Water Policy Brief

Reflecting on the Challenges of Attaining a Green Economy[1] for Botswana

Introduction

This policy brief is aimed at raising awareness on the status, challenges and opportunities of the water sector in Botswana. The policy brief captures progress to-date in expanding access to clean water, reflects on the challenges of the water sector in light of the natural aridity of Botswana, her rising population and industrial demands on her scarce water resources, and indeed her water insecurity. The policy brief also reviews the global target under the Millennium Development Goals (MDG-7), the global commitments to balance development and ecological needs in the interest of wetland habitats, and thirdly, the regional cooperation agreements on shared water-courses. A further reflection is made on the likely impacts of a drier climate with more extreme weather events as anticipated due to climate change. As water stress increases, the environment is likely to suffer. This is discussed in the context of dams and natural wetland systems where the balance between economic developments, social needs for water and the ecological requirements of natural habitats.

Status of Water Resources

Botswana's water sources consist primarily of surface water (in rivers, pans and dams of various sizes) and underground water in aquifers some of which are of a fossil nature with no recharge. Of the eight dams, Dikgatlhong is the largest with a capacity of 400Mm^3 (see Figure 1). All of Botswana's perennial rivers are shared with neighbouring countries. The shared river-basins are Okavango, Zambezi, Orange-Senqu and Shashe-Limpopo. Botswana's storage capacity is one of the lowest in the region, owing to its flat topography.

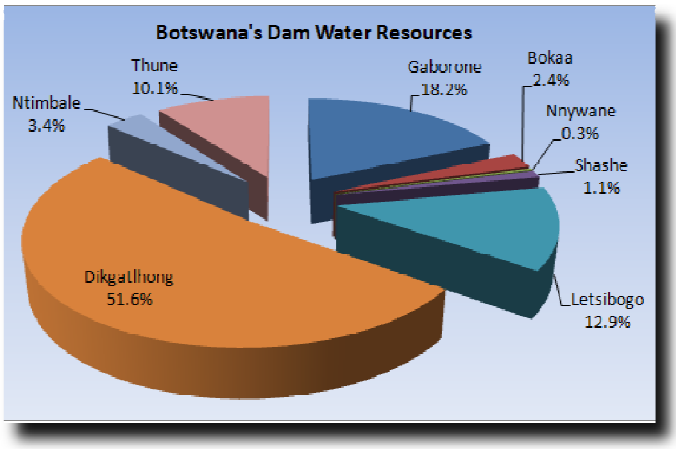

Figure 1: Botswana's dam-water resources showing the proportions of their carrying capacities **(Central Statistics Office, 2009).**

Botswana's access-to-drinking water has at 2001 reached 99.5% for urban areas and 83.5 for rural areas (Central Statistics Office, 2009). Most rural areas are supplied with borehole water while nearly all the urban centres, except Gantsi Township on the western part of the country are supplied with surface water. Total dam-water capacity is currently approaching 800Mm^3 while underground capacity (developed resources) is at 131,290 m^3/day. The national per-capita consumption has remained generally unchanged at 0.15m^3/d. Wastewater recycling has also added to the national water resource-base. Ministry of Agriculture has partnered with the Water Utilities for the economic utilisation of recycled water from Gaborone city sewage treatment plant with plans to follow a similar pattern with other cities in the rest of the country through roll-out of the National Master Plan for Arable Agriculture and Dairy

[1] A Green Economy is one that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities (United Nations Environment Programme, 2011). Operationally, it entails adoption of low carbon options, greater resource efficiencies and social inclusion.

Development (NAMPAADD). A number of government institutions including schools and army camps have established grey-water recycling facilities and thus reducing the demand on clean water for uses such as gardening and brick-making.

A national Integrated Water Resources Management (IWRM) plan is under preparation through support from the United Nations Development Programme and the Global Environment Facility. The plan is scheduled for completion at the fall of 2012. The IWRM plans marks one of the MDG7 targets and will help facilitate coordination of various stakeholders in the water sector to achieve greater ecological and socio-economic efficiencies. Part of the plan preparation has been to support some elements of the Water Sector Reform such as formulation of a national Water Resources Management Policy and capacity building for local authorities in water resources planning. The reform also includes separation of roles between service providers and regulators.

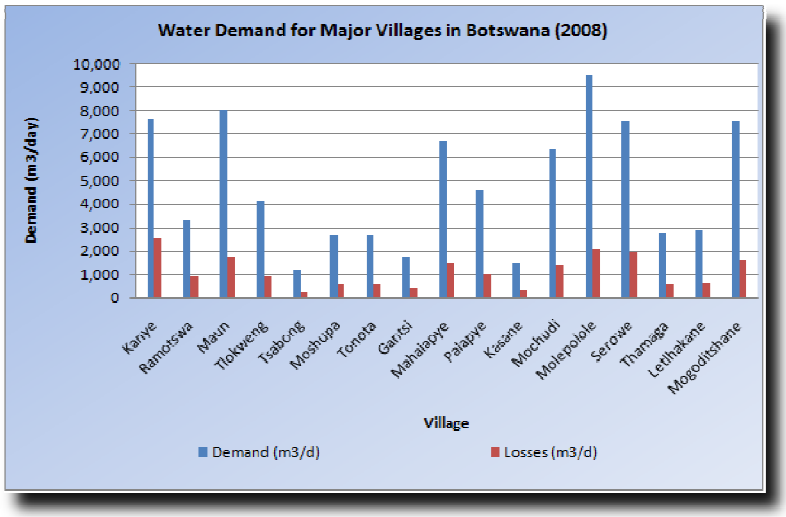

Figure 2: Water demand and losses in major villages **(Central Statistics Office, 2009)**.

Consumption for the different major villages (including losses) is shown in Figure 2. The highest consumption is in Molepolole, followed by Maun, Kanye, Mogoditshane and Serowe - all of which are above 7,000m^3/day. Vis-a-vis water losses, Kanye has the highest losses totalling as much water as Tsabong and Kasane collectively consume per day.

Trends in overall consumption in villages have been rising, especially in peri-urban areas (see Figure 3 below). Consumption figures have risen most sharply for Mogoditshane, followed by Kanye, Mahalapye and Molepolole. Most villages have remained in the average to below average range. The average consumption ranges from 500,000m^3 in 1996 to 1.14Mm^3 in 2006. The influence of proximity to urban centres is clear as in the case of Mogoditshane village and carries implications for physical planning and water demand management.

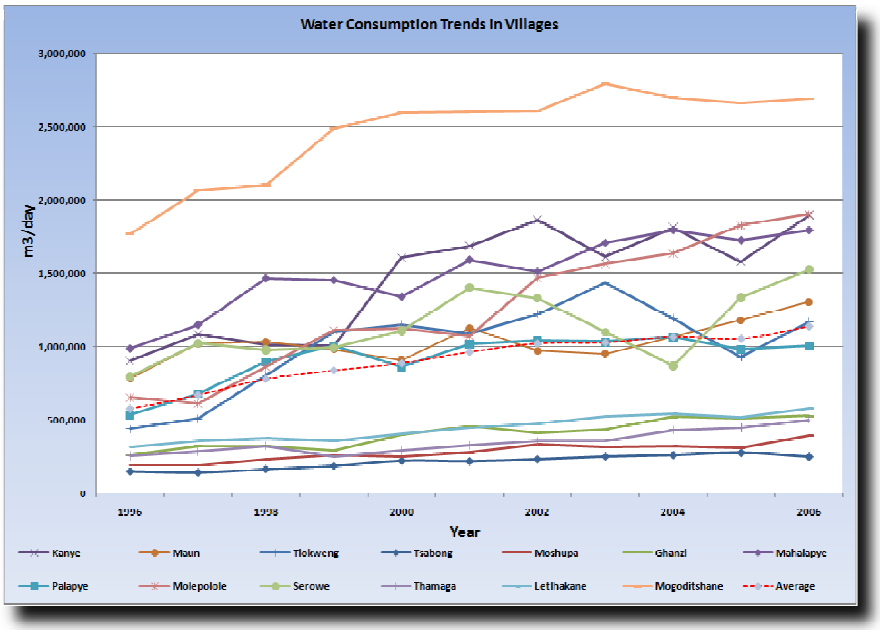

Figure 3: Trends in water demand in major villages **(Central Statistics Office, 2008)**.

Villages generally have a lower per capita consumption than urban centres. Villages have on average about 0.15m^3/day per capita consumption while cities and towns have as high as 0.55m^3/day. Amongst the urban areas (see Figure 4 below), the highest per capita consumption is in Selebi Phikwe and the lowest is in Francistown. Gaborone and Jwaneng are running at par except for year 2003 when Gaborone was higher. In terms of trends, Sowa Town has had a significant steady decline in its per capita consumption from 2001 at 0.45m3/day to 0.24m^3/day – almost reducing to half its per capita

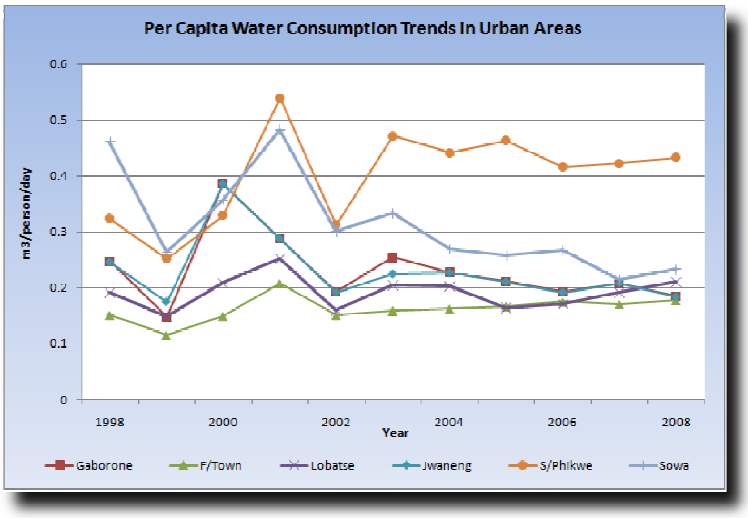

Figure 4: Trends in per-capita water consumption in urban settlements. **(Central Statistics Office, 2009)**

consumption. All urban areas show only a modest per-capita increase and are fluctuating around 0.2m3/day except for Selebi Phikwe which is maintaining its 6-year average at 0.44m^3/day – almost doubling the rate of other urban areas.

Analysis of wastewater infrastructure shows that a number of the systems have exceeded their design limits while some are on the brink of doing so (see Figure 5 below). This represents a risk to freshwater resources. Kasane and Gumare have both exceeded their design limits and are therefore likely to be under-treating the effluent. Both are located within wetlands of both national and global importance (Chobe and Okavango, respectively) thus risking polluting the water-table with immense consequences for the environment and local communities. Serowe has one of four systems way beyond its design limits and even with inadequate data on the location and geology of the aquifers in the areas, the impact on the ecology cannot be ignored. Gantsi's waste water system is approaching its design limit. The Gantsi situation is even more delicate because of the proximity of the aquifer to the ground surface and the aquifer being the only source of water in one of the driest parts of the country. Anecdotal data on income poverty in Gantsi suggests that the use of water-borne sanitation may not be affordable to many residents though essential. This may lead to a high number of pit latrines and soak-away toilets therefore presenting risks of underground water pollution to a scarce water resource.

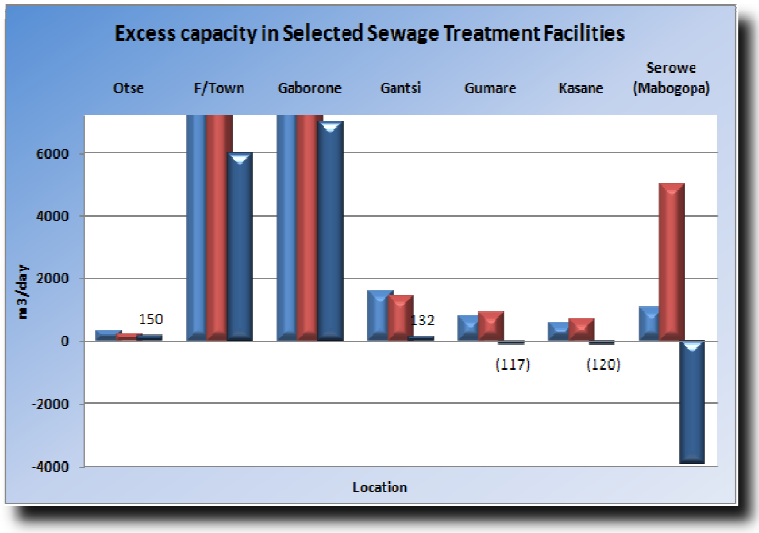

Figure 5: Excess processing capacity of selected wastewater treatment plants **(Department of Waste Management & Pollution Control, 2012)**.

Challenges Facing the Water Sector

Botswana's economic success has transformed quality of life through provision clean drinking water. Access to drinking water in urban areas had reached 99.5% at 2008 and rural areas at 84.1%. This success has also had positive impacts on health and sanitation thus contributing to the other MDGs, especially on gender equality and child mortality. Collecting water and ensuring that there is enough water for household use is usually the domain of women and girls. This, in addition to other household tasks, can be labour-intensive and time-consuming. There also have been challenges of a sheer increase in consumption of water resources in response to access. Human population increase has remained a relatively low factor compared to other factors that exert pressure on Botswana's water resources. Challenges in the water sector are discussed in the context of Green Economy, which for the water sector (as with others) implies ecological and socio-economic efficiencies, increasing numbers of decent jobs and reinvesting in the environment. These are discussed below.

Dam Development and Management: Botswana has reached her peak of dam development owing to the flat topography of the country. With economical development of dams declining with any additional sites, the need for

efficient use of existing dams is even greater. As dams also act as wetlands, the challenge of managing them as wetlands is prominent. Dams are currently managed by the water utility company (Water Utilities Corporation – WUC) as a parastatal. WUC's main objective is the supply of both treated and raw water to households and industry. This mandate has been extended through the recent Water Sector Reform to cover not just urban areas but the entire country. WUC is the management authority for all the major dams in the country. The primary use of the dams currently is water storage, representing only one of several economic and ecological uses of dams. These include tourism, real estate, fisheries, biodiversity conservation and agriculture. These untapped opportunities represent losses in numbers of decent jobs, contribution to GDP, and improvement of ecosystems.

Water Demand Management: Considering the limited supply of water and the evident declines in rainfall owing to climate change, the per capita consumption remains high for some of Botswana's urban areas. At nearly double the per capita consumptions of other urban areas, Selebi Phikwe presents a major water demand management challenge. Against this background is also the significant decrease in per capita consumption in Sowa Town that needs to be analysed and lessons drawn for country-wide application.

Management of water demand hinges on technology investments for efficient water use within the industry, especially agriculture and mining. Progress has been visible in the mining sector, especially the diamond-processing water demands and in agriculture's interest in drip irrigation. The scale of drip-irrigation in Botswana is still too low to bring out empirical strength. Pilot initiatives through Department of Water Affairs have shown effective reduction in water demand in schools. The wider replication for more empirical strength of these pilots is however negated by the lack of policy within Ministry of Education for water efficiency, or even basic per-capita consumption standards against which the institution's administration is measured.

The neglect of water demand management can result in severe food shortages, disruption of business and essential services such as health and education. The ever rising water demand requires prudent management and employment of technology to optimise efficiencies

Underground Water: All of the western part of the country depends on underground water for both human consumption and livestock. The mining sector also depends largely on underground water (Central Statistics Office, 2009). Current extraction rates exceed sustainable levels for the aquifers (see Figure 6). This represents a challenge of exceeding the ecological limits. This is an even bigger challenge for aquifers of a fossil nature or those with low recharge rates. With climate change causing progressive declines in rainfall, recharge rates are projected to be even lower (Department of Meteorological Services, 2009).

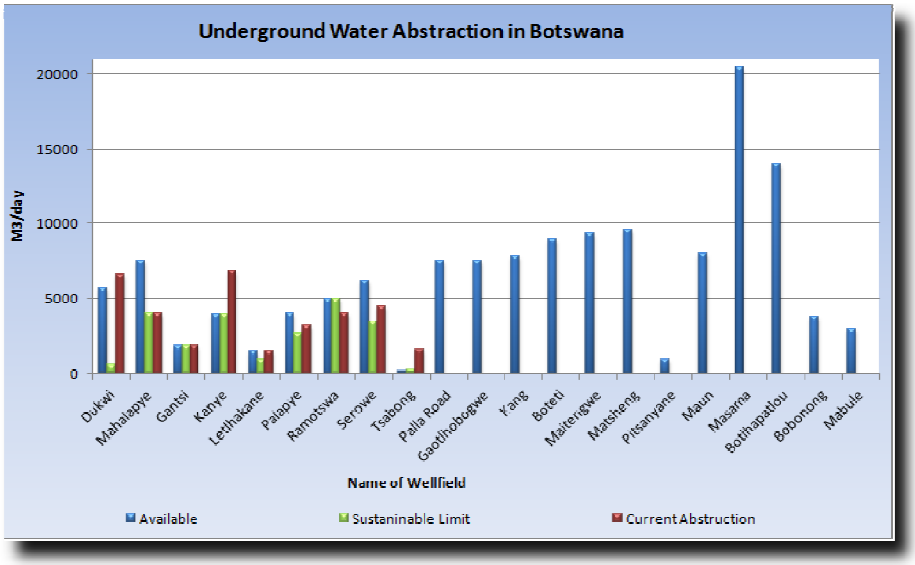

Figure 6: Underground water availability, extraction rate and recommended sustainable off-take levels **(Central Statistics Office, 2009)**.

Further challenges with underground water relate to the land-use planning and positioning of such facilities as landfills. Prudent management of facilities such as petroleum stations, sewage treatment plants is important to ensure zero-contamination to underground water.

Water Losses: Waste water/effluent constitutes 16% of all the water resources of which only 20% is re-used. This represents an opportunity in agricultural production through irrigation. Additionally, despite efforts in the sector to

promote conservation of scarce water resources, water losses and wastage continue with limited abatement. An estimated 46% of purified water is not accounted for (Ministry of Finance and Development Planning, 2010). At such a rate of water-losses, water efficiency levels need to be increased drastically. Most villages are at the peak of their resource availability with water losses factored in. A 46% increase in water availability may be achieved by either developing more water resources (assuming infinite availability) or reducing water losses.

Water, Health and Sanitation: The quality of drinking water, management of sanitation infrastructure, positioning of potentially hazardous facilities such as oil reservoirs and waste landfills and wastewater processing plants require greater institutional diligence. Although waterborne sanitation systems are allocated according to the size of the settlement and within the settlement, these are allocated to middle and upper income residences; where pit-latrines and soak-away systems represent a risk to aquifers, the system of allocation should be revised. This proactive approach stands to bring long-term savings against treating polluted aquifers contrary to the case in Ramotswa village.

Current records show 55 wastewater treatment facilities in the entire country. Of the 33 for which data on their capacities was readily available, it totalled 103,400m^3/day of water spent on water-borne sanitation (Department of Waste Management & Pollution Control, 2012). Assuming twice the volume when adding the unknown figures and considering the projected 300,000 by 2020 quoted in the National Policy on Wastewater and Sanitation Management (Ministry of Local Government, 2001), the current figure could be in the range of 210,000m^3/day. The policy advocates for Sealed Dry Composting Latrines (SDCLs) but specifically for areas where there is no piped water. The benefits may therefore need to be compared with the infrastructure costs and water as an ecological limit to the universal use of a water-borne sanitation system. The World Toilet Organisation (WTO) has supported many governments to transform into a dual sanitation system of water-borne and dry sanitation for different parts of the country. There are health issues to consider (Peasey, 2000) as are agricultural benefits from dry waste for which the Ministry of Health and Ministry of Agriculture with their vast coverage of extension officers, are best placed partners. Botswana needs to engage with this discussion as part of the Green Economy agenda that offers Triple-Win[2] solutions. Through their role as carers, women are most affected by poor sanitation and water-borne diseases resulting from inadequate sanitation infrastructure.

Water for Industry: The Industry is a major element of the economy for generating jobs and taxes for the running of governments and subsequent economic growth. Water is an essential medium for many processes in industries. In Botswana, agriculture, mining, and ecosystems are the main consumers of water. There already is evidence of over extraction of underground water some of which is for industrial use (see Figure 6, page 2). Agriculture also has high demands for water, especially for irrigation purposes. Irrigation is an important technology for mitigation against the negative impact of flush rains on crop production. Current land under irrigation in Botswana totals 3,000ha (Ministry of Finance and Development Planning, 2010). According to You, *et. al* (You, et al., 2010), Botswana is one of several countries in Africa with a disproportionately low percentage of agricultural land equipped for irrigation (see Figure 7).

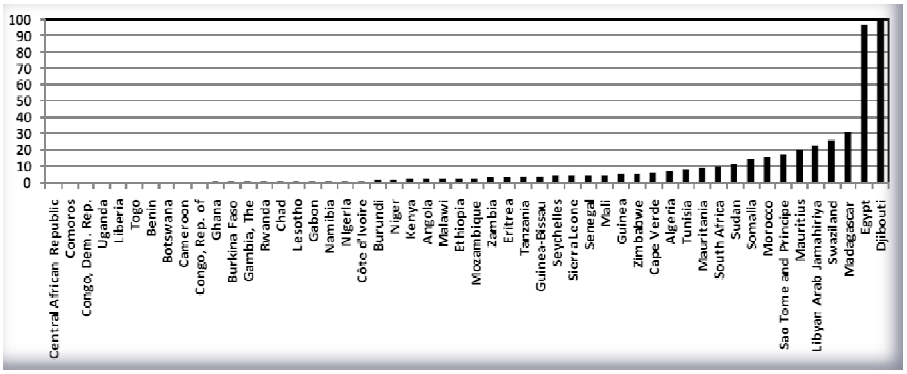

Figure 7: Share of area equipped for irrigation as a percentage of Africa's total agricultural land area. Adopted - **(You, et al., 2010)** .

[2] Triple-Win solution are those development interventions that deliver social benefits while increasing economic returns and enhancing environmental sustainability.

Water for Ecological Services: As a result of the Integrated Water Resources Management planning process, awareness about the ecological needs for water has increased. This, in the context of Botswana, is most relevant for the rivers and wetlands (including dams). As fewer villages draw their drinking water directly from rivers, concerns about water quality may minimise. This latency in public concern notwithstanding, polluted water in rivers reduces the level of biodiversity; eliminate certain species of fish and thus altering the riverine ecosystem, including plants, birds and mammals. Little is presently understood about the ecology of Botswana's riverine ecosystems and their levels of vulnerability. Other challenges relating to ecological needs for water relate to the management of dams where there is no binding requirement for the dam authority to release water from the dam for the maintenance of the downstream ecosystem. Further neglect of this aspect of dam management can cause irrecoverable damage to the downstream ecosystem and in-turn reducing the livelihood sources of downstream communities (International Water Management Institute, 2007).

Integration Water Resources Management: IWRM is probably the most significant challenge as without it, a number of the opportunities identified in the section below may prove unattainable. Education, training and extension, entrepreneurial capacity, sectoral programmes (agriculture, energy, fisheries, tourism, etc) need to coordinate in setting the agenda for a green economy. For example, with acute water shortages Botswana is yet to face, exporting coal-generated electricity is in part, exporting water and the gains need to be assessed more critically; technology transfer requires extension services in order for water to make the optimum impact in agriculture and food security. These examples demonstrate the importance of integration and coordination in leveraging the Green Economy opportunities within the water sector as a country.

Opportunities

As part of embracing a Green Economy, Botswana's water sector has opportunities in being efficient, generating more jobs through various industries (as they increase their profitability through water efficiency), and increasing its contribution to societal and ecological wellbeing, especially food security. Taking advantage of these opportunities may require initial capital investments but these tend to pay-off after 3years. Some of the opportunities will require institutional reform in order for the Botswana to benefit fully from them.

Irrigation and Food Security: Irrigation as a technology still delivers some of the highest yields in agricultural production. With over 210,000m3/day in wastewater, Botswana has potential to raise irrigation output from the current 3,000ha to more than double it with a commensurate increase in food tonnage. A commensurate number of jobs would be created in the process. This green economy opportunity has with it a number of risks such as pollution from fertilizers, and soil salinisation from overwatering if appropriate technology such as drip irrigation is not applied. Additional irrigation planned for the new dams (Thune and Dikgatlhong) presents a delicate balance requiring the most optimal water use and highest efficiencies to bring about food security at the lowest of ecological and social costs. It is important that access to technologies such as irrigation and the financial barriers be noted especially as they are likely to affect women more than men thus calling for appropriate financial instruments to facilitate effective participation and in-turn, food security. A nearly 100 small dams located in different parts of the country, mainly the eastern belt provide opportunities for additional water storage at community level.

Tourism: The use of open water-bodies such as rivers, lakes and dams for tourism carries the highest Green Economy tag as incomes and jobs are generated with minimal consumption of the resource. All of Botswana's dams present these opportunities. The Okavango delta, being the largest wetland in Botswana, is a shining example of how wetlands can generate substantial revenues through tourism. A similar opportunity exists with all of the dams in Botswana although this may require some institutional reforms to effect this transition. These include the following:

(i) Appointing a dedicated authority for management of dams with the capacity for ecosystem, fisheries, tourism and wetland management;
(ii) Increasing the area around dams to create protected areas thus allowing for higher wildlife population sizes and diversity needed for tourism;
(iii) Including neighbouring communities as active beneficiaries and stock-holders through their annexed communal land;
(iv) Establishing community structures for effective management of upstream catchment to reduce siltation and pollution;

(v) Adherence to environmental flows and water-release protocol for the dam to ensure sustenance of downstream ecosystem;
(vi) Collaborating with land authorities (Ministry of Lands and Housing) to establish high-value real estate overlooking the dams;
(vii) Collaborating with Ministry of Trade and Industry to facilitate markets and value-chain for products and services generated by the dam, especially fisheries and horticulture.

Health and Sanitation: The acute shortage of water in Botswana presents opportunities for diversifying sanitation options to include dry sanitation with added benefits to the agriculture sector through dry compost. This waterless sanitation option represents a significant greening of the economy. Added benefits include the reduction in costs to the beef industry currently imposed by measles and other parasitic veterinary diseases caused by cattle coming into contact with human faecal matter in rural Botswana.

Where contamination of aquifers is most likely due to the proximity to the surface, settlements within the proximity needs to be prioritised for improved sanitation even if they are not in the class of major villages, as those aquifers may be serving even the major villages. A mapping of aquifers and their risk-levels is therefore a priority action. Gantsi Township is one such priority-area where improved sanitation needs to be implemented across the township and not restricted to high-income residential areas. Dry sanitation presents opportunities for saving drinking water, contribution to agriculture through reduced parasites in livestock, increasing soil fertility and protecting underground water.

Underground Storage: The lack of further economical dam-sites in Botswana represents a cap in water storage capacity. This can be overcome by underground storage of surface run-off water. This technology will allow Botswana to harvest additional water thus improving water security. In addition to the technical challenges, underground harvesting will require a more stringent regime of monitoring the use of aquifers which are being recharged through this technology.

Water Demand Management: Managing demand is more important that investing is water development because it makes available the same amount of water at a lower cost thus making the economy more efficient. Demand figures include water losses and a Water Demand Management Programme should also address these. Reducing losses and water wastage decreases water processing and transmission costs in the form of electricity and chemicals used for purification. These green saving do not only protect the environment from the negative impacts of coal-generated electricity but also make Water Utilities Corporation more viable thus securing jobs. The application of technology can also reduce water losses substantially. These include leak detection devices, pressure and flow control sensors with real-time and on-line data transmission, automated pressure valves and a GIS-based computerised system to manage these components.

Environmental Flows: The challenge of rising demands for water is only made more complex by the need to retain enough water in rivers to keep their ecological and hydro-geological processes functioning. This is an important part of a Green Economy for which the water sector can make a significant contribution. For Botswana, a starting point will be the dam-release protocol implementation for the respective dams. Other initiatives could include community dialogue to reserve parts of the rivers for limited development to allow regeneration of natural riverine ecosystem and enhancement of water quality and fishing prospects. A third initiative would be to institutionalise assessment of rivers' ecological status and the environmental flows needed to maintain or improve this status. Simple tools exist for use by community groups and the scientific community alike.

Economic Instruments: The preparation of National Water Accounts represents an important step towards integrating economic dimensions into the management of natural resources. Further work requires the establishment of instrument that shape economic behaviour in relation to water resources. Notable examples are payment for ecosystem services where local communities residing upstream within catchment areas are incentivised to prevent soil erosion and pollution for the benefit of the rivers and dams downstream. It also entails identifying and terminating perverse incentives such as water consumption subsidies for employees.

Further opportunities exist in setting tradable pollution permits which recognise that some element of pollution will exists side-by-side with economic development but that such pollution is be within specific Limits to Acceptable

Change. Polluters may therefore trade their permits amounts one another through an authority whose costs are covered by a share of such trade. Such a system has the benefit of stimulating reduction in pollutions as a measure of the company's progression to a greener economy and a means of financing such a transition. NGOs may also but such pollution permits and resell them for a premium.

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