

---

---

## WASTE MANAGEMENT IN AFRICAN COUNTRIES: SOCIAL & ENVIRONMENTAL FEATURES

M.D. Kharlamova, Fuad M. Koroma

Ecological Faculty  
Peoples' Friendship University of Russia  
*Podolskoe Avenue, 8/5, Moscow, Russia, 113093*

Problems and features of waste management in two African countries — Sierra Leone and Zimbabwe, are analyzed. Environmental, economic and social aspects of dumpsites in the cities and estimation of sanitary landfills organization are considered.

**Key words:** sustainable development, waste management, least developed countries, sanitary landfills, illegal dumps, occurrence of diseases, types of solid waste, Multi criteria Decision Analysis

### Introduction

Almost 15 years ago, the Millennium Development Goals were agreed. But there has been uneven progress made especially when considering least developed countries where some of the Millennium Development Goals remain off-track.

In August, 2015 the General Assembly approved the document of the United Nations summit for the adoption of the post-2015 development agenda. According to p. 9 “... sustained, inclusive and sustainable economic growth” is necessary for “...a world in which consumption and production patterns and use of all natural resources — from air to land, from rivers and lakes to oceans— are sustainable”.

According to the 9-th Goal of Sustainable development: “Inclusive and sustainable industrial development is the primary source of income generation, allows for rapid and sustained increases in living standards for all people, and provides the technological solutions to environmentally sound industrialization”.

Notwithstanding, Goal 3 is to ensure healthy lives and promote well-being for all at all ages. Major progress has already been made on increasing access to clean water and sanitation, reducing malaria, tuberculosis, polio and the spread of AIDS. However, many more efforts are needed to fully eradicate a wide range of diseases and address many different persistent and emerging health issues.

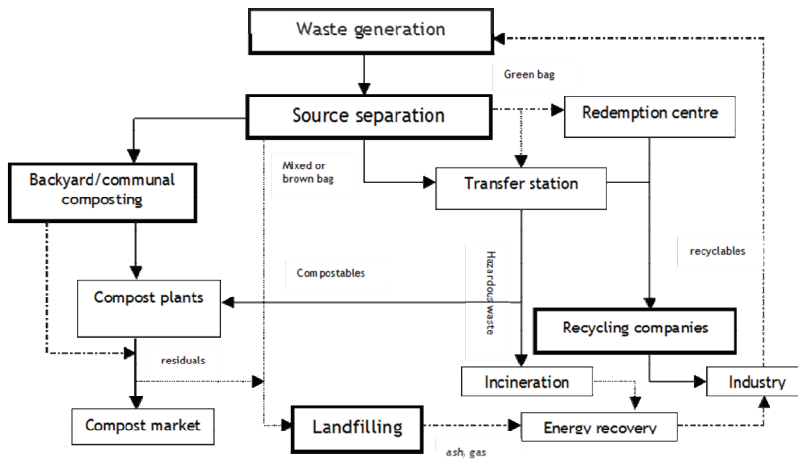
Today, many countries struggle with the consequences of unsustainable growth programs affecting the climate, people and natural resources. Local authorities of some least developed countries and their inhabitants are faced with global ecological problems and local problems of air, water and soil pollution. This is also predominant in some developed nations like China and in some Middle East countries and African oil-producing nations.

Some of the underpinning reasons to such problems are apparently related to the absence of low technological level of nature protection and Waste management.

This makes it exclusively difficult to manage the increase of such problems.

### Waste management systems

Waste management procedure includes collection, transportation, and disposal of garbage, sewage, gas emissions and other industrial waste products. It is the process of treating solid wastes and offers variety of solutions for recycling items that don't belong to trash. There are eight major groups of waste management methods, each of them divided into numerous categories. These groups include source reduction and energy reuse, animal feeding, recycling, composting, fermentation, landfills, incineration and land application. The components of an Integrated Waste Management System, demonstrating how waste ends up at a landfill are shown in Fig. 1.



**Fig. 1.** Example of Integrated Waste Management System

But in spite of this fact, least developed countries especially in Africa and developing nations like India, use dumps and landfills methods of all waste type disposals. Inappropriate waste disposal is the main cause of environmental pollution especially when considering illegal dumps which has caused the outbreak of diseases in recent times.

Two African capitals Harare (Zimbabwe) and Freetown (Sierra Leone) are the objects of our study with special analysis made on their waste management, social and environmental situation. It would be of importance in considering the problems that these two cities face with regards waste management and possible decisions/recommendations that should be implemented.

### Study of case: Harare (Zimbabwe)

Harare is relatively better developed than all other provinces of the country, housing a heavy industrial area and relatively good road network and other facilities such as schools, hospitals, tourism and agriculture. It is Zimbabwe's leading financial, commercial, and communications center, and a trade center for tobacco, maize, cotton and citrus fruits. Manufactured goods include textiles, steel and chemicals, and gold is also mined in the area. Rapid population growth increases pressure on the existing natural resources and infrastructure which has resulted to various environmental problems in the city.

The main environmental problems in Harare are water and air pollution, waste disposal problems, deforestation and effects of urban agriculture on the environment. The air and

water pollution increase in the city is mainly sourced from industries, automobiles and domestic waste (Table 1).

Table 1

**Main sources of solid waste in Harare**

Source	Main Pollutants
Willowvale Car Assembly	Metal solvents, used mineral oil and grease, paint
Zimphos Chemicals	Hydrochloric acid, ferrous phosphates, sulphuric acid, caustic soda
Olivine Industries	Sodium hydroxide, gypsum, sulphuric acid
Hunyani Pulp and Paper works	Caustic soda, dyes, hydrochloric acid
Municipality of Harare	Sewage Effluent
Urban Farmers	Nitrogen fertilizers and phosphates

Some households in Harare have small industries (hair salons, surgeries, garages, welding and black smiths) in their backyards and tend to mix waste from these small industries and domestic waste to do their productions. Table 2 shows main types of solid waste generated in Harare.

Table 2

**Types of solid waste generated in Harare**

Source	Waste Generators	Type of solid wastes
Household/Domestic	Single and multi-family dwellings	Food wastes, Paper, cardboard, cans, leather, wood, glass, batteries and hazardous household wastes, fertilizers, rat poison
Commercial	Shops, markets, office buildings, restaurants, bars	Packaging material (cardboard/plastic), paper, Wood shavings, food waste, electronic waste, wood preservatives
Industrial	Light and heavy manufacturing and packaging industries	Plastic, paper, electronic waste, food wastes, cans, steel/ metal, fabrics, fertilizers, leather, rubber, pesticides
Institutional	Police camps, schools, hospitals, prisons	Food waste, paper, plastics, needles, syringes Expired drugs, other medical waste
Municipal Services/ Street Sweepings	Streets	Leaves, paper, human and animal excreta, glass, cans, paper
Construction debris	Construction sites	Wood, concrete, steel and metals, glass, cardboard, paper, bricks

The fact is that the presence of undesignated dumps has been determined as one of the major sources of disease such as cholera and dysentery, which caused over 4 000 deaths in Zimbabwe in 2008.

Rapid growth of Harare (Zimbabwe) has resulted in increased consumption of resources to meet the growing demands of the urban population and this has led to the generation of large amounts of wastes. At the same time municipal waste collection systems have been collapsing due to the economic crisis and this has pushed the cost of services beyond the means of the Harare City Council. As a result, solid waste has not been collected efficiently which has led to the dumping of waste in areas such as storm drains, open spaces and roadsides (Fig. 3).

However, a direct link between disease incidence and waste disposal hadn't been confirmed until our researches in Harara district Budiriro were completed. Thanks to

them it was proved that the occurrence of diseases (cholera, dysentery and diarrhoea) can be explained by the spatial distribution of dumpsites. At Fig. 4 occurrence of diseases in relation to presence of dumpsites is shown (Source: Mada Sharon Yeukai, Kharlamova M. Science, Technology and Higher Education, 2014).



Fig. 3. Dumping of waste in storm drains, open spaces and roadsides

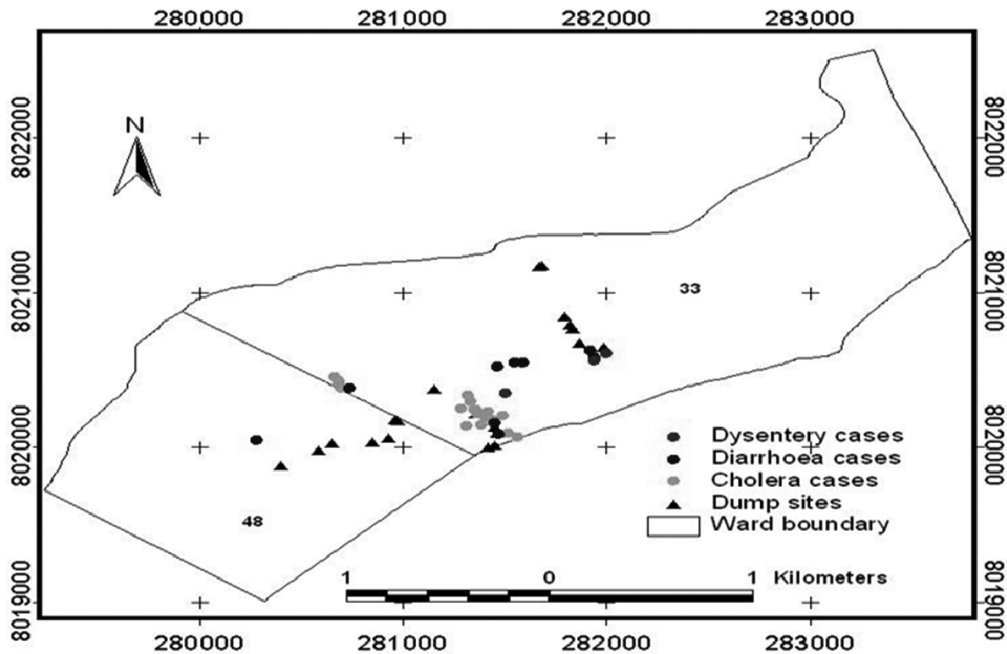
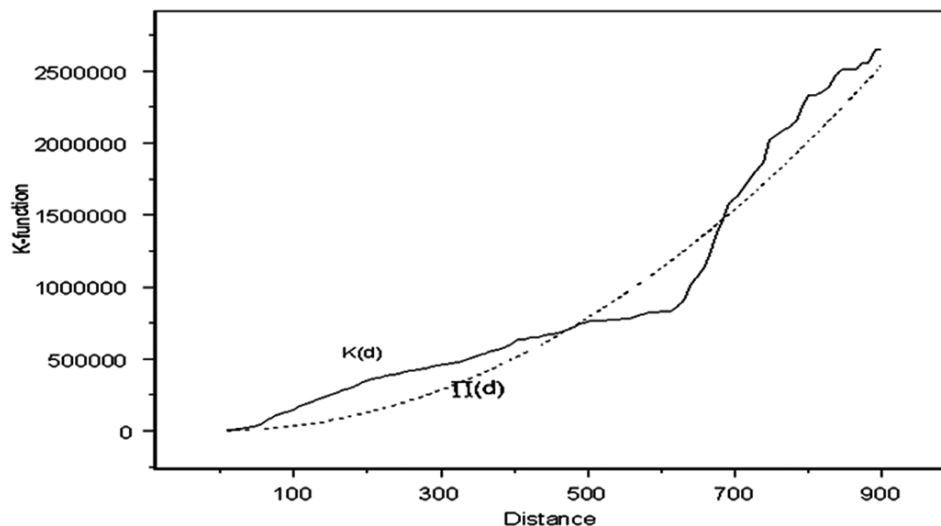


Fig. 4. Occurrence of diseases in relation to presence of dumpsites

To test for the relationship between undesigned dumpsites presence and disease occurrence in Budiriro a Confirmatory data analysis (CDA) was used (Fig. 5). There was also hold Clustering Analysis to support conclusions about dumps and diseases cases relationship.





**Fig. 5.** Confirmatory data analysis (CDA) results

The study has also shown that diseases such as cholera and dysentery can even occur in area where dumpsites are not present because they are highly contagious.

Waste management involves the fulfillment of managing waste from its inception to final stage of disposal. The United States Environmental Protection Agency referred to waste management as ‘source reduction—means of reducing waste by not producing it. Examples of waste prevention would include purchasing durable, long-lasting goods and seeking products and packaging that are as free of toxic substances as possible. It can be as simple as switching from disposable to reusable products, or as complex as redesigning a product to use fewer raw materials or to last longer’.

### **Study of case: Freetown (Sierra Leone)**

Another example of insufficient settlement of municipal waste problem is Freetown — the capital of Sierra Leone. Most of the cities in Sierra Leone are subjected to poor waste management, but Freetown serving as the capital remains to face the worst scenarios in managing waste. The Freetown City Council and other private owned institutions are in operation in the city with regards waste management.

Due to the changes in the degree of development in any country, it stands to be difficult in the application of a single developmental strategy within the framework of managing waste. By considering a typical large urban community and its surrounding (Freetown), waste management should be set to meet the nature and quantities of the waste generated and the most available technology for handling and processing.

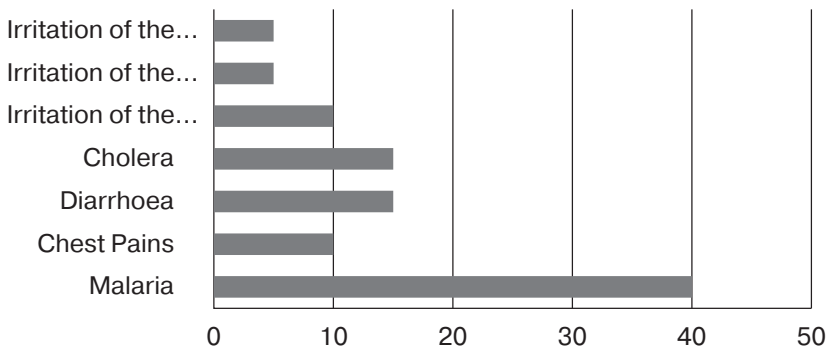
Municipal solid waste generation comprises of a heterogeneous collection of wastes that are produced in urban areas with the nature varying from region to region. In most cases, the quantity of solid waste generated does not only depend on the living standard and way of behavior of the people but it is also greatly dependent on the abundance of the type of natural resources that are found in that region.

In Freetown, the rate of municipal waste disposal is on an increase with population growth, style of living and behavior serving as the main factor.

The increase in garbage pile-up can be seen throughout the city. The garbage increase can be linked to the broken containers that were used for transfer stations for waste. The effort by government and other institutions in solving such issue should be of priority.

According to the World Bank Global of Solid waste, solid waste management is the one thing just about every city government provides for its residents. While service levels, environmental impacts and costs vary drastically, solid waste management is arguably the most important municipal service and services Hoornweg, Daniel [2012].

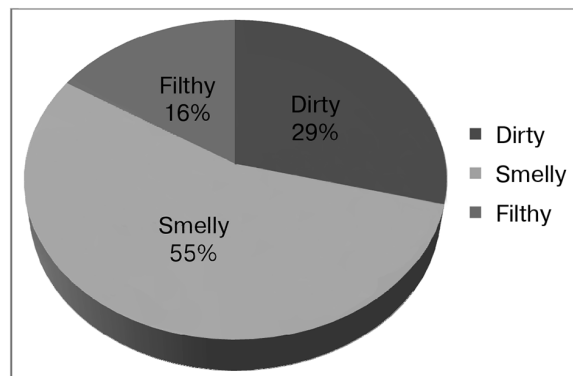
Based on the concept of Daniel and World Bank, a study was conducted in Freetown, Sierra Leone to figure out the way communities are prone to the closeness of dumpsite to residential areas. And in most cases children are highly affected by the outbreak of disease especially those that are very close to these dump sites (Fig. 6). Source: Field survey Sankoh F, et al 2013.



**Fig. 6.** Disease due to location of dump sites (%)

From the chart above, Sankoh et al put it forward that ‘household residents, especially those who are closer to the dumpsite are not happy about the location of the dumpsite in their community. They complained that the dumpsite is too close to their houses causing them a lot of sicknesses. Furthermore, they argued that their surroundings are smelly and filthy and some of the wastes from the dumpsite overlap their houses causing pollution in the environment [2013]’.

Results of analysis is done below in relation to how the people in the residential areas feel about closeness of the dumpsites (Fig. 7).



**Fig. 7.** Nearby residents to dumpsites

From the pie chart it is argued that with location of the residential areas to the dumpsites and the improper waste disposal methods that takes place has led to the smelly, dirty and filthy presentations of the areas. It is rather clear from the analysis that this normally creates the increase in uncontrollable disease outbreak. This impact of waste disposal does not only imply to disease outbreak but can also lead to poor ground water quality.

By agreeing with the work of Sankoh et al, government and communities should make the most appropriate way of waste disposal a priority. Waste disposal methods like landfills, incineration, recovery and recycling, plasma gasification, composting and waste to energy should serve as different alternative sources of waste disposal by the communities with government supervision with skilled training possibilities.

The improper and failure in the disposal of household cleaning supplies, paints and solvents, lawn and garden supplies, automotive fluids, motor oils and a rest of other waste can have direct impact on receiving water body quality. Waste are disposed in communities in an uncontrollable way. This normally creates either traffic blockages on streets as in most cases the disposable bins get full and people continue throwing them on the street (Fig. 8).



**Fig. 8.** Waste on Freetown streets

In Freetown, the high rate of street trading is also predominantly exhibited. Most households depend on petty trading to generate income. And these petty traders normally find themselves closer to the location of these bins hence inhaling polluted air that will lead to disease.

Furthering our concept on the work of Thomas A, [2013] which agrees with this paper that ‘major roads in the capital Freetown, such as Fourah Bay Road and Aberdeen Road have become overwhelmed with uncollected garbage, and are getting worse. Those living adjacent to rubbish dumps are bracing themselves for an inevitable outbreak of cholera and other poor sanitation related diseases’.

The government and private institutions are immensely contributing to halt the improper disposal of waste with the Freetown city council imposing laws.

And in doing this, an action plan system is required in any country for such to be fully implemented either by the government or private institutions. In determining the status of how waste is managed in a country, there should be an extensive contribution from the institutions, community and societal role play.

### **Sanitary landfills: multi factorial analysis**

For many least developed countries sanitary landfills are the only possible way to settle the problem with waste. While sanitary landfills are regarded as the last management option in most developed countries of the world, the open dump (uncontrolled landfill) has been the most preferred MSW disposal alternative available in countries with developing economies.

This problem is not only found in developing countries but can also be seen in Moscow regions with improper waste disposal by some households even with the presence of disposable bins.

In halting such problem with regards sanitary landfills, areas for dumping should be chosen well by the appropriate authorities. These should be based on state sanitary requirements for waste disposal. These should make water objects protection a prerequisite and tries to consider a lot of important parameters — local geographical, climatic, infrastructural and other conditions.

Several countries like Australia, Malaysia, Niger and United States among others have put in place guidelines for selecting suitable sites for sanitary landfills for waste management. These guidelines and policies act as the primary mechanism used to protect the environment and avoid nuisance to the host community.

Multi criteria Decision Analysis (MCDA) approach is commonly used to solve the landfill site selection problem and provide decision makers the most satisfactory and preferable alternative. The principle of the method is to divide the decision problems into smaller more understandable parts, analyze each part separately and then integrate the parts in a logical manner. There are 15 environmental, social and other factors which are used to determine the appropriateness of a site to be used as a sanitary landfill:

- 1) Site Capacity;
- 2) Adjacent Land Uses or Land cover;
- 3) Airports;
- 4) Surface Water;
- 5) Groundwater;
- 6) Local Topography;
- 7) Soils structure;
- 8) Local climatic conditions;
- 9) Unstable Areas;
- 10) Infrastructure;
- 11) Local Flora and Fauna;
- 12) Distance from environmentally sensitive or protected areas;
- 13) Distance from urban areas;
- 14) Coastline areas;
- 15) Population density.

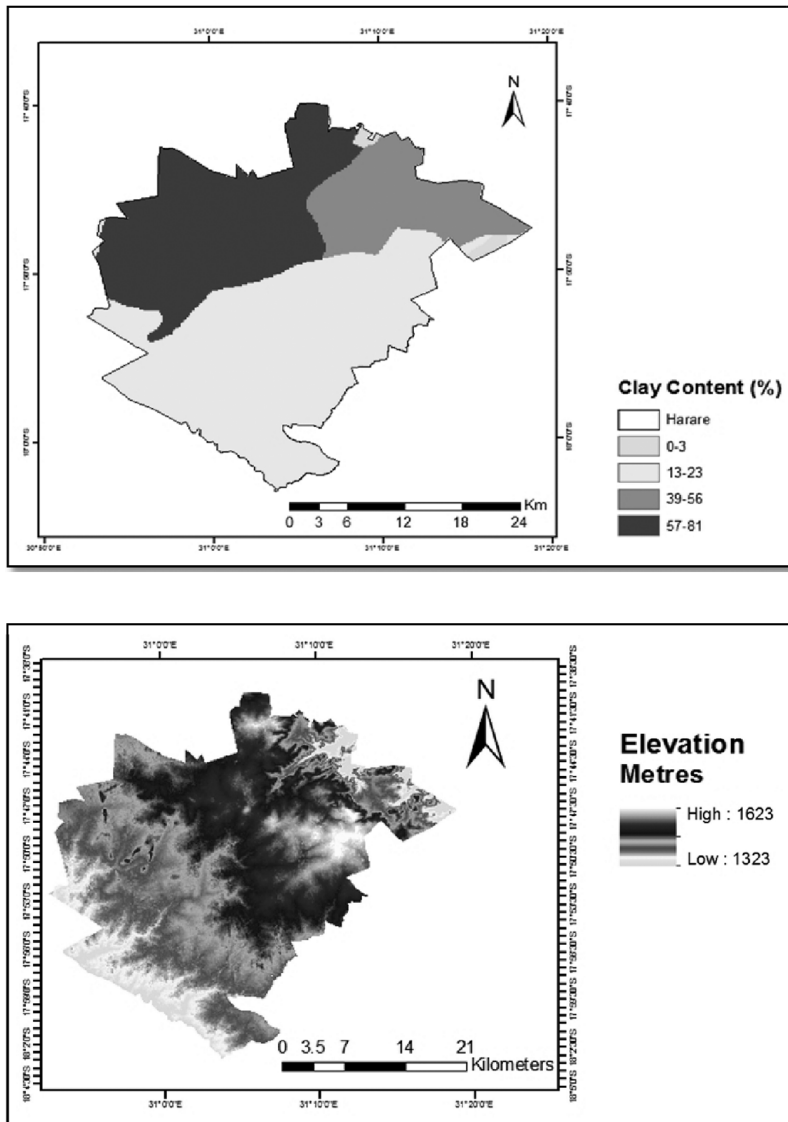
Financial and economic criteria for landfill site selection (such as Cost of Land, Material&Transport, and costs for the after-care) are also taken into account at the last stage of analysis.

In the situation of Harare, the site selection model involved three steps: *multi-criteria evaluation, preliminary analysis and identification of the most suitable site*. The Analytic

Hierarchy Process (AHP) was selected for the decision rules to analyze the data for landfill site selection using GIS. The 9-point scale used in typical analytic hierarchy studies ranges from 1 (indifference or equally preferred) to 9 (extreme preference or absolute importance).

The parameters analyzed were: elevation, slope, soil type (clay content %), land-cover type, proximity to built-up areas/settlements; roads and railway lines; rivers; proximity to environmentally sensitive areas, proximity to airports.

On the Fig. 9 maps examples of Clay content percentage of Harare soils and Elevation in Harare are shown.



**Fig. 9.** Clay content percentage of Harare soils and Elevation in Harare

As a result the final constraint map and the final factor map were overlaid and merged to produce final suitability map with candidate sites (Fig. 10).

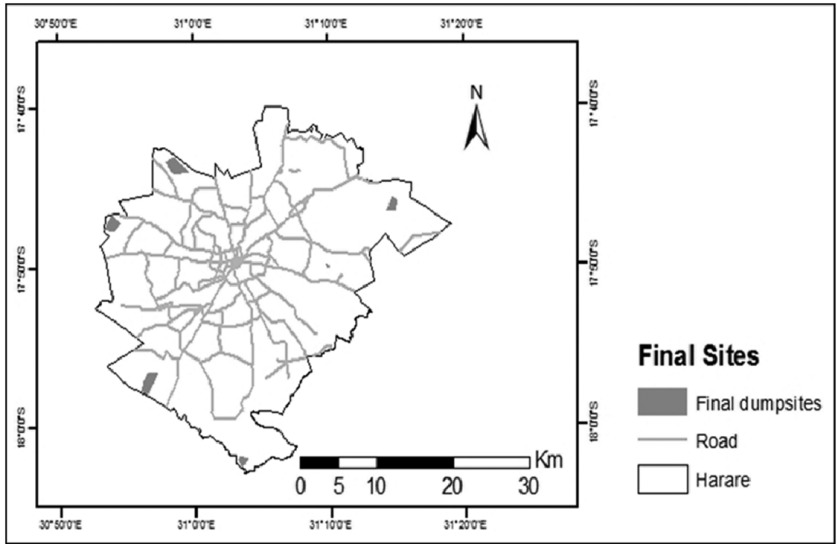


Fig. 10. Final Suitability map with candidate sites in Harare

### Conclusions

Waste management does not only involve the shouldering of everything by the government or private institutions. City councils with 90% of their budget are incurred from country governments. This budget is used in managing all waste disposable forms in the cities but yet the work by councils to meet the required targeted goals by these two countries still remains unattainable.

The community involvement in managing waste is of significance if waste management should become successful. Attitudinal change needs to prevail in all communities.

Skilled labor and government involvement in switching to a more technological means of managing waste is of importance. Though on the other hand it requires financial supports, but making it a priority will attract donor agencies to provide the skill support especially when considering the level of disease outbreak based on analysis done in this work.

By developing sustainable growth policies, local governments in partnership with the community, can improve the quality of life of citizens and contribute to protecting the environment. Local authorities can respond and adapt to climate change, plan and implement solutions for environmental and natural resource challenges and promote more sustainable ways of development.

### REFERENCES

- [1] Mada Sharon Yeukai, Kharlamova M. An assessment of the relationship between the spatial distribution of undesignated dumpsites and disease occurrence in Budiro, Harare, Zimbabwe. // Science, Technology and Higher Education. Materials of the V International Conference. June 20<sup>th</sup>, 2014 / publishing office Accent Graphics communications — Weswood- Canada 2014. P. 236—242. ISBN 978-1-77192-087-2
- [2] A year on — what has changed? More garbage — more early deaths Abdul R. Thomas, 2013. URL: <http://www.thesierraleonetelegraph.com/?p=4837>

- [3] Foday Pinka Sankoh, Xiangbin Yan and Quangyen Tran. Assessment of Solid Waste Management in Freetown, Sierra Leone towards Sustainable Development, 2013. URL: <http://scialert.net/fulltext/?doi=jas.2014.2909.2924&org=11>
- [4] Foday Pinka Sankoh, Xiangbin Yan, Quangyen Tran. Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone, 2013. file:///C:/Users/Fuad%20Koroma/Downloads/JEP\_2013071509411898%20(19).pdf
- [5] Solid Waste Management: A Local Challenge With Global Impacts USEPA, 2002. URL: <http://www3.epa.gov/epawaste/nonhaz/municipal/pubs/ghg/f02026.pdf>

## **УПРАВЛЕНИЕ ОТХОДАМИ В АФРИКАНСКИХ СТРАНАХ: СОЦИАЛЬНО-ЭКОЛОГИЧЕСКИЕ ОСОБЕННОСТИ**

**М.Д. Харламова, Фуад Корома**

Экологический факультет  
Российский университет дружбы народов  
*Подольское шоссе, 8/5, Москва, Россия, 113093*

В статье анализируются проблемы и особенности управления отходами в двух африканских странах — Сьерра Леоне и Зимбабве. Рассматриваются социальные, экологические, экономические аспекты несанкционированных свалок в городах и проводится оценка эколого-экономических возможностей организации санитарных полигонов.

**Ключевые слова:** устойчивое развитие, управление отходами, наименее развитые страны, санитарные полигоны, несанкционированные свалки, случаи заболеваний, виды твердых отходов, метод анализа иерархий (МАИ)