Ethiopian Journal of Environmental Studies & Management 14(5): 554 – 564, 2021.
ISSN:1998-0507 doi: https://ejesm.org/doi/v14i5.1
Submitted: July 15, 2021 Accepted: August 6, 2021

IMPROPER MUNICIPAL SOLID WASTE DISPOSAL AND THE ENVIRONMENT IN URBAN ZIMBABWE: A CASE OF MASVINGO CITY

AMATO, C. AND *TOGO, C.A.
University of South Africa, Preller Street, Muckleneuk Ridge, City of Tswane
PO Box 392 UNISA 0003, South Africa
*Corresponding author: catogo@gmail.com

Abstract
This study was conducted with the objective of examining environmental risks associated with improper municipal solid waste disposal (MSWD) in Masvingo City. A sample of 406 residents and key informants was used. Residents were from high-density, medium-density and low-density suburbs while key informants were city council formal waste workers and Environmental Management Agency workers. Mixed methods design was employed in which concurrent triangulation was used for data collection and data analysis. Questionnaires, interviews and personal observations were employed to examine environmental risks. The highest number of respondents (87%) noted land pollution as an environmental risk and the second highest (76%) highlighted air pollution. In addition, 62% of the respondents noted surface water pollution while 59% highlighted loss of urban beauty as a risk. Thus the study revealed that land pollution, surface waste pollution, air pollution and loss of urban beauty were environmental risks associated with improper municipal solid waste disposal. Therefore, municipal solid waste management in Masvingo was not sustainable.

Key Words: *Integrated, Improper disposal, Municipal solid waste, Sustainability*

Introduction

Municipal solid waste management has remained a thorn in the flesh for local authorities globally (Addaney and Oppong, 2015; Mbue *et al.*, 2015). Since acknowledgement of this in 1992 at the Conference on Environment and Development in Brazil, efforts to improve municipal solid waste management (MSWM) have been negated by urbanization and industrialization which outstrips the development capacity to manage waste in a sustainable manner (Choudhury and Choudhury, 2014; Samwire *et al.,* 2017). Thus, municipalities seem to be trying to drown a floater which consistently pops on water surface at slightest chance of slackening. Hence these local authorities should continue to be innovative in managing municipal solid waste (MSW) under their jurisdictions.

Municipal solid waste (MSW) generation rate in African cities is about 0.6 kg/capita/day and outstrips the capacity of city authorities to collect and dispose safely (Simelane and Mohee, 2012; Emelumadu *et al*., 2016).

Municipal solid waste disposal constitutes one of the most crucial environmental problems facing governments of African cities since collection systems in these cities is grossly inadequate (Mahar, 2014; Dlamini *et al*., 2017).

Zimbabwe experiences poor municipal solid waste collection. Municipal solid waste collection rates in all urban areas of Zimbabwe dropped from at least 80% in mid 1990s to virtually none (Mafume *et al*., 2016; Chanza *et al*., 2017). As a result, most of MSW generated in Zimbabwean cities are dumped at open disposal sites that do not meet basic environmental standards (Financial Gazette, 2016; Jerie, 2016). Poor disposal of MSW has an adverse impact on all components of the environment (Makwara and Magudu, 2013; Kinobe, 2015). Masvingo which is one of the cities in Zimbabwe is experiencing similar problems (Musingafi *et al*., 2014).

Municipal Solid Waste Disposal and the Environment

Studies showed that the environment is in danger as a result of illegal municipal solid waste disposal. Waste management has a direct impact on the environment because it can generate carbon dioxide, methane and nitrous oxide that can damage and alter the environment depending on how waste is managed (Lethbridge, 2017). Open dumping is common is developing countries and has resulted in environmental damage (Vaidya, *et al.,* 2014; Zohoori and Ghani, 2017; Balasubramania, 2018; Kabera, *et al., 2019*). Local authorities should manage municipal solid waste properly to protect the environment (Elagroudy, *et al.,* 2016). The research problem was rampant municipal solid waste illegal disposal in Masvingo City and the objective was to examine environmental risks associated with this illegal disposal.

Insufficient disposal of waste in low income and developing countries can contaminate surface and ground water through seeping of leachate while air pollution is a result of open burning of waste (Zohoori and Ghani, 2017). Similarly, there were environmental problems in Latin America and the Caribbean since the predominant means of waste disposal is open dumps (Hettiarachchi *et al.*, 2018). There was risk of water, land and air pollution in India due to improper municipal solid waste disposal (Saikia and Nath, 2015; Vilas, 2015).

The World Bank (2012) cited in Mohammed and Eyasu (2017) reports that solid waste ends up in open dumps or drainage system threatening both surface and ground water quality in Addis Ababa City, Ethiopia. Municipal solid waste heaps were identified as sources of water pollution and burning of solid waste in backyard or open place caused air pollution as thick and dark smokes from burning of plastic components of electronics have been seen spiraling up the sky in computer villages in Nigeria (Babayemi and Dauda, 2009; Butu and Mshelia, 2014). In relation to this, there was air, land and water pollution in Kenya as a result of the Dandora dumpsite (Muniafu and Otiato, 2010). In Zimbabwe, leachate from solid waste dumps contaminated ground water and nine people died in Glenview, Harare in 2013 after drinking contaminated borehole water (Nyanzou and Jerie, 2014). The above suggest that improper disposal of waste causes various forms of environmental pollution and the problem is dominant in developing countries due to lack of capacity for proper management.

In addition to being harmful to human life, municipal solid waste illegal disposal can damage ecosystems. Poor disposal of MSW in China has resulted in disruption of ecosystems (Bouanini, 2013). There was risk of soil and aquifer contamination and disruption of flora and fauna in the Caribbean as a result of solid waste disposal (Riqueleme *et al.*, 2016). The rich biodiversity of Clermount in South Africa was threatened by illegal solid waste disposal as noted by Njeleka (2010).

Municipal solid waste illegal disposal has also been found to be disrupting vegetation in Gweru, Zimbabwe (Jerie, 2014). It can be deduced that, poor waste management is a threat to biodiversity thereby having negative effects on industries like tourism which rely on plants and animals. Thus, improper disposal of waste cause damage to the environment. This implies that improper disposal is not sustainable.

There has been loss of aesthetic appearance in towns and cities of India as a result of MSW illegal disposal (Khati, 2015; Balasubramania, 2018). Reporting on Kampala, Uganda, Kinobe (2015) highlighted that uncollected municipal solid waste degrades urban environments leading to unattractive aesthetic conditions. Related to this, polluting fires caused by waste pickers at Alice dumpsite in South Africa reduced aesthetic value of the area as the disposal site was covered in soot (Mangizvo and Mapindu, 2012).

In Zimbabwe, reduced aesthetic value was noted as an environmental risk of illegal MSWD in Gweru, Zimbabwe (Mangizvo, 2010). Basing on studies above, it implies that an urban area can lose its beauty as a result of poor waste management. Considering that environmental risks of municipal solid waste illegal disposal was documented in relation to cities other than Masvingo, it is the intention of this study to determine if residents of Masvingo share similar sentiments and if direct observations can corroborate that with respect to current waste management practices in Masvingo City.

Methodology

Study Area

Masvingo is shown on Figure 1 below.

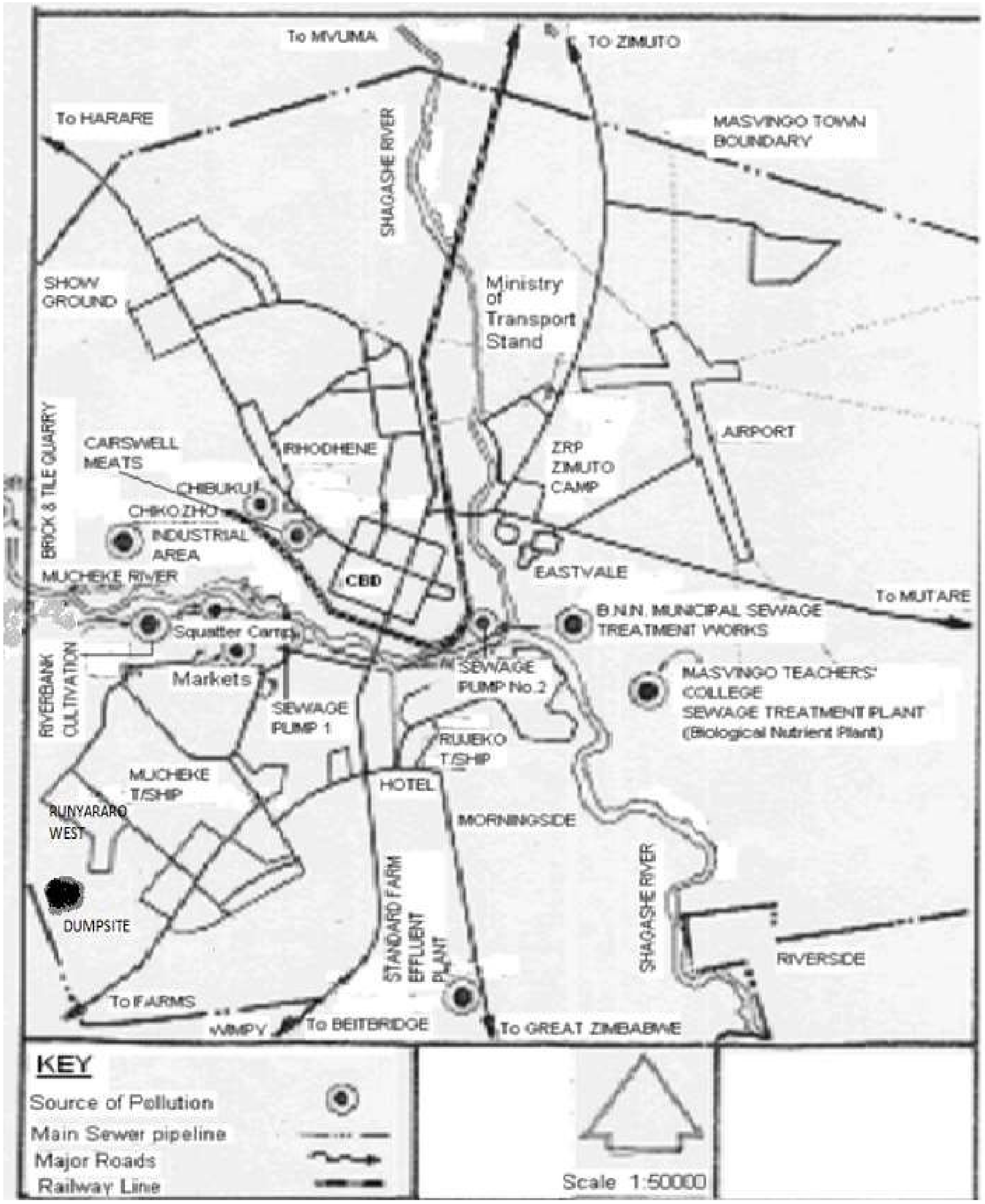

Fig. 1: Map of Masvingo (Source: Masvingo city council, 2019)

Masvingo is located in the southern part of Zimbabwe and is located 20°4′28″ S and 30° 49′58″ E. It is 288km north of Beitbridge, 290km east of Bulawayo and is 292km south of Harare. The vegetation includes species such as Yellow wood, Red mahogany and Pines. Masvingo is 1098 metres above sea level. In terms of climate, its annual rainfall is 615mm and the average temperature is between 17, 5 and 20°C. The City is made up of resistant (strong) and non-resistant (weak) metamorphic rocks. In 2012, Masvingo had a total population of 87 886 (Zimbabwe National Statistics Agency, 2012). Currently, the city has a population of 100 000 (Masvingo City Council, 2019).

Study Population and Sampling Techniques

Population consists of all the possible observations of a random variable under study (Waugh, 2003; Etikan *et al.*, 2016). The population in this study was all the residents in the city of Masvingo. The total number of households in Masvingo was 14374 (Masvingo City Council, 2019). Households were stratified into high-density, medium-density and low-density suburbs. The number of households in each layer was used to determine percentage to be included in the sample as shown on Table 1 below.

Table 1: Number of households in Masvingo

Suburb	Number of households	Percentage included in sample
High-density	12980	90
Medium-density	615	4
Low-density	779	6
Total	14374	100

(Source: Masvingo City council, 2019)

The researcher then used Cochran formula to determine sample size (Cochran, 1963).

$$n=\frac{Z^2pq}{d^2}$$

n is desired sample size (when population is > 10 000)

z is standard normal deviate at 95 percent confidence interval which is set at 1.96

p is estimated proportion of an attribute that is present in a population. In this case it was municipal solid waste collection efficiency for Masvingo City which is 40% (0.4).

q is 1-p. In this case it is 1-0.4=0.6

d is degree of accuracy desired = 0.05

$$n=\frac{(1.96)^2(0.4)(0.6)}{(0.05)^2}$$

$$n=\frac{3.8416\times0.24}{0.0025} = 368.79= 369$$

The calculated sample size was 369. The researcher expected a 10% non-response rate, so the required sample size was increased with 10% of the calculated sample size. The required sample size was 406. Out of 406, three hundred and ninety four were heads of households while 12 were key informants. Stratified random sampling was used to select residents as it produced a representative sample by capturing the diversity of suburbs (Etikan and Bala, 2017). Three hundred and fifty four households were from high-density suburbs while 16 households were from medium-density and 24 from low density-suburbs.

Purposive sampling was used to select 12 key informants namely city council director of waste management, nine council waste collection workers and two officials from Environmental Management Agency (EMA) because they had knowledge on environmental effects of MSW illegal disposal. By focusing on participants who are well informed with a phenomenon of interest, purposive sampling enhances collection of data of high quality (Etikan *et al.,* 2016; Etikan and Bala, 2017).

Data Collection Strategy

Concurrent triangulation was used. Both quantitative and qualitative data were collected simultaneously giving equal priority to both strategies (Terrel, 2012). Concurrent data collection was possible since research team was used (Doyle *et al.*, 2009). The researcher had five research assistants. Concurrent triangulation enabled the research team to capture different dimensions of the same phenomenon and less time was required as compared to sequential (Terrel, 2012). In this case the researcher was able to collect environmental risks from residents using questionnaire and from key informants using interview within a short period of time. Questionnaires, interviews and personal observations were used to collect primary data while municipal publications, policy documents and local newspapers were used as secondary data sources.

Data Analyses and Interpretation

The researcher used triangulation data analyses because the data was both qualitative and quantitative. Triangulation data analyses means using at least two methods of data analyses within the same study (Terrel, 2012). The advantage of triangulation data analysis is that it promotes validity (Ndanu and Syombua, 2015; Daniel, 2016). Figure 3.2 below illustrates concurrent triangulation data analysis.

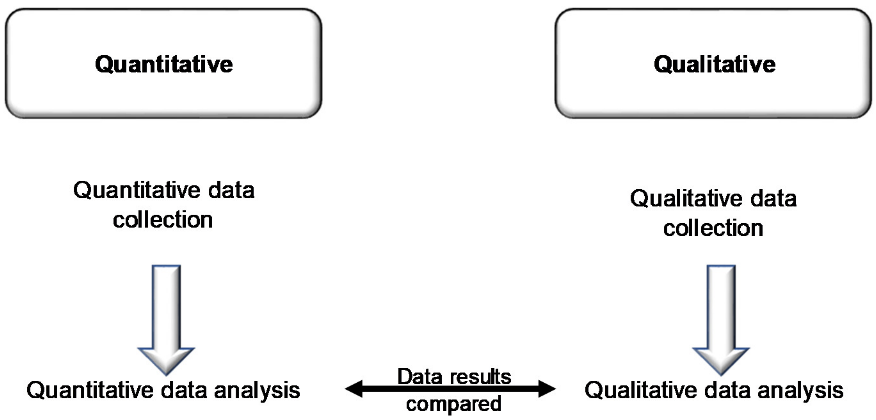

Fig. 2: Concurrent triangulation data analysis (Source: Terrel, 2012)

Questionnaire data was coded using Microsoft Excel software and basic numerical analysis was used in which data from questionnaires was assigned numerical values. Tables with number of frequency a question was answered were drawn. Findings of the research were presented through the use of tables and pie charts and the significance of each illustration was briefly explained.

For qualitative data, the researcher used thematic coding approach because it is flexible (Ibrahim, 2012; Jugder, 2016; Maguire and Delahunt, 2017). Themes were identified after initial codes were generated and then there was integration and interpretation (Maguire and Delahunt, 2017; Salleh *et al.,* 2017). Analysed quantitative and qualitative data were integrated during interpretation phase as illustrated on figure 3.2 above.

Results and Discussion

Environmental Risks

The majority of respondents 356 (99%) agreed that surface water pollution was an environmental risk associated with municipal solid waste illegal disposal while 2 (0.5%) were not sure and 2 (0.5%) disagreed as indicated on Table 4.1. This could be an indication that surface water pollution was an environmental problem of MSW illegal disposal. 332 (92%) of the respondents were in agreement with the point that ground water pollution was an environmental risk (Table 4.1). In addition, more than 90% of the respondents agreed that land pollution, air pollution, death of vegetation, soil contamination, death of aquatic life, loss of urban beauty and increase in rodents were environmental risks as illustrated on Table 2. This could imply that ground water pollution, land pollution, air pollution, death of vegetation, soil contamination, death of aquatic life and increase in rodents were environmental risks in Masvingo.

Table 2: Environmental risks

Environmental risk	Response					
	Agree		Not sure		Disagree	
	No. of Respondents	%	No. of Respondents	%	No. of Respondents	%
Surface water pollution	356	99	2	0.5	2	0.5
Ground water pollution	332	92	19	6	8	2
Land pollution	359	100	0	0	0	0
Air pollution	346	96	7	2	6	2
Death of vegetation	331	92	22	6	6	2
Soil contamination	333	93	23	6.2	3	0.8
Death of aquatic life	326	91	25	7	6	2
Loss of urban beauty	349	97	8	2.2	2	0.8
Increase in rodents	326	91	26	7	5	2

Main Environmental Risks

The highest number of respondents 312 (87%) indicated land pollution. The second highest 274 (76%) noted air pollution while the third highest 222 (62%) indicated surface water pollution and the fourth highest 211 (59%) noted loss of urban beauty as highlighted on Table 3 below. These results showed that land pollution, air pollution, surface water pollution and loss of urban beauty were the 4 main environmental risks associated with MSW illegal disposal in Masvingo.

Table 3: Main environmental risks

Environmental risk	Number of respondents	Percentage (%)
Surface water pollution	222	62
Ground water pollution	95	26
Land pollution	312	87
Air pollution	274	76
Death of vegetation	60	17
Soil contamination	68	19
Death of aquatic life	85	24
Loss of urban beauty	211	59
Increase in rodents	63	18
Death of domestic animals	0	0
Climate change/Global warming	0	0

Questionnaire results on environmental risks were in harmony with interview results. Formal waste workers one, two, three and four noted surface water pollution, air pollution, ground water pollution, destruction of vegetation and loss of urban beauty as environmental risks. EMA officials also highlighted similar environmental risks. For example formal waste worker one revealed that:

Water in streams is not clean, land is dirty and smoke is now common in the air and the city has lost its beauty (Excerpt from interview, Masvingo City, 2019).

In relation to this, EMA official two commented that:

Air has been degraded as a result of burning solid waste, Mucheke River has been polluted and the city has lost its aesthetic value (Excerpt from interview, Masvingo City, 2019).

Land pollution could be due to solid waste dumped on any vacant land by waste generators as a result of infrequent collection. Air pollution could be due to open burning of solid waste to reduce volume and burning by informal waste workers when recovering wire from tyres. Surface water pollution could be a result of solid waste dumped in these water sources due to lack of awareness and solid waste washed into water sources during rainy season. Loss of urban beauty could be due to littering and open burning.

The findings on environmental risks seem to corroborate what has been reported in other cities. Loss of aesthetic value, surface water, land and air pollution were environmental risks in Indian cities (Saikia and Nath, 2015; Vilas, 2015; Balasubramania, 2018). Water pollution was noted as a risk in Dar es Salaam (Kasala, 2014). Loss of aesthetic value was also highlighted as a risk in Kampala (Kinobe, 2015), in South African cities (Mangizvo and Mapindu, 2012) and in Gweru, Zimbabwe (Mangizvo, 2010).

Conclusion

The study concluded that municipal solid waste management in Masvingo City was not sustainable since disposal was a threat to the environment.

Recommendations

Basing on the main findings, the following recommendations were made:

a. Masvingo local authority should implement a holistic approach in MSWM.
b. There should be effective education for all stakeholders to promote positive attitude towards waste management.
c. Suitable receptacles should be provided for all waste generators to enable separation at source.
d. Reuse, recycling and recover must be promoted to reduce the quantity of solid waste collected for disposal.
e. All waste generators should pay refuse fees in time to enable responsible authorities to collect waste frequently.

References

Addaney, M. and Oppong, R.A. (2015). Critical issues of municipal solid waste management in Ghana. *JENRM*, 2(1): 30-36.

Babayemi, J.O. and Dauda, K.T. (2009). Evaluation of solid waste generation, categories and disposal options in developing countries: A case study of Nigeria. *J. Appl. Sci. Environ. Manage,* 13(3): 83-88.

Balasubramania, M. (2018). Municipal solid waste management in India: status, problems and challenges. *Int. J. Environment and Waste Management,* 21(4): 253-268.

Bouanini, S. (2013). Assessing municipal solid waste management in China.

World Journal of Social Sciences, 3(4): 71-73.

Butu, A.W. and Mshelia, S.S. (2014). Municipal solid waste disposal and environmental issues in Kano metropolis, Nigeria. *British Journal of Environmental Science,* 2(1): 1-16.

Chanza, N., Nyahuye, A., Mundoga, T., and Moyo, F.F. 2(017). Emerging solid waste management issues in Beitbridge Border town: Evidence from participatory approach. *International Journal of Advanced Research*, 5(4): 771-781.

Choudhury, M. and Choudhury, M. (2014). Trends of urban solid waste management in Agartala City, Tripura, India. *Universal Journal of Environmental Research and Technology,* 4(4): 227-235.

Cochran, W.G. (1963). *Sampling Techniques*. (2nd ed) New York: John Wiley and Sons, Inc.

Daniel, E. (2016). The usefulness of qualitative and quantitative approaches and methods in researching problem-solving ability in Science Education Curriculum. *Journal of Education and Practice,* 7(15): 91-100.

Dlamini, B.R, Rampedi, I.T. and Ifegbessan, A.P. (2017). Community resident's opinions and perceptions on the effectiveness of waste management and recycling potential in the Umkhanyakude and Zululand District Municipalities in the KwaZulu- Natal Province of South Africa. *Sustainability,* 9: 1835, pp. 1-19.

Doyle, L., Brady, A. and Byrne, G. (2009). An overview of mixed methods research. *Journal of Research in Nursing,* 14(2): 175-185.

Elagroudy, S., Warith, M.A., and El Zayat, M. (2016). *Municipal Solid Waste Management and Green Economy.* Global Young Academy, Berlin, Germany.

Emelumadu, O.F., Azubike, O.C., Nnebue, C.C., Azubike, N.F. and Sidney-Nnebue, O.N. (2016). Practice, pattern and challenges of solid waste management in Onitsha Metropolis, Nigeria. *American Journal of Public Health Research,* 4(1): 16-22.

Etikan, I. and Bala, B. (2017). Sampling and sampling methods. *Biometrics and Biostatistics International Journal,* vol. 5(6): 211-217.

Etikan, I., Musa, S.A. and Alkassin, R.S. (2016). Comparison of convenient sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics,* 5(1): 1-4.

Financial Gazette (2016). "Poor waste management-public health threat". Andrew Kanambura, Harare.

Hettiarachchi, H., Ryu, S., Caucci, S. and Rodolfo, S. (2018). Municipal solid waste management in Latin America and the Caribbean: Issues and potential solutions from government perspective. *Recycling,* 3(19): 1-15.

Ibrahim, A.M. (2012). Thematic analysis: A critical review of its process and evaluation. *West East Journal of Social Sciences,* 1(1): 39-47.

Jerie, S. (2014). Analysis of enterprise profile and composition of solid waste generated in informal sector of Gweru, Zimbabwe. *Journal of Waste Management*, 9(2): 179-185.

Jerie, S. (2016). Occupational risks associated with solid waste management in the informal sector of Gweru, Zimbabwe. *Journal of Environmental and Public Health*, 2016(10): 1-14.

Jugder, N.C. (2016). *The thematic analysis of interview data: An approach used to examine the influence of the market on curricular provision in Mongolia higher education institutions.* (3rd ed), Hillary Place Papers. University of Leeds.

Kabera, T., Wilson, D.C., and Nishimwe, H. (2019). *Waste Management and Research*, 37(1): 58-72.

Kasala, S.E. (2014). Critical analysis of challenges of solid waste management initiatives in KekoMachungwa informal settlement, Dar es Salaam. *Journal of Environmental Protection*, 2014(5): 1064-1074.

Khati, P. (2015). *Municipal Solid Waste Management in Kalimpong Town: An Economic Analysis*. Masters Thesis. Sikkim University.

Kinobe, J.R. (2015). *Assessment of urban solid waste logistics systems: the case of Kampala, Uganda*. Doctoral Thesis, Swedish University of Agricultural Sciences Uppsala.

Lethbridge, J. (2017). *Municipal Solid Waste Management Services in Latin America.* PSIRU, University of Greenwich, London, UK.

Mafume, P.N., Zendera, W., Mutetwa, M., and Musimbo, N. (2016). Challenges of solid waste management in Zimbabwe: a case study of Sakubva high-density suburb. *Journal of Environment and Waste Management,* 3(2): 142-155.

Maguire, M. and Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *AISHE-J,* 3(2017): 3351-3364.

Mahar, A. (2014). Public health risk management through environmentally sustainable solid waste management strategies: A case study of Pakistan. *International Journal of Analytical, Pharmaceutical and Biomedical Sciences*, 3(5): 44-50.

Makwara, E.C. and Magudu, J.C. (2013). Confronting the reckless gambling with people's health and lives: urban solid waste management in Zimbabwe. *European Journal of Sustainable Development*, 21:67-98.

Mangizvo, R.V. (2010). Illegal dumping of solid waste in the alley in central business district of Gweru, Zimbabwe. *Journal of Sustainable Development in Africa,* 12(2): 110-121.

Mangizvo, R.V. and Mupindu, S. (2012). The management practice and environmental health implications of municipal solid waste dump site in Alice, South Africa. *Online Journal of Social Sciences Research,* 1(5): 125-131.

Mbue, I.N., Bitondo, D., and Azibo, B.R. (2015). Municipal solid waste generation, composition and management in Duala Municipality, Cameroon. *Journal of Environmental and Waste Management*, 2(4): 91-101.

Mohammed, A. and Eyasu, E. (2017). Solid waste management solutions for a rapidly urbanizing area in Thailand: Recommendations based on stakeholder input. *International Journal of Environmental Research and Public Health,* 15(1302): 1-23.

Muniafu, M. and Otiato, E. (2010). Solid waste management in Nairobi, Kenya. A case for emerging economies. *The Journal of Language, Technology and Entrepreneurship in Africa,* 2(1): 342-350.

Musingafi, M.C.C., Manyanye, S., Ngwaru K. and Muranda, K.E. (2014). Public health and environmental challenges in Zimbabwe. The case of solid waste generation and disposal in the city of Masvingo. *Journal of Environment,* 1(2): 68-72.

Ndanu, M.C., and Syombua, M.J. (2015). Mixed methods research: The hidden cracks of the triangulation design. *General Education Journal,* 4(2): 46-67.

Njeleka, P.S. (2010). *An Investigation into Solid Waste Management in Townships: The Case Study of Clermount Kwa-Zulu Natal*. Masters'Thesis, University of KwaZulu Natal, Durban.

Nyanzou, P., and Jerie, S. (2014). Solid waste management practices in high density suburbs of Zimbabwe: a focus on Budiriro 3, Harare. *The Dyke*, 8(3): 33-49.

Riqueleme, R., Mendez, P. and Smith, L., (2016). *Solid Management in the Caribbean, Proceedings from the Caribbean Solid Waste Conference*. IDB, Filipe Herrera.

Saikia, D. and Nath, M.J. (2015). Integrated solid waste management model for developing country with special reference to Tezpur municipal area, India. *International Journal of Innovative Research and Development,* 4(2): 241-249.

Salleh, I.S., Syuhada, N., Ali, M., Mohd-Yusof, K. and Jamaluddin, H. (2017). Analysing qualitative data systematically using thematic analysis for deodoriser troubleshooting in palm oil refining. *Chemical Engineering Transactions,* 56(2017): 1315-1320.

Samwire, T., Wu, P., Xu, L., Shen, E., Appiah, E. and Yaogi, W. (2017). Challenges and prospects of solid waste management in Ghana. *International Journal of Environmental Monitoring and Analysis*, 5(4): 96-102.

Simelane, T. and Mohee, R. (2012). *Future directions of municipal solid waste management in Africa.* African Institute of South Africa. Briefing No 81.

Terrel, S. (2012). Mixed-methods research methodologies. *The Quantitative Report*, vol.17, no.1, pp. 254-280. Retrieved from http://www-nova.edu /ssss/ QR17-1/terrel. pdf

Vaidya, P., Kumar, R. and Kantoji, P.R. (2014). Status of municipal solid waste management system in India. *Int. J. Environmental Technology and Management,* 17(2/3/4): 310-333.

Vilas, M.A. (2015). A critical overview of legal profile in solid waste management in India. *International Journal of Research in Chemistry and Environment,* 5(1): 1-16.

Waugh, D. (2003). *An integrated approach*. Nelson Thomes Ltd, Cheltenham, UK.

World Bank (2012). *What a Waste: A Global Review of Solid Waste Management*. Urban Development Series Knowledge Papers.

Zohoori, M. and Ghani, A. (2017). Municipal solid waste management challenges and problems for cities in low-income and developing countries. *International Journal of Science and Engineering Applications,* 6(2): 39-48.

Zimstat, (2012). *Preliminary Report*: Harare: Zimbabwe National Statistics Agency.