

REPORT ON THE STATE OF WATER POLLUTION IN KENYA

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INTRODUCTION

Most human activities have deleterious effects to nature. The impacts are more pronounced in the more civilized societies where quantity, quality, and speed of degradation are beyond the natural rates of purification and recovery processes. These effects on the environment interfere with the human environment causing man physical, physiological, and mental problems. So industrially more developed and culturally more civilized countries have paid very expensive retribution for a long time for their damages to nature.

At present if the Kenya Government follows the political patterns of the developed countries, they can advance industrially without undergoing the economic strains the advanced countries went through when they industrialized. The process will even be shorter as it will be based on technology transfer. These could be achieved without the environmental destruction if safe methods (Environmental friendly technologies) are applied.

Basing my experience at home and from the survey I have contacted during my short stay in Kenya(at KMFRI), I would like to make a frank report on the levels of pollution in Kenya within the framework of scientific and political assistance, especially on problems facing water quality management. I do hope that my advice will help and initiate some direction of development towards safer environmental standards in Kenya.

AIM OF THE POLLUTION SURVEY AND SOLVING PROCESSES OF PROBLEMS

Field survey is an important area for the studies of the pollution on water, air, and soil, but field surveyed data themselves can not solve the pollution problems. If we have the data which some item of the pollutant is very high, so what ? No matter what color water has or no matter what smells waters have, if high level of pollutant has no relationship with living organisms, there is no problem. But pollutants have always influences on the living things. So we have to survey the pollutant levels and then we can solve the pollution problems to be based on the surveyed data. The aim of the survey of the pollutant concentrations is to know the levels affecting the living organisms and to solve the problems.

Pollution problems can be solved through following steps of the study.

**1. Field surveys, identification of the pollutants,
and analysing the data.**

**2. Surveys on point sources and non - point sources
of the pollutants.**

3. Impact tests of the pollutants using living organisms

Toxicity tests (acute and chronic) of the organisms from the various taxonomical niche have to be made against various toxicants and various levels of toxicants.

4. Setting up the maximum discharge level of pollutants

Upper limits of discharging level of pollutants from the pollution sources should be set up according to the results of toxicity tests by government for the conservation of the ecosystem and sustainable utilization.

5. Application of the rules to the pollution makers.

STATE OF WATER POLLUTION IN KENYA

1. Sources from industrial activities

Industrial activities in Kenya are centred mostly in Nairobi (Athi River Town), Mombasa, and other large cities except agro - chemical facilities located in the rural areas like as Kisumu (Mohoroni near Nyando River) and Kwale, Kilifi, and Lamu located along the coastline.

In Mombasa, industrial effluents are the major sources of BOD₅, accounting for about 72% of the total load with over 94% of the organic load due to food and beverage manufacturing activities. At least 66% of waste oils are products by the slaughter houses and fish processing plants, with iron and steel industries and the oil refinery contributing most of the rest of the load. Industrial liquid waste, with most probable contaminated toxic chemicals, is often allowed to discharge into the storm water drain and eventually into the creeks. In Mombasa District, considering the location of the industrial area and drainage on the Mombasa Island and the West Mainland, most of the pollution load due to industrial effluents, which contributes 99% of BOD, 51% of nitrogenous compounds, and 77% of phosphorus compounds, ends in the Kilindini and Port Reiz creeks (Munga *et al.*, 1993).

The few major industrial establishments in Kilifi District use the septic tank - soakage pit systems for sewage disposal. At least one manufacturing plant has been found to discharge waste water effluent into the sea without pretreatment. There are considerable

quantities of undetermined liquid wastes that are disposed of directly into the sea, thereby exerting a BOD (Munga *et al.*, 1993).

Major source of BOD in Lamu District is also industrial effluent which is attributed with about 45% of the total load, most of it due to the cotton ginnery. Small quantities of the waste oil are produced by a vegetable oil manufacturing plant, with the slaughter houses contributing over 90% of the waste oil load (Munga *et al.*, 1993).

In this state, a few industries have facilities for effluent pre-treatment before disposal only. A number of them use septic tank and soakage pit system, vertical drains, or discharge waste directly into the sea from coast area and into the rivers from the upcountry. The soakage pits and vertical drains are more dangerous than the direct discharge into the sea or rivers because untreated waste water with detergent can meet with the underground water table. Then Kenyan people can use no more underground water and if untreated waste water with detergent goes down to the underground water way, they would have no more clean water to drink in Kenya in the future.

2. Sources from the domestic sewage

Most of the waste from domestic uses are discharged into the inshore waters from the coastal areas, into the river waters from the upcountry, or into the coastal waters from the near lake areas. No other urban centres along the coastal area of Kenya have sewerage systems or sewage treatment facilities except Diani Beach Tourist Resort equipped recently and Mombasa.

Mombasa Municipality has separate sewerage systems for domestic sewage, covering about 17% of the pollution (GOK, 1974) from storm water runoff. However, the two old sewage treatment plants have been ineffective due to overloading and poor maintenance of the Kizingo primary treatment plant and unserviceable for the last 4-5 years due to the rehabilitation and expansion of the Kipevu secondary treatment plants. The Local Authority of Mombasa operates a refuse collecting service, which manages to dispose of approximately 60% of the domestic waste at an uncontrolled dumpsite known as Kibarani in shore of the Makupa mangrove creek. The rest of the inhabitants utilize pit latrines (59%) and septic tanks and/or soakage pits (24%) for sewage disposal. Tourist beach hotels also utilize septic tank-soakage pit systems for sewage and sullage disposal, which are often allowed over flow into the sea for disposal. Sludge from septic tanks and pit latrines is usually dumped at the Kibarani site and other undetermined mangrove areas. Domestic sewage from Mombasa Municipality including the beach hotels is a source of about 40% of nitrogenous compounds and 33% of the phosphorus compounds. The liquid and solid waste occupy 30% of the overall BOD load. 83% of the Mombasa

residents use pit latrines and soakage pits (Munga *et al.*, 1993).

There are no sewerage systems in any of the population centres in Kwale District. The method of disposal of domestic sewage is predominantly by the use of pit latrines and includes septic tanks and soakage pits. All beach hotels use septic tank and soakage pit systems for liquid waste disposal except Diani Tourist Resort equipped recently with a biological treatment system for domestic waste water. Diani Beach Tourist Resort has one of the most rapidly growing tourism industries in the coastal region. Domestic sewage from population centres and beach hotels generate at least 76% of the BOD load. About 50% of nitrogenous compounds are due to domestic sewage from population centres and beach hotels of Kwale District (Munga *et al.*, 1993).

All major urban centres in Kilifi District, namely Kilifi and Malindi, have also no sewerage systems. The methods for sewage disposal are invariably pit latrines and septic tank and soakage pit systems. Likewise, beach hotels use septic tank-soakage pit systems for sewage disposal. Liquid and solid domestic waste from the population centres and beach hotels contribute over 70% of the BOD load. Domestic sewage, including waste from beach hotels, produces about 45% of nitrogenous compound load (Munga *et al.*, 1993).

Lamu township has no sewerage systems too. The uses of pit latrines and septic tank-soakage pit systems are the main modes of domestic waste disposal. Domestic waste contributes about 25% of BOD load (Munga *et al.*, 1993).

These liquid wastes from the pit latrines or soakage pits seep out into the underground as mentioned above (p. 6) and causes damage to underground water, hence contamination of underground water ways.

3. Sources from the agricultural activities and livestock productions

In Mombasa, major contributors of phosphorus compounds are livestock waste at 50% of the load (Munga *et al.*, 1993).

Over 80% of phosphorus compound load in Kwale District is due to livestock waste. Nitrogenous compounds from the livestock are 40% of the load (Munga *et al.*, 1993).

Agricultural runoff and livestock waste in Kilifi District make about 45% of the total nitrogenous compound load. Livestock waste is the source of about 60% of phosphorus compounds (Munga *et al.*, 1993).

Livestock waste in Lamu District attributed to 25% of the total BOD load. The high concentration of donkeys in Lamu is also contributes at least 92% of suspended solids, nitrogenous compounds (91%), and phosphorus compounds (94%) loads generated. Liquid waste from the Lamu slaughter houses is disposed of into a soakage pit which effectively reduces the loads of BOD₅ and suspended solids. Soakage pits are widely utilized to dispose the liquid waste from the industrial facilities, domestic activities, and slaughter houses (Munga *et al.*, 1993).

Kenyan Government and people have to know pit latrines and soakage pits end on the water tables. If it stops before to meet the underground water, it would be helped by rain water and continued itself by pouring the waste at the same point.

4. National parks, national reserves, and lakes

4-1. National parks and reserves

1) Inland national parks and reserves

From the Table 1 (page 12) you can see that almost all of the accommodation facilities except only one lodge in Masai Mara National Reserve make their liquid wastes to reach the underground water tables by soakage pits from the septic tanks. Keekorok Lodge in Masai Mara National Reserve drains normally from the septic tank, through the surface flow, to the near river.

They do not understand that they are spoiling their life spring. They are also using the bore holes or springs from the underground near the pits for their water.

2) Marine national parks and reserves

Mombasa Marine National Park and Reserve look like healthy. They decided very fine decision to cut off the inflow of the liquid wastes from the beach hotels and fishing by trawlers in the park or reserve. But they remain still the seepage problem from the soakage pits of the hotels.

It would be better to have protected (water proof) pits instead of soakage pits for large scale treatment of waste from them. It would also be better to have the fixed survey station for

Table 1. Rooms and water volume used daily of accommodation facilities of the inland national parks

No.	Name of Accommodation Facilities	Palace Located	Rooms	Water Volume Used(m ³ /day)	Waste Water Treatment Type
1	Meru Mulika Lodge	Meru Nat. Park	66	-	Soakage pit from septic tank
2	Sarova Shaba Lodge	Shaba Nat. Res.	85	97	"
3	Buffalo Springs Lodge	Buffalo Springs Nat. Res.	80	50	"
4	Kaindongoro Fishing Lodge	Aberdare Nat. Park	248	1	"
5	Lake Nakuru Lodge	Lake Nakuru Nat. Park	68	25	"
6	Sarova Lion Hills Lodge	"	65	80	"
7	David Roberts Wildlife Camp	Lake Baringo	14	11	"
8	Block Hotel Lake Baringo Fishing Club	"	48	22	"
9	Keekorok Lodge	Masai Mara Nat. Res.	84	32	Small Stream from septic tank
10	Mara Sopa Lodge	"	82	60	Soakage pit from septic tank
11	Sarova Hotel	"	75	24	"
12	Mara Serena Lodge	"	78	111	"
13	Kilimanjaro Safari Lodge	Amboseli Nat. Park	100	-	"
14	Amboseli Lodge	"	114	-	"
15	Amboseli Serena Lodge	"	96	-	Swamp from septic tank
16	Kilaguni Lodge	Tsavo Nat. Park West	53	30	Soakage pit from septic tank
17	Tsavo Wildlife Safari Lodge (Kitani Lodge)	"	13	2.5	"
18	Ngulia Safari Lodge	"	52	9	Valley through pipe line from septic tank
19	Voi Safari Lodge	Tsavo Nat. Park East	53	750	Soakage pit from septic tank Included water for animal pond
20	Taita Hills Hilton Safari Lodge and Salt Lick Lodge	Taita Hills	172	140	Soakage pit from septic tank

Nat.:National, Res.:Reserve

regular survey for a long time, and then Kenyan Government can protect her valuable properties, fish and coral, in her marine parks and reserves from the abrupt changes of water qualities.

4-2. Lakes

1) Lake Victoria and Turkana

Two lakes Victoria and Turkana should be protected from the inflow of waste. Particularly, the liquid wastes must be treated before discharge from the industrial and domestic activities and other facilities or activities because firstly ecosystems should be protected from the pollution and then pollution problems can bring the international dispute.

2) Lakes in the valley: Lake Baringo, Nakuru, and Naivasha

These lakes have geologically special character. They have inflow from the rivers but no outflow. They have coarse ground under the lake basin. So lake water can seep easily into the underground with evaporation. Therefore these lake waters should be kept clean for Kenyan peoples' drinking water because these lake waters are connected with underground water.

5. Port Mombasa

Mombasa Port has no reception facilities for bilge water or other wastes from ships (Munga *et al.*, 1993), and also no facilities to collect the spilled oil from the water (oil separator). There is need for a contingency plan to combat oil spills and minimize environmental impact, especially in Mombasa, where some quite damaging oil spills have occurred. Raw sewage is being discharged into the Mombasa creeks. Sludge from septic tanks and pit latrines is usually dumped at the Kibarani Harbour because of inefficiency of Kizingo sewage treatment plant and rehabilitation and expansion of Kipevu plant. Oil residue from ship tanks is usually sold to soap manufacturers and other industries who use it to fuel boilers. It is all right if they have perfect facilities to take off the residue oil from the ship. Mombasa Port needs the quick expansion and new extension of the sewage treatment plants and to have the collecting facilities of dispersed oil from the water (oil separator and oil fence, etc.).

CONCLUSIONS

I have two main results from this study.

1. Kenyan people make the non-point sources of water pollution from the point sources.

There are many pit latrines, soakage pits, and vertical drains in the industrial facilities, accommodation facilities in beach and inland national parks and reserves, and private houses. Seeped sewage from them is already connected with underground water table and underground water ways. So underground waters in Kenya are going on badly day by day. Seepage of sewage reduces to inorganic matters from the organic matters of sewages during the seepage but there are many nitrogenous compounds as the products from organic matters in the sewage and also high concentration of undegraded chemical detergent mixed with nitrogenous compounds. If Kenyan Government does not want to improve the waste water disposal system, eventually Kenyan people have no more clean water to drink in the future in Kenya.

2. Kenyan Government does not have accumulated surveyed data of water pollution.

Kenyan Government needs many accumulated surveyed data for the solution of water pollution problem as mentioned above. Kenyan Government can not have continuous surveyed data by research project or survey project because the project can not be guaranteed continuously. The surveys should be guaranteed long term period by government.

To solve above two big problems resulted from this study, I hope to give the Kenyan Government several recommendations as follows;

1. To improve on the soakage pit as protected one without soakage

The pits of the soakage pits should be waterproof without seepage for conservation of underground water to drink continuously. Overflowing waste water from the pits should be drained into the streams or rivers for large scale treatments.

2. Toxicity tests of the waste waters

Toxicity test of the waste water should be tested against living organisms for the discharging standards.

3. To have the fixed survey stations for water quality monitoring

Water quality monitoring stations should be fixed and water quality should be surveyed periodically for a long time for waster water treatment plants. Kenyan Government has firstly to fix the water quality monitoring stations in the estuaries and marine national parks and reserves.

4. Treatment plants for estuary waste water

Waste water treatment plants should be established in the estuaries according to the water qualities, particularly in Mombasa.

**5. Dispersed oil collecting facilities(oil separator)
from the seawater in Mombasa**

Mombasa Harbour is the largest one in the East Africa as well as in Kenya, and incoming vessels are increasing year by year (KPA, 1993). Kenya Ports Authority (KPA) needs the dispersed oil collecting facilities (oil separator and oil fences etc.) from the seawater in Mombasa, and contingency plan for unexpected oil spills.

6. Other recommendations

These recommendations are different from this study, but I think these recommendations would be better for Kenya herself.

There are many national parks and reserves with bad roads to reach them from the trunk roads. Expensive admission fee distinguished from the resident rates makes foreigners feel bad.

Good roads (unbroken pavement) and cheaper admission fees with nice services will bring more visitors from abroad. Bus lines from town to the parks would transport more visitors without personal vehicles. Inner Shuttle Buses in the parks make the visitors enjoy without damages to the park and the government would have increased income. More convenient shuttle buses with nice services make more visitors. All of the such improved management of the parks and reserves will serve the experienced foreigners visit other parks.

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