YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF ECONOMICS
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LOCAL RESIDENTS' PERCEPTIONS TOWARDS MUNICIPAL SOLID WASTE MANAGEMENT IN FINAL DISPOSAL SITES (CASE STUDY: HTEIN BIN FINAL DISPOSAL SITE IN HLAING THAR YAR TOWNSHIP)

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LOCAL RESIDENTS' PERCEPTIONS TOWARDS MUNICIPAL SOLID WASTE MANAGEMENT IN FINAL DISPOSAL SITES

(Case Study: Htein Bin Final Disposal Site in Hlaing Thar Yar Township)

A thesis submitted in partial fulfillment of the requirements for degree of the Master of Development Studies (M.DevS)

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This is to certify that the thesis entitled **"Local Residents' Perceptions towards Municipal Solid Waste Management in Final Disposal Sites (Case Study: Htein Bin Final Disposal Site in Hlaing Thar Yar Township)''**, submitted as a partial fulfillment towards the requirements for the degree of Executive Master of Development Studies has been accepted by Board of Examiners.

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ABSTRACT

This study is conducted local residents' perceptions towards municipal solid waste management in final disposal sites at Hlaing Thar Yar Township, Yangon City. The objectives of the study are to analyze knowledge and practice on waste management of local people near the final disposal site, to investigate the environmental impacts including air, land and water of the surrounding area of the final disposal site and to analyze the suggestion by local residents. It is found that the respondents strongly agreed that safe waste disposal is of utmost important to prevent fire incident and infection transmission, without treating at the final disposal site posed a threat to the environment and health. YCDC should make proper management plan to consider with current local residents' perceptive and need to more negotiations for waste collection and enhance the awareness program.

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LIST OF ABBREVIATIONS

ADB	-	Asia Development Bank
CBD	-	Central Business District
CDCs	-	City Development Committees
ECD	-	Environmental Conservation Department
FDS	-	Final Disposal Site
FDSs	-	Final Disposal Sites
GHG	-	Greenhouse Gas
GWP	-	Global Warming Potential
Ha	-	Hectare
IGES	-	Institute for Global Environmental Strategies
ISWM	-	Integrated Solid Waste Management
JFE	-	Japanese Future Engineering
JICA	-	Japan International Cooperation Agency
kW/Hour	-	Kilowatt/Hour
L	-	Liter
MBT	-	Mechanical Biological Treatment
MCCSAP	-	Myanmar Climate Change Strategy and Action Plan
MJ/kg	-	Megajoules per kilogram
MoC	-	Ministry of Construction
MONREC	-	Ministry of Natural Resource and Environmental Conservation
MSDP	-	Myanmar Sustainable Development Plan
MSW	-	Municipal Solid Waste
MSWM	-	Municipal Solid Waste Management
NSWMSM	-	National Solid Waste Management Strategies in Myanmar
pcd	-	per capita per day
RDF	-	Refused Derived Fuel
SDGs	-	Sustainable Development Goals
SUDP	-	Strategic Urban Development Plan
SW	-	Solid Waste
SWAN	-	Solid Waste Advisory Network
SWM	-	Solid Waste Management

TDCs	-	Township Development Committees
TPD	-	Ton Per Day
UECCD	-	Urban Environmental Conservation and Cleansing Department
UN-Habitat	-	United Nations Human Settlements Programme
USD	-	United State Dollars
WACS	-	Waste Assessment and Characteristics Survey
WtE	-	Waste to Energy
YCDC	-	Yangon City Development Committee
YRG	-	Yangon Region Government
YWTEP	-	Yangon Waste to Energy Plant

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Solid waste management (SWM) is important for maintaining a clean and healthy environment. There is also a direct relationship between public health and the environment. SWM problem has already become critical in many cities. This problem is compounded by the rapidly increasing amounts of wastes and composition which result from the growth in urban population and the changes in their consumption patterns. SWM system needs to be both environmentally and economically feasible. Inadequate SWM services adversely affect the environment, causing water and land, air pollution and will ultimately results in ill effects on human health and the quality of life. Solid Waste Management (SWM) challenges, particularly in the rapidly urbanizing developing cities, are of critical importance.

Five typical problem areas in Municipal Solid Waste Management (MSWM) in developing nations can be identified: 1) Poor service coverage, 2) Inefficient operational 3) limited utilization of recycling activities, 4) inadequate management of non -industrial hazardous waste, and 5) inadequate landfill disposal. (Chris Zurbrugg, 2002)

Due the rapid population, urbanization and industrialization of the Yangon City, an unprecedented volume of solid waste daily reaching the final disposal sites around Yangon. Htein Bin final disposal site, the largest is approximately 290 acres in size, of which 220 acres are said to be in use at the moment. Yangon City produces 2,500 tons of waste every day that is a combination of waste from households, commercial centers, institutions and industries. The composition of this waste is majorly 76% organic waste with rest being mixtures of plastic, textiles, wood, and rubber. These untreated huge amounts of wastes produced daily are dumped in open dumping sites in and around Yangon.

Virtually all Municipal Solid Waste (MSW) collected by Urban Environmental Conservation and Cleansing Department (UECCD), Yangon City Development Committee, and some industrial waste (assumed to be non-hazardous), is disposed to land in the absence of any alternative treatment facility. The current method of disposing of MSW at all Final Disposal Sites (FDSs) are open dumping.

Open uncontrolled dumping is still the most common method of solid waste disposal in Yangon City. There are significant risks to people's health, the environment, and safety in the area, including fires and explosions that release toxic gases into the air, diseases spread by mosquitoes, flies, and rodents, contaminated soil and groundwater, and explosions that contaminate drinking water. These risks significantly reduce the quality of life for people living close to the dump and the surrounding community.

In addition, local residents frequently illegally dump their solid waste into alleys, streets, BDS (back drainage space), rivers, channels, and drains/ditches. These are not only causing a number of health hazards from pathogenic organisms, insects and rodents, etc. and environmental impacts but also affecting negative landscape images. They also represent specific health risks to municipal workers, waste pickers and residents who live closely to the final disposal site area . seasons.

As of the above circumstances, respondents are still having negative effects on the final disposal site and on the other hand, as the open dumping system is still being used in final disposal site, there is an urgent need to develop controlled dumpsites. Additionally, it is necessary to prevent the public from being affected by the negative environmental effects caused of open dumping system. Therefore, this paper discusses about the environmental, health and social impacts effected by local residents at the FDS and conduct a survey of Kalargyi Su Village and staff and family members who lived in Staff Housing at Htein Bin FDS, Hlaing Thar Yar Township in Yangon City.

1.2 Objectives of the Study

The objectives of the study are to analyze knowledge and practice on waste management of local residents near the final disposal site and to investigate the environmental, health and social impacts effected by local residents near final disposal site area.

1.3 Method of Study

Descriptive method is used based on primary data and secondary data. Both quantitative and qualitative approaches are used in this study. The primary data were collected by using self-administrator structured questionnaire for local residents. The sampling method of the survey is selection of household who lived near Final Disposal Site area. The survey period is within July, 2022 to August, 2022. The secondary data

were obtained from previous studies government official reports and records of the UECCD and through internet, libraries, publication and review of record, return and report from the surveyed area of Htein Bin Final Disposal Site, Hlaing Thar Yar Township.

1.4 Scope and Limitations of the Study

This study mainly focused on local people who lived near Htein Bin Final Disposal Site located in Hlaing Thar Yar Township. Among the local residents, 100 households are selected as a sample size from staff housing at Htein Bin Final Disposal Site and Kalargyisu Village in Hlaing Thar Yar Township.

1.5 Organization of the Study

This study consists of five chapters. In Chapter I consists of rationale of the study, objective of the study, method of study, scope and limitations of the study and organization of the study are presented. Chapter II deals with literature review literature on Solid Waste and Reviews on Previous Studies. Chapter III review on Solid Waste Management in Yangon City, Final Disposal Sites in Yangon City and Air Quality Index at Htein Bin FDS. In chapter IV analyze the survey is with the survey profile, survey design and analysis on survey result. Chapter V presents conclusion, findings and suggestions.

CHAPTER II
LITERATURE REVIEW

2.1 Solid Waste

Solid waste refers to any type of garbage, trash, refuse or discarded material. It can be categorized according to where the waste is generated, for example as municipal solid waste, health care waste and e-waste. Annual production of municipal solid waste exceeds 2 billion tons. (WHO,2021)

Waste can be categorized based on material, such as plastic, paper, glass, metal, and organic waste. Additionally, wastes that are radioactive, combustible, infectious, poisonous, or non-toxic may be divided into categories based on their potential for danger. The origin of the waste may also fall into other categories, including industrial, domestic, commercial, institutional, and building and demolition. (Rick LeBlanc,2020)

One of the most significant issues that many cities throughout the world suffer is solid waste management. The problem is particularly due to urbanization, industrialization, poor urban planning and lack of adequate resources which contribute to the massive generation of solid waste. In the poorest countries, this issue has caused significant environmental, social, and economic problems.

Waste is produced by human activity, and how it is handled, stored, collected, and disposed of can have an impact on the environment and public health. Municipal Solid Waste Management (MSWM) problems and issues, particularly in the rapidly growing urban cities of the developing countries, seem to be of fundamental importance. (Chris Zurbrugg, 2002)

2.1.1 Classification of Waste

Tons of solid waste are disposed of every day at various final disposal site locations. This waste is generated by numerous agricultural-related activities as well as waste from residences, businesses, and enterprises. If waste is not adequately processed and stored, these disposal sites emit unpleasant odors. It has the potential to seriously harm the health of people, animals, and the environment while also affecting the air around us.

These are the major components of solid waste:

(1) Residential - The majority of solid waste comes from residences and households where people live.

(2) Industrial - The Industrial waste comes from manufacturing, building, fabrication, canning, power and chemical facilities etc.

(3) Commercial - The commercial waste comes from commercial buildings and facilities such as hotels, markets, restaurants, stores etc.

(4) Institutional - The institutional like schools, university, other government organization also produce solid waste.

(5) Construction - Road construction, building renovation, building and Demolition destruction, and new building construction are all examples of construction sites and these sites also involve to the solid waste issues.

(6) Municipal Waste - Street sweeping, waste from parks and playgrounds, wastewater treatment plants, gardening wastes, and waste from outdoor spaces, including sludge, are produced by public utilities.

(7) Agriculture - Agriculture Farms are also produce cultivated waste, decayed food, pesticide bottles and other hazardous materials.

(8) Healthcare - Hospitals/Clinic produce different types of solid waste such as needles, strappings, hand gloves, medicines, paper or plastics, food wastes and chemicals.

2.1.2 Key Components of Solid Waste Management

Solid waste Management are basically related to the collection, transportation, transfer station, and transport of solid waste disposed at the final disposal site that is environmentally friendly and adheres to the principles of economy, aesthetics, energy efficiency, and conservation. It can be divided into five key components such as Generation, Storage, Collection, Transportation and Disposing.

(a) Waste Generation

Waste generation is an environmental problem of a global dimension. Countries and cities generate different amounts of solid trash at various rates due to different factors such as geographical location, seasonal variation, recycling, economics condition of the people, characteristics of services, frequency of collection, public

attitude and legislation.

(b) Storage

Storage is a method for storing objects after they have been thrown away before reached to collection point and final disposed. On site storage is primary important because of public health concerns and aesthetic considerations. Improved storage facilities include (1) different sized of dust bin (2) plastic bins (3) communal bins (4) container location and (5) public health and aesthetic. Handling at the source includes processes like composting garden waste and waste compaction is used to (1) reduce the volume (2) recover usable materials or (3) alter the physical form of solid waste.

(c) Collection

Waste management includes the process of waste collecting. It involves shifting solid waste from source of generation and disposal to a facility for treatment or disposal in a final disposal site.

(d) Transportation

There is various type of transportation method based on the categories of waste type. It will also depend on local availability and the volume of waste to be transported to final disposal site. In generally, the following methods are most common used in transportation system;

(1) Man Power System – open hand- cart, hand- cart with bins, wheelbarrow, tricycle
(2) Motorized System – tractor, compactor, tipper-truck

(e) Final Disposing or Waste Treatment

Disposal is the essential component of solid waste management. Collected waste can use as resource recovery, recycling, reuse or treated or reduce before reach to final disposal and if there is no option to find out the ways that finally will dispose into landfill. There are four main methods to dispose of solid waste;

(1) Sanitary Landfill
(2) Composting
(3) Incineration
(4) Recycling (Resource Recovery)

2.2 Waste Treatment Options

The following technology options are recommended based on the assessment assuming no change to the current collection system and methods of collection:

2.2.1 Sanitary (engineered) Landfill Method

The disposal of MSW not subject to any alternative treatment (because of capacity limitations of treatment facilities) and to cater for residual waste from other treatment facilities. Regardless of how much waste is treated by alternative technologies there is always a requirement for a safe method of disposal. This requirement is satisfied by the development of a new sanitary landfill, engineered to international standards. Key engineering measures include basal and top containment systems (engineered liner), a leachate collection and transfer system, a leachate treatment plant, landfill gas collection and extraction system, landfill gas utilization system, and surface water drainage measures, allied with specified standard operational procedures.

2.2.2 Composting Method

The organic component of the mixed MSW waste stream is a mixture of food/kitchen waste and green waste (grass, vegetation and wood) from yards and gardens. The grade of the input and the quality of final output are crucial elements in assessing whether composting is appropriate. Composting requires a clean feedstock, in which contaminants such as plastic, metals, glass, etc., are reduced to an absolute minimum since these are not removed by processing and thus appear in the final product, affecting severely the uses to which the product can be applied, and its salability. Accordingly, the organic component of mixed MSW is not considered suitable for the production of compost since it is extremely difficult to manufacture a high-quality compost free of contaminants from mixed MSW.

2.2.3 Thermal Treatment via Incineration with Energy Recovery

The derived calorific value of the mixed MSW is at the low end of material considered suitable for incineration without the use of supplementary fuel; however, the calorific value may be improved by pre-treatment of the waste stream to remove moisture and/or by separating higher calorific components (such as plastic or paper,

textiles, wood and leather and rubber) from low calorific waste components. The removal of inert materials, particularly glass and metals which are suitable for recovery for recycling, and other non-combustible waste would improve the calorific value and may provide a residual Refuse Derived Fuel (RDF) suitable for incineration.

2.2.4 Recycling and Recovery Facility

Despite the diversion of materials at source from entering the waste stream (recovery by informal waste pickers and waste collectors for recycling), a significant presence of recyclable materials from most sources of MSW, with commercial and institutional sources, as well as industrial sources, having the highest recyclable component.

2.2.5 Rehabilitations

This may be described as a method of excavating rubbish from an existing dumpsite and either reusing it or disposing of it in an environmentally acceptable way. It can be decreased the volume of MSW at final disposal site.

2.3 Integrated Solid Waste Management System

A strategy idea for the long-term management of solid wastes is integrated solid waste management that covers all sources and all elements, including generation, segregation, transfer, sorting, treatment, recovery, and disposal. The functional aspects of each of these ISWM components are briefly discussed below;

(1) **Source Reduction** also known as waste prevention, aims at reducing unnecessary waste generation.

(2) **Recycling and composting** are fundamental to the entire ISWM process. Recycling involves collecting, sorting, and recovering materials that are recyclable and reusable as well as reprocessing recyclables to create new goods. The buildup of organic waste and its transformation into soil amendments is known as composting, which is a part of organics recycling.

(3) **Waste transportation** refers to the removal of waste from municipal and commercial locations as well as collection points, where waste may be collected and reloaded onto other compactor garbage truck for disposing waste to the final disposal site.

(4) **Waste Disposal** requires to handle non-recyclable waste items include waste

disposal, including via final disposal site and incineration. Engineering Secured Landfills are the most popular method of managing these wastes, but they need to be carefully designed, built, and operated.

2.4 Environmental Impacts of Open Dumping System Used in Final Disposal Sites

Final Disposal Sites in Asian nations are comparable and defined by heaps of exposed waste that have been disposed of carelessly. Open burning, pools of dirty water, rat and fly infestations, domestic animals digging through the waste, and rag-picking by the scavenging population are all familiar sights.

Surface and groundwater sources are contaminated by the leachate produced by the breakdown of garbage, rendering them unsuitable for human consumption.

Air pollution from open burning, fire hazards and explosions cause public health risks as well as add to the emission of greenhouse gases (methane and carbon dioxide). Nuisance is caused by the wind's dispersal of waste and the scavenging of waste by birds, animals, and waste pickers.

Land development is prohibited due to waste degradation at the disposal area, which also affects the economic and social values of the surrounding area. Both animal and human scavengers are attracted to abandoned waste due to lack of proper management

Regarding the ultimate in the open dumping, the main detectable environmental impacts are:

- visual impacts,
- air pollution, odors and greenhouse gas (GHG) emissions,
- vectors of diseases,
- pollution of surface water and groundwater.

Improper handling can cause adverse health effects, for example by contamination of water, soil and air. Hazardous waste or hazardous waste disposal, such as open burning, can directly harm waste workers or others involved in waste incineration and neighboring communities. Vulnerable groups such as children are at high risk of adverse health effects. Improper waste collection leads to pollution of the environment and sea and can clog sewers. Flooding and other types of standing water lead to waste that promotes cholera and vector-borne diseases such as malaria and dengue. (WHO,2021)

2.4.1 Major Challenges of Open Dumping System

Health problems are associated with waste burning when people are directly exposed to the smoke. Children, the elderly, and those with sensitive respiratory systems are most affected. Short-term effects of smoking include rashes, headaches, and nausea. It may eventually make susceptible to getting heart disease. Possible contaminants in open ignition gas include dioxins, furans, arsenic, mercury, carbon monoxide, lead, toxic gases, sulfur dioxide, hydrochloric acid. Some of these toxins can also end up in the ash produced when waste is burned outdoors.

Another environmental issue due to organic waste open dump is the GWP due to waste anaerobic degradation. Methane is a by-product of municipal solid waste landfilling; Since MSW is mainly disposed of in open-air landfills, the generated methane is released directly into the atmosphere. Experimental studies indicate that the anaerobic biodegradation of MSW organic waste produces about 200 Nm3 of methane per ton of dry biomass. (Themelis N.J., Ulloa P.A).

Methane is one of the important gases that help enhance GWP, 25 times higher than CO2 (Boucher O., Friedlingstein P., Collins B., Shine K.P.). Therefore, open-air landfills and uncontrolled landfills are direct sources of greenhouse gas emissions.

The key problem is the absence of suitable waste management and sanitary landfills, as well as non-compliance with engineering frameworks, design, and regulations for landfill site selection. The issues also include open air burning, dumping and careless waste disposal in disposal area, all of these can have negative effects on the environment and human health. Unfortunately, in most developing cities, very few of the relevant criteria are used. The open dumping system can degrade natural resources, including soil and river pollution, deforestation, groundwater contamination, and total land degradation in the forest.

2.4.2 Phase Approach to Rehabilitation at Final Disposal Site

Developing countries suffer from limited available resources for upgrading or relocating open dumps. They also do not have sufficient resources and technical expertise to operate and maintain synthetic waste repositories. It may not be possible for these countries to soon reach the level of highly complex landfill design and construction practiced by developed countries. Improvements in disposal practices can therefore only be achieved through a stepwise approach from open landfills to controlled landfills until to sustainable landfills. (Rushbrook, 1999, 2001)

Remediation processes used at landfills can reduce the adverse environmental and human health impacts of poor municipal solid waste treatment practices at open landfills. The process of excavating waste from an existing dumpsite and either reusing it or disposing of it in an environmentally acceptable way may be referred to as this. To provide an acceptable gradient for the closed site, excavated waste may need to be transported or shifted to higher parts of the site or placed in the right locations.

The scope of a Final Disposal Site Rehabilitation will be determined by the combination of following goals;

1) Reduce final disposal site footprint and coverage
2) Recover disposal space for continued operation and prevent land scarcity problem
3) Final Disposal Site upgrading or installation of liner and relocation and emerging waste cell of the entire site

2.5 Reviews on Previous Studies

Saw Win Maung (2018) studied on current situation of municipal solid waste treatment in Yangon City. In this paper intended to explore the solid waste management and analyze the waste hierarchy and to examine the 3Rs (Reduce, Reuse, Recycle) awareness of solid waste management in Yangon City. According to the Yangon Municipal Waste Survey, 97% of waste is officially collected and only three are illegally discarded in Yangon. It is estimated by YCDC that 5% of the total waste of 2149.69 ton per day are recycled. There should be no major constraints in terms of political, economic, social, technical, legal and environmental factors that could affect the commercial green compost production as well as the plastic waste recycle products production. Finally, the waste hierarchy, 3Rs awareness for solid waste management in Yangon City should be incorporated into the school curriculum for primary and secondary school students to change their awareness and behavior.

Martin Edge (2018) studied on Rapid SWM Assessment and Analysis of Options in Yangon City. In the last few years, the UECCD have been exploring the possibility of developing waste to energy (WtE) projects with private sector support and financing. The imperative for this derives from large increases in waste generation, arising from rapid urbanization, population growth and socio-economic development. In addition to these considerations, the two main final disposal sites (FDS) are nearing their potential maximum capacity based on current methods adopted for waste disposal.

The main recommendation of the technical analysis is that integrated waste management (ISWM) facilities should be planned, designed, procured and implemented to meet immediate/short-term waste management needs.

Navarro Ferronato (2019) studied on Waste Mismanagement in Developing Countries: A Review of Global Issues through secondary data. In the finding, it described that environmental pollution due to improper management of solid waste is a global problem. Open landfills and incineration are the most commonly practiced waste treatment and disposal systems, mainly found in low-income countries. The main consequences of improper waste management in developing countries with a focus on environmental pollution and social issues. Informal sector activities in developing cities were also reviewed, focusing on the main health risks associated with waste management. The results showed that environmental impacts are widespread around the world. Marine litter, air, soil and water pollution, and the direct interaction between garbage collectors and hazardous waste are key issues. Many reviews of specific waste streams have been published in the scientific literature to quantify their environmental impact. This narrative literature review assessed global problems due to different proportions of waste and showed how different sources of pollution affect the environment, public health and sustainable development. Planning an Integrated Solid Waste Collection and Treatment System to Improve Global Sustainability.

Min Htut (2019) studied on medical waste management is an issue of increasing concern, as it is a major source of pollution and environmental pollution. The main point of tracking and disposal of infections wastes in hospital is concerned not only with the medical personnel but also with hospital administrators. The medical wastes generated from hospitals can be dangerous, poisonous and even deadly because they have great potential for transmission of the diseases and injury that can also result in environmental degradation. The purpose of this study was to determine the level of awareness of medical waste management systems and to analyze medical waste management practices in government hospitals. The present situation of health care providers on medical waste management in this study will help the hospital authorities to develop the standard operation procedures and guidelines for improving this situation in future, including plans for better training programed and monitoring of medical waste management system in the study hospital.

Minn Nay Han (2019) examined the attitude and ability of Yangon People and willingness to pay for waste management in Yangon Region. The survey revealed a

relatively low level of waste perception. It was discovered that awareness of waste separation and reduction is very low, with less than 30% of respondents being attentive. measuring respondents' profiles, being aware of their daily waste disposal behavior at home and on the street. I understand. Waste awareness and willingness to pay. Although YCDC's services are improving, the problem of improper waste disposal that harms people still remains. To improve the solid waste management status of Yangon City, it is important to strengthen effective awareness raising.

Etea T, Girma E & Mamo K (2021) studied on risk perceptions and experiences of residents living nearby municipal solid waste case studies in Ginchi Town, Ethiopia which has 4816 houses and a total population of 23,118 in central-western Ethiopia. One of the sources of pollution in the town is a lack of MSWMS. The key observation is there are no organized collection, transfer and disposal of the generated MSW in the town. Solid waste bins, or landfills are not available in survey area. Solid waste from homes, businesses and institutions is illegally dumped in open lands, riverbanks, drains and roadsides. Food waste, plastics, festivals, plastic bottles, clothing, shoes, cleaning supplies, dead animals, broken eyeglasses, used batteries, ash and hair are the main components of waste dumped into rivers. According to the survey results, respondents believed that open landfills could cause air, water and soil pollution. Also, living near vacant lots may be a risk factor for adverse health effects. In addition, he had health problems because he lived near a landfill. They were concerned about the direct and long-term effects of these health problems on themselves and their families, and the potential for future health problems as a result of continued illegal dumping. And they were disappointed and upset by the lack of solutions and the continued disposal of household waste. Respondents also stressed that landfills cause human disease, and respiratory-related health problems were frequently cited. Diseases such as the common cold, sinus infections, asthma, trachoma, allergies, malaria, tuberculosis, and cancer have been thought to originate from open dumps of MSW. Coughing; sneezing; other breathing problems; eye, nose, and throat irritation; burning and watery eyes; Choking; cracked mouth; runny nose; sleep disturbance;

CHAPTER III

SOLID WASTE MANAGEMENT IN YANGON CITY

3.1 Solid Waste Management in Myanmar

Myanmar has been facing a tremendous challenge with the management of waste in the recent past because of a growing population and economy, increasing complexity of waste streams, lack of effective waste management systems, absence of proper infrastructure, capital investments, financial and human resources, as well as effective policy and regulatory environment. Waste management is also a cross-cutting issue that touches all aspects of sustainable development, including environmental, social and economic, as well as public health, climate change, poverty, food security, resource efficiency, sustainable cities and consumption. and production. (NWMSMP, 2018)

In Myanmar, typically in charge of waste collection and disposal by cities. Waste management inside each jurisdiction's borders is the duty of the City Development Committees (CDCs) in Yangon, Mandalay, and Nay Pyi Taw, along with their respective administrative divisions and sub-units. The management of garbage collection and disposal is the responsibility of the respective Township Development Committees (TDCs) in 285 townships and other regions of the country. Cities in Myanmar have generally relied on both manual labor and non-specialized vehicles. Similar to this, recycling activities are carried out by the informal sector, which includes scavengers, waste collectors, and waste traders, in several cities in Myanmar.

Currently, there exists no accurate and reliable data on the total waste generation in the country. According to the World Bank's report in 2019, solid waste generation in Myanmar was 0.56 kg/capita/day, totaling 28.850tons/day and 10.5/ Million/tons/year (World Bank, 2019). Solid waste was expected to reach about 21,012 tons/day with 0.85 kg/capita/day by 2025. (Hoornweg, D. & Bhada-Tata, P, 2012)

In rural areas, there is no officially appointed government body responsible for waste collection. Consequently, households typically deposit waste at informal dump sites, and some regularly burn their wastes. Community based waste management involves volunteers collecting waste from public spaces, including monasteries, schools and urban streets, using small trucks which are not exclusively used for transporting the collected waste to unorganized landfills. (NWMSMP, 2018)

3.1.1 Legislative Framework and Institutional Policies in Myanmar

The following concerned policies both at national and local levels are being examined with the aim to grasp the present legal measures being taken for municipal waste management activities.

The following policies and strategies developed specifically for waste management are relatively advanced and some are still in development. It may be noted that many of these legislations have been drafted in close collaboration and with support from bilateral donors and multilateral organizations. Regulations and strategies for waste management have mostly been developed at national level. The exception refers to the situation in Mandalay and Yangon where the respective City Development Committees has developed waste management strategies.

Table (3.1) List of Concerned Legislations in Myanmar

Category	National Level	Local / Municipal level
Law/By-law	The Environmental Conservation Law (2012) Environmental Conservation Rules (2014)	The Yangon City Development Law (2013) Yangon City Development Law (2018) The Yangon City Bylaw (under amendment as of February 2020)
Plan/Policy	National Waste Management Strategy and Master Plan for Myanmar (2018-2030) (2019) Myanmar Sustainable Develop - ment Plan (MSDP) (2018-2030) Myanmar Climate Change strategy and action plan (MCC SAP) (2017 – 2030) Master Plan for Hazardous Waste Management in Myanmar (2020)	The Strategic Urban Development Plan of the Greater Yangon (SUDP) (2013) The Updated Strategic Urban Development Plan of the Greater Yangon (SUDP2) (2018)
Guidelines/ Procedures	National Environmental Quality (Emission) Guideline (2015) National Environmental Policy (2018) Procedures on Transboundary Movement of Hazardous Waste and Other Wastes:	
Others		Yangon Pollution Control and Cleansing Rules (1999) City Environmental Conservation Procedures (2001)

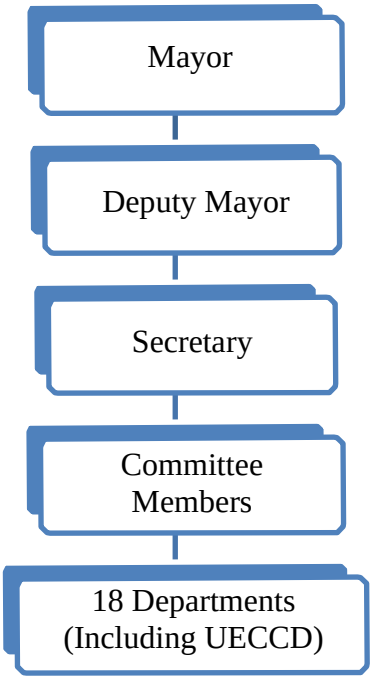
Source: Yangon City Development Committee, 2019

3.2 Overview of Yangon City Development Committee

Yangon City Development Committee (YCDC) has administrated Yangon City since enactment of Yangon City Development Act in 1985. This Act gave YCDC a ministerial status as well as a wide range of duties and responsibilities, including urban planning, urban sanitation and environment in Yangon City. (YCDC,2016)

Yangon City Development Committee (YCDC) is principal agency responsible for planning, development, infrastructure provision and operation of municipal services in Yangon City. YCDC has the duties and responsibilities to lay down the policy, give guidance, supervise or implement for the development works of the City of Yangon. YCDC is formed with eighteen departments and one committee office to fulfill its duties and responsibilities.

Figure (3.1) Organization Structure of YCDC



Source: Yangon City Development Committee, 2021

3.2.1 Duties and Responsibilities of YCDC

The Committee shall, in respect of the following duties and responsibilities, lay down the policy, give guidance, supervise or implement; (YCDC,2016)

(a) preparation of civil engineering projects and establishment of new towns within Yangon Municipality;

(b) management of land within the boundaries of Yangon City;

(c) Determine only the population legally residing in Yangon City.
(d) Construction, repair or demolition of buildings; Squatter Ville and Squatter District.
(e) Demolition and resettlement of squatter huts, squatter buildings and squatter quarters;
(f) Construction and maintenance of roads and bridges;
(g) Establish conditions for passage and parking of vehicles and slow-moving vehicles;
(h) Construction and maintenance of gardens, parks, playgrounds and recreation centers;
(i) Carrying out street lighting works;
(j) Performing water supply works;
(k) Construction and maintenance of reservoirs and pipelines;
(l) Implementing remedial work;
(m) Conducting public health services;
(n) Construction, maintenance and management of markets;
(o) Establish the terms of the porch stall.
(p) Implementing fire prevention measures;

3.2.2 Organization Structure of Urban Environmental Conservation and Cleansing Department-Yangon City Development Committee

Urban Environmental Conservation and Cleansing Department (UECCD), Yangon City Development Committee (YCDC) is one of the departments of YCDC, that is responsible for waste management of Yangon City. They are the main entities having technical experience and knowledge on Waste Collection Management, Waste Transportation Management, Disposal Site Management, and Environmental Management, Pollution Control including land, water and air. (YCDC-UECCD, 2016) UECCD-YCDC has many duties and responsibilities, which are as follows:

(a) Sweep, collect and transport the waste from roads and streets in the townships that have to pay tax for waste collection from the boundary area of YCDC.
(b) Plan and manage suitable waste collection systems for disposing waste in the taxed township and wards.
(c) Designate disposal places, construct brick tanks and keep waste bins in order to carry out the designated collection systems regularly.

(d) Guide to clean the waste in non-tax accuracy of government buildings, compound sand campus tax to discard the waste in designated places.
(e) Manage to dispose the collected waste at final disposal site.
(f) Open the advanced public toilets with charges.
(g) Designate and manage cemeteries for burial and cremation systematically.
(h) Supervise and monitor necessary preventive ways for water pollution, air pollution and soil pollution and noise pollution and, directive for essential additional conducts and take action with current Laws and Regulation in order to prevent environmental pollution.
(i) Submit to buy necessary equipment, garbage trucks and international standard dustbins, to maintain, use and record them systematically.
(j) Take action for irresponsible dumping according to laws, by-laws and directives.
(k) Give public information, campaign, awareness to discard waste systematically and to obey the system of discarding the waste separately such as dry waste and wet waste.
(l) Supervise the enterprises, which can make department's income.

3.3 Solid Waste Management in Yangon City

The generated quantity of solid waste collected is currently 2500 TPD. The household waste collection in Yangon City is generated from household and disposed to the near collection point such as dust bin (240L or 660L) and brick tanks or some places collected with bell ringing system. Then collected waste from dust bin, brick tank and pushcarts disposed to the Compactor garbage truck and finally the Compactor garbage truck directly disposed to the end point of Final Disposal Sites. The industry waste, construction waste, commercial waste and garden waste are collected with the On-Call System and the hospital waste collected by the hospital compactor truck and disposed to the Cemeteries. The waste collection system includes not only mixed waste and recyclables, but also the transportation of these materials to their respective disposal sites.

Collection as practiced by UECCD can be categorized into five types as follows (YCDC-UECCD,2017);

(a) Brick Tank System
(b) Bins System: discard at Euro Standard Size dust bins and also at brick tanks

which are kept in townships at set time

(c) Bell Ringing System: collect the waste with bell ringing truck and cart on the designated date and time after negotiation with ward supervisors.

(d) Door to Door to Collection System: (Designated waste throw time from public and collected time by department) shall follow with the collection time according to the discussion with local ward authorities and department also conduct the collection with designated carts/vehicles.

(e) Collection with three wheels tri-cycles for inner lanes and sub-urban areas.

Waste generated from hospitals are basically collected and disposed by UECCD. UECCD also collects the industrial wastes at the request of respective factories concerned and disposes of along with domestic wastes.

At present, transportation of solid waste is performed by UECCD. The subsequently transport of wastes, usually have long distances, to a processing of disposal sites and therefore, introduction of waste transfer system is required in Yangon City as a top priority, in order to transfer the waste to the designated final disposal sites and Model Waste to Energy Plant respectively.

Waste segregation is a very important task for waste producers willing to conduct legal due diligence and avoid potential fines.. According to YCDC law, there are eight kinds of waste are classified as of the followings (YCDC Law, 2018);

- Kitchen Waste: is defined as left-over organic matter from restaurants, hotels and households such as vegetable peelings, cheese rind, and scraps from people's plates.
- Garden Waste: is defined as unwanted organic material produced by gardening, such as grass cuttings and hedge clippings.
- Construction Waste: is defined as solid waste that is produced or generated throughout construction, remodeling, or repair of pavements, houses, commercial buildings and other structures.
- Industrial Waste: is defined as waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, industries, mills, and mining operations
- Healthcare Waste: is defined as waste generated by healthcare facilities like physician’s offices, hospitals, dental practices, laboratories, medical research facilities, and veterinary clinics.

- Hazardous Waste: is defined as any residue or combination of residues that may be a potential hazard to humans or the environment that may contain toxic substances.
- Offensive Waste: is defined as non-clinical waste that's non-infectious and does not contain pharmaceutical or chemical substances, but may be unpleasant to anyone who comes into contact with it.
- Normal Waste: is defined as the natural percentage of unavoidable wastage in a process or operation.

3.3.1 Waste Composition

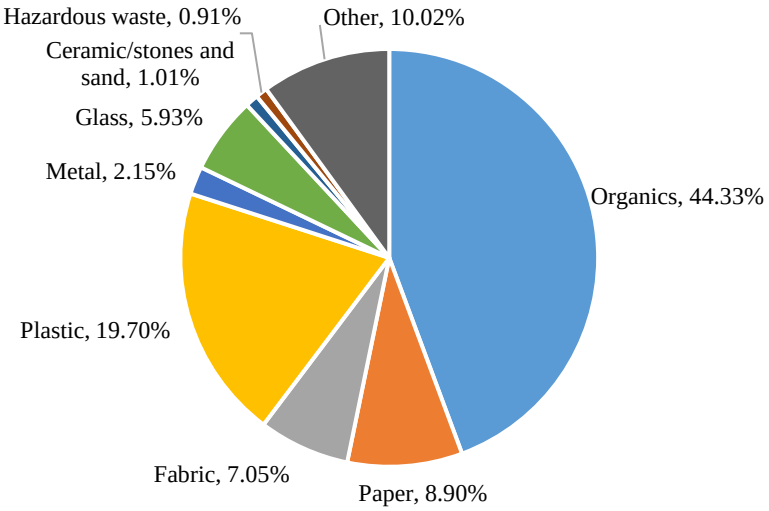
A Waste Assessment and Characterization Survey (WACS) was conducted in September 2017 on samples of MSW delivered to the FDS at Htein Bin and Htawe Chaung.

Table (3.2) List of Waste Composition Result (2017)

No.	Type of Waste	Compositions (%)
1.	Hazardous Waste	0.91
2.	Ceramic/stones and sand	1.01
3.	Glass	5.93
4.	Metal	2.15
5.	Plastics	19.70
6.	Fabric	7.05
7.	Paper	8.9
8.	Organic	44.33
9.	Others	10.02
	Total	**100**

Source: Martin. E, 2018

Figure (3.2) Overall Weighted Average Composition of MSW as Delivered to the Final Disposal Site (%)



Source: Martin. E, 2018

The 2017 WACS results indicate that kitchen/food waste is the primary component recorded for all sources of MSW (excluding industrial waste), ranging typically between 25% and 35% by weight. The lowest content of kitchen/food waste in MSW is recorded for commercial shops and institutional offices. The highest content of kitchen/food waste in MSW is recorded from commercial restaurants, followed closely by household waste (both middle and low income).

Grass and wood waste form a significant but subsidiary component in household waste (high and low income) and also in some samples of industrial waste. Hospital waste contains the lowest content of grass and wood waste. Waste from markets and public spaces contains the highest content of grass and wood.

Overall, the highest content of organic waste is found in waste from markets and public spaces, averaging approximately 65% by weight, whilst the lowest content of organic waste is recorded for commercial shops and institutional offices, averaging approximately 28% by weight.

Plastic waste is the second largest contributor to the waste stream. Plastic waste is recorded across all waste sources and generally exceeds 18%-20% by weight. The highest percentage of plastic waste is found in commercial waste (shops) and institutional waste (office), at around 30% by weight on average. Market and public space waste contains the least plastic waste at around 16.5% by weight on average.

3.3.2 Waste Generation Rate

UECCD-YCDC have provided the results of waste generation surveys conducted on two occasions, in 2012 and in 2016. Survey results are summarized on Table (3.3). There are significant differences in the results of the two surveys.

Table (3.3) List of Reported Waste Generation Rates

District	2012 Survey kg/pcd[1]	Sample Size (% of population)	2016 Survey kg/pcd	Sample Size (% of population)	Min. kg/pcd[2] (2016)	Max. kg/pcd[2] (2016)
East	0.53	4.45	0.41	7.52	0.40	0.44
West	1.13	3.20	0.40	30.45	0.28	0.49
South	0.62	3.36	0.41	14.29	0.39	0.43
North	0.94	4.44	0.39	4.99	0.31	0.44
Average	**0.81**	**4.00**	**0.40**	**9.96**	**0.34**	**0.45**

Source: UECCD, 2017

There are no details available of the methodology adopted for the 2012 survey; it is not known, for example, whether the data relate to all sources of MSW or only to household waste and at what point in the system the generation rate was determined (for example, at source, point of collection or point of disposal).

The 2016 waste generation survey was restricted to households only and, therefore, excludes an assessment of the contribution of other sources of MSW, including solid waste from commercial enterprises, institutional sources, waste from markets and public spaces and waste generated by the floating population.

3.3.3 Waste Segregation

Separation at source would necessitate a change in the way in which MSW is collected currently, since there would be a requirement to collect different waste streams separately (for example, by 2 bins, 3 bins, 4 bins or more system). UECCD-YCDC had been initiated to segregate the two types of waste called wet and dry waste since 2012.

Generally, solid waste is segregated publicly into two: wet and dry. Wet waste such as kitchen waste, left-over, flowers can be discarded safely tight with green bags daily. Dry waste such as paper, cork, plastic, broken toys, pieces of metal, pieces of wire can be discarded safely tight with blue bags. But they are loaded on the same vehicle for transportation to the sanitary landfills. Due to the weakness of awareness

raising practice on waste segregation, the citizen disposed the mixed waste to the designated places until today.

3.3.4 Waste Collection and Transportation

(1) Collection Rate

In Yangon, 90% of the waste are formally collected and only 10% of them are illegally disposed. Waste collection rate based on serviced population of each zone was calculated. Serviced population means a number of residential which is provided waste collection service by UECCD.

(2) Collection and Transportation System

The 3 major systems are door-to-door collection, station collection and on-call collection. Based on increase of the citizen's needs on door-to-door system, UECCD has been expanding service area of door-to-door system.

For door-to-door collection system, citizen discards designated day and time in front of their own houses or buildings and UECCD collect them. Once the collection vehicle is filled up, waste is unloaded to waste bin or container placed roadside. Unloaded waste at wastes bin and containers are collected by secondary transportation vehicle such as compactors or arm roll trucks and are transported to the final disposal sites.

In case handcarts are used, collected waste is transported to waste bin. In case hopper trucks or tricycles are used, collected waste is transported to containers. In case of the bell ringing system, UECCD goes to each house or building at designated timing and citizen discard waste directly to waste collection vehicle. When UECCD collect waste, UECCD informs citizen about collection vehicle coming by ringing bell and citizen comes out to discard waste.

(3) Collection Vehicles

UECCD owns approximately 500 vehicles in total. The 2 major vehicles are 14 m^3 compactor which can load waste from dust bin mechanically and $1m^3$ hopper truck which is mainly used for door-to-door collection. Motor Vehicle Management and Maintenance Department provides vehicles to Townships in cases vehicles are under maintenance/repair work and Townships does not have enough vehicles.

3.3.5 Amount of Cleaning and Collection Service Fee Paid

UECCD charges as property tax for collection as below;

Table (3.4) List of Waste Collection Fee for Households

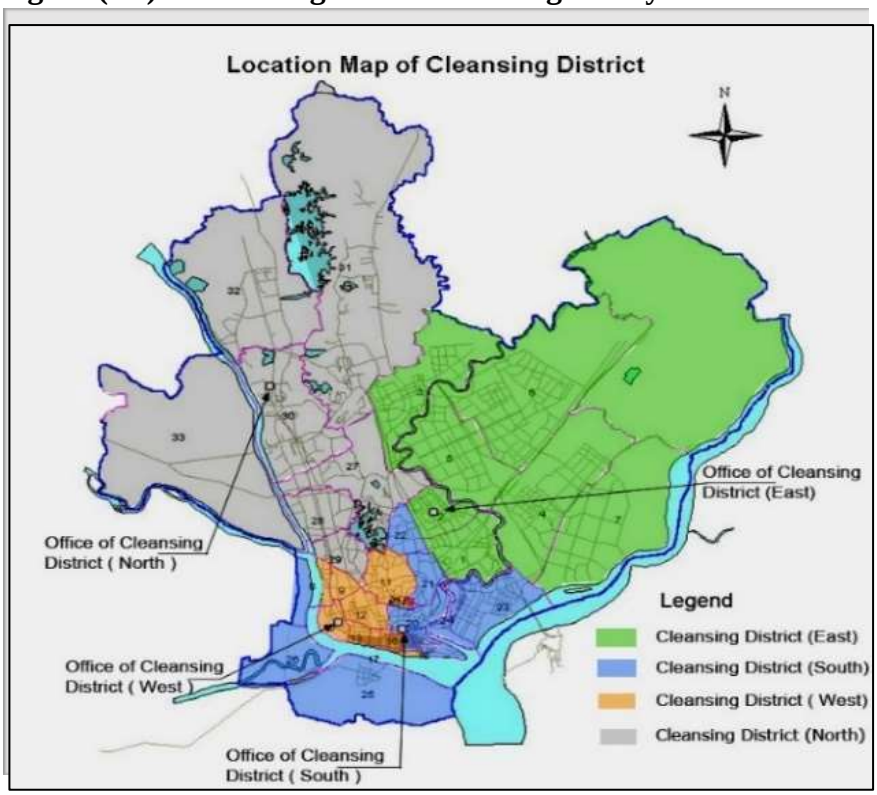
Area	Fee (Kyat/month)
CBD	600
Suburban	450
Satellite	300

Source: UECCD, 2014

3.3.6 Served Area and Served Population

For the administration of the SWM services, UECCD has subdivided the City into four Districts, as shown on Figure 5. The whole of the East and West Districts lie north of the main tributaries of the Yangon River draining through Yangon. Part of the North District and the South District is split by the Hlaing River, with the townships of Hlaing Thar Yar (North District) and Kyee Myint Daing, Dala and Seikkyi Kanaungto (South District) lying west and south respectively of the Hlaing river.

Figure (3.3) Cleansing Districts of Yangon City



Source: UECCD, 2015

As of 2014, the recorded resident population in Yangon City was 5.211 million, whilst the (Greater) Yangon Region had a recorded population of 7.4 million.

The Strategic Urban Development Plan (SUDP) (JICA, 2016) assumed an average population growth rate for the whole city of 2.6% per annum for the foreseeable future (to 2040 and beyond). On this basis, the current population of Yangon City is anticipated to have grown to approximately 5.63 million by the end of 2017.

SWM services provided by UECCD do not cover all of the population within the city. Whilst the actual physical service area may be equivalent to the boundaries of the city, it is understood that SWM services are provided only in areas within the city in which residents are charged for, and pay for, such services.

3.4 Final Disposal Sites in Yangon City

Under the authority of UECCD-YCDC, there are total four FDSs that have been currently operating to receive the waste generated from the 33 townships of Yangon City.

- Htein Bin FDS: Major FDS
- Htawei Chaung FDS: Major FDS
- Dala FDS: Small-scale FDS
- Seikkyi Kanaungto FDS: Small-scale FDS

Table (3.5) Data of Current Final Disposal Site in Yangon City

No.	Name of FDS	Constructed Year	Site (Plant) Area	Remaining Area (Acre)	Dispose Ton Per Day (Current)	Life Span (year)	Remark
1	Htein Bin	2002	290 - Acre Used- 220 Ac	70	1500	5	Open Dumping
2	Htwei Chaung	2001	141- Acre Used- 110 Ac	31	1000	3	Open Dumping
3	Dala	2003	1.3 - Acre Used- 1.0 Ac	0.3	50	1	Low Landfill Temporary Site
4	Seikkyi Khaungto	2003	0.25 - Acre Used - 0.1Ac	0.15	8	2	Low Landfill Temporary Site

Source: YCDC-UECCD, 2022

In current situation, none of the FDS have any form of engineering measures or

controls to manage such as the infiltration of water into the waste and the consequent production of leachate(contaminated, potentially toxic, water),emissions of leachate from the waste mass to surface water and groundwater, the degree of compaction of the waste once placed, the production of landfill gas and emissions of landfill gas (which contain greenhouse gases) to the surrounding land and air, potentially in hazardous concentrations, leaching of pollutants to the underlying soil, including heavy metals, emissions of airborne pollutants, including particulate matter and access to the site by waste pickers, including young children, and foraging animals.

It is found that small fires at the larger FDS are common, especially during the dry season, at which times smoke and toxic fumes can impact surrounding areas. The FDS are located adjacent to residential areas, to surface water bodies and to shallow groundwater and are a significant source of pollution of the surrounding environment. The pollutant load from these sites, and the associated adverse environmental impacts, will become much more significant and have a greater impact with continuing uncontrolled disposal of MSW.

3.4.1 Htein Bin Final Disposal Site

Htein Bin FDS is the largest FDS in Yangon city which is located at Hlaing Thar Yar township. Due to the highest temperatures in the dry season, high emission of methane gases from the massive piling up of the waste, there was a noticeable fire broke out in Htein Bin FDS which began on 21st April 2018 by spreading rapidly more than half of the land area. The below table indicates the information concerning the fire incident in Htein Bin FDS.

Table (3.6) List of Information of Fire Incident in Htein Bin FDS

Final Disposal Site	Htein Bin FDS
Total land Area	290 Acres (120 Ha)
Receiving Waste Volume	1200 - 1500 tons/day
Fire Occurred Date	21st April 2018
Burnt Area	120 Acres (50 Ha)
Completed Date for Fire Extinguishing	3rd May 2018
Causes to Fire Incident	Chemical reaction from biological decomposition Heat resulting in hot temperatures Potential occurrence of fire from deep side of the massive waste dumping

Source: UECCD, 2018

According to the observation of UECCD, the blaze was caused by the emission of methane produced by the decomposition of disposed waste. To complete the fire extinguishing, around 800 personnel from which the Myanmar Fire services Department, YCDC, and Yangon Military command were deployed for more than 3 weeks. The disastrous consequences of the fire incident, especially smoke which led to the deterioration in air quality happened in surrounding areas. The dozens of residents inclusive of elder people and children in the nearby community suffered the impacts, in which they were hospitalized as inpatients with respiratory problems.

3.4.2 Htawei Chaung FDS

Htawei Chaung FDS is the second largest FDS which is located at North Dagon Township with 30km distancing from central of Yangon City. The FDS has been operated with a Landfill system with land utilization of 110 Acres in a total land area of 141 Acres. Because of dangerous conditions due to high accumulated waste, rehabilitation activities that are being performed at Htein Bin FDS are required. Moreover, the following issues are being encountered in Htawei Chaung FDS currently. The remaining capacity for the dumping waste is limited.

The simple leachate treatment system using small tanks is being operated in Htawei Chaung FDS, it is not enough capacity to treat all of them. As a result, the leachate and wastewater are being discharged to the surrounding residential areas which also cause an unpleasant odor.

3.4.3 Dala FDS

Dala FDS is a small scale FDS which is situated in Dala Township, the southern bank of Yangon River across from downtown, aiming to manage the waste generated from Dala Township. The Dala FDS is a sort of low landfill that has been operated as a temporary site to undertake the waste generated from the township. In the beginning of the site operation, there was the proper excavation until the specific depth under the ground level, however, the waste level is higher than the current main road in front of the Dala FDS due to the increasing waste generation. Despite the disposal site was initially established on the outskirts of city territory, it became within the residential areas with the development of settlements at present. Thus, the nearby residents are willing the existing final disposal to be shifted to the outmost area.

In addition, the Dala FDS undergoes numerous issues such as the insufficient assignment of staffs, the lack of fencing alongside the site which leads to the waste scattering and informal waste picking activities. Currently, the rearrangement of waste and some activities that was learned from rehabilitation projects in Htein Bin FDS have been implemented to upgrade the limitation of a lifetime which is expected to be utilized for more than 3 years.

However, the removal of the existing Dala FDS had been suggested by the Yangon Region Government due to the urban development and the implementations of the Korean-Myanmar Friendship project titling “Dala- Yangon Bridge”. Therefore, UECCD attempts to allocate the new FDS in Dala Township which is owned by YCDC as well as plan for the construction of the required access road, drainage, and others.

3.4.4 Seikkyi Khanaungto FDS

Seikkyi Khanaungto FDS is the smallest FDS with 0.1 Acres of land utilization which is situated on the southern bank of Yangon River as similar to Dala FDS. Due to the poor transportation, the development of Seikkyi Khanaungto Township is left behind compared to the other 32 townships in Yangon City. The waste disposing system in Seikkyi Khanaungto FDS is the simplest, dumping onto the ground unless special management of waste. Since 2003, the disposal site has been operated beside the township cemetery yard and there is no proper fence for the site boundary which is regarded by marking some points.

According to the New Yangon City project which is an urban planning project proposed by the Yangon Region Government, the new bridge will be developed

passing through the existing FDS to connect the Dala Township and Seikkyi Kanaungto Township. Given the condition, it is urgently in need to develop the new candidate FDS in Seikkyi Kanaungto Township to manage the waste generated from the township as well as to consider the appropriate landfill system or the small-scale incineration plant.

3.4.5 Current Treatment Options (Yangon Waste to Energy Plant)

A small WtE plant, of capacity 60 tonnes per day (tpd) has been constructed in Hlawgar, Yangon and has been operational since April 2017. The plant was designed by JFE Engineering on the basis of waste analysis conducted on Yangon's MSW from the area served by the plant (northern townships in Yangon, principally Insein, Shwepyithar, North Okkalapa and Mingalardon).

Yangon Waste to Energy Plant (YWTEP) currently receives mixed MSW mainly from markets and residential areas, which is sorted by hand. The plant receives 75 tpd of mixed MSW, of which 10-15 tpd is rejected as not suitable for incineration. After sorting the waste is fed into the plant without size reduction.

The plant has been designed on a minimum net calorific value of 6.0 MJ/kg. However, during the rainy season the MSW received at the plant has a net calorific value lower than this. In order to improve the quality of the feedstock attempts are being made to target non-hazardous industrial waste of higher calorific value, principally paper and plastic.

Ash from the treatment process is around 10% of the input tonnage. Bottom ash is dumped on the ground, whilst fly ash is bagged. For cooling of the ash, there is a requirement for approximately 3.8 (tpd) of water.

Control of the plant is undertaken by four teams of seven people operating in two 12-hour shifts, working on a rotation of two days on and two days off. In all, the plant employs 102 people, of which 90 are from YCDC and 12 from JFE. YCDC supply all of the staff required for sorting of the waste. Shutdown of the plant is scheduled for three times a year, with a major shutdown lasting for 40 days, and minor shutdowns of between 10-15 days.

No major problems have been encountered in the first period of operation, other than issues associated with feeding into an unstable grid. Blackouts on the grid preclude the export of electricity from the plant and thus have an impact on plant operations.

Investment in the plant amounted to USD 16 million, half of which was financed by YCDC and the other half by Japan. Electricity production capacity is 750 kW/hour, of which 300-350 kW is consumed by the plant and the balance is available for feeding into the grid. Anticipated operational costs for the first year are of the order of USD 1.5 million.

Based on both the investment cost and the operational cost, the plant is considered to be very expensive and not financially viable without direct subsidies or the imposition of a gate fee. Operation and maintenance of the plant also requires the continued input and expertise of expatriate staff for the foreseeable future. (YCDC-UECCD,2017)

3.5 Air Quality Index at Htein Bin Final Disposal Site

Air pollution is a major threat to human health and environment, especially pollution from uncontrolled disposal sites creates acute health problems to the surroundings habitants. The continue inhalation of particulate matters consists of dust, fumes, mist and smoke cause lung damage and respiratory problems.

Regarding with air quality monitoring in Yangon City, YCDC was tried to measure the particulate matters in the air and Carbon dioxide emitted by automobiles, Gases such as sulfur dioxide and nitrogen peroxide from manufacturing industry have been monitored and measured since 2015.

In the middle of 2015, YCDC purchased three number of air quality monitoring devices and two devices are placed to measure at City Hall and Hledan Junction Point. One device is used for mobile monitoring in cemeteries, Industrial Zones and Final Disposal Sites. (YCDC-UECCD, 2016)

Before and after of fire incident at Htein Bin Final Disposal Site, YCDC measured air quality index with two time per each year. The parameters were assessed including CO2, CO, CH4, NO2, SO2, PM2.5 and PM10. During the COVID 19 situation, there is no continuous measurement and the calibration indications of the device are no longer correct.

CHAPTER IV
SURVEY ANALYSIS

4.1 Survey Profile

This survey was conducted in local residents' who lived near Htein Bin Final Disposal Site, Hlaing Thar Yar Township, Yangon. Htein Bin Final Disposal Site is the largest FDS in Yangon City. Due to the large amount of waste being dumped, there is currently not well management the waste. Since the open dumping system is still being used, the employees who work at the site as well as the people in the surrounding area are suffering from negative environmental, social and health effects. In Hlaing Thar Yar Township consists of 20 wards. Among them, selected area of the survey is (70) Household from Kalargyi Su Village and (30) Household from family members who lived in staff housing at Htein Bin Final Disposal Site, Hlaing Thar Yar Township, Yangon which is currently effected the impact of final disposal sites.

4.2 Survey Design

A survey was carried out mainly in Kalargyi Su Village and Staff housing at Htein Bin Final Disposal Site, Hlaing Thar Yar Township, Yangon. The survey size is 100 households. 30 Respondents from staff and their family members currently lived in Staff Housing at Htein Bin Final Disposal Site and 70 respondents are local residents who lived in Kalargyi Su Village. The survey period is within July, 2022 to August, 2022. This study mainly used a descriptive method using self-administrator structured questionnaires.

The survey questionnaire had multiple choice questions yes or no and also used five point ‘Likert Scale’ (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly agree) for perception of local residents. Collected data were tabulated, analyzed and interpreted in the light of objective of the study by applying descriptive statistics.

This questionnaire consists of six parts. The first part is the characteristics of respondents and the second part on their knowledge on solid waste management. The third part is their environmental impact for living near in final disposal site area. The

fourth part is health conditions and social impacts of final disposal site. The fifth parts consist of their current practice and issues of waste management they faced. Finally, the sixth parts, write suggestions to improve waste management.

4.3 Analysis on Survey Results

The survey findings are presented below in four sections; (1) characteristics of respondents, (2) knowledge on solid waste management, (3) environmental impacts, (4) health conditions and social impacts for living near in final disposal site area (5) current practice and issues of waste management they faced and (6) any suggestions for improvement of waste management system in Yangon City.

4.3.1 Characteristics of Respondents

The first part of the questionnaire was design to collect characteristics of respondents such as gender, age, locations, educational background, household size and income Level shown in table (4.1).

Table (4.1), within the age group the highest number of respondents 39 respondents have between 41 years to 50 years. However, the majority of the respondents are between 31 to 50 years making up a total of 72 respondents of the total respondents. For gender, there 67 of total respondents are males and the remaining 33 respondents are female showing that male number is larger than female number. The education status of respondent shows the most of 52 respondents is the graduate.

The household size status of respondent shows that 3-4 People (51%) is heighted number although there is more nearly 3-7 People (total 87%) are stayed in the survey area. The most of 74 respondents have above 150,000 income level and the result show that there is no below 80,000 MMK income for each household.

Table (4.1) List of Characteristics of the Respondents

No.	Descriptions	Characteristics	Respondents	Percentage
1.	Gender	Male	67	67
		Female	33	33
		Total	**100**	**100**
2.	Age Distribution	20-30 years	16	16
		31-40 years	33	33
		41-50 years	39	39
		Older than 50 years	12	12
		Total	**100**	**100**
3.	Educational Background	Primary School	2	2
		Middle School	8	8
		High School	38	38
		Bachelor	52	52
		Other	-	-
		Total	**100**	**100**
4.	Household Size	1-2 People	13	13
		3-4 People	51	51
		5-7 People	36	36
		8-10 People	-	-
		More than 11 people	-	-
		Total	**100**	**100**
5.	Income Level	> below 80,000 MMK	-	-
		> below 150 ,000 MMK	26	26
		< above 150,000 MMK	74	74
		Total	**100**	**100**

Source: Survey Data, 2022 August

4.3.2 Knowledge on Solid Waste Management

The second part of this questionnaire was design to collect about the knowledge on solid waste management in Yangon City. It has two topics to ask question and mainly focused on (A) Knowledge about Waste and (B) Practice on Waste Management shown in table (4.2) and (4.3) respectively.

(A) Knowledge about Waste

In knowledge about waste, table (4.2) shows 99 respondents answered that such kinds of recyclable waste can sellable like as PET bottle, Paper, Cardboard, Glass or Metal. In current situation the respondents are selling those kinds of recyclable waste by doing this they can get some income for their families. Moreover, 97 respondents answered that if we cannot manage our household waste, it will be effect to our health and environment. Because the collection time is irregular, very far away to dust bin and if they are not catch up the waste compactor truck, they kept their old waste more than 3 days so that are impacted to their environment and health. 94 respondents answered that they are accepting to develop effective waste collection system in our society. Because they are actually faced the impact of inefficient waste management system such as not enough dust bin, manpower, not efficient Protective Personnel Equipment due to the COVID-19 situations and also that can challenge on their health problem as well.

Table (4.2) Knowledge about Waste

No.	Descriptions	YES	(%)	NO	(%)
1.	Do you know types of waste in Yangon City?	89	89	11	11
2.	Do you know Law and Regulations about Solid Waste Management in Yangon City?	29	29	71	71
3.	Do you know such kinds of recyclable waste can sellable like as PET bottle, Paper, Cardboard, Glass or Metal?	99	99	1	1
4.	Do you know wet waste as well as kitchen waste (peels of vegetable or food residues) can composting?	89	89	11	11
5.	Do you know if we cannot manage our household waste, it will be effect to our health and environment?	97	97	3	3
6.	Do you think to develop better waste collection system can efficient our society?	94	94	6	6

Source: Survey Data, 2022 August

89 respondents answered that wet waste as well as kitchen waste (peels of vegetable or food residues) can compost and know types of waste in Yangon City.

Because they are knowing wet waste can compost and after they making compost, they are using their urban firm and home gardening. That's why most of them are known the type of waste and sort the waste such as recyclable or wet waste. Only 29 respondents are knowing the SWM laws and the rest of 71 respondents answered that they didn't know about the law and regulations of Solid Waste Management in Yangon City. Although YCDC conducted awareness on solid waste management laws and distributed pamphlets within central business and sub-urban in the past 3 years ago but it is not effective and people are still careless on the law and regulation. YCDC should take action also some punishments including SWM laws and promote this awareness campaign on satellite townships area as well.

(B) Practice on Waste Management

Table (4.3), 98 respondents are paying Waste Collection Fee to YCDC and most of the respondents are making practice of waste disposing at designated place and separation of waste as well. Therefore, YCDC collected waste collection fee to survey area by quarterly using door to door system so that the respondents are paying waste collection fee regularly. 93 respondents are disposing their waste at the designated place. Although the distance of dust bin and household is quite far, they are regularly disposed waste to the dust bins.

Table (4.3) Practice on Waste Management

No.	Descriptions	YES	(%)	NO	(%)
1.	Do you dispose your waste at designated place by YCDC?	93	93	7	7
2.	Do you pay designated waste collection fee to YCDC?	98	98	2	2
3.	Do you frequently separate Wet/Dry Waste at household?	79	79	21	21
4.	If there is no dustbin near at household, do you dispose your waste either beneath of home or discharge to drainages or backyards?	87	87	13	13

Source: Survey Data, 2022 August

Moreover, 87 respondents answered that if there is no dustbin near at household, they will dispose waste either beneath of home or discharge to drainages or backyards.

Because they didn't know the impact of waste, they thought it is easy to dispose because of their habitual practice. Some respondents reported that sometime, they are faced difficulties to dispose their waste cause lack of dust bin, sometime dust bin placed was very far away from the place they lived. In general, the respondents are still weakness in using designated disposal bag for household waste with Wet Waste for Green Bag and Dry Waste for Blue Bag. 79 respondents answered that they are frequently separated Wet/Dry Waste at household. The respondents are usually sorted out the waste types and separated the waste which can be recyclable or home-made composting.

4.3.3 Environmental Impacts for Local Residents in Final Disposal Site Area

Environmental impacts for local residents in final disposal site area is shown in table (4.4).

In this question, 100 respondents have the knowledge of wind shifts brings an odorous smell to offend residents living close the disposal area. Currently they felt the air pollution around FDS area and some old ages are feeling related respiratory diseases cause of smell shifted from FDS to our households. 94 respondents are well known the fire incident occur in Htein Bin final disposal site in 2018. At this time, they faced many health problems such as lack of oxygen, feeling headaches, omitting due to the burning waste especially plastic residues and also immediately moved away from FDS. 88 respondents are known the cause of contamination in final disposal site that can be directly social impact to the people who lived near final disposal site but 9 respondents are do not have knowledge on that and 3 respondents are do not know. Because FDS area is still open dumping and most of the respondents known that the contamination is always occurred and quickly spreading out to atmosphere. It can also socially impact to our environment as well. 87 respondents are known the plants will not survive cause of open dumping system but 2 respondents are do not have knowledge on that and 11 are do not know. Because most of the respondents have not knowledge that the plants will not survive on FDS using open dumping system and if there is planting, it cannot be survive and ends with short life spans. Moreover, if planting the edible plants that will be side effect for our body health.

Table (4.4) Environmental Impacts for Local Residents in Final Disposal Site Area

No.	Descriptions	Yes	(%)	No	(%)	Don't Know	(%)
1.	There is harmful gas emitted from final disposal sites.	80	80	19	19	1	1
2.	Methane gas emitted from waste is one of the gases of GHGs that can cause global warming.	83	83	2	2	15	15
3.	Wind shifts brings an odorous smell to offend residents living close the disposal area.	100	100	-	-	-	-
4.	Fire incident occur in Htein Bin final disposal site in 2018.	94	94	6	6	-	-
5.	The plants will not survive cause of open dumping system.	87	87	2	2	11	11
6.	It can be directly social impact to the people who lived near final disposal site cause of contamination in final disposal site.	88	88	9	9	3	3

Source: Survey Data, 2022 August

83 respondents are known methane gas emitted from waste is one of the gases of GHGs that can cause global warming but 2 respondents are do not have knowledge on that and 15 respondents are do not know. Because most of the respondents are not educated and also, they have no knowledge on which gas emitted from FDS. 80 respondents are known there is harmful gas emitted from final disposal sites but 19 respondents are do not have knowledge on that and 1 percent are do not know. Because they know that FDS has no sorting of waste and some people can dispose combustible waste such as batteries, crude oils., pieces of cloth and plastics bag that can be explosive and although they did not know kinds of harmful gas but they know that burning of plastic waste and breathing in of those gas to our body can impacted to our environment and health.

4.3.4 Health Conditions, Social Impacts for Local Residents in Final Disposal Site Area

The survey results from analysis on health conditions, social impacts for living near in final disposal site area were examined and their mean value is shown in Table (4.5).

Table (4.5) Health Conditions, Social Impacts for Local Residents in Final Disposal Site Area

No.	Descriptions	Mean
1.	Pests, insects, rat and flies from the near final disposal site can more contaminate in your area.	4.43
2.	Air quality can pollute around final disposal site area.	4.44
3.	We had ever seen polluted water in our areas we lived.	3.64
4.	We had occurred diarrhea disease cause of water pollution around our areas frequently.	3.37
5.	People living closer to landfill sites suffer bad health conditions and impacts.	4.13
	Total Mean Value	**4.0**

Source: Survey Data, 2022 August

Table (4.5) presents the analysis on Health conditions, social impacts for living near in final disposal site area. The maximum mean value of 4.44 indicates respondents strongly agreed that the air quality can pollute around final disposal site area. The reason is that they are now currently faced the impacted of FDS and they faced health problem especially respiratory diseases and asthma. The mean value of 4.43 indicates respondents strongly agreed that the pests, insects, rat and flies from the near final disposal site can more contaminate in household area and 4.13 indicates respondents agreed that people living closer to landfill sites suffer bad health conditions and impacts. Moreover 3.64 indicates respondents agreed that respondents ever seen polluted water in our areas we lived and the mean value of 3.37 indicates respondents occurred diarrhea disease cause of water pollution around our areas frequently. The reason is that flies, pests and insects from FDS are contaminated very quickly then come to their home and break on the drinking water and foods. People are eating those food and then felt on diarrhea and other intestinal disease.

Calculated the overall mean value analysis on health conditions, social impacts

for living near in final disposal site area mean value is 4. All of the respondents normally known open dumping of final disposal site that bring hazards such as odor, smoke, noise, bugs, and water supply contamination. The reason is that waste is not properly managed, especially solid waste from households and the community, are a serious health hazard and lead to the spread of infectious diseases. UECCD-YCDC should promote proper segregation and minimization waste, educating, implement the sustainable waste management in final disposal sites.

4.3.5 Current Practice and Issues of Waste Management

The survey results from analysis on Current practice and issues of waste management were examined and their mean value is shown in Table (4.6).

Table (4.6) shows the mean score of respondents' choice current practice and issue of waste management in Yangon City. Respondents' choice decision that authorities should develop and improve final disposal site by using advanced technologies is 4.6 mean score which means that they know the impact of opening dumping system and should apply some proper technology in order to prevent fire incident and reduce the volume of waste at the final disposal site.

Respondents' choice decision related to conduct awareness training at community level is 4.58 mean score which means that people are not changing their behavior on regarding waste, most of the people who do not still know the basic principle of waste management and how's its impact to our environment and social environment.

Respondents' choice decision related to people didn't segregate waste at source is one of the problems of waste management and placing of dust bin or transfer station for dispose waste will need more than usual are 4.47 mean score which means that they know that it can be more contaminations occurred without segregation and spreading bad smell to environment. If do not sorting the waste at the source, the sellable material cannot get valuable amount. Moreover, if YCDC placing the dust bin at the respective area, they can be easier to dispose their waste from household.

Table (4.6) Current Practice and Issues of Waste Management

No.	Descriptions	Mean
1.	People didn't segregate waste at source is one of the problems of waste management.	4.47
2.	Placing of dust bin or transfer station for dispose waste will need more than usual.	4.47
3.	Waste collection times are not enough reflected by the ratio of city populations.	4.17
4.	Recyclable material should be sorted before reached to final disposal site.	4.31
5.	Plastic waste and polymer will appear as bad impacts.	4.22
6.	Fire incident might be occurred when using open dumping system.	4.17
7.	Formal waste pickers have in final disposal sites.	2.33
8.	We will need to conduct awareness training at community level regarding waste management.	4.58
9.	Open dumping system can harmful to our health and environment.	4.35
10.	Authorities should develop and improve final disposal site by using advanced technologies, Waste to Energy or Rehabilitation Process.	4.6
	Total Mean Value	**4.17**

Source: Survey Data, 2022 August

Respondents' choice decision that opens dumping system can harmful to our health and environment is 4.35 mean score which means that they lived near final disposal site, breath always in impure air quality and sometimes flies, pests and insects are coming to their household. Respondents' choice decision that recyclable material should be sorted before reached to final disposal site is 4.31 mean score which means that they can earn some incomes and sell those material to recycler shops and some informal recyclers located around in their wards.

Respondents' choice decision that plastic waste and polymer will appear as bad impacts is 4.22 mean score which means that they felt the bad smell of burning of plastics waste during the fire incident occurred in 2018. And they know that will be impacted to our health especially asthma, and related respiratory diseases. Respondents' choice decision that wastes collection times are not enough reflected by the ratio of city

populations and fire incident might be occurred when using open dumping system are 4.17 mean score which means that currently, YCDC's truck is not coming daily, dense population in ward can be more generated of waste. Reflected that waste collection time is not sufficient from now. Besides, they also felt on the impact of fire incidents in final disposal site.

Respondents' choice decision that formal waste pickers have in final disposal sites is 2.33 mean score which means that they found some other waste pickers at final disposal site before fire incident. After the fire incident, YCDC made fence to prevent fire incident occur in site also only allowed to enter authorized person not for waste pickers.

Calculated the overall mean value analysis on current practice, issues of waste management mean value are 4.17. All of the respondents normally known an inefficient municipal solid waste management system may create serious negative environmental impacts like infectious diseases, ranging from existing collection systems to ineffective disposal causes air pollution, water and soil contamination. Open Dumping System contribute to contamination of drinking water and can cause infection and transmit diseases.

4.3.6 Suggestions for Improvement of Waste Management System in Yangon City by Respondents

Htein Bin Final Disposal site is a typical final disposal site of the city where fires break out and the untreated leachate flow into public waters, the other adverse factors that seriously affect the surrounding environment. As of the results of suggestion that 10 % of respondents are currently impacted and faced the pollution of land, air and water caused by open dumping system and lived near the final disposal site area. Respondents are suggested to YCDC that to use proper management in order to prevent and safe from environmental or health impacts they lived and also should promote community mobilization as well as awareness on the principle of refuse, reduce, reuse and recycle is needed.

CHAPTER V
CONCLUSION

5.1 Findings

This study highlighted the knowledge, attitude, environmental impacts for living near in final disposal site, health conditions, social impacts and current practice and issues on waste management to 30 Household from family member and staff from staff housing at Htein Bin Final Disposal Site and 70 Household from Kalargyisu Village. In fact, that would have good attitude and towards sustainable solid waste management and UECCD also should prepare proper practice on waste management such as segregation at source, separated vehicles should have depend on the kinds of waste, placed transfer station and also should find out the best way of waste reduction method and proper management of final disposal site.

According to the findings, it can be found that some household does not have knowledge and practices and does not have knowledge on Laws and Regulations of waste management. Although among them, most are well known the impact of open dumping in final disposal sites and its impact also it can be polluted our land, air and water. The respondents from quantitative assessment and interviews suggested that it will need more effective awareness training program and well-managed of final disposal sites, adequate human resources, materials and financial support.

The study seeks to determine the environmental pollution and health effects associated with Htein Bin Final Disposal Site. Most of the respondents revealed that open dumping system is associated with various environmental pollution problems, namely, (a) underground water pollution due to the leaching of organic, inorganic, (b) air pollution due to suspension of particles and (c) odor pollution from the deposition of municipal solid waste (MSW). Furthermore, health impacts may occur through the pollution of the underground water and the emissions of gases. It will subsequently blowout and lead to carcinogenic and non-carcinogenic effects of the exposed population living in their vicinity.

The respondents strongly agreed that safe waste disposal is of utmost important

to prevent fire incident and infection transmission. The respondents feel that the personal protective equipment should wear to handle solid waste. The respondents feel that the waste segregation should do at the sources. The respondents strongly agreed that to conduct effective awareness training in each township or ward. And also, the respondent agreed that should have to develop rehabilitation process in each final disposal site in order to reduce waste volume and to prevent fire accidents at the site.
In conclusion, due to the lack of alternatives way and continuous disposing, without treating at the final disposal site posed a threat to the environment. Moreover, it assumed that there were risks associated with MSW open dumping system from respondents that the risk perception is increased among people who were self- sufferers of health issues.

5.2 Suggestions

The following suggestions are depending on the outcome of the sample survey of local residents' perception for municipal solid waste management in final disposal site. Most of the respondents have adequate knowledge on kinds of recyclable waste, unwell waste management can effect of health and environment issues by themselves, they know the way of composting from wet waste, and they have positive attitude to improve efficient waste management system.

YCDC-UECCD should meet with communities, explain about the procedure and share the challenges between government organization and public. The aim of the meeting should be to solve the gaps of waste collection method and to avoid irregular collection time for both sides. YCDC-UECCD should provide adequate dust bin at designated place and collect the waste in time. YCDC-UECCD should provide efficient Protective Personnel Equipment to their waste workers and should strictly enforced to wear mask and PPE in the late period of COVID-19.

Another finding is that some of the respondents are still weakness of the knowledge in publishing SWM law. YCDC-UECCD should enhance awareness of waste management law using with broadcasting media or websites, billboard or some poster in crowded area of the city. The respondents should dispose their household waste to designated place by YCDC-UECCD that will avoid unnecessary health impacts within the family members. UECCD should also effectively take action for illegal waste disposing around public area and SWM law should be strengthened.

For the prevention of environmental, health and social impact by using open

dumping system in final disposal site, respondents know that it can be more contaminations occurred without segregation and spreading bad smell to environment. YCDC-UECCD should separate the waste bin as of the defined in the law and also proper management in Htein Bin Final Disposal Site. It is necessary to take appropriate measures to prevent fires and to safe the negative effects caused by open dumping.

As of the local residents' perceptive on municipal waste management is should be implemented proper waste disposal method in the final disposal site that will avoid negative effects by current experiencing in air, land, water pollution, environmental impact and some other effects.

Finally, YCDC-UECCD should promote proper segregation and placing dust bin in necessary wards that will need to allocation budget in so far, build recycle center to sell the waste can be recyclable, enhance awareness campaign both schools and communities, now open dumping system is very bad impact and can cause fire incident. The best way to solve the problem of current waste management issues are that by using advanced technologies such as Waste to Energy or rehabilitation process is crucial.

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APPENDIX (I)

STRUCTURE TYPE OF QUESTIONNAIRE

I am studying Master of Business Administration at Yangon University of Economics. I have designed the following questionnaire for "“Local Residents' Perceptions towards Municipal Solid Waste Management in Final Disposal Sites (Case Study: Htein Bin Final Disposal Site in Hlaing Thar Yar Township)’’ which requires for my thesis work as an integral part of the study to complete the Master Program. This questionnaire is concerning knowledge, attitude and environmental, health and social impact of final disposal site and current issues on waste management at Htein Bin Final Disposal Site, Hlaing Thar Yar Township, Yangon Region.

I would highly appreciate if you answer the following questionnaire and your responses would be strictly confidential. It will take approximately 15 minutes. I expect your kind cooperation in this respect. Please put a ( ) mark to indicate your responses. Thank you for your time.

Part (1) Characteristics of the Respondents

1) Gender

   (a) Male ☐ (b) Female ☐

2) Age Group (Completed) ---------- (years)

3) Education Background

   (a) Primary Level ☐ (b) Middle Level ☐ (c) High Level ☐

   (d) Bachelor ☐ (e) Other ☐

4) Household Size

   (a)1-2 people ☐ (b) 3-4 people ☐ (c) 5-7 people ☐

   (d) 8-10 people ☐ (e) more than 11 people ☐

5) Income Level

   (a) > below 80,000 MMK ☐ (b) > below 150,000 MMK ☐

   (c) <above 150,000 MMK ☐

Part (2) Knowledge on Solid Waste Management

(A) Knowledge about Waste

No.	Descriptions	YES	(%)	NO	(%)
1.	Do you know types of waste in Yangon City?				
2.	Do you know Law and Regulations about Solid Waste Management in Yangon City?				
3.	Do you know such kinds of recyclable waste can sellable like as PET bottle, Paper, Cardboard, Glass or Metal?				
4.	Do you know wet waste as well as kitchen waste (peels of vegetable or food residues) can composting?				
5.	Do you know if we cannot manage our household waste, it will be effect to our health and environment?				
6.	Do you think to develop better waste collection system can efficient our society?				

(B) Practice on Waste Management

No.	Descriptions	YES	(%)	NO	(%)
1.	Do you dispose your waste at designated place by YCDC?				
2.	Do you pay designated waste collection fee to YCDC?				
3.	Do you frequently separate Wet/Dry Waste at household?				
4.	If there is no dustbin near at household, do you dispose your waste either beneath of home or discharge to drainages or backyards?				

Part (3) Environmental Impacts for Living near in Final Disposal Site Area

No.	Descriptions	YES	(%)	NO	(%)	DON'T KNOW	(%)
1.	There is harmful gas emitted from final disposal sites.						
2.	Methane gas emitted from waste is one of the gases of GHGs that can cause global warming.						
3.	Wind shifts brings an odorous smell to offend residents living close the disposal area.						
4.	Fire incident occur in Htein Bin final disposal site in 2018.						
5.	The plants will not survive cause of open dumping system.						
6.	It can be directly social impact to the people who lived near final disposal site cause of contamination in final disposal site.						

Part (4) Health Conditions, Social Impacts for Living near in Final Disposal Site Area

1 = Strongly Disagree **2 = Disagree** **3 = Neutral**

4 = Agree **5 = Strongly Agree**

No.	Descriptions	1	2	3	4	5
1.	Pests, insects, rat and flies from the near final disposal site can more contaminate in your area.					
2.	Air quality can pollute around final disposal site area.					
3.	We had ever seen polluted water in our areas we lived.					
4.	We had occurred diarrhea disease cause of water pollution around our areas frequently.					
5.	People living closer to landfill sites suffer bad health conditions and impacts.					

Part (5) Current Practice and Issues of Waste Management

1 = Strongly Disagree **2 = Disagree** **3 = Neutral**

4 = Agree **5 = Strongly Agree**

No.	Descriptions	1	2	3	4	5
1.	People didn't segregate waste at source is one of the problems of waste management.					
2.	Placing of dust bin or transfer station for dispose waste will need more than usual.					
3.	Waste collection times are not enough reflected by the ratio of city populations.					
4.	Recyclable material should be sorted before reached to final disposal site.					
5.	Plastic waste and polymer will appear as bad impacts.					
6.	Fire incident might be occurred when using open dumping system.					
7.	Formal waste pickers have in final disposal sites.					
8.	We will need to conduct awareness training at community level regarding waste management.					
9.	Open dumping system can harmful to our health and environment.					
10.	Authorities should develop and improve final disposal site by using advanced technologies, Waste to Energy or Rehabilitation Process.					

Part (6) Any Suggestions for Improvement of Waste Management System in Yangon City

APPPENDIX (II)

Air Quality Monitoring Index in Htein Bin Final Disposal Site, Hlaing Thar Yar Township

No	Pollutant	Average Concentration	Limits/Guideline Value/ Standards
1	Carbon Dioxide (CO_2)	450 ppm	345 ppm (WHO)
2	Carbon Monoxide (CO)	0.03933 ppb (0.0000393 ppm)	9,000 ppb (8-Hr) (US-EPA) 9 ppm (8-Hr) (Air NEPM) 25 ppm (1-Hr) (WHO)
3	Methane (CH_4)	4272.91 ppm	160 ppm (WHO)
4	Nitrogen Dioxide (NO_2)	147.288 ppb (277 $\mu g/m^3$)	200 $\mu g/m^3$ (1- hour) (MONREC) 100 $\mu g/m^3$ (1-Hr) (NAAQS) 40 $\mu g/m^3$ (1 -year) (MONREC)
5	PM_{10} (Sensor A)	34.8 $\mu g/m^3$	50 $\mu g/m^3$ (24- hour) (MONREC) 20 $\mu g/m^3$ (1- year) (MONREC)
6	$PM_{2.5}$ (Sensor B)	76.244 $\mu g/m^3$	25 $\mu g/m^3$ (24- hour) (MONREC) 10 $\mu g/m^3$ (1- year) (MONREC)
7	Sulfur Dioxide (SO_2)	389.244 ppb (1020 $\mu g/m^3$)	75 $\mu g/m^3$ (1- hour) (NAAQS) 20 $\mu g/m^3$ (24-hour) (MONREC) 500 $\mu g/m^3$ (10-minute) (MONREC)
8	Wind Direction/ Win Speed	82.13° N (From NorthEast) 1.5 kph	
9	Humidity/ Temperature	19.2 % / 47 °c	

Source: YCDC-UECCD