

# Nairobi city is crying out for more water

To meet deficit, the city needs to diversify water sources, reduce wastage and conserve the water catchments

BY JORAM K. KAGOMBE

**N**airobi receives its water resources from two drainage systems. The oldest sources, the Kikuyu Springs (used since 1906) and the Ruiru Dam (since 1938) are located in the Athi River Basin. Sasumua Dam, Ndakaini-Thika Dam (since 1996) and Chania-B Dam supply Nairobi through inter-basin transfer from the Tana River drainage area.

About 20 per cent of the supply is from ground water resources, which works to around 60,000 to 70,000m<sup>3</sup> per day. Total water supply from both systems is about 570,000m<sup>3</sup> per day. In addition, Nairobi residents pump water from their own deep wells.

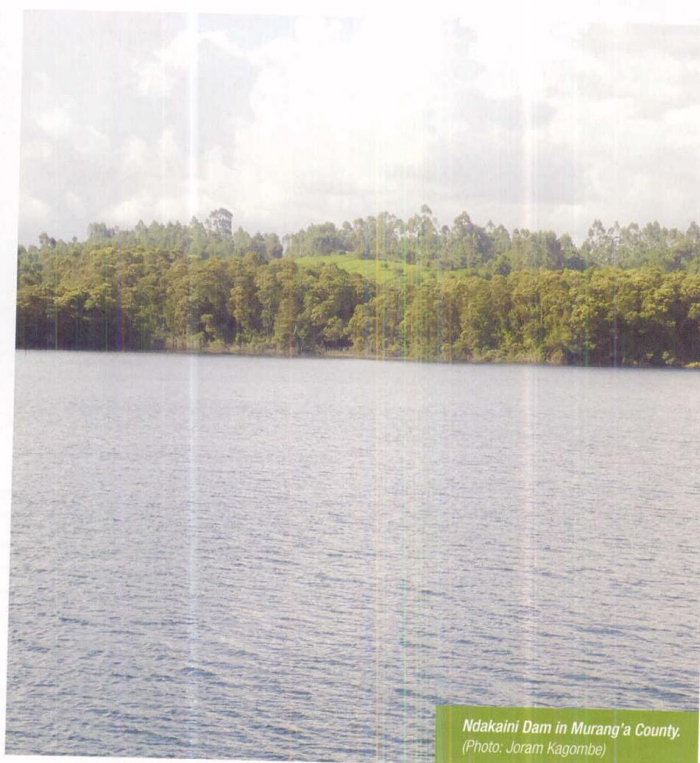
If one takes into account that the population of Nairobi swells to 5 million people during daytime, this corresponds to less than 120 litres per capita per day before distribution losses. However, water is not equally distributed; wealthier users with access to piped water use much more than average, while those without access to piped water receive much less.

Half of Nairobi's population lives in slums, but they consume only 34,500m<sup>3</sup> a day, corresponding to less than 20 litres per capita per day (Aquaclean Services Limited, 2010). The heavily polluted and relatively small Nairobi River that flows through the city is not used for drinking water supply.

## Surface water

The Nairobi Water Company relies almost exclusively on surface water to satisfy the growing city's water needs. Surface water supply for Nairobi stood at 484,500m<sup>3</sup> per day in 2010 (Karanja Joseph, 2011). The storage capacity in reservoirs is gradually reduced through sedimentation, mainly attributed to poor farming practices in the water catchment areas.

The Nairobi utility company receives 94 per cent of its water from the Tana River basin north of the city through three reservoirs; Sasumua Dam on the Chania River, Thika Dam (Ndakaini) and Chania-B Dam. Thika Dam is the largest, supplying 225,000m<sup>3</sup> per day.



Ndakaini Dam in Murang'a County.  
(Photo: Joram Kagombe)

Water from the reservoirs is treated in two treatment plants, the largest of which is in Ngethu. The remaining 6 per cent of the water comes from local sources, namely the Kikuyu Springs and Ruiru Dam, both located in the Athi River Basin and whose water is treated in two smaller treatment plants. Figure 1 shows water sources for Nairobi.

## Groundwater

Groundwater supplies an additional 85,000m<sup>3</sup> per day or more from an estimated 3,000 boreholes, up from an estimated 2,250 boreholes

in 2001. The groundwater table has declined; in one well it declined by 40 metres between 1958 and 1996. The average depth of new wells in 2001 was 238 metres. In that year, 97 new wells were drilled because of drought.

Most wells are operated by industrial enterprises - hotels, farms for flower production in greenhouses, and private houses in parts of the city that receive only intermittent water supply. Groundwater is also used to irrigate gardens and to supply tankers that resell the water. Many private well-owners are also connected to the mains water supply network

## WATER SOURCES FOR NAIROBI CITY WATER AND SEWERAGE COMPANY

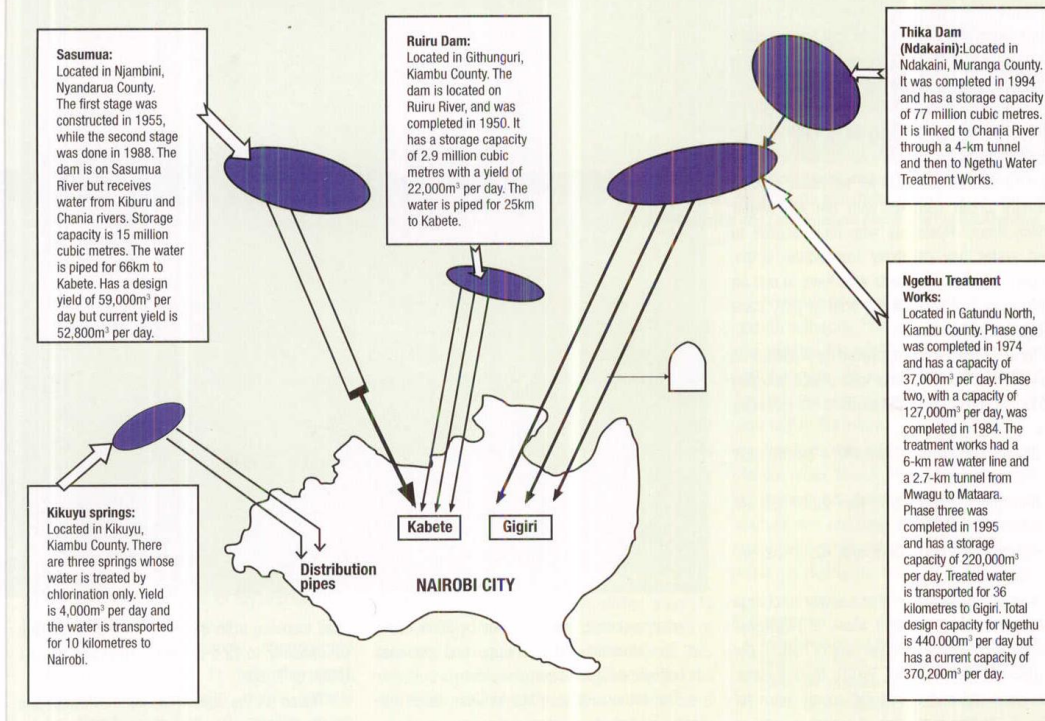


Figure1: Water sources for Nairobi City

(Source: Nairobi Water and Sewerage Company)

and use groundwater as a back-up supply. Natural groundwater quality is good.

### Achievements and challenges

Among the achievements in water supply and sanitation in Nairobi is the expansion of infrastructure to keep pace with population growth, in particular through the construction of the Thika Dam and its associated water treatment plant and pipelines during the 1990s; the transformation of the municipal water department into an autonomous utility in 2003; and the more recent reduction of water losses – technically called non-revenue water – from 50 to 40 per cent.

Challenges include:

- Poor quality and intermittent water supply (only 40 per cent of those with house connections receive water continuously);
- Loss of storage capacity in reservoirs behind dams through siltation accelerated by erosion in the Aberdare ranges;

- Lack of access to adequate sanitation in slums where half the population of Nairobi lives;
- Blockages of sewers resulting in overflows;
- Unused capacity in the city's largest wastewater treatment plant in Dandora.
- Absence of good farming practices that would greatly contribute to reduced siltation of the dams, and
- Reduction in cost of water treatment.

### Institutional framework in water supply

The responsibility for water supply and sewerage in Nairobi is shared between an asset holding company, Athi Water Services Board (AWSB), and an operating company, the Nairobi City Water and Sewer Company (NCWSC) that operates under contract with the AWSB.

Ten other water service providers (WSPs) operate under the AWSB in localities outside Nairobi County. Service standards are set and

monitored by a national water regulatory agency called the Water Services Regulatory Board (WASREB). In addition, WASREB regulates water tariffs within Nairobi. The Athi Water Services Board is under the authority of the Ministry of Water and Irrigation and covers its costs through a Regulatory Levy collected from the Water Service Providers (Athi Water Services, 2011).

**Nairobi City Water and Sewerage Company Ltd** is owned by the Nairobi County Government and is the main supplier of water to Nairobi residents.

Ten other water service providers under contract with the Athi Water Services Board operate water and, in some cases, sewer systems, in towns around Nairobi. They are the Kiambu Water and Sewerage Company, the Gatundu South Water and Sanitation Company, the Karimenu Community Water and Sanitation Company, the Gatanga Community Water Project, the Limuru Water and Sewerage Company, the Kikuyu Water Company, the Ruiru Juja Water and



Sewerage Company, the Kitisuru Water Company, the Runda Water and Sewerage Company and the Githunguri Water and Sanitation Company.

Some of these water service providers are private, such as the Runda one that has provided piped water to the executive residential housing estate of Old Runda since 1975.

### Water pricing, billing and cost recovery

Water tariffs are identical for all water service providers under contract with the Athi Water Service Board. Residents who have access to piped water pay relatively low water tariffs, compared to slum residents who have to rely on much more expensive water sold in jerry cans through water kiosks.

Tariff increases are approved by WASREB. In June 2009, a tariff increase took effect, bringing residential and commercial tariffs to the following level:

- Between 0 and 10m<sup>3</sup>: Ksh 18.71 per m<sup>3</sup> (US\$ 0.18/m<sup>3</sup>),
- Between 11 and 30m<sup>3</sup>: Ksh 28.07 per m<sup>3</sup> (US\$ 0.28/m<sup>3</sup>),
- Between 31 and 60m<sup>3</sup>: Ksh 42.89 per m<sup>3</sup> (US\$ 0.43/m<sup>3</sup>).

A sewer connection invites a sewer surcharge of 75 per cent. If a water kiosk is registered properly, it is billed at a lower rate of Ksh 10 per m<sup>3</sup> (US\$0.10/m<sup>3</sup>) (NCWSC, 2011). Nevertheless, slum residents end up paying much more for water. A 20-litre jerry can of water in a slum typically sells for Ksh 2, translating into Ksh 100 per m<sup>3</sup> (US\$ 1). This is double the recommended price of Ksh 1 (Ksh 50 per m<sup>3</sup>) and more than five times the water tariff in the lowest consumption bracket (Ksh 19 per m<sup>3</sup>).

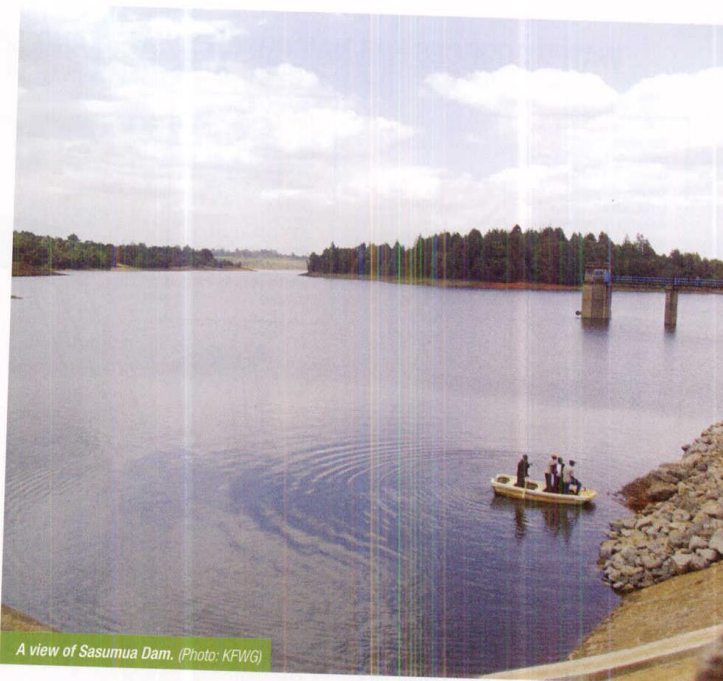
Provision of adequate and affordable water to the low income population in the slums remains a challenge to NCWSC. This is especially so with the enactment of the constitution that mentions water as one of the basic rights that every Kenyan should enjoy.

### Future supply: Nairobi Water Master Plan

The National Water Master Plan 2030 is based on the Kenya Vision 2030 of 2007 that is the country's new development blue-print covering the period 2008 to 2030.

National Water Master Plan 2030 has developed plans that would ensure that:

- Improved water and sanitation are available and accessible to all by 2030.
- In agriculture, to increase the area under irrigation to 1.2million hectares.
- To be a nation that has a clean, secure



A view of Sasumua Dam. (Photo: KFWG)

- and sustainable environment by 2030, and
- To generate more energy and increase efficiency in the energy sector.

The National Water Master Plan 2030 has analysed the effect of climate change on the country's water resources up to 2050, based on the 17 General Circulation Models. This projection indicates that Kenya's surface temperature will rise by around 1°C by 2030 and by 2°C by 2050 uniformly.

The mean annual rainfall and actual evapotranspiration are expected to increase for 2030 and 2050, with the annual rainfall increasing to 750mm and 801mm respectively from 670mm in 2010; and evapotranspiration to 613mm and 659mm respectively from 549mm in 2010.

The evolution of the country's renewable water resources is predicted as follows:

Table 1: Evolution of the country's renewable water resources (in billion m<sup>3</sup>)

Type	2010	2030	2050
Surface water	20.0	24.9	26.7
Ground water	21.55	19.4	19.3
Total water	41.55	44.3	46.0

This scenario has put the country's water per capita availability to just above the 1,000m<sup>3</sup> global benchmark. The total water demand

shall increase from the 2010 level of 3.2 billion m<sup>3</sup> annually, to 12.5 billion by 2030 and to 23.1 billion by 2050.

Based on the water resources available and the projected water need, the country's average ratio of water demand/availability, is 14 per cent by 2010, 81 per cent by 2030 and 81 per cent by 2050.

However, the situation in the Athi River Basin is even worse, with a 281 per cent ratio (that is a yearly need of 4.6 billion m<sup>3</sup> against an availability of 1.6 billion m<sup>3</sup>). This is followed by the Tana River Basin with a ratio of 105 per cent (a requirement of 8.2 billion m<sup>3</sup> against an availability of 7.8 billion m<sup>3</sup>).

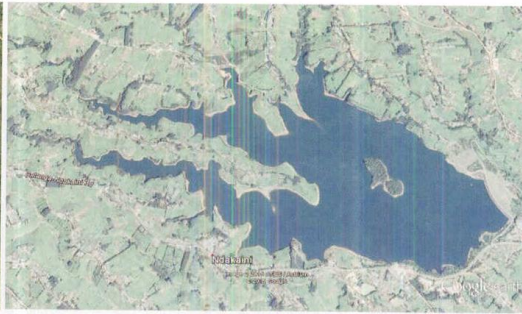
Further findings from the Water Master Plan show that by 2030, water demand will increase in all catchment areas, and the water balance is expected to be tight in all areas except in Lake Victoria North. As for the 2050 water balance, the ratio between water resources available and demand is almost the same as that for 2030 due to increase in both water resources (due to climate change) and demand.

As a result of the findings of the National Water Master Plan 2030, areas with water deficits would require promotion of water resources development to the maximum in order to meet future water demand. Water demand management such as water savings and





Sasumua dam on Sasumua stream, a tributary of Chania River, on the southern end of the Aberdare Range (on the right). Its designed storage capacity is 15.9 million m<sup>3</sup>, providing Nairobi with 12 per cent of its water supply.



Ndakaini or Thika dam, 50 km north of Nairobi, with a storage capacity of 70 million m<sup>3</sup>. Three main rivers drain into the dam: Thika, Githika and Kayuyu. The main catchments are Kimakia and Gatara natural forests, part of the Aberdare Range (to the left of the photo).

effective and efficient water use, recycling of water, etcetera, should be introduced to control water demand increase. This will specially apply to control of irrigation that now takes up some 80 per cent of the available water.

### The Master Plan for developing new water sources for Nairobi and 13 satellite towns

The plan provides least-cost development options to be implemented in five phases between 2012 and 2030 to ensure adequate supply of safe water to Nairobi city and satellite towns up 2035, as listed below:

- A 25-year water supply infrastructure investment blueprint to fulfil the short, medium and long-term water demand for Nairobi City and 13 satellite towns including Kikuyu, Ruiru-Juja, Kiambu, Karuri, Githunguri, Mavoko, Ngong, Ongata Rongai (including Kiserian), Thika, Gatundu, Limuru, Tala and Kangundo.
- Addressing a growing water supply infrastructure deficit.
- The Nairobi Metropolitan area is a high economic and political priority of the

Government.

The total water supplied to Nairobi City and its satellite towns is at the moment 580,000m<sup>3</sup> per day against a demand of 750,00m<sup>3</sup>. This demand is projected to increase to 860,000m<sup>3</sup> per day by 2017 and 1.2million m<sup>3</sup> per day by 2035, requiring large and sustained investments in expanding water supply to meet the growing water needs.

### Relation of water towers and water supply

The principal water tower providing water to Nairobi is the Aberdare Range. The main effect of the forest is to regulate seasonal flow of rivers, thus ensuring continued supply during the dry periods. The forest creates soil-protective and infiltrative conditions conducive to water-holding capacity and slow release of water to the catchments. This results in a more even distribution flow throughout the year (UNEP, 2012).

Conservation of the forest in the catchments will lead to continued river flow during the dry seasons. The role of a water reservoir like Ndakaini Dam is to store water that is later gradually released during dry spells.

Provision of water to Nairobi is crucial to the growth of the city. This will spur economic growth and improve the health of the residents. Surface water remains the key source of water for many Nairobi residents. There is eminent low supply now and in the future.

However, the Kenya Water Master Plan and Nairobi Water Master Plan have given strategies of meeting the deficits through increasing the sources and reducing wastage. Conservation of water catchments will ensure a good flow of water to Nairobi during dry spells.

### References

- Aquaclean Services Limited (2010). "Environmental Impact Assessment Report for Nairobi Informal Settlements Water and Sanitation Improvement Projects". National Environment Management Authority. Retrieved 6 November 2011.
- Athi Water Service Board. "Water Service Providers". Retrieved 6 November 2011.
- Athi Water Services Board (22 July 2011). "Eng. Malaquien Milgo appointed new Chief Executive Officer, Athi Water Services Board". Retrieved 13 November 2011.
- Athi Water Services Board Retrieved 6 November 2011.
- Athi Water Services Board. "AWSB ISO 9001:2008 Certified". Retrieved 13 November 2011.
- Karanja, Joseph. 2011. "Improving water provision in Nairobi through control of non-revenue water" (PDF). *Global Water Summit 2011*. Global Water Intelligence. pp. 212–213. Retrieved 6 November 2011.
- Kenya National Water Master Plan 2030 MINISTRY OF ENVIRONMENT, WATER AND NATURAL RESOURCES.
- Nairobi City Water and Sewerage Company. "Regular Tariff Adjustment in Athi Water Services Board (AWSB)" (PDF). Retrieved 6 November 2011.
- Nairobi City Water and Sewerage Company: Map of Nairobi water sources
- UNEP, 2012. The role and contributions of montane forests and related ecosystems services to the Kenyan economy. UNON Publishing Services Section, Nairobi
- Water and Sanitation Program of the World Bank: Rogues No More? Water Kiosk Operators Achieve Credibility in Kibera, June 2005, p. 9-11.

The writer is a Principal Research Scientist, Kenya Forestry Research Institute (KEFRI)  
Email: jokagombe@yahoo.com

Members of the Forestry Society of Kenya at Sasumua Dam. Sustainable management of Kenya's water catchments is vital to ensure water supply to Nairobi and other places. (Photo: FSK)

