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WATER, SANITATION AND HYGIENE:
SUSTAINABLE DEVELOPMENT AND MULTISECTORAL APPROACHES

Urban sanitation and wastewater treatment in Addis Ababa in the Awash Basin, Ethiopia

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Improvement of sanitation facilities and subsequent practices is considered to contribute to overall human development with far reaching benefits for the welfare of people. It can reduce wastewater flows when treatment capacities are upgraded, but it can also create a higher load of wastewater flowing into the environment downstream. Additional sanitary water requirements in a water scarce city may be difficult to meet. In this paper we explore the scale of impact of improving sanitation in Addis Ababa in terms of water quality and quantity of water flows in and out of the city. Conventional approaches to sanitary improvement at the city level, like extension of the sewage coverage and upgrading of wastewater treatment capacities will require additional water in a city that is already water scarce. Also, it will change the characteristics of irrigation water that is used by farmers in and around the city.

Introduction

The population and built-up area of Addis Ababa is rapidly expanding as a result of urbanisation. One of the important basic needs of its growing population is water. While the city is growing, its dependency on primarily rural areas upstream to supply water, is increasing. The area downstream of the city that is affected by industrial and domestic pollution seems to be growing as well.

This paper provides a perspective on urban water management that goes beyond the boundaries of the city. For Addis Ababa (in this paper shortened to Addis), an initial assessment is made of the 'urban water use' by looking at the sources and water supply, sanitation and fate of wastewater flows. This paper may be of interest to urban water managers, policy makers and researchers that work in this field.

Portraying Addis Ababa in the Awash River Basin

The city of Addis is situated in the Western part of the Awash River Basin, which is the third largest basin in the country with 112,700 km2 and accommodates a population of 10.5 million (Figure 1). The urban population of Addis has grown from 0.5 to 3 million from 1950 to 2008, and is expected to rise to between 4.5 and 7.5 in 2030, based on different forecasts (Figure 2).The city's urban area is located on a slope ranging in elevation between 3,000 and 1,200m, lying at the foot of the Entoto mountain range, which forms the border with the (Blue) Nile River Basin, North of the Awash Basin (Figure 3). Addis is located in the upper reaches of the river, with only a small area of the basin being upstream of Addis, whereas the downstream basin area extents all the way to the upper Northern part of the Awash Basin. The Awash River is born West of Addis Ababa and flows through the Rift Valley into the terminal Lake Abbe, close to the border with Djibouti. The main river is stretched out on a length of 1,200km and descends roughly from 4,800 to 100m above sea level.

Addis is depending on its surrounding rural area for imports of water, food products and other raw materials (Zeleke *et al.,* 2007). As for water supply, all of Addis' surface water sources are reservoirs situated in rural landscapes. (Figure 3). Water is being supplied from three reservoirs (80%) and one well system (20%) with a total volume of 210,000m^3 day^{-1} or 77 Million Cubic Meters (MCM) yr^{-1}. As can be seen in the sketch in Figure 3, the reservoirs supplying Addis are called Legadadi and Dire Dams (~30km Northeast of Addis), Gafersa Dam (~20km Northwest of Addis) and the Akaki Wells (10km South of

Addis). The reservoirs are fully allocated for water supply to Addis and all the available water is being used. In the last 15 years, little capital investments were made in urban water supply, As a result, water demand in Addis has remained suppressed, with a current supply demand gap of about 40-50% (World Bank 2005, Tekle 2008). Plans exist to start withdrawing water from the neighbouring Abbay Basin by constructing two dams, namely Sibilu and Gerbi Dam (30km North of Addis) (Tahal, 2005). If planned infrastructural works and water supply increment would be realised, water supply would increase fourfold from a current 0.2 MCM day^{-1} to 0.8 MCM day^{-1} by the year 2016. This ambitious project, if carried out, will entail a growing wastewater volume, since the bulk of water used will turn into wastewater. Unless wastewater disposal and treatment infrastructure is upgraded, larger wastewater volumes could have a bigger impact on the environment and agricultural and domestic water users downstream. It is important that these linkages are recognised and accounted for in future urban water development strategies and plans. A boost in water supply should ideally be accompanied with an assessment of wastewater disposal and potential for downstream re-use.

Upstream developments in the reservoir catchments may threaten water quality and the reliability of reservoir inflows. At the same time, farmers inside and downstream of the city are depending on water that originates from urban drainage and wastewater generation. The cultivated area in and around Addis that is being irrigated with (a mix of stormwater and) wastewater is estimated approximately 400ha. (Kebede, 2008). This area is in use by farmers that are registered at the bureau of agriculture. It is assumed that total irrigated area (including all peri-urban lands) is much higher. Satellite images could be very useful to get a good estimate of the scale of peri-urban agriculture in Addis.

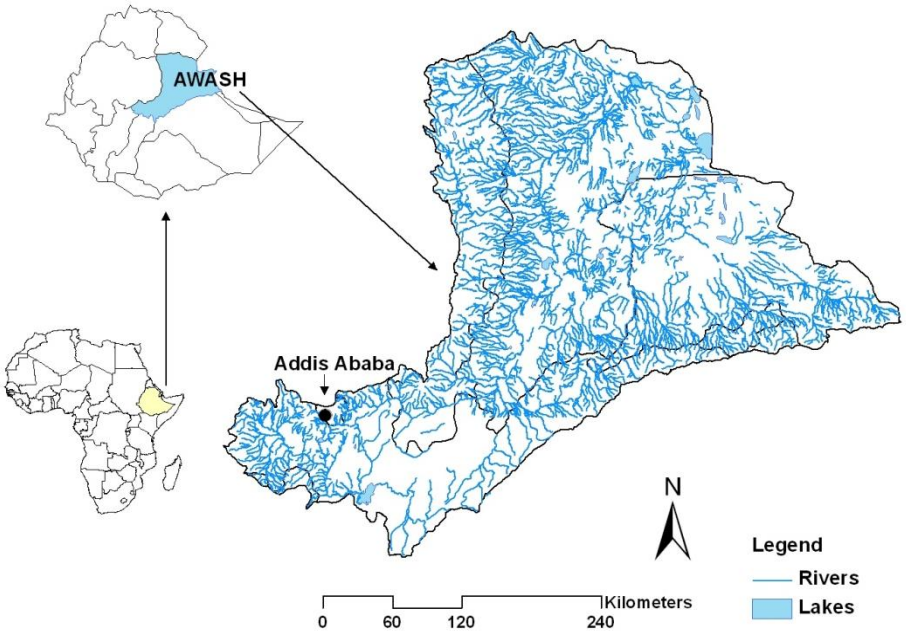

Figure 1. Location of Ethiopia, the Awash Basin and Addis Ababa

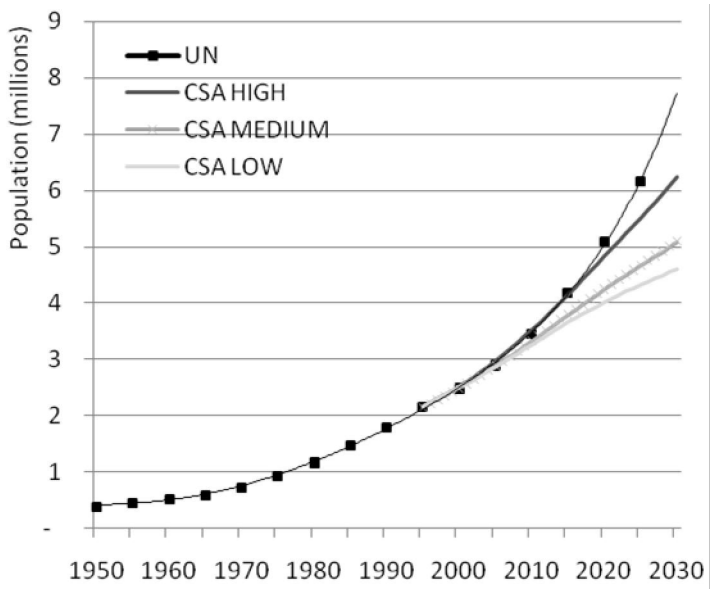

Figure 2. Growth of population of Addis Ababa between 1950 – 2030

Source: UN 2006. CSA scenarios are from Central Statistical Authority, as in Tahal 2005

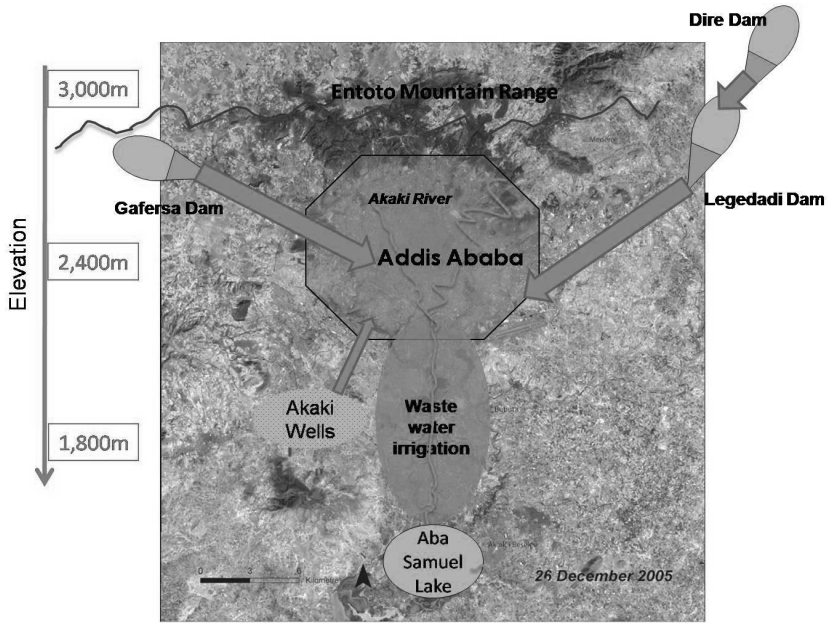

Figure 3. Water links of Addis Ababa with surrounding rural area

Source: Satellite image downloaded from UNEP website, last accessed on 17 Feb. 2009 at: http://na.unep.net/atlas/AfricaAtlas/site_images.php

Water quality related issues in the Awash River Basin

The Awash River Basin is facing land and wetland degradation, soil erosion due to deforestation and overall water quality declines (Taddesse et al., *undated*). All of these issues can be accounted either directly or indirectly to growing population pressure and human activities in Addis. The planting of eucalyptus trees on

the slopes of the Entoto Mountains has resulted in the eucalyptus out-competing traditional vegetation that previously covered the soil. Deforestation due to wood consumption in the city has entailed increased erosion in the Entoto Mountains (Horst, 2006). In the agricultural sector, pesticides in drainage waters and obsolete stockpiles can threaten the aquatic environment and human health (PAN, 2006).

The Awash River is prone to various types of pollution with wastewater, of which most originates from the urban agglomeration of Addis. Much of the wastewater, both domestic and industrial, produced in that area reaches the Awash river untreated, seriously polluting the water course. Since downstream Addis river water is being used for various purposes such as drinking water supply (Nazareth town) and irrigation, public health risks are high, not only in the urban area.

Current wastewater treatment capacity is very small in Addis (NEDECO, 2002). Therefore, wastewater is discharged directly into natural watercourses of the Akaki River, which eventually joins the Awash River. The Akaki River is an important source of water for small scale farmers in and around Addis who are producing vegetables and fodder for livestock. The Akaki River serves as an important drainage system that disposes of abundant runoff and wastewater into the Awash River. Few rigorous investigations have been undertaken on the quality of the urban water bodies. Nitrate levels above 10 mg l^{-1} in the surface water have been reported. According to Biru (2002) and Itanna (2002), arsenic and zinc are measurably higher in the soils irrigated by water from the Akai River.

A major health concern in much of the middle and some of the lower Awash River Basin is high levels of fluorides in the groundwater, which is used as a source for drinking water (Gizaw 1996, Tadesse *et al.,* 1998). High concentrations of fluoride occurring naturally in groundwater water are a major source of fluoride intake. It has long been known that excessive fluoride intake is associated with serious health effects. The long-term use of high- fluoride drinking water results in both dental and skeletal fluorosis, which is found in populations in the Middle and Lower Awash, and the Rift Valley Basin (Haimanot 1990, Tekle-Haimanot *et al.,* 2006).

From the above we can conclude that water bodies and soils inside and outside Addis are exposed to various forms of pollution. To bring down pollution by industries, pollution control measures are needed to mitigate further contamination of water, soils and crops. Areas upstream the city that serve as basins for providing urban water supply, should be protected from activities that may pollute soil and water in those areas.

Sanitation and wastewater treatment in Addis Ababa

Due to unregulated urban growth and a high fraction of informal settlements, it is difficult to quantify the sanitary conditions for the entire city. Findings from Worku and Adam (1999) may be considered as outdated, but sanitary development[1] in the city has not gone fast, so their description of overall condition of poor sanitation and its environmental burden unfortunately still remains valid today. Less than 10 percent of the urban area is sewered while in the major part of the remaining area pit latrines are used that dispose their wastewater in the stormwater drainage network (AAWSSA, 2008). Addis has two sewage treatment plants. The first one, called Kality treatment plant, runs under its designed capacity of 7,600 m^3 day or 200,000 population equivalents, while it treats on average 5,200 m3. The other treatment plant, called Kotebe treatment plant, receives only sludge from vacuum trucks that empty septic tanks, with an estimated annual volume of 85,000m^3 (NEDECO, 2002).

The majority of the households (75%) in Addis make use of a pit latrine of which the majority is shared with other households (see Figure 4). The remaining quarter relies mostly on a flush toilet (17%) or uses a field/forest (6%) or another way (2%). These statistics should be interpreted with reservations for reliability and should only serve to provide a general impression of the sanitary conditions in the city.

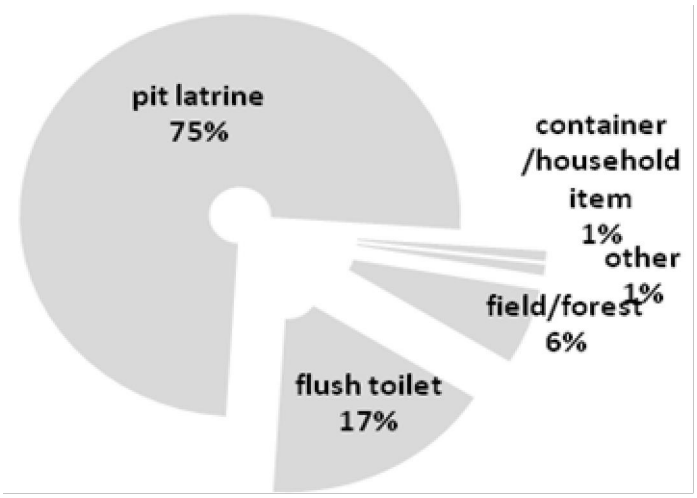

Figure 4. Breakdown of households in Addis Ababa by sanitation facility in use in 2004

Source: CSA 2005

Conclusion

Like many cities in SSA, Addis has a lot of scope for sanitary development. The nature and scale of sanitary development is likely to change the urban water balance at the city level. For example, more flush toilets will require more water which, when provided, will generate more wastewater (Van Rooijen and Erni, in prep). Simple calculations could indicate the additional volume of water needed to provide water for newly installed or upgraded toilet facilities. Also, a likely increase of connections to the sewerage network will mean a larger wastewater volume inflow into the existing treatment plants which in turn may entail less water available for peri-urban farmers.

Based on our findings we agree with many that large investments are needed on both the water supply and sanitation/wastewater treatment infrastructure side, to combat the current water related challenges. Where appropriate, projects related to urban water development should take into account the following;

- Projects that aim to boost water supply should incorporate measures that account for the impact of increases in wastewater flows on the environment and downstream agricultural and domestic uses.
- Industrial pollution control measures are needed to mitigate further contamination of water, soils and crops with especially heavy metals.
- Land use restrictions to prevent water pollution should be put in place in those areas upstream that serve as natural water catchments for urban water supply.

Note

1. With the term ‘sanitary development’ is meant in this paper, the development of sanitation infrastructure at the individual or household level and city level (toilet facilities and wastewater disposal and treatment systems).

Keywords

Urban sanitation, wastewater treatment, pollution, Addis Ababa, basin level.

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