty analysis are factored in.

The ability to withstand shocks (such as droughts, floods and hurricanes) to water services infrastructure is a matter that has hereto not received much attention in the Caribbean region. More attention has been paid to the formulation of drought management measures and sector responses to hurricanes than to disaster and emergency response planning across affected sectors. This is changing as greater attention is being paid by water managers to the development of Water Safety Plans (LAC-WSP Network, 2008; CEHI, 2009) and, more recently, by the industry in developing source vulnerability assessments.

At the heart of it, the ability to cope with shocks is as much a governance issue as it is an infrastructure issue.
Even under the current economic circumstances, there is a trend of increased investment in infrastructure such as production wells, water treatment works, pumping installations, leakage reduction initiatives and mains replacement programmes. Water utilities in Dominica, Barbados, Grenada, Jamaica and others are investing, sometimes out of their own resources and sometimes with the help of international financing institutions, in works that extend existing supplies or make them more robust. Jamaica is currently planning to invest US$44 million in upgrading rural water supplies, benefiting 250,000 people over three years in addition to obtaining an Inter-American Development Bank (IDB) grant to carry out a rural-water master plan and a review of its water sector policy.

Efforts to address institutional weaknesses have not been universally successful nor have the key linkages between land and water management been incorporated into policies and planning. This is probably the second biggest challenge, after economic development, facing the region.

The Global Environmental Facility project, Integrated Watershed and Coastal Area Management (IWCAM), prepared integrated water resources management plans for Grenada, Barbados, St Vincent and the Grenadines, Saint Lucia, Dominica, St Kitts and Nevis, and Antigua and Barbuda. The IWCAM was credited with helping to put into force the LBS Protocol (Protocol Concerning Pollution from Land-Based Sources and Activities), thereby paving the way for the launch of the Caribbean Fund for Wastewater Management (CReW). These initiatives have bolstered efforts to improve data gathering with Barbados, Guyana, Grenada, Saint Lucia and Jamaica, and with implementing national water information systems. Such systems are fundamental in improving overall water management.

**Conclusion**

The efficient management of water resources and services continues to be a concern in many small island states in the Caribbean. There are growing concerns over the ability of governments in the region to ensure the good management and provision of water without jeopardising economic growth and the maintenance of social well-being. Data gathering, and information availability and management are major challenges that have been highlighted on many occasions. Furthermore, a lack of data, compounded by barriers to making data available, hampers the understanding of current water vulnerabilities, the ability to plan ahead and the ability to identify appropriate adaptation strategies. Thus far, forward planning has been largely neglected and this is symptomatic of a lack of appreciation of the need for having national water policies. In this respect, Jamaica’s development of a national master water plan serves as an example of what can be done. The reluctance to involve the private sector in a range of activities, such as localised water supply, waste water facilities and outsourcing, needs to be addressed and a conducive environment to facilitate its involvement established.

Lastly, the perception has to be addressed that welfare and water are synonymous. Water service providers have to be efficient, well managed and allowed to do their job. This means that they have to be on a sound financial footing. The challenge is to find the balance between appropriate political and regulatory oversight, and the autonomy of water managers and service providers. Compared with 50 years ago, water security in the Caribbean has improved enormously and the achievements are all the more impressive given where the region has come from socially, politically and economically. There are still many challenges to be faced and these are acutely apparent through the impact of natural hazards.

However, climate change, in itself, is not the most pressing problem; rather the issue is the macroeconomic conditions of the Caribbean since it is this that determines the creation and availability of resources – natural, human intellectual and financial – needed to facilitate a water-secure Caribbean.

**Endnotes**

1 In October 2012, at the Eighth High-Level Session Ministerial Forum on Water, the importance of ensuring long-term water security as a driver for economic and social development, and the urgent need to address water scarcity in the Caribbean region were recognised (GWP-C, 2012).


3 Barbados is utilising close to 100 per cent of its available water resources; Saint Lucia has a water supply deficit of approximately 35 per cent; Nevis of 40 per cent; Trinidad has had a water supply deficit since 2000 (WASA, 2003); Jamaica is projected to experience deficits in supplies to areas of important economic activity by 2015 (GoJ, 2011); Antigua and Barbuda is reliant on desalination to meet water demands; and in Dominica, Grenada, and St Vincent and the Grenadines demand exceeds supply during the dry season due to reduction in stream flows (UWI, 2012).

4 Situations are more complex at sub-national levels, with disparities between available surface and groundwater resources, their spatial distribution and the location of centres of demand. This can give rise to situations where, as in the case of Jamaica, some of the water resources are exploited beyond their renewable levels. This is particularly the case for groundwater, for which changes in recharge rates due to climate change are likely to have severe supply implications.

5 Desalination as a source of supply is being used on 14 islands and in some cases, such as the Cayman Islands and Aruba, there is little other choice available. In other instances, desalination plants supplement existing resources or are a drought-proofing measure, such as in Barbados. There has been a growing tendency to push desalination as a solution for water supply difficulties. The attraction is that such plants can be built relatively quickly and are often outsourced to the private sector under long-term build–own–operate contracts.
Whilst desalination plants do provide a ‘backstop’ source of water, the continued affordability of such supplies, when reliant on fossil fuels, is open to question.

6 The predominant financing model in the Caribbean is one whereby operation and maintenance costs are covered by revenue from tariffs, but capital works are funded through loans guaranteed by governments and by government transfers. This ‘cash needs’ approach (Baietti and Curiel, 2005) does not take into account implicit costs, such as exchange and inflation risks; environmental costs; bad debts; and costs of foregone operation and maintenance. If tariffs are not regularly reviewed and adjusted there will be an increasing reliance on taxation transfers. A compounding factor is the lack of a clear institutional framework of policies, legislation and regulations that sets out duties and responsibilities, such as cost recovery policies (Cashman, 2012).

References


BWA (Barbados Water Authority), 2008. Cost–Benefit Analysis for Implementing the West Coast Sewerage Project under a Public–Private Partnership Agreement. Bridgetown: BWA.


ECLAC (Economic Commission for Latin America and the Caribbean), 2010. Energy Efficiency in Latin America and the Caribbean: Situation and Outlook. Santiago: ECLAC.


UNEP (United Nations Environment Programme), 2008. Climate Change in the Caribbean and the Challenge of Adaptation. Panama City: UNEP Regional Office for Latin America and the Caribbean.


WASA (Water and Sewerage Authority), 2005. State of Water Resources. Port of Spain: WASA.


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