Fresh Water Sources Pollution: A Human Related Threat To Fresh Water Security in South Africa

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Abstract
This paper is mainly an overview of the challenge of human induced water sources pollution in South Africa. The major line of argument in this paper is that the rapidly growing population, urbanisation, agricultural, industrial and mining activity in South Africa pose a threat to availability, accessibility and quality of potable water resources in the country. This is more acute in the major centres of economic activity; for example in the Gauteng Province, where the Johannesburg and the Tshwane metropolitan municipalities are situated. To make matters worse these cities are located upstream of the water system drainage in the catchment area and effluent disposal is directly into the raw water reservoirs posing serious threat to both human life and the ecosystem. The government of South Africa has to take pollution control policies and their implementation as a serious governance issue. The country has to take a clue from the developed countries where pollution control laws have helped to clean up rivers, lakes and streams. Our final conclusion is that, in South Africa, like anywhere else in the world, freshwater management and governance is of critical importance to avoid artificial freshwater shortages. The supply and demand for water, and therefore its abundance or scarcity, depend significantly on the management of the resource and its use. Poor management may create functional water scarcity even in a country with seemingly abundant supplies of fresh water.

Key words: fresh water, availability, accessibility, governance, corruption, management

1. Introduction

Fresh water is a common pool natural resource for which everyone is responsible. It is highly delicate and vulnerable to pollution and contamination. As such it has to be handled with a high degree of care. The Oxford advanced learner’s dictionary (1995) defines fresh water as, ‘a liquid without colour, smell or taste that falls as rain, is in lakes, rivers, seas, and is used for drinking, washing’. Therefore, if water starts smelling and showing colour it means it is contaminated and no longer qualifies to be water in its pure and natural sense. In South Africa, it has been established that freshwater quality of the available sources has declined due to increased pollution caused by industry, urbanisation, afforestation, mining, agriculture and power generation (Ashton, et al., 2008). In this qualitative study we look at the level of water pollution and the associated environmental, ecosystems and public health risks in South Africa. We conclude the paper by recommending enforcement of water pollution laws in the country.

A brief description of the South African landscape

South Africa is located at the southern tip of Africa with a surface area of 1,219 million km². It is a water scarce country with a large percentage of the population falling below the poverty line (Naidoo et al., 2009). South Africa is a semi-arid country and, as in the rest of Africa, ‘urbanisation has led to deterioration in the quality of water in streams and lakes near urban centres’ (Moyo and Phiri, 2002). Deteriorating water resource quantity and quality is likely to become a serious restriction to future socio-economic development (Peart and Govender, 2001).

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According to Heath, et al (2009), South Africa is globally recognised as a leading supplier of a variety of minerals. Its mineral wealth is found in diverse geological formations, some of which are unique and extensive by world standards. South Africa has the world’s largest reserves of platinum-group metal ores including manganese, chromium, vanadium, gold and alumino-silicates. It is also prominent in terms of reserves of titanium, zirconium, vermiculite, and fluorspar. More than 20 different types of precious metals and minerals, energy minerals, non-ferrous metals and minerals as well as ferrous minerals are mined in South Africa. From 1976, South Africa’s coal exports have increased rapidly on the strength of the country being one of the world’s most reliable suppliers (Ibid).

![Map of South Africa showing the nine provinces](Source: WRC website [www.wrc.org.za], accessed 24 January, 2011)

As is the case in many other African countries, the majority of the population lives in rural areas. Eales, et al (1996) observe that most rural people in South Africa rely on unimproved water sources (streams, rivers, and unprotected springs). This direct dependence on natural water sources has made many communities highly vulnerable to droughts, increases in water-abstraction patterns, upstream land-use changes, and effluent discharges. Furthermore, nearly all South Africa's surface water is unsuitable for human consumption in an untreated state, largely because of contamination by human, animal, and industrial waste (Eales, et al, 1996).

**Bond (2007: 2) observes that:**

In South Africa, there are millions of people who can tell stories of water ‘delivery drought’. Rural areas are underserviced due to lack of operating subsidies which mean that a large percentage of taps installed in the post-apartheid era are now dry. And for those lucky to be on municipal water grids, mass disconnections due to unaffordability affect more than 1.5 million South Africans each year, even the government admits.

2. Water pollution

Figure 2 and Figure 3 show the effects of water contamination to the ecosystem and animals that live in the water in South Africa.
Water pollution can be seen as any undesirable change in the state of water, contaminated with harmful substances. For the World Health Organisation (WHO) (1997), any change in the physical, chemical and biological properties of water that has a harmful effect on living things is termed as ‘water pollution’. Human activity (e.g. mining, agriculture, industrialisation and domestic waste) is the major factor contributing to water-pollution (Park, 2009). There are however, other various micro-biological agents that include bacteria, viruses and protozoa which can also cause water pollution and may cause various water-borne diseases (Gambhir, Kapoor, Nirola, Sohi and Bansal, 2012).

Due to water pollution, the entire ecosystem gets disturbed. This becomes more frightening and life threatening when we consider Oberholster and Ashton’s (2008) observation that a large proportion of the sewage emanating from South African urban areas is not treated properly prior to discharge. The reasons for this state of affairs are twofold: the sewer systems are incomplete, or sewage treatment plants are overloaded. This is particularly true in densely populated areas and in those areas where summer storm runoff enters sewerage systems (Ibid).

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Industrial development has been identified as another aspect of human activity that has left its mark on South Africa’s water resources. Many industrial processes produce waste products that contain hazardous chemicals, and these are sometimes discharged directly into sewers, rivers or wetlands. Even those waste products that are disposed of in landfills or slag heaps, for example, may release substances that eventually seep into nearby watercourses resulting in both wildlife and human deaths as shown in figure 2 (Oberholster, et al., 2008).

Statement of the problem

The brief description of the South African landscape above shows that, in South Africa, available fresh water sources are exposed to pollutants and contaminants from the mining, industrial, agricultural and domestic waste production activities. It has been established that South Africa produces around 450 million tonnes of waste annually, with 70% of this generated by the mining industry (Heath, et al., 2009). Surface mining of coal leaves large areas of land bare, without vegetation and soils. The land is often covered with waste rocks that have been separated from the coal, as well as residual coal materials. Mining and industrial activities have adverse consequences on water supply and the environment because these activities involve the use of large quantities of water to remove the overburden and wash the core product so that it is ready for use. Polluted water contains viruses, bacteria, intestinal parasites and other harmful micro-organisms, which can cause waterborne diseases such as diarrhea, dysentery, and typhoid. The description of the South African landscape above has already shown that the majority of the South African population lives in rural areas where most of them rely on unimproved water sources (streams, rivers, and unprotected springs). This direct dependence on natural water sources has made many communities highly vulnerable not only to droughts, increases in water abstraction patterns and upstream land-use changes, but also to watershed and upstream effluent discharges. As a result, almost all South Africa’s fresh water has been found to be unsuitable for human consumption in an untreated state. With all this in mind, the question addressed in this study is whether there are any techniques being developed to ensure that in the near future everyone will have access to clean and pure water and that too at an affordable cost in South Africa.

3. Study methodology

This paper is based on both theoretical literature review and empirical evidence. The methodology used was largely qualitative research based on documentary analysis and personal observation.

4. Waste and water pollutants in South Africa

The major waste and water pollutants come from mining activities that, as observed by Banks, et al. (1997) and Pulles, et al. (2005), produce uncontrolled discharge of contaminated water. This is commonly known as acid mine drainage. The acidic water dissolves salts and mobilizes metals from mine workings and residue deposits. It is not only associated with surface and groundwater pollution, but is also responsible for the degradation of soil quality, aquatic habitats and for allowing heavy metals to seep into the environment (Adler and Rascher, 2007). The reckless release to the environment of mining waste results in irreversible destruction of ecosystems. In many cases the polluted sites may never be fully restored, for pollution is so persistent that there is no available remedy (EEB, 2000).
Figure 4: Toxic water pollution in South African rivers
(Source: Google Earth, accessed 16 October, 2011)

Musingafi (2013) established that water sources in the Vhembe District are highly vulnerable to contamination from the mining and agricultural activity in Limpopo Province itself and its southern neighbour, Gauteng Province. Nandoni Dam and the Luvuvhu River are reportedly highly exposed to DDT which is sprayed to control the spread of malaria:

The Luvuvhu River Catchment ... near Thohoyandou, Vhembe District in Limpopo Province, is a tropical, high-risk malaria area where 1,1,1-trichloro-2,2-bis (pchlorophenyl) ethane (DDT) has been used annually since 1945 for controlling malaria (Bornman, et al, 2009: 4).

In the Gauteng Province, the City of Tshwane Metropolitan Municipality (CTMM) boreholes and springs are located in dolomite rock formations which are known for forming cracks and sinkholes, having a high risk of pollution, and a high percentage precipitation recharge to the groundwater of the underground water aquifers (Musingafi, 2013). According to Mothopong Consulting (2005) because of this characteristic of the underlying geology, soil and ground surface, the water sources are polluted by cemeteries, sewage, industrial and commercial waste, agricultural manure, fertilisers and other chemicals.

Figure 5: Acid mine dam in Gauteng
(Source: Musingafi, 2013)

The acid and pollutants in the acid mine dam in Figure 5 find their way into the Gauteng groundwater and surface water systems resulting in situations shown in Figure 2 and Figure 3 above. Thus mining waste can result in profound, generally irreversible destruction of ecosystems. In 1989, it was estimated that about
19 300 km of streams and rivers, and about 72 000 ha of lakes and reservoirs worldwide had been seriously impacted by mine effluents, although the true scale of the environmental pollution caused is difficult to assess and quantify accurately (Johnson and Hallberg, 2005).

Post-closure decant from defunct coal mines is estimated at 62 ML/d (DWAF, 2004), and in the order of 50 ML/d of acid mine water discharges into the Olifants River Catchment (Maree, et al., 2004). It is clear, therefore, that in South Africa, significant volumes of polluted water need to be managed on a continuous basis for decades to come.

Figure 6: Radioactive acid pours into the Crocodile-Limpopo River system
(Photograph: M. Liefterink, Google Earth, accessed 15 October 2011)
De Lange (2011) observes that the aquifers found in Gauteng Province are diverse due to the varied and complex geology of the province. She further notes that the quality of water in these resources is highly variable depending on the geology, ecological setting and influence of man. On the Witwatersrand, many of the aquifers have been clogged up with acid mine drainage as a result of gold mining activities in the region since the 1880s.

Naicker, et al. (2003) found that the groundwater in the mining district of Johannesburg, Gauteng Province, is heavily contaminated and acidified as a result of oxidation of pyrite contained in the mine tailings dumps. This situation has elevated concentrations of heavy metals. The researchers established that where the groundwater table is close to surface, the upper 20 cm of soil profiles are severely contaminated by heavy metals due to capillary rise and evaporation of the groundwater. They further found that the polluted groundwater is discharging into streams in the area and contributes up to 20% of the stream flow. This results into an increase in the acidity of the stream water. The effect of the contaminated water from the mines can persist for more than 10 km beyond the source (Naicker, et al., 2003).

Figure 6: Acid mine drainage outflow from Hippo Dam
(Photograph: M. Liefterink, Google Earth, accessed 15 October 2011)

Figure 7: Satellite map of the Witwatersrand
(Source: Google Earth, accessed, 29 September 2011)
This contamination of the Gauteng Province’s groundwater and surface water is considered detrimental for future plans to access groundwater to cope with the growing demand for water in the province.

During rainy seasons the resulting floods carry all the pollutants from human activities and disposals into catchment water systems (see Figure 7) resulting in disasters if water treatment and reticulation is below standard.

In addition to the acid mine drainage, Mothopong Consulting (2005: 6) identified the following as major fresh water contaminant sources in the Gauteng Province:

- Laudium and Verwoerdburg cemeteries;
- petrol stations and fuel storage tanks;
- sewage pipelines and pump stations;
- high density septic tanks in subdivisions;
- industrial areas;
- fertilisers, herbicides from golf courses and irrigated greens; and
- diffuse urban contamination (oils, detergents, salts, herbicides, faecal matter, nitrates etc)

![Figure 7: River water system pollution in the Gauteng Province](Source: Musingafi, 2013)

5. Conclusion

In this study we established that human activities have a series of progressively worsening effects on South Africa’s scarce freshwater sources through water pollution. Water pollution damages not only individual species and populations but also the biological communities. It renders much of the available water unsafe for both human consumption and utilisation by the ecosystem. We found that the pressure of increasing population, loss of forest cover, untreated effluent discharge from industries and municipalities, use of non-biodegradable pesticides/ fungicides/ herbicides/ insecticides, use of chemical fertilizers instead of organic manures, among many others, are causing water pollution. We established that there are numerous water borne diseases like cholera, diarrhoea and dysentery which are transmitted by drinking contaminated water.

It therefore follows the government of South Africa has to take pollution control policies and their implementation as a serious governance issue. The country has to take a clue from the developed countries where pollution-controllaws have helped to clean up rivers, lakes and streams. In the developed countries, the
laws have been found to promote conservation and the efficient use of water. Nevertheless, in Africa and the other developing countries (although most countries in this region have pollution-control laws), many of them lack the political will or financial resources to enforce them (see Musingafi, 2013).

Thus, our final conclusion is that, in South Africa, like anywhere else in the world, freshwater management and governance is of critical importance to avoid artificial freshwater shortages. The supply and demand for water, and therefore its abundance or scarcity, depend significantly on the management of the resource and its use. The management of available water supplies is therefore critical. Poor management may create functional water scarcity even in a country with seemingly abundant supplies of fresh water.

References


