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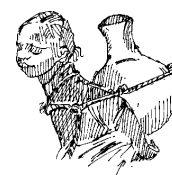
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Worku, Getahun, and Adinew Adam. 2019. "Wastewater Management in Addis Ababa". figshare.  
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## Wastewater management in Addis Ababa

*Getahun Worku and Adinew Adam, Ethiopia*

THE ADDIS ABABA city currently having a population of about 2.5 million is the capital city of Ethiopia with a total population of about 60 million and it is a seat for various regional and international organizations as well as diplomatic offices. It is also a major commercial and industrial center of the country. According to an economic analysis made by Ethiopian Central Statistical Authority in 1991, Addis Ababa accounts for more than 30 per cent of the nations urban population, and on average 58 per cent of the establishments, 62 per cent of the employment, 61 per cent of the out-put and 79 per cent of the fixed assets of the country are located here. However, the city lacks proper infrastructure and basic social services, especially with regards to public health and environmental sanitation. The sewerage system is very limited in its coverage. The stormwater drainage system is also insufficient. Though, the majority of the city's population use on-site sanitation system, still a significant proportion use open fields for disposal of wastes. Due to lack of proper design and routine maintenance, most of the available sanitation facilities do not serve the intended purpose and are rather acting as sources of health risks. The insanitary situation created due to mismanagement and lack of facilities for waste disposal is seen to cause public health problems and environmental degradation.

### Wastewater sources, quantity and quality

The major categories of the city dwellers contributing to liquid waste production and pollution of the environment are: domestic house holds, industries, public toilets, hotels, hospitals and institutions. From domestic sources, quite a significant quantity is generated each day. Using the current population of the city, it is estimated that the volume of wastewater produced is about 100,000 cubic metre per day while the generation of fresh excreta and urine is about 3,600 tons everyday. This waste is mainly loaded with pathogens and organic pollutants. Waste from industrial source varies both in quality and quantity based on their capacity, raw material used and products of the industries. Some of the major industries can be categorized as tanning and leather manufacturing industries, distilleries and breweries, textile, food processing chemicals, oil mills, soft drinks, dairies, pulp/paper industries and metal industries. The volume of liquid waste produced everyday from these industries ranges from 1 to 1000 cubic meter per day. There is no well defined industrial area in the city and industries are spread out and mainly located in the vicinity of water courses. Almost all of the industries in the city directly

discharge their liquid wastes into the nearby streams or stormwater drains, however, some of these industries produce liquid waste with concentrated toxic chemicals like oxygen consuming organics, sulfides and chromium. There are several big hotels with a number of bed rooms and a very large volume of wastewater being generated. Hospitals have similar characteristics and their liquid waste production rate is significant. However, most of them do not have organized waste management system and they are equally polluting the environment. The wastewater/sludge generated in the city has biological oxygen demand ( $BOD_5$ ) up to 7,600 mg/l and total coliforms/faecal coliforms in the order of  $10^7$  counts/100 ml.

### Available sanitation (wastewater) facilities

#### Collection and storage facilities

The majority of the population in the city uses on-site sanitation facilities and a very minor proportion use off-site facilities while a significant proportion use open fields and stormwater drains for liquid waste disposal. According to the 1994 Population and Housing Census, 24 per cent of the city population don't have their own toilet facilities whereas 63 per cent use pit-latrines and 12 per cent use flush toilet. Housing units with water-borne systems (flush toilets) have good internal conditions, but often seepage overflows from storage tanks into public places, streets, ditches, and the like. Few of them have connections to the existing sewer system. Such sanitation facilities are safe for users but can cause potential health hazard where seepage is allowed to overflow to those living in the surrounding areas.

Pit-latrines are the predominant on-site sanitation technology being used in the city. They are relatively cheaper and need less maintenance and attendance. The pit-latrines are either used by private households or shared among several households. Private pit-latrines can be mostly of an acceptable standard, reasonably clean and well maintained. However, some of them are overflowing into streams, roadside stormwater drains and ditches causing health hazards to the surrounding areas as well as to their users. Shared pit-latrines are latrines that are used by several households ranging from 2 to 10 or more. These latrines are of very poor condition, dangerous for users, have no privacy, over-used, often impossible to clean and are considered as no man's land as regards to maintenance and management. These latrines are major health hazards to users and to those living in the surrounding areas by being possibly worse than having no facilities. Pit latrines are used not only for excreta disposal but also receive all sorts

of rubbish and solid wastes generated in the households mainly due to poor solid waste collection activities. Due to poor construction and maintenances they are also subject to receiving flood, underground water and street cleaning especially during rainy seasons, leading to un due filling and overflowing of pits. The garbages and solid wastes especially plastic materials cause severe problems in emptying the pits by blocking the suction pipes of vacuum trucks and also up on discharge on to the discharge site. It further causes difficulties during the treatment process. According to a survey conducted in 1993, 45 per cent of desludged pits had difficulties with emptying due to blockage in the tanker hoses and 60 per cent of the latrines were overflowing.

Population with no facilities use either a very limited public toilets, open fields, river banks, ditches, bushes, road sides, or corners etc. This creates health problems to the whole community as excreta is present everywhere in the environment. Particularly, this situation is dangerous to children playing in streets and open fields. There are about 60 public toilets in the city in which most of them are located in central commercial areas. All of these toilets are with flushing system but are not connected to the sewer system. Some of them directly discharge their wastewater to stormwater drainage system or to their nearby streams. The rest conserve the wastewater and are emptied by vacuum truck on a regular basis. Almost all of the toilets are poorly maintained and contribute to pollution of their surrounding areas.

### **Wastewater collection and transportation facilities**

Governmental and non-governmental organizations as well as few private investors are participating in the development activities of environmental sanitation in Addis Ababa city. The government organizations carry-out sanitation activities as per rules and regulations mandated to them. Also, quite a number of NGOs are engaged in the sanitation activities. A study conducted in 1997 identified about 118 projects related to sanitation. Of these, 72 were being run by 23 NGOs. All Woredas of the city, except one have at least one such project and of 305 Kebeles in the city about 47 per cent have been beneficiaries of at least one project. These projects are funded by different donors including international and foreign agencies, national government bodies and NGOs. The sanitation projects deal with stormwater drainage and excreta, solid waste and sillage disposal activities.

The input of these projects to the effort being made to improve the sanitation situations in Addis Ababa as well as the number of actors involved in the sector activities are significant, however, they lack institutional coordination and integration of activities. It is not well known to the majority of the population in the city, even to those involved in the sanitation sector activities that such a big number of projects are being under taken in the city. The same is true for the number of institutions that are involved in the upgrading of the sanitation situation of the city.

Pit latrine sludge and septage is collected by vacuum trucks from each site and transported to a disposal site at Kalitti some 15 kilometers from the city center. Currently, there are about 50 vacuum trucks engaged for such services in the city but owned by different organizations. It is only 60 per cent of the pit-latrine that are accessible for vacuum trucks. This is mainly due to access road problems mostly in unplanned congested city centers. The rest 40 per cent are either connected to stormwater drains, streams, ditches or simply overflow into the surrounding open spaces. There are cases where manual emptying of pits and dumping sludge into streams are practiced due to lack of access for vacuum truck service. Out of the quantity of sludge and septage generated in the city, currently about 230,000 m<sup>3</sup>/year is being collected by vacuum trucks and dumped at kalitti plant site.

The city has conventional sewerage system which serves a very limited area with water-borne systems. About 110 kilometres of main and secondary sewer lines and a wastewater treatment plant are currently serving about 35,000 population equivalent. However, the ultimate capacity of the existing sewer system is 200,000 population equivalent. The wastewater from housing units connected to the city's sewer system is conveyed to the treatment plant by the sewer network. Currently about 4500 m<sup>3</sup>/day wastewater is transported and treated at the Kalitti wastewater treatment plant. Besides the low percentage of housing units with flush toilets in the city, it is only about 1.2 per cent of the population that are being served by this system. The rest are illegally connected to stormwater drainage system and to the nearby streams or share the limited truck service.

### **Wastewater treatment facilities**

A biological wastewater treatment plant (lagoon) having a capacity of serving 50,000 population equivalent was constructed at Kalitti in the late seventies and have been operational since then. It produces good quality effluent as regards to the sewerage wastewater. However, digestion tanks designed for pit-latrine sludge and septage treatment failed to perform as designed.

### **On-going projects and future plans**

Wastewater Master Plan Study was conducted for the city in 1992/93. This study assessed the sanitation situation in the city and proposed development plan for the coming 20 years. The implementation of the study was planned as of 1995, however, until 1998 nothing has been accomplished due to lack of the required fund. Understanding the urgency of the issue, The Addis Ababa Water and Sewerage Authority (AAWSA) has initiated some projects to be funded from its own source. Accordingly, a treatment facility for pit-latrine sludge and septage is constructed in the southern part of the city at Kalitti with a treatment capacity of 400 cubic metre per day. A similar treatment facility with equivalent capacity is also under construction in eastern part of the city at Kotebe with a fund secured from The

Ethiopian Government and The Netherlands Government. These two facilities can handle the volume of sludge being currently collected. Expansion of the conventional sewer lines and increasing sludge collection efficiency are also being considered in a piece meal due to the financial constraints. There is an attempt being made to implement community based sanitation projects especially focusing on population without basic facilities like toilet. The contribution of non-governmental organizations is significant in this respect. Implementation of The Wastewater Master Plan Study is still to be pursued for the sanitation improvement strategy.

### Environmental impacts

Lack of facilities, poor design and maintenance of pit-latrines and mis-handling of wastes in general has caused insanitary situations in the city. The major proportion of waste water and excreta that should be removed from the city and be systematically treated are left uncollected and is polluting the environment.

The excreta as well as solid and liquid wastes which are left uncollected in open spaces are the main source of offensive smell and nuisance that also serve as transfer media for water borne diseases which are the predominant diseases recorded in hospitals of Addis Ababa. The surface water quality within the city is strongly affected by pollution effects of wastes discharged into them.

The storm drains convey water of similar characteristics to that of the sewered wastewater. Streams and rivers in the metropolitan boundaries are also acting as open sewers. Samples collected from rivers crossing the city have  $BOD_5$  as high as 400 mg/l and total coliforms/faecal coliforms in the order of  $10^7$  counts/100 ml. Considering 25 mg/l  $BOD_5$  as the upper limit for a non nuisance of surface water, the high levels of  $BOD_5$  in almost all the streams indicate that environmental sanitation of the city is in poor quality conditions. On the other hand, the results of water samples from Aba Samuel lake which is a recipient of almost all flows from the city demonstrate relatively better quality standard as regards to the measured parameters, whereas its contents respective to heavy metals and some toxic substances are subject for further study. Aba Samuel lake is acting as a biological treatment plant for the wastes discharged into the streams, i.e., little Akaki and great Akaki rivers. However, pollutants that sink into bottom sediments and organics that degrade in the lake can have adverse effects on the lake ecosystem. These effects are being observed as part of the lake surface is completely covered by vegetation like water hyacinth that in turn prevents sunlight rays from penetrating into the water and air mixing or turn-over of the water leading to low oxygen content. Bottom sediment might be highly loaded with chemicals especially from industrial sources, which might rise up into the water body during turbulence in the lake. In any case, this hypothesis needs verification through rigorous sample tests and further studies in depth. The fate of the lake and its capacity to handle such a load in the future has to be assessed.

Ground water is the other resource exposed to the pollution effect of the mismanagement of wastes in the city. There are over 600 wells used as a water supply sources in the city. Most of these wells are privately owned by individuals as well as different institutions and no chemical treatment is applied except very few to which disinfectants are added. Most of the wells are hand dug and shallow in depth. The majority of these wells are found in the densely populated areas of the city. Shallow wells are susceptible for surface pollution especially for nitrate ( $NO_3^-$ ) pollution from faecal contamination. A survey made in 1992 showed that out of 45 wells tested, 19 showed very high incidence of  $NO_3^-$  pollution. Source of this nitrate pollution may be attributed mainly to the indiscriminate wastewater disposal as well as from pit-latrines used in those areas. Currently, ground water development works are underway in the southern part of the city at Akaki. Protection of this well field should also necessitate the efficient and proper wastewater management in upper catchments of the city.

### Conclusion and recommendations

The insanitary situation in the city has affected public health and the surrounding natural resources. Sanitation facilities are inadequate both in coverage as well as quality standard. Irrespective of their assumed living standards and residential locations, the majority of the population are daily exposed to an excreta-borne diseases either from their inadequate sanitation facilities or from poor facilities of those in the neighbourhood. Environmental protection issues especially wastewater handling practices are backward mainly due to lack of awareness and economic constraints among the majority of the city dwellers. Lack of policies, standards, rules and regulations or non-enforcement of the existing legislation have contributed to the insanitary situation.

The improvement of the situation should focus primarily in creating the proper awareness both from the public as well as the government sides on sanitation issues and significance of environmental protection. Sanitation sector activities should be coordinated and integrated to enable all parties for economical utilization of the available resources and to guarantee sustainability of facilities as well as services.

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