

The urban growth of Mombasa coastal town and its implication for surface and groundwater resources

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Abstract Mombasa is the second largest urban centre in Kenya after the city of Nairobi. The historical development of the town dates from the 15th century during the Arabian rule of the coastal strip. The town which is about 500 km south east of Nairobi is situated on Mombasa Island with an extension on the mainland. It has the largest harbour in eastern Africa with good sheltered harbour facilities at Kilindini port, and is the gateway to the East and Central African regions. The major industrial activity is associated with oil refining but the town is a major tourist destination due to its natural clean beaches. The city experiences acute water shortages due to increased demands from both industrial and population growth. This paper describes the historical and current growth of Mombasa town in terms of population and industrial activities as it affects water demand and use. The geology is examined as a means of quantifying groundwater resources and pollutant sources and the overall effects are examined in view of suggesting possible strategies to ensure continued urban growth without further environmental degradation impacts.

INTRODUCTION

The location and administrative boundaries of Mombasa are indicated on Fig. 1. The historical development of the town stretches back to the tenth century when it was a trading centre between the East African coast and the Far East. Its early visitors were the Arabs, Indians and the Chinese (Blij, 1968) with the town developing as a trade centre mostly during the 15th century, then growing to become the most important port in Eastern and Central Africa. Today, Mombasa is the second largest harbour in the African Indian Ocean coast with a hinterland stretching back to Uganda, Rwanda, Burundi, Tanzania, Ethiopia and parts of southern Sudan.

GEOLOGY

The Mombasa district is located on a coastal lowland with extensive low-lying areas rising from 8 m a.s.l. in the east to about 100 m in the west. The Island and Kisauni area are basically flat alluvial plains while the Changamwe region consists of Jurassic plains as indicated in Fig. 1. Near the sea, the land is composed of Pleistocene coral reef (Ojany & Ogendo, 1973) which is commercially exploited as a source of limestone for the cement industry, and also as a source of building stone. The seashore has extensive sandy beaches which make the town an attractive tourist destination.

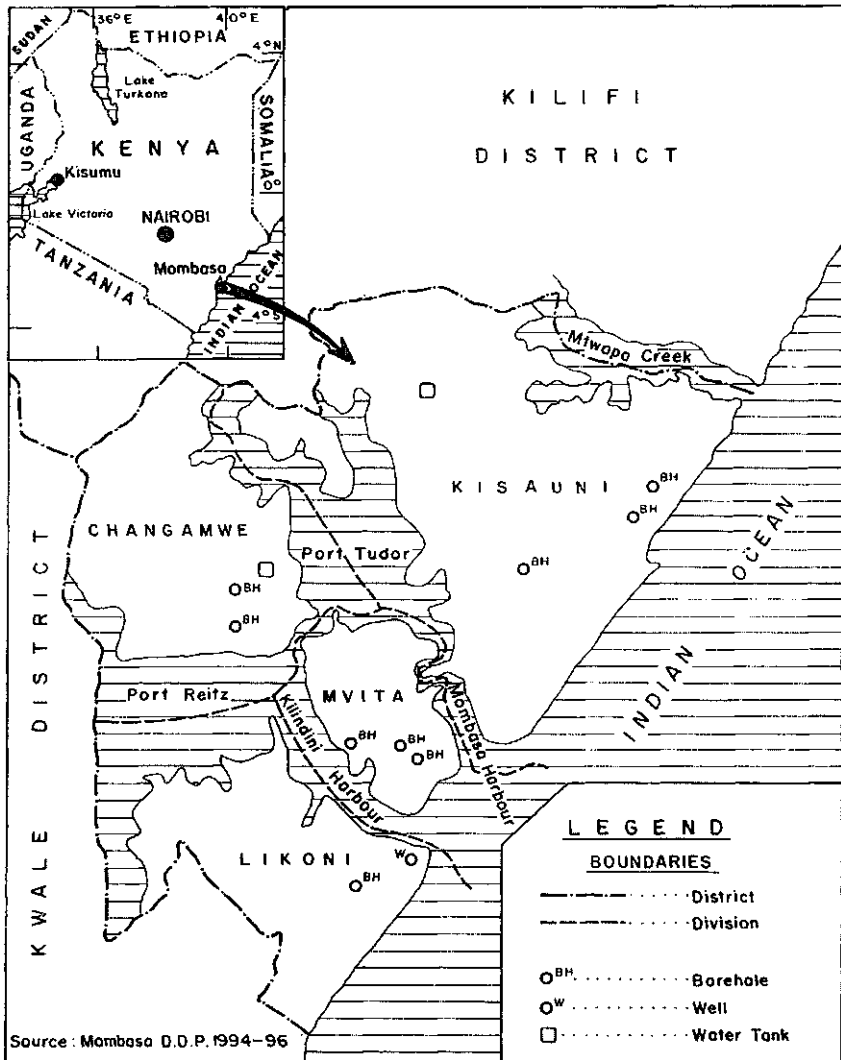


Fig. 1 Mombasa District water resources.

POPULATION AND INDUSTRIAL GROWTH

The population of the town has increased from 247 073 in 1969 to 461 753 in 1989 (CBS, 1994); a growth rate of between 3.5% to 3.8%. This fast growth is attributed both to natural and rural-urban migration. It is therefore, projected that by the turn of the century the town will have a population of 623 367 people. It is the second largest industrial centre after the capital city Nairobi and is linked by an international railway to Uganda and trunk road to major eastern and central African cities. Major industries include oil refineries at Kipevu and Changamwe, cement factories at Bamburi, with tourist related industries, textile and engineering works spread through the urban area. The industries attract a labour force from the entire coastal region and the hinterland

thus increasing population growth. This high population growth and industrial expansion has exerted a high pressure on water resources, e.g. 10 l of water are taken to refine one litre of oil, 35 l to produce one kilogram of cement and 4×10^6 to 5×10^6 l of water to produce one kilogram of synthetic textiles (Linenger, 1995). This in turn puts considerable strain on the quantity and quality of water supplied to the town and its environs.

WATER RESOURCES

Mombasa town, like many other towns in Kenya receives its water supply from distant areas. Its main source of water supply is the Mzima springs some 300 km away in the Chyulu hills (Taita Taveta District). These springs are believed to be part of the Kilimanjaro Mountain system but generally this falls under the Athi River drainage basin, generally referred to as Sabaki in the coastal zone. Apart from the Mzima springs, Mombasa town and the coastal region in general receives surface water supplies from Baricho, Marere and from the Tiwi boreholes in the south coast area as shown in Fig. 1. Fresh water supply is a major pre-requisite for sustainable urban development of the region and thus as urbanization increases and water demands increases, new water supply systems must be developed.

From the outset, Mombasa and the coastal area in general has encountered persistent water problems due to many factors but mostly due to the unavailability of any permanent river, the increasing population growth and poor maintenance of existing water supplies systems. Though geologically the town is rich in groundwater, exploitation has been limited due to salinity caused by sea water intrusion, the presence of pit latrines and poorly kept septic tanks. Presently water demand in Mombasa and the coastal area stands at some $200\ 000\ \text{m}^3\ \text{day}^{-1}$, against a total supply of $92\ 800\ \text{m}^3\ \text{day}^{-1}$ as indicated in Table 1. This leaves the region with a water deficit amounting to $10\ 200\ \text{m}^3\ \text{day}^{-1}$ and thus calls for an urgent water policy to address this shortage problem.

Table 1 clearly demonstrates that the supply sources have not reached the designed capacity leaving a deficit of $60\ 200\ \text{m}^3$ due mainly to breakages, leakages, silt deposits and insufficient capacity volume. In addition, the designed capacity is far below the total water demand of $200\ 000\ \text{m}^3\ \text{day}^{-1}$ thus calling for development of other sources and expansion of the existing ones.

Table 1 Source of water supply in Mombasa.

Source	Year of construction	Quantity ($\text{m}^3\ \text{day}^{-1}$)	Design supply capacity ($\text{m}^3\ \text{day}^{-1}$)	Deficit ($\text{m}^3\ \text{day}^{-1}$)
Mzima pipeline	1955	35 000	50 000	15 000
Baricho pipeline	1955	47 000	82 000	35 000
Marere pipeline	1926	6 900	12 000	51 000
Tiwi boreholes		3 900	4 000	1 000
Total		92 800	148 000	60 200

Source: NWCPC (1998).

REMEDIAL MEASURES

To alleviate the problem of water shortages in Mombasa and the coastal region, the following steps need to be undertaken:

- (a) Development of a second Mzima pipeline, reconstruction of the Marere pipeline and the expansion of the Tiwi and Baricho wellfields. When fully implemented these sources will supply some $260\,000\text{ m}^3\text{ day}^{-1}$ to meet demand within Mombasa and the coastal area up to the year 2020.
- (b) Rehabilitation of the Baricho waterworks and the Sabaki pipeline as well as augmentation of the Tiwi wellfield by developing an additional five boreholes all adding a total of $140\,000\text{ m}^3\text{ day}^{-1}$ of water supplied to Mombasa and the coastal area.
- (c) Given the availability of funds, inter-basin water transfers can be attempted to augment the rural discharge and boost up the supply especially in the Sabaki River and Baricho waterworks.
- (d) Desalination, though expensive could be a future option.
- (e) Mombasa, like many other island towns in the world receives frequent and unseasonal convectional rains, whose water can be tapped through roof catchments and gutters and channelled into underground manholes or tanks to be used in times of water shortages.
- (f) Recycling of sewage water after purification could be another useful option to augment the water resources in the region.

REFERENCES

- Blij, H. J. (1968) *Mombasa: An African City*. North Western University Press.
- Linsenger, H. (1995) *Endangered Water*, vol. 12. Centre for Development and Environment; Institute of Geography, University of Bern, Switzerland.
- Ojany, F. O. & Ogendo, R. B. (1973) *Kenya: A Study In Physical And Human Geography*. Longman Press.
- Mombasa DDP (1994–1996) *Mombasa District Development Plan*. Republic of Kenya Government Printer, Nairobi, Kenya.
- CBS (Central Bureau of Statistics) (1994) *Kenya Population Census 1989*. Central Bureau of Statistics, Republic of Kenya. Government Printer, Nairobi, Kenya.
- NWCPC (National Water and Conservation Pipeline Corporation) (1998) *National Water and Conservation Pipeline Corporation, Ministry of Water Resources, Annual Report 1997*. Republic of Kenya, Government Printer, Nairobi, Kenya.