



Waste Management

A Modern Approach

Victor Bonn



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Edited by Victor Bonn



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Preface

A modern approach in the field of waste management has been extensively discussed in this profound book. Solid waste management poses significant challenges for society because of its great variability in composition and production, and also due to its environmental and sanitary effects. For the purpose of fighting against this situation, this book has been compiled of analyses of technical and conceptual advancements and experiences gained through research and development projects worldwide. In addition to decreasing generation, regarded as the most preferable practice, this book also presents alternatives of valuation for potentially recoverable waste and techniques to decrease final conditioning and disposition risks. The book also covers the political, technical, social and economic aspects for the purpose of finding solutions for solid waste management.

This book has been the outcome of endless efforts put in by authors and researchers on various issues and topics within the field. The book is a comprehensive collection of significant researches that are addressed in a variety of chapters. It will surely enhance the knowledge of the field among readers across the globe.

It is indeed an immense pleasure to thank our researchers and authors for their efforts to submit their piece of writing before the deadlines. Finally in the end, I would like to thank my family and colleagues who have been a great source of inspiration and support.

Editor

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Solid Waste Management in Different Regions of the World. Strategies for the Sustainability

Waste Management Threats to Human Health and Urban Aquatic Habitats – A Case Study of Addis Ababa, Ethiopia

Elias Mazhindu, Trynos Gumbo and Tendayi Gondo

Additional information is available at the end of the chapter

1. Introduction

Over recent decades one of the commonest characteristics manifest in the developing nations has been the disparity between rapid urban population growth and sanitation infrastructure provision. This disparity is being worsened by the challenges of poor waste management practices impacting on the deteriorating ecosystems of the rapidly transforming cities in these countries. The product of this mismatch, described as 'urbanisation without health', is the catalogue of overcrowding, growth in illegal settlements, uncollected household waste, and the absence of water, sanitation and other basic facilities which are typical of many urban centres in Africa, Asia and South America. As a result many millions of the urban poor live in neighbourhoods typically hazardous to their everyday health and general well-being. The major concern is that despite advances in technology and innovative responses towards mitigating the threats to environmental health, notable deficiencies in the access, maintenance and management of sanitary facilities in the cities of most developing countries still persist. Despite these advances, the question is why are the environmental threats endangering human health and ecosystem welfare on the increase?

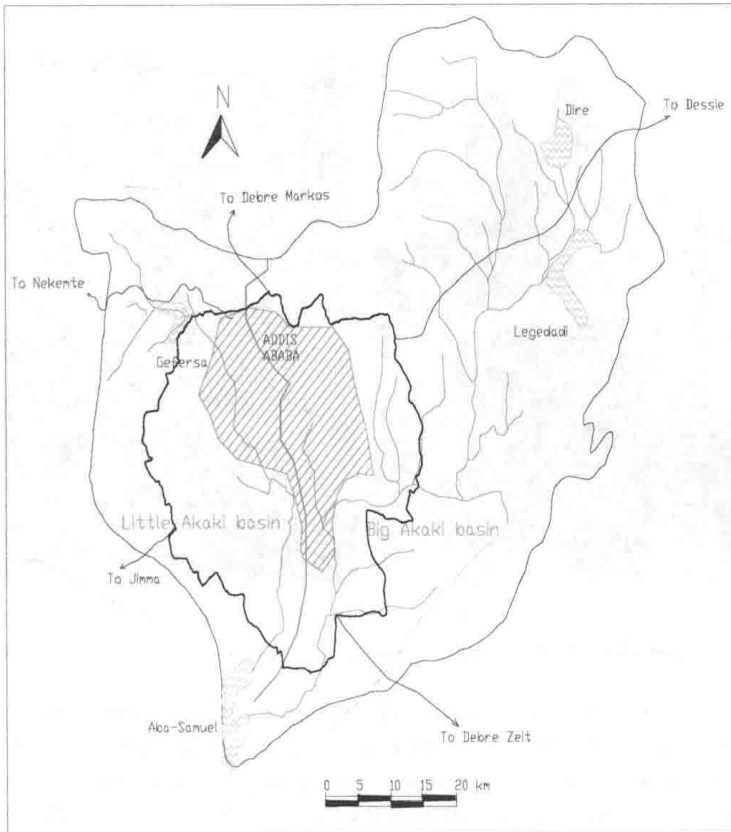
In explaining this question, some studies have argued that the rapid rates of urbanization in Third World countries – in both spatial and demographic terms, are urban growth and transformations in Third World countries in recent decades – which are the major drivers of the current environmental and public health problems [1, 2]. An environmental health problem has been defined as "either an inadequate supply of a resource essential to human health or urban production (e.g. sufficient fresh water) or the presence of pathogens and toxic substances in the human environment which can damage human health or physical resources such as forests, fisheries or agricultural land" [3]. Most studies, discussed in this

chapter, concur that the health of the residents of Addis Ababa is imperiled by the pitiable physical environmental conditions that are presently characterized by poor shelter, overcrowding in squalid housing and neighbourhoods, unsafe drinking water, poor sanitation, water pollution, indoor and air pollution and poor waste management. This poor urban environmental fabric, worsened by the low priority accorded to sanitation, has been largely blamed for the high incidence of waterborne pathogens in the catchment interface of Addis Ababa that are responsible for the spread of communicable diseases such as cholera, typhoid, and amoebic infections, mainly dysentery.

The built-up area of Addis Ababa – featuring ultra-modern buildings adjacent to slums - lies within the Big Akaki and Little Akaki river basin which has a catchment area of about 540 square kilometres. The Big and Little Akaki rivers, with their dendritic tributaries, drain the city from north to south (Fig. 1). The inappropriate practices of dumping household and industrial wastes in the river catchments has resulted in the spread of anthropogenic diseases in the city. Some earlier studies lament that the biological pathogenic vectors in the hydrological cycles of urban centres in Ethiopia account for four-fifths of all diseases and the related high mortality rates [4]. These diseases have been closely associated with the high prevalence of urban poverty and weaknesses in municipal waste management interventions – thereby increasing the vulnerability of the majority low income households.

Recent studies have established that nearly two-thirds of the urban citizens of Ethiopia use pit latrines for sanitation while close to a third defecate in open fields and less than 5% of the population use flush toilets [5]. It is mainly the residents in the slum settlements, constituting an estimated 80% of Addis Ababa's estimated 4 million people, who live with the most insidious environmental problems due to poorly developed existing environmental infrastructure and services such as sewers, drains, or services to collect solid and liquid wastes and safely dispose of them [6]. This situation is comparable to other sub-Saharan African cities where the majority of the urban population – 65% in Dar es Salaam [7], 67% in Blantyre [8], and 80% in Luanda [9] lives in squatter settlements. The most recent household survey conducted in 1998, revealed that 11% of the households in Addis Ababa had private flush toilets, while 73% owned private or shared pit latrines and 16% of the households had no toilet facilities of any kind [10]. In the peripheral residential areas of the rapidly sprawling city, 40% or more of the households had no access to latrines. It is common practice that some of the city residents who have no access to both public and private latrines are forced to defecate in nearby open grounds hidden from public view or else they have to walk longer distances to ravines, ditches, or wooded areas. The sight of some residents resorting to relieve themselves in public along road pavements and in storm water drains is also common – not least, in the congested areas of the city such as Merkato, Piassa, Bole and Gurd Shola.

Not surprisingly, the informal vending and sub-letting of private latrines on house plots and in the concealed spaces is a growing trend in the poorly serviced slum areas of Addis Ababa. The bathing of limbs on street pavements and in the congested public spaces of the city centre is a common sight during the lunch hour breaks. The practice is most visible



Akaki river catchment (in red built up area)

Figure 1. Addis Ababa catchments of the Little and Big Akaki River basin.

along the pedestrian alleys of the Merkato Open Air Market and the congested bus termini throughout the city. Urinating and defecating on open spaces scarcely hidden from public view - does not seem taboo (Fig. 2 a and b). These examples illustrate the rising importance of the environmental health risks inherent in the waste management challenges at the municipal, neighbourhood and household or personal levels. In addressing such challenges, both international and development aid communities have recognized the identification of waste management as an integral component in the conceptualization and implementation of city-wide development policy strategies – guided by the protection and enhancement of ecosystem services. Thus the United Nations Conference on the Environment and Development concluded that “...solid waste production should be minimized, reuse and recycling maximized, environmentally sound waste disposal and treatment promoted and waste service coverage extended” [11]. Not surprisingly, the UNCHS Habitat prioritizes “environmentally sound and resource efficient approaches in mitigating the problem of growing solid waste quantities, and considers waste management as a crucial component of human development policies and programmes” [12, 13].

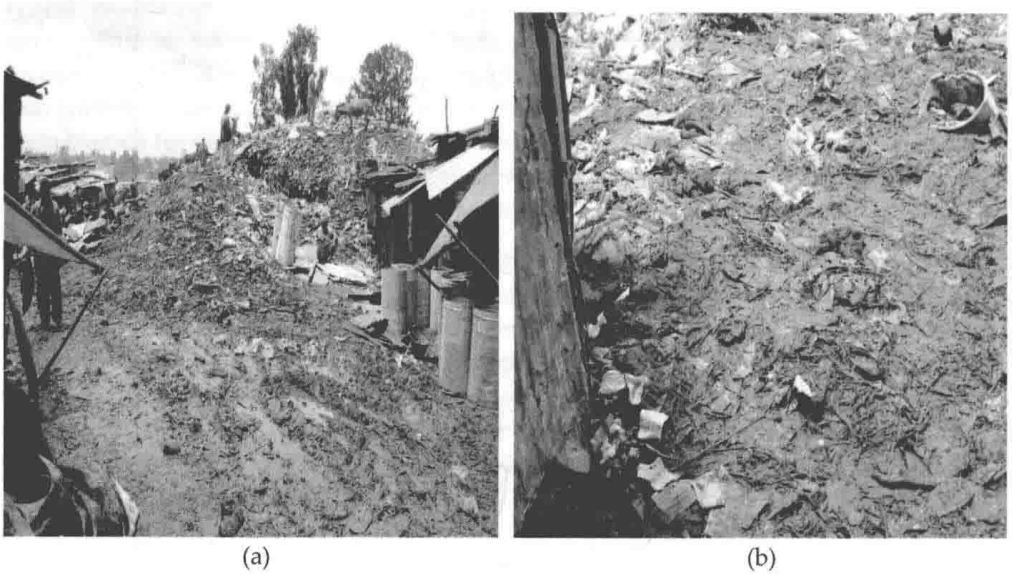


Figure 2. a. Waste dumping site in Merkato; b. Human excreta in home surroundings in Merkato

The management of waste in the urban centres of Ethiopia is the responsibility of the Municipal Division of Health. All municipalities – except the chartered cities of Addis Ababa and Dire Dawa who have cabinet representation – exercise some autonomy in managing their own affairs. All the chartered cities and the certified smaller urban centres are mandated “to provide, maintain and supervise environmental health services along with other activities in their own areas” [14]. However worthy these objectives sound, most of the municipalities and urban centres do not seem to have efficiently run environmental planning and management institutions let alone sufficient resources for discharging their responsibilities effectively. This scenario is worsened, in part, by the sustained low priority accorded to essential sanitation activities in most of the country’s urban centres largely attributing to insufficient local revenue bases. Besides their routine administrative duties, the sanitarians assigned to the regional health departments and environmental health centres can only afford attending to emergency cases especially water pipe outbursts and toilet flooding - considered imminent threat to the residents.

With this scenario in view, the chapter assesses some of the current waste management practices of domestic households in the slum areas of the city and the risks to both human health and ecosystems that these practices play out in the surroundings of homes and aquatic systems of Addis Ababa. In doing this, the chapter draws on the growing body of literature on waste management in urban Ethiopia in order to trace some of the important relationships between the current waste management practices and their impact on public health, especially in the congested parts of the central business district (CBD) of Addis Ababa. In the context of this chapter, solid waste management is taken to mean “the

processes of controlling the generation, storage, collection, transfer and transportation, processing and disposal of solid wastes in accordance with the best principles of public health, economics, engineering...that is also responsive to public attitudes" [15]. Meanwhile, sanitation will be taken to extend further than physical access to latrines and toilet facilities such as hand washing basins, cleaning towels and lighting. Sanitation encompasses the whole process of enhancing the conditions of the living environment (both inside and outside the home), personal hygiene, as well as improving the physical infrastructure of [latrine and] toilet facilities, a safe and adequate water supply, and the safe disposal of domestic solid and liquid wastes [16][own emphasis]. The quality of water – for domestic or personal consumption - depends on healthy ecosystems and sustainable land use management in watersheds.

The chapter examines some of the key underlying questions of improving the sustainability of ecosystems and the environmental health status of sub-Saharan African cities that continue to be threatened by the fragmented waste management policy responses using an ecohydrological perspective. As a new trend of thinking towards promoting livable urban settings, the theory and implementation of ecohydrology has been developed in the framework of the International Hydrological Programme of UNESCO (Zalewski *et al.* 1997[17]; Zalewski and McCain 1998[18]). Zalewski *et al.* (2010: 102) have suggested that "an integrative approach, expressed by ecohydrology principles, should be helpful to distillate the general patterns of ecohydrological interplays, which confronted with social challenges [largely due to the rapid urban population growth rates and underlying transformations] should provide a dynamic framework for the formulation and implementation of realistic strategies for problem solving by focusing on ecological processes for enhancing sustainability [19][own emphasis]. But why is the ecohydrological perspective particularly useful for mitigating the negative effects of the current poor waste management on the environmental public health status of residents through the enhancement of ecosystem services to society? In answering this question, Zalewski *et al.* contend that "...given the conditions of the increasing demographic pressures, sustainability can be achieved through policy responses that regulate the whole range of water biota interactions with the human settlement activities towards enhancing the carrying capacity of the city – water resources, biodiversity and ecosystem services [20]. Due to the complexity of such interactions, an integrative understanding of the interactions between different biological and settlement activity patterns in urban ecosystems is essential. The integration for synergy in the basin scale and regulatory measures have been viewed as reducing the negative effects of the cumulative load of excessive effluents into the aquatic system significantly [21].

The essence of the ecohydrological perspective is rooted in the defining classification by Odum (cited in Zalewski *et al.* 2010:102) that "ecology is the economy of nature" [22]. Thus the implementation of this strategy posits that the enhancement of the carrying capacity of urban ecosystems has to begin by quantifying the hydrological cycle (such as trends in the eutrophication of rivers through waste dumping) and the identification of threats to ecosystems and public health engendered by such waste disposal practices. The next step is

the assessment of the ecosystems as they are modified by human settlement activities, their distribution in the catchment interface and their impact on the livability of the urban built environment. Finally, the regulation of water biota processes through interventions such as the reduction of point source pollution should be based on an understanding of the hierarchical complexity of ecological processes in the catchment area [23]. However, this approach contradicts the many environmental management policies that are top-down (command and control approaches) involving direct regulation along with monitoring and enforcement standards, permits and licences that have been criticized for being costly and difficult to enforce [24, 25]. The regulatory approaches have been perceived as contributing to the worsening of environmental health risks attributing to waste management policy strategies, mainly due in part to the lack of awareness of existing environmental instruments on the part of many residents [26, 27].

In this definitive context, the chapter examines the current domestic solid and liquid waste management practices in Addis Ababa with a view to suggesting possible policy options for mitigating the environmental health risks that are highlighted in the most recent literature (Kebbede 2004 [28]; Kuma 2004 [29]; Tadesse *et al.* 2004 [30]; Bihon 2008 [31]; Van Rooijen *et al.* 2009 [32]). A number of environmental health problems occurring at the varying spatial scales from the home through the neighbourhood to the city will be reviewed in light of the findings of case studies carried out mainly in the built-up area of Addis Ababa. The surveys by Abebe 2001[33], Kuma 2004 [34], and Tessema 2010 [35] attribute the proliferation of pathogens in the living areas of poor homes and neighbourhoods to a combination of inadequacies in the provision of sanitation facilities, inappropriate anthropogenic practices of sanitation at household level and the current waste management problems. The surveys reveal that the cramped living conditions and the presence of pathogens in the home environments due to the lack of basic infrastructure; the dangerous and unhealthy sites of some neighbourhoods due to the irregular or non-collection of garbage and the city-wide problems of toxic or hazardous waste disposal pose the major threats to the health of most residents in city.

The upsurge in the urbanization and industrialization following the structural reform programmes adopted by most sub-Saharan African countries is generating domestic waste in the form of raw sewage, untreated effluents with potential contaminant pollutants and toxic waste in the urban settlements. Current literature reveals that most of this waste ultimately finds its way into the clogged city streams and rivers ending up in inland water bodies such as the Aba-Samuel Dam, one of the main sources of water supply to Addis Ababa city. This trend persists as the standard practice by both the population and the practitioners. According to Alebachew *et al.* (2004), deficiencies of sanitary services, low capacity for urban waste management and the absence of regulations and scientific criteria for enforcement pose increasing environmental and public health hazards in the major towns of Ethiopia [36]. Arguably, there are many interconnected factors militating against the current top-down policy engagements in mitigating these problems. These factors include massive rural-urban migration fuelling rapid urban population growth, poor planning and ineffective development control measures, weak urban institutions, and

insufficient institutional resources set aside for tackling the ever present environmental health risks prevailing in the city. Drawing on the diverse case study findings reviewed in this chapter, the empirical findings of our case study suggest that the integration and harmonization of the interactions of hydrological and ecological processes in urban settings, and striking the balance, can be the key for sustainable waste management in the “city-to-come” in sub-Saharan Africa - comparable to Addis Ababa.

Ligdi and Nigussie (2007) suggest that the presence of elements of ecohydrology in relevant policy and project documents, as well as the various capacity building efforts are good starting points to promote the use of ecohydrology in the country [37]. This approach will have the potential of bringing the fragmented approaches into one whole system that promotes sustainable waste management. Specific studies that can reveal the importance of the hydrological and ecological processes in managing waste should be carried out in selected “ecological hot spots” [38]. The results of such studies will help in convincing decision makers and practitioners to understand the value addition of ecohydrology as a tool for integrated waste management in the fragile ecological hot spots prone to widespread anthropogenic health risks. We first turn to the problematic of environmental waste management in Addis Ababa to help us map out the spread of pathogens and threats to the health of residents living in the overcrowded enclaves of the city particularly in Merkato and Kasanchis where the epidemiological footprint and its associated anthropogenic practices is most visible.

2. Research problem

The challenges brought about by inappropriate anthropogenic practices threatening the health of most residents and sustainability of the existing aquatic habitats are mostly visible along stream banks and public open spaces in Addis Ababa ranking the city as one of the dirtiest in the world. These threats and related land use imbalances have not scaled down for a long time in the city [39] owing mainly to unrelenting in migration into the city and the paucity of resources to manage the increasing quantities of waste accumulating in the living spaces. The excessive pressure of “unplanned” (by modernist planning standards) land uses including encroachments on the fragile aquatic systems through the dumping of all range of solid waste into the riverine network seems to continue unabated (Fig. 3 a and b). The impacts of poor waste management and disposal most visible in the slums of the city have associated with the endemic spread of communicable diseases affecting mainly the poor sections of the city residents.

Table 1 depicts the trends in the spread of the top ten diseases mainly attributed to the indiscriminate solid waste management practices in the city. As can be noted in the table, the number of cases and their frequencies over the three years was too high for a city of 3 million (in 1999) relative to other cities in developing countries.

However, even these figures obscure the true picture of the number of cases not reported to the health institutions and the widespread practices of self-treatment and traditional healers in the city.