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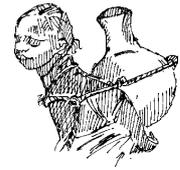
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Solid waste management in Ethiopia

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THE BOOMING GROWTH of cities of the developing world has outpaced the financial and manpower resources of municipalities to deal with provision and management of services, of which solid waste is the major one. Lack of these services greatly affects the urban poor, women and children who are vulnerable to health hazards. 22 human diseases are related to improper solid waste management (World Bank, 1999). Moreover, its effects are also reflected in reduced productivity, low income and poor quality of life and deteriorated environment.

Similar to cities of most developing countries, provision of required services lags behind the need and development of settlements in urban areas of Ethiopia. Integrated infrastructure and housing development is not widely practised. Provision of solid and liquid waste collection and disposal is low (most urban areas lack the service). In addition to this, deterioration of the immediate environment in the households and their surrounding is increasing.

With the current growth rate of urban population in Ethiopia, it is estimated that the population of most urban areas especially small urban centers is doubling every 15-25 years. As solid waste generation increases with economic development and population growth, the amount in these urban areas will double within a similar time range. So, is the cost for solid waste management. Municipalities in Ethiopia have to be prepared for this challenge. The author believes that, Addis Ababa can serve as a model, and selected the city for this particular paper. A lot of research works and projects have been undertaken on solid waste management in Addis Ababa which helped to gradually improve the service, but the provision still lags behind the need. This paper tries to investigate present shortage and spatial distribution problem of the service from town planning point of view and finally forwards recommendations. The final outputs can be used as basis to solution of solid waste problem for other urban areas in the country.

Review of solid waste management in urban areas of Ethiopia

An integrated urban rural development study undertaken in 1988 showed that among the 11 project towns (Addis Ababa, Akaki, Assela, Ambo, Arsi Negele, Goba, Mizan Tefferi, Robe, Wolisso, Ziway, Shashemene), only Addis Ababa had centralized waste disposal system (NUPI et al, 1989). The towns had no waste collection trucks, 4 of the municipalities assigned other vehicles to collect waste once or twice a week. Among those who have the service the

coverage is very low, usually being limited to street and market cleaning.

Recently, most municipalities in Ethiopia have become aware of the negative consequences of poor sanitation. Accordingly, they have devised and adopted a system to collect and dispose off solid waste. A survey of present status of the system in 15 randomly selected large (Dessie, Bahir Dar, Debre Zeit, Gondar, Mekele, Nazareth) and medium urban areas (Woldiya, Axum, Adigrat, Robe, Gimbi, Adwa, Arbaminch, Wolayita Sodo, Debre markos) shows that from the sample urban areas studied 13, i.e. 86.6 per cent used open dump to dispose waste, while the rest used holes. Most of the other urban areas in Ethiopia are believed to use open dump for disposal. Open dumps pollute surface and ground water, soil and the natural environment as a whole.

Even though, the beginning is encouraging, some technical matters should have been considered in the selection of disposal techniques and also siting. Almost all municipalities visited did not take the required care in selecting the site for collection and disposal. For instance, in case of Gimbi, and Robe towns, open sites will just be selected, holes of about 1 Mt. deep will be dug and then people start dumping garbage. When the holes are filled they will be covered by soil, and the process goes on like that. In Dessie town, the collected waste is dumped along the main road and its vicinity, where it will be carried away downstream to Kombolcha town. Most of the urban areas have no collection containers, and the number is low in those having. For instance, Gondar, with population of more than 90000, has 5 existing 8m³ containers and now obtained additional 4 containers.

Solid waste management in Addis Ababa

A lot of studies and projects have been undertaken on the problem of solid waste management in Addis Ababa. These studies provided solutions for different aspects ranging from problem of collection to institutional management and assessment of community based projects. All contributed to the gradual improvement of the system. Even though the situation is better than before, the provision still lags behind the need as shown in the following sections.

Collection

A detailed survey conducted in 1986 concluded that only 21.6 per cent of waste had been collected (NUPI et al, 1988). A recent study made by the Addis Ababa City Administration shows that, the coverage has been constantly increasing

from 38 per cent in 1993 to 40 (1994), 53 (1995) and 53.9 in 1996. It also shows that, the amount of waste generated in the city increases by 4 per cent. (Hassen, 1998). Generally in Addis Ababa, each kebele (equivalent to a neighbourhood) has no more than two or three solid waste collection containers. There are 305 kebeles while the number of containers is 416. The 1994 Population and Housing Census shows that, population of a kebele ranges from 2500–37031. A study made by the author shows that if all the population of the city use proper collection system, a single container will be shared by up to 14934.75 people. This figure is about 8 times that recommended by NUPI (one container for 2000).

The settlement pattern of Addis Ababa is a spreading out, consisting of predominantly single storey buildings. People need to travel long distance to use containers. Local and international standards set to control the location of containers show that distance between containers should not exceed 200 Mts. (UNHCS, sighted in NUPI, 1998). According to the Nor consult study conducted in 1982, (sighted in the same report), the recommended distance between communal containers is 50-100 Mts., these requires 50-100 containers per sq. km. In case of Addis Ababa, assuming that containers are evenly distributed which actually is not, the catchment radius is as high as 1233 m for densely developed part and up to 2285 for areas at the peripheries.

Some areas face more serious problem. For instance, a study made on the solid waste management of Woreda 28 shows that, out of the four kebeles studied, only three have communal collection containers, with emptying interval of one week or more. Based on this, the coverage in this area is estimated to be only 19.5 per cent (NUPI, 1998). The shortage of containers was pointed out by various consultants. For instance, in 1988, NUPI and associates estimated that a total of 616 are required (442 containers in addition to the existing 174).

The selection of sites for collection containers is not appropriate. Containers at or around city center and other old parts of the city are usually located along main roads for ease of access (Fig.2). The site for the location is not demarcated. User population size is not also sufficiently given consideration. Most of the containers are used by those coming by vehicles with their household garbage and owners of catering services rather than people they are intended for. The area of sites is not delineated. They are not protected from rain or sun which makes the garbage to cause smell pollution, unsightly urban scene and deterioration of the neighbourhood and disturbance of human activities. The site is also exposed to animals like dogs, cats, and others which during scavenging scatter the waste in the surrounding area. The situation in the newly developed parts of the city is not different. Solid waste disposal system is not integrated with settlement development. Actually this is true of other services too. The design and size of containers does not facilitate the collection system. In areas where there is problem of access, smaller

and lighter containers could have been easier to carry to the trucks. It is the type of the containers which actually in a way resulted in poor collection in some cases.

The remaining 46 per cent of waste is disposed off through informal means, except smaller percentage going to incineration and open dump by households. The rivers are widely used as disposal sites. A field observation in selected parts of the city shows that, large percentage of the uncollected waste goes to these rivers. In areas of high population concentration the intensity of using the rivers increases (fig. 1) and waste is seen accumulated along rivers (fig. 3). The hygiene and environmental sanitation regulation issued by the Addis Ababa city administration (proclamation number 1,1994) prohibits people from disposing waste along roads, avenues, rivers, ponds and other sites. People need to dispose off waste as long as they live and consume so, alternative mechanisms should be provided otherwise people continue to violate the regulations.

Transportation

The number of trucks is 60, which is low as compared to the amount of waste generated. Of these, about 50 per cent are not working regularly due to old age. According to the Health Bureau, in 1996 the actual required trucks were 77 (cited in UNDP, 1997). The vehicles carry only a single container at a time to the disposal site. A trip is made to and from collection sites only for single containers of maximum capacity 8m³ or 2160 kegs. Considering the cost of fuel, manpower and overhead costs for transportation per single trip, the system is inefficient and not economical.

Disposal

The sanitary landfill disposal site located 12.5 km away from the city center is used to dump solid waste. The site has been giving service since 1968. The Addis Ababa Master Plan had envisaged an alternative site at Ketena levels (District, population 600000). However, this was not accepted by Nor consult who undertook the study of the city's solid waste management system. The firm criticised the sites to have low area capacity, poor road condition, surface water pollution, and slope (sighted in NUPI, 1998). The consultant instead proposed the extension of the present landfill. However, the health bureau, selected another site at the eastern part of the city, 13 km away from the center with an area of 6.25 hect. Other techniques like decomposing, incineration and recycling are not used as alternative methods of disposal.

Anaerobic decomposition of organic solid waste produces what is termed as Landfill Gas (LFG) which constitutes of methane and carbon dioxide and sometimes toxic gases (internet, 1998). This is true of the Addis Ababa landfill site where the gases generated from the landfill sets the waste on fire and the toxic liquid produced from the site contaminates the surface and underground water (Hassen, 1998). Even though detail studies were not conducted, the gas produced can be methane since it has fire or explosive nature and the liquid part is probably Licheate which



Figure 1. Areas using rivers as waste disposal sites



Figure 2. Containers located along roads



Figure 3. Waste disposed and accumulated along rivers

escapes from the landfill due to failure of the piping system. Studies show that, this system can clog up in short period, even less than a decade due to mud, silt, chemical attacks, micro-organisms, and the weight of waste (ERF, 1999). LFG must be controlled to protect property and human life loss. The danger in case of Addis Ababa is high, since the city has been developing towards the present landfill site, and it is now in the proper urban area.

Conclusion and recommendations

The study shows that even though various studies and programs are undertaken to curtail the problem of solid waste, the service still falls short of the required level. The points discussed below are forwarded for the improvement of the service. The points can be adopted for other small and medium urban areas in Ethiopia, which might eventually face the same problem in the future. The study is also believed to make municipalities aware of problems of waste and helps them to deal with it at the earliest stage.

Required number of containers, sites, trucks manpower and preliminary cost estimate

Combination of large and small container should be used for efficient collection. Assuming that 2000 people can use one container, the total required is 1200. The total cost for the, additional 784 containers at 2000 US Dollars for each is 1568000 US Dollars. Additional sites are required for waste containers both in the old, and recently developed parts of the city. In Addis Ababa, especially in the developed part, there is no open space for solid waste collection. Minimum area required for each container is 9 m² (including allowance for selection of waste and other items to be disposed off). The total area for 1200 sites will be 10800 m². The ground should be built of concrete slab the total cost will be 891000 US Dollars. Taking the already developed part of the city to be 34,000 hectares and adopting the standard catchment radius of containers 100mts. the total required no. of small size containers will be 10828. i.e. 1 transfer container for 9 small size (120 litre bins or drums) containers or one small size for 222 people. At 26.67 US each total cost is 288782.76 us.

The number of existing trucks allows the collection of only 53.9 per cent. Considering the target amount of waste generated by the year 2000, and four trips can be made per day the total required trucks is 80. So, additional 20 trucks are needed. Taking the price for a single truck to be 50000 US dollars the total cost will be 1000000 US. Regarding manpower, additional 20 drivers, 20 assistants, office workers and clerks are required. So, the total preliminary cost estimate for the said provision in the city is 3.748 million US for construction of collection sites, purchase of containers and trucks in addition to the land area, and manpower size quoted above.

Considerations and proposed guidelines

Collection containers and siting

The design of containers has to be changed in the long run, so that collection and disposal becomes easier. The existing 8m³ containers have problem of handling. More handy, smaller size containers which can also be sited in areas where there is no access and carried away to collection trucks should be provided. Containers should have cover and made of plastic. The sites of most existing containers should be changed to center of user population. Containers should not be sited along roads, rivers, open air children playgrounds. The waste makes people not to use the space for the pre-designed activity and the area will be abandoned. Areas inside neighbourhoods and clusters should be selected to protect the containers and develop sense of ownership and belongings, and consequent appropriate usage of containers. Areas for large containers should be delineated, protected and fenced. Periodical supervision of sites should be carried once or twice a week. Classify the waste into categories by the users at collection sites, So that other disposal means will be devised. As organic matter constitutes significant percentage of the waste, it should be collected and disposed off within a maximum of three days before it smells and pollutes the surrounding. Technical requirements for the design, sitting and usage of containers and concrete stands and operational standards should be prepared at the national level and distributed to urban authorities to develop balanced provision of service.

Landfill

Sites located away from the growth axis and growth trend of the urban areas should be selected so that they will not be constraint. It is better to choose areas nearer to the city and at a reasonable average distance from most sites of collection. As the present situation shows, the disposal site in Addis Ababa is far away from the northern and eastern parts of the city. So, additional landfill sites should be provided in these parts to reduce the transportation cost. Expansion areas should be considered for the same purpose around selected sites and should be used in phases. Since landfill has its own negative effects, it is better to use the same area. Care should be taken in the design and construction of land fill to control the escape of gases and toxic liquid. The natural hydrologic setting must carefully be selected, to minimise the possibility of waste escaping to the ground water beneath landfill. It should make waste water not to escape or, if it does it should make it easier to easily track, treat, and dispose it off.

Selection of Landfill sites should not jeopardise the lives of the surrounding rural population. As some of the materials remain undecomposed it is necessary to take the greatest care in locating them both by safe guarding the interests of the rural and urban population. Prevailing wind

direction must be considered in the selection of site to avoid smell pollution. Controlled incineration possibilities for combustible wastes, and recycling for plastic items should also be considered. For this, wastes should be Identified and classified at collection sites. Land fill construction and tighter technical and operational standards should be prepared and distributed for urban areas in Ethiopia to control the negative effects of improper land fill and open dumping activities and overcome regional disparities.

Institutions and management

The provision of solid waste management at present is the responsibility of municipalities. Efforts by NGOs, the Private sector, the population is very low. An inventory of community based sanitary projects made by the UNDP, World Bank Regional Water and Sanitation group shows that among 118 such projects identified only 8 consisted of solid waste disposal. Similarly, the private sector, has almost no role because the government has not designed the mechanism to accommodate, manage, and integrate partnership and co-operation. Some of the activities of government can be carried out by the private sector with a reduced cost, due to minimised overhead and running costs. So, the author believes that, government should delegate or contract out some of its responsibilities to private partners and also should prepare the ground to work with others.

Improving the condition of solid waste management requires co-ordinated and collective effort. Efforts by the city government and policies of the Ethiopian government show that there is the political will. Regular campaign, education, and training programs should be carried out at the neighbourhood level, in health institutions, at work places, schools etc. to create public awareness. Educating women should also be given the highest priority since in the Ethiopian society, cleanliness of the family, the housing units and the immediate surrounding is the responsibility of women. Responsible authorities should work together,

plan and execute their programs so that the collective effort towards improvement can be fruitful.

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