SOLID WASTE GENERATION AT PASIR MAS DISTRICT

MOHD RAIS BIN MOHD KAMARUDIN

A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Civil)

School of Civil Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

FEBRUARY 2021

DEDICATION

I would like to dedicate this to my family, acquaintances and lecturers.
Thanks for everything

ACKNOWLEDGEMENT

Praise to Allah, I finally managed to complete this research and project report after going through many hurdles and limitation in the period of Covid 19 pandemic crisis.

First and foremost, I would like to express my humble appreciation to supervisor Dr. Shamila Azman for her patient, time, guidance and everything from the beginning of my master project until its completion date.

Then, I would like to acknowledge and thanks to the Mr. Eliff Ashraaf from Pasir Mas Municipal Council for his dedication and cooperation in giving information regarding the research done on municipal solid waste in Pasir Mas district. Next to him was Mr. Fikri and staff from Universiti Malaysia Kelantan who give me amazing feedback and cooperation in perform sample analysis.

Furthermore, I would like to extend my sincere appreciation to my beloved family and friends whom always give me a morale support.

Finally, I would like to thank you so much to anyone whom had helped me whether directly or indirectly throughout the journey of completing this thesis. All kindness given are really well appreciate.

ABSTRACT

This study discusses the effectiveness of solid waste management and landfill at Pasir Mas district. The objectives of this study are to determine solid waste generation for municipal solid waste (MSW) at Pasir Mas district, to study existing method of solid waste disposal at the landfill as well as problems and challenges that arise, water quality at the landfill surrounding areas and propose for more sustainable solid waste disposal method for this district. The study begin with the process of finding the amount of solid waste volume managed by local municipal council in the year of 2018, 2019 and 2020. Pasir Mas Municipal Council management representatives estimated solid waste collection around 126 tonnes per day. Based on data analysis it is clearly seen that the trend of solid waste collection by month in the year 2018 and year 2019 are quite similar with minimal differences. However the trend of solid waste collection in the year 2020 is still not fully available according to record given by municipal council . This study also focused on the possibilities of leachate in the surrounding landfill area at Kampung Pusu Empat Puloh compared with Environmental Quality Act. So, as a result if compared mean pH value which is 6.61 still in the permissible range value. Chemical Oxygen Demand (COD) mean measure at 59.00 mg/L was within the limit and below the 400 mg/L. However Biological Oxygen Demand (BOD_5) mean value was 34.93 mg/L and 74.65% more than 20 mg/L. Lastly, Ammoniacal Nitrogen (NH_3-N) mean reads at 0.20 mg/L was below standard of 5 mg/L with percentage different more than 100%. Most of parameters in sampling result acquires on the site gives positive feedback on water quality. It can be conclude that the best alternative for this landfill was by turning it into sanitary landfill which is more efficient and sustainable in handling solid waste.

ABSTRAK

Kajian ini membincangkan keberkesanan pengurusan sisa pepejal dan tapak pelupusan sampah di daerah Pasir Mas. Pelbagai kaedah yang sesuai telah digunakan untuk mendapatkan jumlah sebenar sisa sampah pepejal di daerah ini. Berdasarkan matlamat diatas, objektif kajian ini adalah mendapatkan jumlah sisa sampah pepejal bagi daerah Pasir Mas, kajian terhadap prosedur kutipan sampah sehingga ke tempat pembuangan sampah dan cabaran yang dihadapi, kualiti air di sekitar kawasan tapak pembuangan sampah dan mencadangkan kaedah pelupusan sampah yang lebih lestari. Kajian dimulakan dengan proses mendapatkan data jumlah isipadu sisa pepejal bagi tahun 2018, 2019 dan 2020. Pihak majlis daerah Pasir Mas menganggarkan kutipan harian sisa pepejal adalah 126 tan/hari. Berdasarkan analisis data yang dilakukan, didapati pola jumlah kutipan bulanan bagi tahun 2018 dan tahun 2019 hampir sama dengan perbezaan jumlah yang tidak ketara. Walaubagaimanapun, bagi tahun 2020 pola jumlah kutipan bulanan masih belum dapat dikenal pasti kerana data yang diberi oleh Majlis Daerah Pasir Mas hanya setakat bulan Julai sahaja. Kajian ini juga memfokuskan kepada kemungkinan air larut resap (leachate) wujud dalam sumber air seperti parit di sekitar kawasan tempat pelupusan sampah berpandukan kepada Akta Kualiti Alam Sekeliling Peraturan (2009). Hasil kajian mendapati nilai pH diperolehi iaitu 6.61 masih di dalam takat yang dibenarkan piawaian perbandingan dengan standard. Begitu juga dengan nilai COD iaitu 59.00 mg/L tidak melepasi 400 mg/L. Tetapi untuk BOD_5, nilainya adalah 34.93 mg/L dan 74.65% melebihi standard 20 mg/L. Akhir sekali, nilai bacaan Ammoniacal Nitrogen (NH_3-N) pada 0.20 mg/L tidak melepasi had standard 5 mg/L dengan perbezaan peratusan melebihi 100%. Sebahagian besar keputusan sampel air menunjukkan hasil yang positif berkaitan kualiti air di kawasan ini. Berdasarkan kajian yang telah dijalankan tersebut, menaiktaraf tapak pelupusan sampah disini kepada tapak pelupusan sanitari akan membuatkan pengurusan sampah lebih efisien dan lestari.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CMCO	-	Conditional Movement Control Order
DOE	-	Department of Environment
EQA	-	Environmental Quality Act
MCO	-	Movement Control Order
MDPM	-	Majlis Daerah Pasir Mas
N.A	-	Not Available
UMK	-	Universiti Malaysia Kelantan
MSW	-	Municipal Solid Waste

LIST OF SYMBOLS

TDS	-	Total dissolved solid
COD	-	Chemical oxygen demand
BOD_5	-	Biological oxygen demand
NH_3-N	-	Ammoniacal nitrogen
%	-	Percentage

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Globally, almost all municipal facing a hard task in municipal solid waste (MSW) management moreover for fast developed town such as new commercials and residentials areas. Malaysia also categorized as one of the several nations which in line to be a developed nation in the world. The good pace show by economic figure and lower rates of unemployment due to good governance from appointed political party members and richness in variety of important resources plays a vital part in driven Malaysia to be a success develop nation. The activity from new urbanisation and mass industrialisation all over Malaysia develop areas also resulted some effects to the environmental due to increase of solid waste generated. Fast grows of industry sectors and township areas have effect the characteristics of solid waste produce by Malaysians citizen and in line with the scenario in other developed countries. Meanwhile, demand of some Malaysian citizen to pursue better quality of life also contributes to the increasing of waste generation rates in the country.

Deduction in solid waste generation from all sectors, minimising solid waste disposals cost, its impact to the environment, as well as impact on human health becomes the priority in solid waste management party. Current practice system of solid waste management in developing country resulted a lot of problems such as: (i) minimal collection coverage areas and unscheduled solid waste collecting services ; (ii) open dumping for solid waste and burning practiced with negligence to air pollution and water pollution control; and (iii) be a spot for breeding of vermin and flies. Nowaday, Malaysia views in organised solid waste management as one of prime environmental issues to be settle seriously (Saeed et al.,2009). The characteristics of solid wastes generates by localities become the most important

aspects in the scope of solid waste management system. Solid waste should be break down by generation rates, types of solid waste production, composition and sources in order to clearly characterising solid waste flow acquired. It is important to come out with these information to help monitoring and controlling waste management systems and provide related parties to come out with standards regarding regulation,financial and instituitional actions. Ministry of Housing and Local Government were responsible to handles any related matters to solid waste management in Malaysia. While, Solid Waste Management Corporation (SWCorp) is the implementation authority of the Solid Waste and Public Cleansing Management Act that is being enforced throughout the Malaysia states. National Strategic Plan for Solid Waste Management (SWM) was enacted in year 2005 in order to emphasized for an integrated municipal solid waste management (ISWM) by local council and figure out the prioritization of waste management hierarchy to reduce solid waste collection by practising the 3R's i.e., reuse, reduce, recycle at both pre-and postconsumer stage at their own outlet (Noor et al., 2013). Municipal solid waste collection in the localities area,transportation of solid waste generates and disposal activities at the gazette landfill was under the control of local municipal council. In the aspect of covering environmental guideline and integrated solid waste compliance should be obey by all parties in this matters,the Department of Environment Malaysia (DOE) become only authority responsible in formulating and regulating environmental act in this nation (Badgie et al., 2012). Based on United Nation data on MSW generation rates, Malaysian on average generates about 1.1 kg/cap/day of municipal solid waste. Due to the facts that Malaysians has a population around 30 millions citizen in present, this huge population suppose to have proper and efficient engineered municipal solid waste management which able to counter the environmental issues regarding MSW. In overall at almost municipalities in Malaysia nation, displayed poor practiced in municipal solid waste management and most of landfill was open dumping without any related environment protection measures were taken. In addition, conventional disposal method by landfilling is very land dependent and create aesthetics disturbance while imposing anxieties and psychological fears due to health and ecological risks to the community (Othman and Khee, 2014). Briefly, Malaysian solid waste contains a very high concentration of organic waste fraction. In Malaysia, organic waste was the highest fraction found in solid waste generates domestically. Furthermore, the

municipal solid waste also contains high moisture content and a bulk density above 200 kg/m3 as reported by Manaf et al (2009). Food, plastic and paper has found to be main components in Malaysian solid waste after waste characterisation analysis done by the researcher which contain 80% of overall weight of waste (Khathirvale et al., 2004). Lifestyle and behaviour of Malaysian citizen really have proportional relationship for the characterization of the municipal solid waste fraction and generation. This study will cover the actual practice regarding of municipal solid waste management in Pasir Mas district. Figure 1.1 shows location of Pasir Mas district in Kelantan state. Pasir Mas is a town in Pasir Mas District and located in north-western Kelantan state, Malaysia. Previously, Pasir Mas town ranked as second biggest town in Kelantan state after Kota Bharu town. However, Tanah Merah town takes the spot in years later.

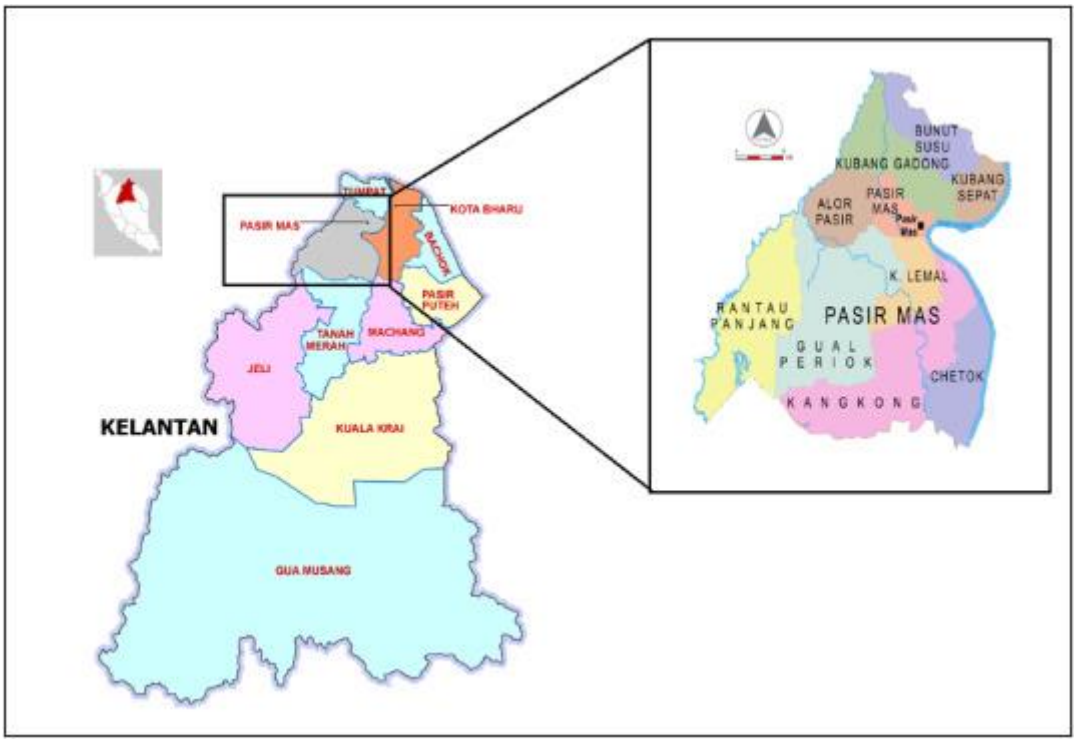

Figure 1.1: Location of Pasir Mas district in Kelantan state.

1.2 Problem Statement

Several issues that bound in municipal solid waste management especially in developing country are (Stroot et al., 2001): (i) conventional open dumping system is more popular among stakeholders mostly due to financial, lack of technical system and social practices.; (ii) low charges for landfill tipping at open dumping site ; (iii) technical challenge ; and (iv) stakeholders facing difficulties to deal with leachate recirculation and gas attraction resulted from landfill. Most popular technique used in disposal of municipal solid waste at localities is through landfill and open dumping basically implemented in all landfill sites in Malaysia (Manaf et al., 2009). The preference to opt for open dumping landfill relatively back by it cheapest cost to dumping solid waste and being the easiest way to treat solid waste with high content of organic substances. In reality, open dumping practice bring many negative impacts on surrounding landfill areas such as : (i) surface and groundwater contamination through leachate, (ii) soil contamination through direct waste contact or leachate, (iii) open burning of solid waste activities causes air pollution, (iv) the probability for spreading of diseases by different vectors like insects, birds and rodents, (v) odour pollution at the surrounding of landfill area, and (vi) anaerobic decomposition of waste release harmfull uncontrolled methane gas (Ngoc et al., 2009).

Without practicing suitable leachate management system at landfill site, the probabilities of river water nearby to contaminate with leachate element is so high. At present, only a few data on leachate impact from landfill whether controlled or uncontrolled to river in Malaysia is accessible (Yusof, 2009). In Malaysia including Kelantan state, the only preferable method use by all local council in the state for the purpose to disposal of municipal solid waste also through landfill with open dumping system. In addition, solid waste collection by local council covers almost all places in urban areas, this data quite different if compare to rural areas which state only about 66% of the populations in rural areas in Malaysia are covered with the collection service by local council (Hamatschek, 2010). As a result, the popular choice for residence in rural areas to dispose solid waste was dumped at backyard of their homes, in nearest drains or river streams and occasionally on the streets. This act actually resulted a lot of environmental problems and given threats to locality such as

flooding, insects and rodent vectors breeding in solid waste dumping areas and high probability to catalyst the spread of dangerous diseases like dengue fever (Zurbrugg, 2002). Table 1.1 below shows the waste to be generated by Malaysians from year 2015 until year 2020.

Table 1.1: Waste to be generated by Malaysians from year 2015 until year 2020 (National Solid Waste Management Department 2012)

Year	**Household,Industrial,Commercial and Institutional Waste Generation. (tonnes / day)**
2015	38563
2016	40566
2017	42672
2018	44888
2019	47218
2020	49670
Total	263577

Currently, 165 landfills are in operation nationwide to support the demand for disposal site and 131 landfills have shut down their operation. Table 1.2 give the clear pictures about the figure of solid wastes disposal sites in every state or place in the nations. The rapid growth of urbanisation in the country also brings some difficulties for local council to find new potential landfill sites because normally communities will object the construction and operation of new landfill site located nearby their residential area. This is due to general perspective or common thought that landfill will bring an odour pollution to the surroundings areas. One of the landfill in operation across Kelantan state including Kampung Pusu Empat Puloh located in Pasir Mas district (Figure 1.2).

Table 1.2: Statistics shows landfill sites in Malaysia (National Solid Waste Management Department 2021).

States	Landfills In Operation	Landfills Have Been Closed
Johor	14	23
Kedah	8	7
Kelantan	13	6
Melaka	2	5
Negeri Sembilan	7	11
Pahang	16	16
Perak	17	12
Perlis	1	1
Pulau Pinang	2	1
Sabah	19	2
Sarawak	49	14
Selangor	8	14
Terengganu	8	12
Federal Territories	1	7
Total	165	131
	296	

Figure 1.2: Active dumping site across Kelantan state including at Kampung Pusu Empat Puloh.

A good practice in handling municipal solid waste by local municipalities especially types of waste treatment method applied is essential in order to improve existing waste management at any area or locality involved. Hopefully by doing this method it will improve the goodness in many aspects.

1.3 Aim and Objectives of Study

The objective of the research are to:

i. Determine solid waste generation for MSW at Pasir Mas district.

ii. Study existing method of solid waste disposal at the landfill as well as problems and challenges that arise.

iii. Analyse water quality in landfill surrounding areas.

iv. Propose an alternative for more sustainable solid waste disposal method for this landfill.

1.4 Scope of Study

This study covers only on solid waste generation at Pasir Mas district in Kelantan. The methods that had been implemented in this study such as site visit, data collection from authorities, data calculation and laboratory analysis for water samples. In the early stage, the data was taken and analyst from previous related solid waste management research and other resources for an example articles, research paper, journal, book, and add with some information using the internet. For a primary data of solid waste disposal, the information from Pasir Mas Municipal Council will be gather. The tests of water samples conducted for research in finding result and information about water quality if there were leachate presents. Two different sampling location obtain to getting different results and information on water quality near landfill area.

1.5 Significant of Study

Selection of proper method or technology use by all the stakeholders in the field being the critical factors in order to succeed in achieving sustainable solid waste management. To be more understood, every stakeholders in this industry must follow and apply strict practice sustainable waste management in order to build a promising future to the Malaysians. In conjuction with the statement above, the main purposes of this study is to get some data on solid waste management implemented in Pasir Mas district, and come out with suitable suggestion to achieving sustainability in solid waste management teams without compromising the human vital factors. In order to get best results, past similar researches is reviewed and combined with new data on waste management in recent years of this district. The results that obtained from this research show the sequence managing solid wastes in Kelantan state in general and level reach or stage on implementation sustainability concept into solid waste management by local council. This study also provide local council an important data finding on solid waste data collection for year 2018 until 2020.The trend of the data was useful to future prediction on solid waste management in Pasir Mas district. Hopefully, local council able to promotes and practice the concept of sustainability in future waste management activities.

REFERENCES

Abdullah, A. R. 1995. Environmental pollution in Malaysia: trends and prospects. Trends in Analytical Chemistry. 14: 191–198.

Agamuthu, P.K.M. Khidzir and F. S. Hamid. 2009. Drivers of Sustainable Waste Management in Asia. Waste Management & Research.27:625-633.

Agyekum, K. 2012. Consultants' perspectives on materials waste reduction in ghana. Engineering Management Research.

Aziz, H. A. 2016 Municipal Solid Waste Management Challenges In Malaysia, Key paper at the Waste Management Asia, 2016, 27-28 January, 2016, Kuala Lumpur, Fleming Gulf.

Badgie, D. 2012. Assessment of Municipal Solid Waste Composition in Malaysia: Management, Practice, and Challenges. Polish Journal of Environmental Studies.

Begum, R. A. 2007. Factors and values of willingness to pay for improved construction waste management–A perspective of Malaysian contractors. Waste management.

Begum, R. A., 2009. Attitude and Behavioral Factors in Waste Management in the Construction Industry of Malaysia. Resources, Conservation and Recycling. 53: 321–328.

Chosson, J. 2020. How to prevent landfill fires through early detection?.

Esin, T. and Cosgun, N. 2007. A study conducted to reduce construction waste generation in Turkey. Building and Environment.

Environmental Quality Act 1974, Environmental Quality (Control of Pollution from Solid Waste Transfer Station and Landfill) Regulation 2009.

Hamatschek, E. 2010. Current Practice of Municipal Solid Waste Management in Malaysia and the Potential for Waste-to-Energy Implementation.

Haron, S. A., L. Paim, and N. Yahaya. 2005. Towards Sustainable Consumption: An Examination of Environmental Knowledge among Malaysians. International Journal of Consumer Studies. 29: 426–436.

https://athenarhd.co.mz/sanitary-landfill-design/

https://en.wikipedia.org/wiki/Pasir_Mas_(town)

https://jpspn.kpkt.gov.my/resources/index/user_1/fileupload/slaid_dapatan_makmal.pdf

https://us.envguide.com/bioreactor-landfills/

https://www.bioenergyconsult.com/biomass-pyrolysis-process/

https://www.cleancoastresources.com/industry-resources/what-is-anaerobic-digestion

https://www.epd.gov.hk/epd/english/environmentinhk/waste/prob_solutions/WFdev_IWMFtech.html

https://www.e-idaman.com/service/landfill-management

https://www.wastack.com/post/how-to-prevent-landfill-fires-through-early-detection

Johari, A., Alkali, H., Hashim, H., Ahmed, S. I. and Mat, R. 2014. Municipal solid waste management and potential revenue from recycling in Malaysia. Modern Applied Science, 8, 37.

Kamaruddin, M. A., Yusoff, M. S., Aziz, H. A. and Hung, Y. T. 2015. Sustainable treatment of landfill leachate. Applied Water Science, 5), 113.

Kathirvale, S., Yunus, M. N. M., Sopian, K. and Samsuddin, A. H. 2004. Energy potential from municipal solid waste in Malaysia. Renewable energy, 29, 559-567.

Manaf, L.A., Samah, M.A.A., and Z.N.I.M. 2009. Municipal Solid Waste Management in Malaysia: Practices and challenges. 29: 2902–2906.

MDC S B Laws of Malaysia-Environmental Quality Act 1974 and Regulation. 4th ed. Kuala Lumpur, Malaysia, 1997.

Meen-Chee, H. and Narayanan, S. 2006. Restoring the Shine to a Pearl: Recycling Behaviour in Penang, Malaysia. 37: 1117–1136.

Municipal Waste Collection in Ketereh District (2019)

Municipal Waste Collection in Pasir Mas District (2018-2020)

National Solid Waste Management Department. http://www.kpkt.gov.my/jpspn/main.php

National Solid Waste Management Department. 2021. [accessed: February 2021]. https://jpspn.kpkt.gov.my/index.php/pages/view/75

Naveen, B. P., Sivapullaiah, P. V. and Sitharam, T. G. 2014. Characteristic of a municipal solid waste landfill leachate. Proceedings of Indian Geotechnical Conference IGC-2014, December 18-20, 2014, Kakinada, India.

Ngoc, U. N. and H. Schnitzer. 2009. Sustainable Solutions for Solid Waste Management in Southeast Asian countries. 29: 1982–1995.

Noor, Z. Z., Yusuf, R. O., Abba, A. H., Hassan, M. A. A. and Din, M. F. M. 2013. An overview for energy recovery from municipal solid wastes (MSW) in Malaysia scenario. Renewable and Sustainable Energy Reviews, 20, 378-384.

Periathamby, A., Hamid, F.S. and Khidzir, K. 2009. Evolution of SWM in Malaysia: Impacts and Implications of The Solid Waste bill, 2007.11: 96–103.

Pitt, M. and A. Smith. 2003. Waste Management Efficiency at UK Airports. Journal of Air Transport Management. 9: 103–111.

Piyaphant, S. and. Prayong, K. 2011. Environmental impact on municipal solid waste management system in Chaiyaphum. in Proceedings of the 10th WSEAS international conference on System science and simulation in engineering.

Purcell, M. and Magette, W.L. 2010. Attitudes and Behaviour Towards Waste Management In the Dublin, Ireland region. Waste Management. 30: 1997–2006.

Raghab, S. M., El Meguid, A. M. A. and Hegazi, H. A. 2013. Treatment of leachate from municipal solid waste landfill. HBRC Journal, 9, 187.

Renou, S., Givaudan, G., Poulain, S., Dirassouyan, F. and Moulin, P. 2008. Landfill leachate treatment: Review and opportunity, Journal of hazardous material, 150, 468.

Rick Leblanc, 2019, https://www.thebalancesmb.com/waste-treatment-and-disposal-methods-2878113

Saeed, M. O., Hassan, M. N. and Mujeebu, M. A. 2009. Assessment of Municipal Solid Waste Generation and Recyclable Materials Potential in Kuala Lumpur, Malaysia. Waste Management. 29: 2209–2213.

Sinar Harian (Wednesday, 20 January 2021).

Stroot, P. G., et al. 2001. Anaerobic Codigestion of Municipal Solid Waste and Biosolids Under Various Mixing Conditions-I. Digester performance. Water Research. 35: 1804–1816.

The International Bank for Reconstruction and Development. 1999. What a Waste: Solid Waste Management in Asia.: The World Bank.

Vaz, J., Ferreira, C.D., Ferreira, J.S. 2015. Biowaste separate collection and composting in a Small Island Developing State: The case study of Sao Tome and Principe, West Africa.

Yusof, N. 2009. Measuring Organic Carbon, Nutrients and Heavy Metals in Rivers Receiving Leachate from Controlled and Uncontrolled Municipal Solid Waste Landfills. Waste Management. 29: 2666–2680.

Yusoff, I., Alias, Y., Yusof, M., and Ashraf, M. A. 2013. Assessment of pollutants migration at Ampar Tenang landfill site, Selangor, Malaysia. Sci Asia, 39, 392.

Zafar, S. 2011. Biomass Pyrolysis Process.

Zakaria, S.N.F and Aziz, H.A. 2018. Characteristic of leachate at Alor Pongsu Landfill Site, Perak, Malaysia: A comparative study.

Zia, H. and Devadas, V. 2007. Municipal Solid Waste Management in Kanpur, India: Obstacles and Prospects. Management of Environmental Quality: An International Journal.

Zurbrugg, C. 2002. Urban Solid Waste Management in Low-Income Countries of Asia How to Cope with the Garbage Crisis etc.: Durban, South Africa.