YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME
(NAY PYI TAW CAMPUS)

A STUDY ON THE CHALLENGES AND PRACTICES FOR HAZARDOUS WASTE MANAGEMENT DURING COVID-19 PANDEMIC IN ZABUTHIRI TOWNSHIP

MAUNG CHO
EMPA - 20 (18th BATCH)

OCTOBER, 2022

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Public Administration (MPA)

Supervised By:

Dr Khin Thidar Nyein
Pro-Rector
Yangon University of Economics

Submitted By:

Maung Cho
Roll No. 20
EMPA 18th Batch (NPT)

OCTOBER, 2022

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This is to certify that this thesis entitled "**A Study on the Challenges and Practices for Hazardous Waste Management during Covid-19 Pandemic in Zabuthiri Township**", submitted in partial fulfilment towards the requirements for the degree of Executive Master of Public Administration (EMPA) has been accepted by the Board of Examiners.

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Department of Applied Economics
Yangon University of Economics

October, 2022

ABSTRACT

This study analyses hazardous waste management in Nay Pyi Taw, and to investigates the challenges and practices on hazardous waste management during Covid-19 pandemic. To reach the study objectives, this study is specified and tested by using correlation analysis and multiple linear regression analysis. In this study, all population of one hundred and fifty of the respondents is asked to collect the data. Their responses are gathered through structured questionnaire with 5 point likert-scale. It is found that health situation and earnings of households have positive and significant effect on practices on hazardous waste management. It is also found that the majority of respondents conduct hazardous waste management in accord with Covid-19 regulations. The results say that there are challenges about health situation and earnings of households during the Covid-19.

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LIST OF ABBREVIATIONS

NPTDC	Nay Pyi Taw Development Committee
PCCD	Pollution Control and Cleansing Department
SWM	Solid Waste Management
MSW	Municipal Solid Waste
WHO	World Health Organization
OECD	Organization for Economic Co-operation and Development
GDP	Gross Domestic Product
NGOs	Non- Governmental Organizations
OSH	Occupational Safety and Health
TSDF	Treatment, Storage and Disposal Facility
HDI	Human Development Index
PPE	Personal Protective Equipment
SPSS	Statistical Package for the Social Sciences

CHAPTER 1

INTRODUCTION

1.1 Rationale of the Study

A hazardous waste is a waste with properties that make it unsafe or capable of having an injurious effect on human health or the environment. Improper hazardous waste management, collection, treatment and waste disposal of waste material can cause a serious threat to human health and safety or the environment. Hazardous wastes include solids, liquids, waste or gases as well as they can be used for chemical production, manufacturing and other industries. Being inadequate storage, transportation and treatment can be harmful. Moreover, improper storage of these items can lead to spills, leaks, fires, and contamination of soil and drinking water.

The rapid increase in medical wastes during the COVID-19 pandemic may disrupt medical waste treatments since they are designed for normal conditions. In Wuhan city, where the COVID-19 was firstly reported, the medical waste dramatically increased from 40 tons/day to about 240 tons/day, exceeding the medical waste treatment capacity of 49 tons/day (Tang, 2020). In Malaysia, the clinical waste increased 30% in March 2020 (Agamuthu and Barasarathi, 2020). Commonly, thermal-based technologies have been widely used to treat hazardous wastes including incineration, plasma method, microwave treatment, and steam treatment (Klemeˇs et al., 2020).

It is not easy for increasing treatment capacity in the short time during the pandemic. As an alternative, the existing municipal solid waste (MSW) incinerators and other facilities can be utilized to ramp up the treatment capacity. For instance, the existing cement kilns are applied to treat the extra medical wastes in Wuhan city. When MSW incinerators are utilized to ramp up the capacity, the technical issue is crucial to ensure that these approaches can deal with the dynamics of the quality and quantity of the infectious wastes.

The improper hazardous waste collection can pollute water and groundwater supplies as harmful water and it is one of the sources of unsafe land pollution. Residents near landfills may be particularly vulnerable. Hazardous wastes are classified as biological, chemical, and physical things. These properties include

toxicity, reaction combustible poisoning. It produces infectious or radioactive substances. In an effort to address current problems and to prevent future threats from hazardous waste, governments closely regulate concerning with hazardous waste management practices.

The recycling of hazardous wastes has many benefits, including reducing the use of raw materials and waste that needs to be cleaned and disposed. It is important to save the environment from the toxic effects of the biological fossils and non-biodegradable elements on the landfill. Improper management of waste can lead to water pollution, air pollution and soil pollution. It can cause soil erosion and air pollution. If waste is collected and managed effectively, it can be reused. Disposal of chemicals into waterways can be unsafe streams, rivers, lakes and aquifers for drinking or agricultural purposes. Animals and plants can get sick and die by drinking that water, which can affect human health badly. It is important to solve these risks.

In some cases, harmful substances can damage the skin or the eyes, making it difficult to breathe, causing headaches and nausea, or other types of illnesses. Increasing the quality of hazardous waste is a major global problem. In Myanmar, daily hazardous waste generation, especially in three of largest cities in the country, which are Yangon, Mandalay and Nay Pyi Taw, have increased gradually, it is leading to numerous public health and environmental pollution. Nay Pyi Taw, the capital of Myanmar, has tried to established good waste management system including hazardous waste. Therefore, this study intends to explore the challenges and practices on hazardous waste management during covid-19 pandemic.

1.2 Objectives of the Study

The objectives of the study are as follow:

(1) To examine hazardous waste management in Zabuthiri Township

(2) To analyze the challenges and practices on hazardous waste management during Covid-19 pandemic.

1.3 Method of the Study

In this study, descriptive and quantitative methods are used and based on primary and secondary data. The primary data is collected from 150 staffs and workers of Pollution Control and Cleansing Department under Nay Pyi Taw Development Committee (NPTDC). The secondary data is collected from Nay Pyi Taw City Development Committee (NPTDC), libraries, published and unpublished reports, relevant textbooks, Articles, previous researches, internet Journal and internet websites. Descriptive statistics is used to describe the profile of respondents and their challenges. Correlation analysis is used to test the relationship of facts. Multiple regression analysis is also used to analyze the challenges and practices on hazardous waste management.

1.4 Scope and Limitation of the Study

This study was focused on the hazardous waste collecting activities of the staffs from Pollution Control and Cleansing Department (PCCD) of Nay Pyi Taw City Development Committee (NCDC) at Zabuthiri Township during Covid-19 pandemic. This study emphasizes on the on hazardous waste management during Covid-19 pandemic. To know the challenges and practices on hazardous waste management during Covid-19 pandemic, 150 staffs and workers of Pollution Control and Cleansing Department under Nay Pyi Taw Development Committee (NPTDC) are asked with structured questionnaires. Data collection period was in September, 2022. This study limits to explore the challenges and practices on hazardous waste management in Zabuthiri Township only.

1.5 Organization of the Study

There are five chapters in this paper. Chapter I introduces rationale of the study, objectives of the study, method of the study, scope and limitation of the study and organization of the study. Chapter II presents literature review on the management and basic concepts of hazardous waste. Chapter III displays overview on hazard waste management in Zabuthiri Township. Chapter IV analyzes on the challenges and practices for hazard waste management during Covid-19 pandemic. Chapter V is the conclusion part, which included findings and suggestions for the hazardous waste.

CHAPTER 2
LITERATURE REVIEW

2.1 Definitions and Basic Concept of Hazardous Wastes

Hazardous wastes can be defined as materials and equipment generated due to either natural or various anthropogenic activities and spiked with hazard ingredients, which there is no further use as well. Therefore, hazardous wastes are materials, direct disposal of which can pose threats to man and his environment. They can be explosive, flammable, oxidizing, poisonous/infectious, radioactive, corrosive and/or toxic. (Hosam M. Saleh et. al., 2020)

Hazardous waste is potentially damaging to the environment and must therefore be controlled. Most of it, however, comes from industries that are among the most important to the growth and maintenance of a modern industrial society, such as iron and steel, nonferrous metals, and the primary and secondary chemical industries. If, in addition to materials that are toxic, flammable or corrosive, the definition of 'hazardous' includes materials with a high water pollution potential, food and food processing waste should also be included in those requiring special control. The needs of environmental protection and economic development must therefore be finely judged if a proper balance is to be achieved. (WHO, 1983)

There was also the difficulty of definition. The OECD adopted that hazardous waste on the basis of harmful effects of the material on its environment, including ignitability, corrosiveness, reactivity, toxicity, radioactivity, infectiousness, phytotoxicity, teratogenicity and mutagenicity. Meanwhile, it is defined as hazardous, including arsenic, mercury, cadmium, thallium, berullium, chromium, lead, cyanide and respective compounds, as well as organic solvents. (WHO, 1977)

Tarr observes that the 1970 Solid Waste Act mandated that the USEPA investigate hazardous waste disposal which led to a 1974 report on the subject. The report and subsequent legislation provided a legal definition of hazardous wastes, and policies that greatly restricted how they were managed. Within this evolving context, he observes that environmental degradation was not always a willful act of the disposer, suggesting a naiveté in terms of knowledge about the environmental risks associated with land disposal of wastes and a crisis-driven science that led to safe

waste management such as the discovery of Love Canal (Tarr 1985; USEPA 1974). Nonetheless, the concept of 'search for the ultimate sink' is built around the notion that legislative bodies took action when wastes prove socially disruptive.

Martin Melosi's review of legal liability for hazardous wastes also traces the waste management from urban refuse and sewage in the nineteenth century to the more recent past. He notes the recognition of industrial wastes as a problem, but one largely confined to surface-water quality. Managing industrial effluents was complicated by the absence of an adequate legal classification. Legal remedies fell into two camps: self-regulation favored by industry and government regulation. Nuisance law and a diverse set of state laws before 1950 provided an inconsistent legal context across the country. However, even where local laws existed, enforcement was lax owing to the tendency for states to accommodate manufacturers by avoiding stringent regulation. The absence of specific hazardous waste legislation hampered any comprehensive control. Since hazardous waste was largely a product of private-sector industry, eliminating its introduction to the environment was more difficult than addressing public sewage and garbage, a responsibility borne mainly by municipalities (Melosi 1988).

Nonetheless, the term hazardous waste became part of the legislative agenda as part of the Resource Recovery Act of 1970, which produced the first ripple of legal disruption for manufacturers. Wagner notes that various legislative efforts to address hazardous wastes floundered before 1976. Love Canal changed all that in 1978 when the national media propelled it into a highly visible position. According to Wagner, the media and public concern about health risks to neighbors of the dump, which constituted an intensely disruptive social situation, impelled congressional action. Wagner's take on events corresponds to new geographies of waste that portray waste as disrupters of normal social and political activities. According to Sarah Moore, by labeling certain industrial wastes as 'hazards' they acquire meaning through contact with society and are inseparable from human actions. Inextricably rooted in the nature-society domain, hazardous wastes are bound up in social, political, and economic matrices as much as in biophysical processes (Moore 2012).

2.2 Classification of Hazardous Wastes

The classification of hazardous wastes is as follow.

Radioactive Substance: These substances are those substances that emitionising radiation and these substances are hazardous because lengthy exposure to radiation often results in damage to living organisms. Such substances are of special concern because they continue for a long period. The period in which radiation happens is commonly measured & expressed as half-life, i.e., the time needed for the radioactivity of a given amount of the substance to decay to half its initial value. (Karan Singh, 2022)

Biomedical Wastes: The primary sources of hazardous biological wastes are biological & hospitals research facilities. The ability to infect other living organisms & the ability to produce toxins are the most noteworthy characteristics of hazardous biological wastes. (Karan Singh, 2022)

Chemicals: Most dangerous chemical wastes can be categorized into different groups: inorganic metals, flammables, acids & bases, synthetic organics, and explosives. Some of the chemicals are dangerous because they are highly toxic to most life forms. When such hazardous compounds or elements are present in a waste stream at levels equal to or greater than their threshold levels, the overall waste stream is recognized as dangerous. (Karan Singh, 2022)

Flammable Wastes: such wastes are also recognized as hazardous chemical wastes. This dual grouping is vital because of the high potential hazard in collecting, robust, and disposing of flammable wastes. Such wastes may be liquid, solid or gaseous, but most often, they are liquids. (Karan Singh, 2022)

Explosives: such hazardous wastes are primarily ordnance (artillery) materials, i.e., the wastes resulting from ordnance manufacturing & some industrial gases. Similar to flammables, these wastes also have a high potential for hazard in storage, disposal, collection; therefore, they should be regarded separately in addition to being listed as hazardous chemicals. This waste may exist in liquid, gaseous, or solid. (Karan Singh, 2022).

2.3 Characteristics of Hazardous Waste

Hazardous characteristics extracted from UN listing.

2.3.1 Industrial wastes

Waste generated from industrial sources can have non-hazardous and hazardous components, with non-hazardous waste usually representing the greater part of the volume. The hazardous component of this waste is relatively small in volume.

This type of waste was identified as hazardous waste when proceeds toxicity test, corrosively test, ignitability test, and some special character test. As a hazardous pollutant, it may impose serious impacts on surrounding environment and such impacts should be quantitatively examined to assess the influence on human health. (Hosam El-Din M. Saleh, 2016)

2.3.2 Household waste

Households generate small quantities of hazardous wastes such as oil-based paints, paint thinners, wood preservatives, pesticides, insecticides, household cleaners, used motor oil, antifreeze, and batteries. It has been estimated that household hazardous waste in industrialized countries such as the United States accounts for a total of about 0.5% (by weight) of all waste generated at home, while in most developing countries, the percentage probably is even lower. (Hosam El-Din M. Saleh, 2016)

2.3.3 Biomedical waste

According to Hosam El-Din M. Saleh (2016), there are some of hazardous medical and dental wastes that, when disposed improperly, could cause harm to the environment. It also presents an occupational health hazards to the healthcare personnel who handle these wastes at the point of generation and those involved with their management, that is, segregation, storage, transport, treatment, and disposal.

- Infectious waste: Which contain pathogens namely bacteria, viruses, fungi, or parasites in concentrations sufficient to cause disease in susceptible hosts. Cultures and stocks of infectious agents from laboratory work; tissues and dressing generated from autopsies, surgeries, and treatment of infected patients and animals; materials or equipment in contact with blood and infected body fluids.
- Pathological waste: Including tissue, organs, body parts, human fetuses, and animal carcasses, blood and body fluids.
- Sharps: It comprise syringes, needles, scalpels, saws, infusion sets, knives, blades, broken glass, or other items that can cause cut or puncture wounds.
- Pharmaceutical waste: It covers expired, unused, spilt, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of in appropriate manner.
- Genotoxic waste: This type combines cytostatic drugs, vomit, urine, or feces from the patients treated with cytotoxic drugs, chemicals, and radioactive materials. Genotoxic waste has mutagenic, teratogenic, and carcinogenic properties.
- Chemical waste: Discarded solid, liquid, or gaseous chemicals should be considered as hazardous if it is toxic, corrosive, inflammable, or reactive. Waste with high content of heavy metals: Mercury (thermometers, blood pressure gauges, amalgam), cadmium (discarded batteries), and lead (reinforced wood panels for radiation proofing in radiology department) generated from hospitals could be represented as a subcategory of hazardous chemical waste.
- Radioactive waste: The use of radioisotopes in vitro analysis of body tissues and fluids, in vivo organ imaging, tumor localization, and treatment and various clinical studies involving certain radionuclides need to be specially managed in a centralized treatment facility for radioactive wastes.

2.3.4 Radioactive waste

Nuclear applications have been rapidly developed recently, and several nuclear power plants started to work throughout the world. The potential impact of released radioactive contaminants into the environment has received growing attention due to nuclear accidents. Contamination of soil and water by radionuclides due to natural processes, global fallout from nuclear weapon testing, discharges from nuclear installations, disposal of nuclear waste, and occasional nuclear accidents (i.e., Chernobyl in 1986 and Fukushima in 2011) poses serious problems to biological systems. Radioactive waste includes a variety of radionuclides and occurs in a variety of physical and chemical forms. It can be generally classified as low-/intermediate-level radioactive waste and high-level radioactive waste. Radioactive waste, arising from civilian nuclear activities as well as from weapon activities, poses a potential problem for handling and saving the environment for coming generations. (Hosam El-Din M. Saleh, 2016)

Radioactive waste includes a variety of radionuclides and occurs in a variety of physical and chemical forms. It can be generally classified as low-/intermediate-level radioactive waste and high-level radioactive waste. Nuclear research establishments include, for example, waste containing different organic components, toxic or chemically aggressive constituents, radionuclides with specific properties (high mobility, high chemical activity, volatile elements, etc.), waste difficult for treatment and not appropriate for direct immobilization (e.g., spent organic ion exchange resins and spent liquid scintillation cocktails). For such waste, application of conventional treatment and conditioning options may not be efficient and appropriate in terms of economy, safety, and performance characteristics. In many cases, such wastes are stored awaiting an appropriate treatment and conditioning solution. (Hosam El-Din M. Saleh, 2016)

2.4 The Economic Impact during Covid-19

The World was gripped by a pandemic over the first half of 2020, of which the second wave emerged in the fall. It was identified as a new coronavirus (severeacute respiratory syndrome coronavirus 2, or SARS-CoV-2), and later renamed as Coronavirus Disease-19 or COVID-19 (Qiu et al., 2020). While COVID-19 originated

in the city of Wuhan in the Hubei province of China, it has spread rapidly across the World, resulting in a human tragedy and in tremendous economic damage. By the end of November 2020, there had been close to 63 million reported cases of COVID-19 globally and over 1.4 million deaths.

Pandemics are anything but new, and they have had severe, adverse economic impacts in the past; COVID-19 is not expected to be any different (see the Online Appendix for a brief history of past pandemics and their socioeconomic consequences). Given the rapid spread of COVID-19, countries across the World have adopted several public health measures intended to prevent its spread, including social distancing (Fong et al., 2020). According to Mandeville (2020), this strategy saved thousands of lives, both during other pandemics, such as the Spanish flu of 1918, and more recently a flu outbreak that occurred in Mexico City in 2009. As part of social distancing measures, businesses, schools, community centers, and nongovernmental organization (NGOs) were required to close down, mass gatherings have been prohibited, and lockdown measures have been imposed in many countries, allowing travel only for essential needs. 1 The goal of these measures is to facilitate a "flattening the curve," that is, a reduction in the number of new daily cases of COVID-19 in order to halt their exponential growth and, hence, reduce pressure on medical services (John Hopkins University, 2020).

The spread of COVID-19 has resulted in a considerable slowdown in economic activities. According to an early forecast of The World Bank (2020), global GDP in 2020 relative to 2019 is forecasted to fall by 5.2%. Similarly, the OECD (2020) forecasts a fall in global GDP by 6 to 7.6%, depending on whether or not a second wave of COVID-19 emerges. In its latest forecast, the International Monetary Fund (2020) projected a contraction of 4.4% in light of the stronger than expected recoveries in advanced economies which lifted lockdowns during May and June of 2020. This was mainly the result of the unprecedented fiscal, monetary, and regulatory responses in these countries that helped to maintain household disposable income, protect cash flows for firms, and support credit provisions.

The economic implications will be wide ranging and uncertain, with different effects expected on labor markets, production supply chains, financial markets, and GDP levels. The negative effects may vary by the stringency of the social distancing measures (e.g., lockdowns and related restrictions), their length of implementation,

and the degree of compliance with them. In addition, the pandemic and the subsequent interventions may well lead to higher levels of mental health distress, increased economic inequality, and particularly harsh effects on certain socio-demographic groups.

2.5 Hazardous Waste Management

Although the percentages might vary from country to country, the increase in healthcare solid waste is seen globally. Facing this reality, Das et al. (2021) recognized that, since the ability to sustainably process and recycle healthcare solid waste depends on its composition, which is already familiar therefore does not pose a big threat, one of the main challenges lies in managing these greater quantities. During the COVID-19 outbreak, many types of additional medical and hazardous waste are generated, including infected masks, gloves and other protective equipment. The safe handling and final disposal of this waste is, therefore, a vital element for an effective emergency response. Prior to this pandemic the control required for this type of waste would be mostly applied to hospitals and health centers, however during this new reality every household could be producing highly infectious medical waste, which poses great threat to public health (Fan et al., 2020).

Effective management of biomedical and health-care waste requires appropriate identification, collection, separation, storage, transportation, treatment and disposal, as well as important associated aspects such as disinfection, personnel protection and training (Sharma et al., 2020). 8 Tsukiji et al. (2020) stated that local governments must apply specific precautionary measures, operations and practices under this pandemic, not disregarding the normal protocols for household and healthcare waste management. In agreement with these statements Fan et al. (2020) pointed to the need to adjust waste collection and allocation to the changes in waste amount and composition, admitting that the existing collection system could be altered by the demand in different places and timing. In Portugal the same possibility was taken into consideration in the beginning of the pandemic, when the proper management plan for the waste collection teams was established (APA, 2020).

Currently the main concern towards the waste management issue is regarding hospitals' and health care centers' waste, since these are the main producers of such,

and so for these establishments it has been devised proper procedures and methods for managing COVID-19 waste (Sharma et al., 2020). Tsukiji et al. (2020) stated that healthcare waste management must be continued for COVID-19 waste, however with specific precautionary measures and adjustments applied to mitigate any potential risks of COVID-19 infection during the process. These same authors find that, ideally, based on the concept of the 3Rs (reduce, reuse and recycle), the better practice of healthcare waste management should aim to avoid or recover as much of the waste as possible, rather than disposing, therefore minimizing the quantities.

Waste segregation at source is also a valid option for a safe management of potential infectious waste. Tsukiji et al. (2020) state that, ideally, all potential infectious waste should be put in a sealed bag and double bagged if possible, and that it needs to be handled as residual waste not meant for material recovery. Through methods of colour coding, it is possible for people to separate waste by types, which would facilitate the disposal and transportation processes and would also help to reduce the potential risk of exposure to the virus (Tsukiji et al., 2020). Regarding storage and transport for private residences there are also specific methods, as these places must not be forgotten since most of the people that have contracted COVID-19 are at their personal residences. For such cases, Tsukiji et al. (2020) state that onsite transportation should take place during less busy times, whenever possible.

Also, mapping out the sources that are potentially generating COVID-19 contaminated waste and healthcare waste is a critical step in controlling the flow of the waste. The handling and transportation staff must be wearing proper personal protective equipment (gloves, masks, closed suits and shoes) and setting routes should be used to prevent staff from being exposed for too long. 9 In some cases, like in Lisbon (Portugal), the people responsible for managing the household waste chose to follow the example and guidance of some more experienced entities like the national environmental agency and the national health department, and also kept in touch with some other cities like Amsterdam, Paris and Los Angeles (Lisboa, 2020). On the 20th of March, 2020, Lisbon's city council ceased some services for waste collection, for a period of time, to control the risk of spreading the virus by handling potentially infected waste. Among such services there were, selective door-to-door waste pick up and glass door-to-door pick up. Despite many efforts to inform the different parties, some countries could not adapt to these safety measures, such as Bangladesh. Rahman

et al. (2020) state that inside Bangladeshi hospitals, there are few measures for proper medical waste collection and separation, the workers do not use adequate personal protective equipment and the waste is disposed of in unauthorized places.

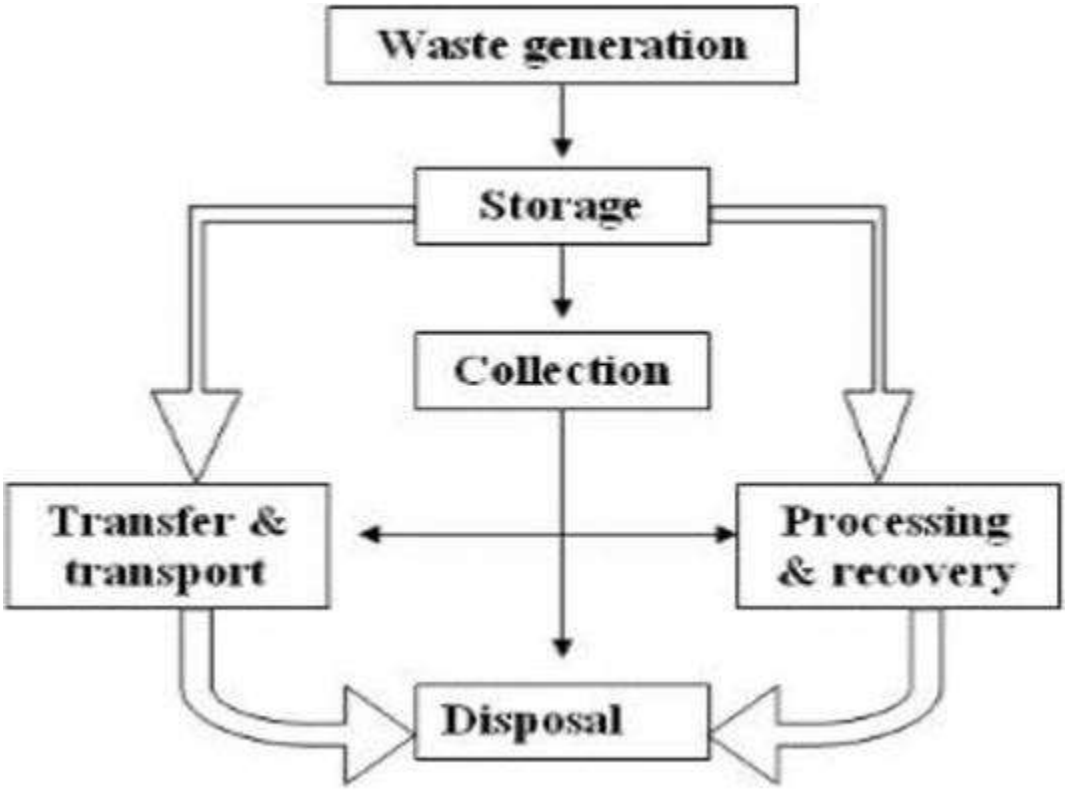
Without proper handling of this waste and a lack of sorting standards, waste collectors are at high risk of getting infected by COVID-19, since they work without proper protective equipment. Healthcare waste handlers are at great risk during the COVID-19 pandemic, therefore, in order to increase awareness regarding such threat and to educate interested parties on how to avoid possible infection while performing an essential duty, most countries have introduced strict guidance on Occupational Safety and Health (OSH) practices, based on national and international standards (Tsukiji et al., 2020). Some of the measures directly influence operational matters, such as providing necessary personal protective equipment, but most of them rely on educating and training the workers on how to use the proper equipment, like masks, gloves, rubber boots, disposable work wear/hazmat suits, goggles and face-shields. As for Portugal, the national environmental agency also states that the proper cleaning of the waste pick up vehicles and enforcing proper hygiene standards of the personal protective equipment is required to prevent any infection during this service (APA, 2020).

2.6 Principles and Methods of Hazardous Waste Management

Hazardous waste management is the general term associated with procedures and policies of hazardous waste management that it does not cause any potential threat to man and the environment. Traditionally, hazardous wastes are disposed by dumping in open space and burning. Open dumping results in soil and water pollution and open burning and incineration contribute to air pollution in the form of particulates, nitrogen oxides, noxious odors, and other constituents. After solid waste residues disposed leads to water pollution. Municipal incineration with sophisticated energy recovery systems were popular in large European and American cities at the turn of the century, but became extinct due to high operating costs. In recent years, for hazardous solid waste management incineration has become less popular because of risk associated with increased air pollution control requirements. Because of rapid industrialization the concern of hazardous waste management is increasing. The waste

generated from various industrial and domestic activities can result in severe health hazards and also leads to negative impact on the environment. The following procedure illustrates the standard waste management strategy in a developed society. (Krishnaswamy Kanagamani, 2020) Various steps involved in hazardous waste management were shown in Figure (2.1).

Figure (2.1) Steps involved in hazardous waste disposal



Source: Environmental Issues and Sustainable Development Book (2020)

2.6.1 Handling of hazardous wastes

Persons handling hazardous wastes are advised to have protective precautions to protect themselves from health effects. Exposure of hazardous waste leads to dermatitis in the skin, asthma on long exposure, eye irritation and also tightening of the chest. (Krishnaswamy Kanagamani, 2020)

2.6.2 Transport of hazardous waste

Hazardous waste generated often requires transport to a particular site for an approved treatment, storage, or disposal facility (TSDF). Because of potential threats to public safety and the environment, transport is given special attention by governmental agencies to avoid any occasional accidental spill. (Krishnaswamy Kanagamani, 2020)

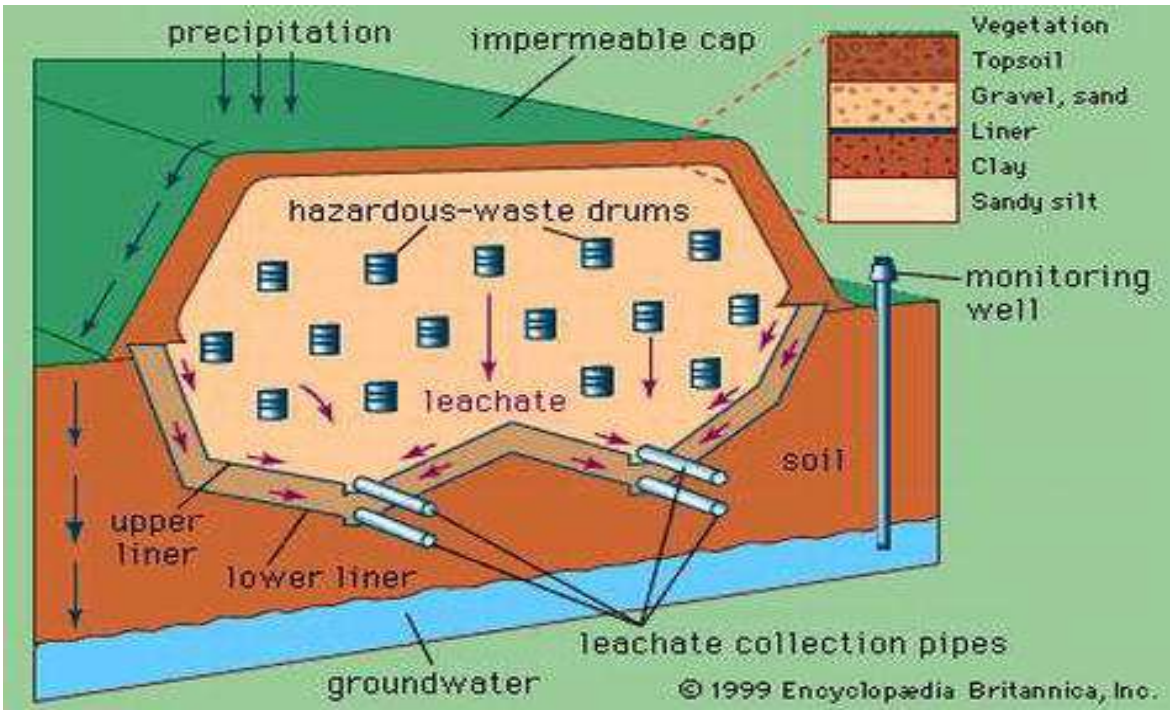
2.6.3 Disposal

Disposal of hazardous waste is the final stage of a hazardous waste management system. The different waste disposal methods includes secure landfill, deep well and bedrock disposal. (Krishnaswamy Kanagamani, 2020)

2.6.4 Secure landfill

Disposal of some hazardous wastes in regular landfills resulted in unfavorable amounts of hazardous materials seeping into the ground. These chemicals eventually enter natural hydrologic systems. So to prevent the chemicals entering the soil, landfill requires a barrier for collecting hazardous substances that may remain in the disposed waste. Now, hazardous wastes are stabilized and made into solid and placed in landfill and this process depends upon the type of hazardous waste. A landfill is a disposal facility where hazardous wastes are placed into and stored in the soil. An example of a recommended design is shown in Figure (2.2). The wastes are dumped in sealed drums before disposal. The hazardous-waste landfill setup consists of two impermeable liners and also includes leachate collection systems. Double leachate collection system is made up of network of pipes placed above each liner. The upper layer reduces the accumulation of leachate trapped in the fill, and the lower layer acts as a backup. The leachate collected is transferred to treatment plant for further process. An impermeable cap or cover is placed over a finished landfill is placed to reduce the amount of leachate in the fill and minimize the potential for environmental degradation. (Krishnaswamy Kanagamani, 2020)

Figure (2.2) Secure land fill method.



Source: Environmental Issues and Sustainable Development Book (2020)

The main components in the leachate from landfill sites are grouped as follows;

- Major elements and ions such as calcium, magnesium, iron, sodium, ammonia, carbonate, sulphate and chloride.
- Trace metals such as manganese, chromium, nickel, lead and calcium
- Wide variety of organic compounds
- Biological agents

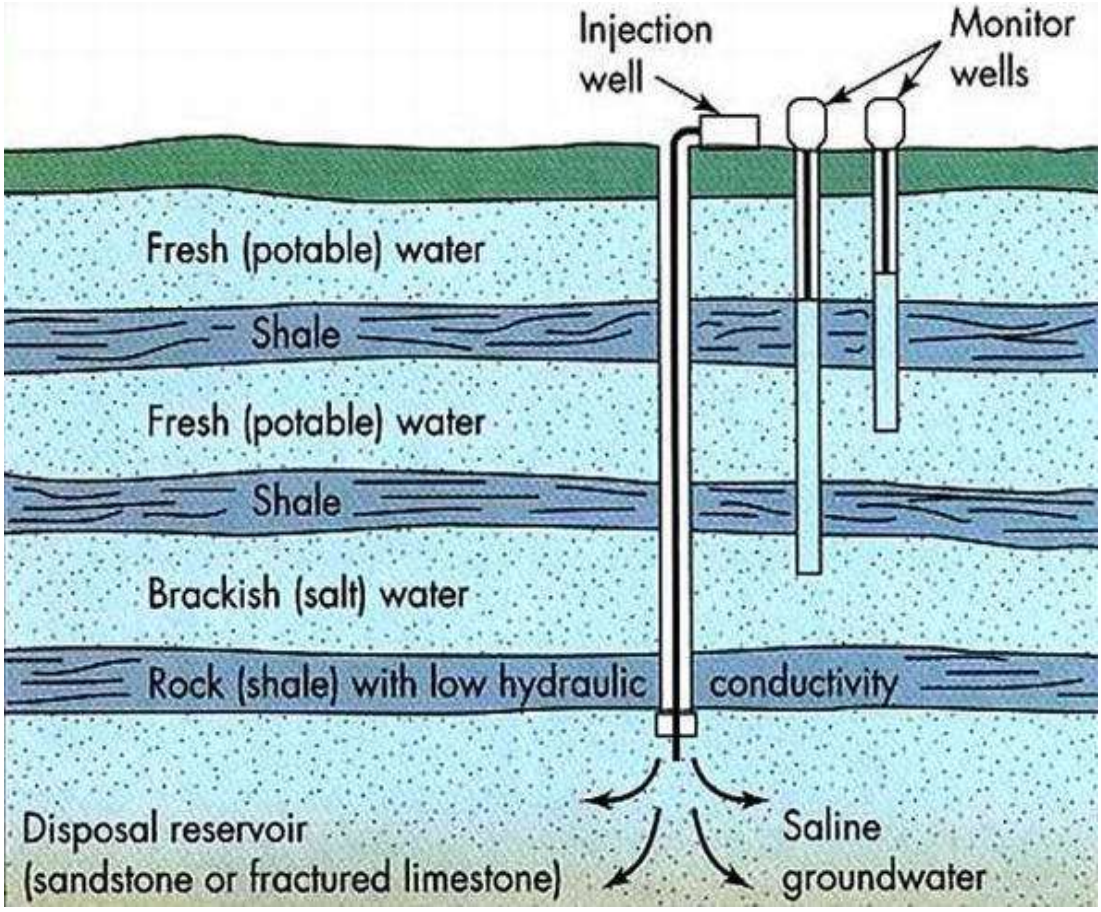
Hazardous waste mainly from industries will give rise to leachate. Heavy metals concentration in the leachate is of greater concern compared to other components of leachate.

2.6.5 Deep well disposal

Another alternative disposal of liquid industrial waste is injection into deep well as shown in the Figure (2.3). Deep well injection is a liquid waste disposal technology. This alternative uses injection wells to place treated or untreated liquid waste into geologic formations that have no potential to allow migration of

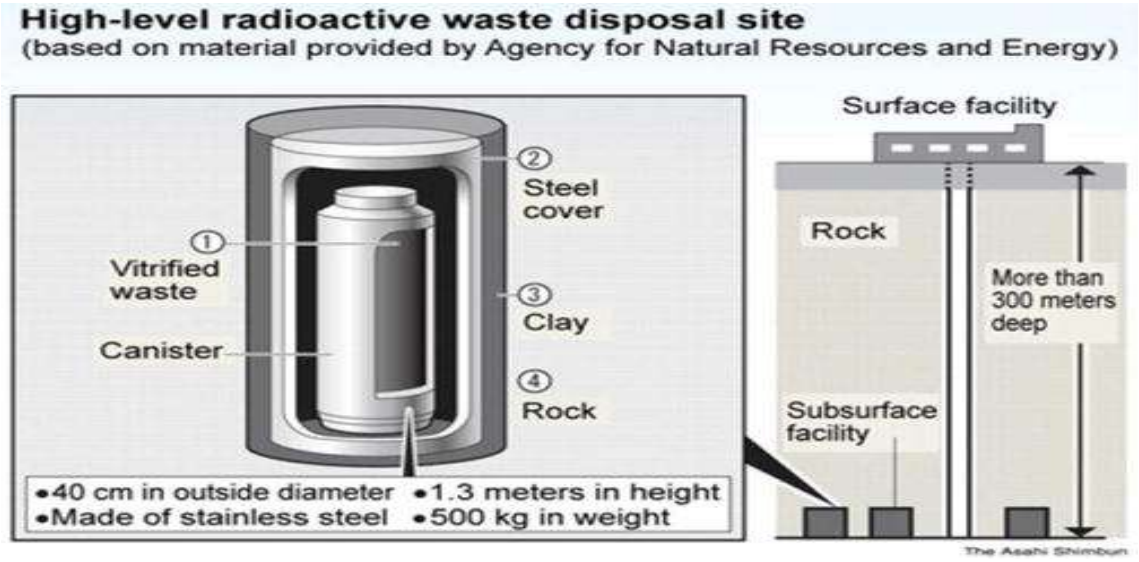
contaminants into potential potable water aquifers. In order to force the liquid into the pores and fissures of the rock, high pressures are applied. The rock unit selected are of porous and permeable (commonly, sandstone or fractured limestone), and must be separated by low permeability layers (for example, shale) above and below. Deep-well injection is a cost effective and requires little or no pretreatment of the waste, but it poses a danger of leaking hazardous waste and eventually polluting underground water resources. (Krishnaswamy Kanagamani, 2020)

Figure (2.3) Deep Well Disposal Method



Source: Environmental Issues and Sustainable Development Book (2020)

Figure (2.4) Bedrock Disposal Method



Source: Environmental Issues and Sustainable Development Book (2020)

2.6.6 Bedrock disposal

Bedrock disposal is mainly meant for solid hazardous waste and a variety of bed rock types are being investigated as host rocks. The design of a bedrock disposal site or repository for hazardous wastes is shown in Figure (2.4). It is based on the multiple barrier (or multi barrier) concept: surrounding solid hazardous waste sealed with several different types of materials to prevent waste leakage or invasion by ground water. A major concern is the nature of the host rock as well as some potential drawbacks. The method is widely used for high-level radioactive wastes. Sealed into stainless steel canisters, or spent fuel rods encapsulated in corrosion resistant metals such as copper or stainless steel and buried in stable rock structures deep underground. Many geological formations such as granite, volcanic tuff, salt, thick basalts such as the Columbia River plateau basalt or shale will be suitable. (Krishnaswamy Kanagamani, 2020)

2.7 Proposed practices of COVID-19 wastes management and disposal

Many countries have existing rules and procedures for the disposal of medical wastes from hospitals and households. Some adjustments to the waste management practice have been made during the COVID-19 pandemic period.

2.7.1 Waste generation, handling, and storage

The restricted movement order and lockdown policy have affected the generation of wastes including medical wastes and MSW. The medical wastes generated in hospitals and health care facilities are aligned with the number of infected patients. These wastes are handled as common medical waste followed by the procedure practiced in general hospitals. However, it is suggested that COVID-19 related medical wastes should be packaged with double-layer medical waste bags and labeled as “COVID-19 infection” (Peng et. al., 2020). The surface of bags should be decontaminated by spraying chlorine-containing disinfectants before placing them into a medical container (Wang et. al., 2020). The generated waste from the infected homes should be double-layer packaged and sealed before storing them in collection bins.

The total lockdown has increased the generation of household food wastes and single-use plastics including plastic-based PPEs and packaging materials. In a typical household with COVID-19 infection, all wastes should be treated as non-recycled wastes since the recycling activities should be avoided to prevent the potential infection from wastes. In developed countries, recycling waste is well-managed and standardized by formal sectors including government or specialized enterprises. However, in most developing countries that have relatively low- or middle-income and no strict regulations, the waste recycling activity is done by both formal and informal sectors. The informal sectors may face some problems in terms of their health and livings by enforcement of lockdown and economies slow down. Thus, the best management practices play an important role in handling such waste and mitigating waste worker’s exposure to infectious wastes. The food waste and its packaging material from suspected or confirmed COVID19 patients should be carefully handled, such as stored in double layers and biodegradable bags. The PPE and other self-health care products should be treated as hazardous or infectious wastes that need to be kept in double-lined sealed bags with a specific COVID-19 symbol. (D. Hantoko et. al., 2021)

2.7.2 Waste treatment or final disposal

As the easiest method for the centralized destruction of pathogens, incineration can be prioritized for treating all infectious wastes. A high temperature of the incineration process can not only destroy the pathogens but also incinerate the organic materials and convert them into inorganic substances. The mass and volume of waste can be reduced by approximately 85–90% (Wang et al., 2020). For the incineration of hazardous waste, the produced ash is suggested to be disposed of in a special landfill. If the hazardous waste incinerator achieves the maximum capacity, co-disposal of COVID-19 related wastes with MSW can be done in the MSW incinerator. However, technical modification such as the improved design of the feeding may be required. On the other hand, the area with limited centralized treatment facilities or no thermal treatment facilities should adopt deep burial of COVID-19 wastes in secured landfills. Direct handling of contaminated wastes in the COVID-19 spots should be completed by skilled and protected workers. Local governments should monitor and advise their citizens to take responsibility. The recycling work should be reduced by doing proper home segregation and always follow the update of guidelines for handling COVID-19 wastes. The awareness of the people in waste management during the pandemic must be strengthened by intensifying good communications and awareness campaigns. (D. Hantoko et al., 2021)

2.8 Challenges of Waste Management during the COVID-19 Outbreak

The COVID-19 pandemic also greatly affected the quality and quantity of the generated wastes including MSW and medical wastes. Due to the lockdown implementation by the government authorities, there are potential changes in the source and volume of solid waste generation (SWANA, 2020). An increase in food waste generation during the COVID-19 crisis might be due to the limitation in storage, overcooking habits, and overbuying (Jribi et al., 2020). In both India and Singapore, a huge amount of fresh fruits and seasonal crops were wasted due to the sudden lockdown policy (Channel News Asia, 2020; FAO, 2020). During the lockdown period, most of the eating places around the have been temporarily closed

to ensure social distancing. Consequently, there is a significant increase in the demand for food delivery services and online groceries which likely caused a surge in packages such as plastics and papers. Fig. 1 shows the demand for plastics by segment. During the COVID-19 pandemic, the packaging materials (44.8%) and others (13.20%) including medical stuff are projected to increase due to the demand for PPE, food delivery service, and online groceries.

The demand for plastics in the medical sector includes face shield (Polypropylene (PP)), vinyl gloves (Polyvinylchloride (PVC)), disposable bags, tubes, masks (non-woven material, such as spun bond and melt blown spun bond) (Klemeˇs et al., 2020; Prata et al., 2020). The huge demand for delivery services and online groceries may increase the common packaging materials such as Low-Density Polyethylene (LDPE), High-Density Polyethylene (HDPE), Polypropylene (PP), Polyethylene Terephthalate (PET), Polystyrene (PS), etc. Unfortunately, the recycling activities of plastic wastes have been reduced due to the COVID-19 pandemic, resulting in a great challenge in plastic wastes management (Tenenbaum, 2020). Even though this surge is unavoidable, the environmental protection approaches should be taken into account during and after the COVID-19 pandemic (Kleme et. al., 2020; Patrício Silva et al., 2020). Particularly, the fully developed plastic waste management strategies are required to assist the system design, footprints, and comparison alternatives. The concept of Plastic Waste Footprint (PWF) can be introduced to capture the environmental burdens of plastic products throughout their life cycle (Kleme et. al., 2020).

Many infectious wastes are produced during the COVID-19 pandemic. The source of contaminated wastes is not only produced from the health facilities including hospitals and temporal medical facilities but also generated by household and quarantine center facilities. Home isolation and quarantine center facilities are common practice in many countries to deal with suspected patients of COVID-19. Home isolation has been used for patients with mild symptoms or travelers for at least 14 days. So that hospitals can be prioritized for severe case patient who needs intensive medical treatment. This approach is believed to control the COVID-19 outbreak; however, it may present new and crucial challenges for waste management and treatment. It is indicated that wastes resulting from households and quarantine

facilities with suspected or positive COVID-19 cases may contain viable COVID-19 virus and possibly be a source of infection.

Based on the Association of Cities and Regions for Sustainable Resource Management (ACRPlus, 2020), the waste collection shall be delayed for 72 h to avoid the life span of COVID-19 in the environment. The collected wastes need to be directly transferred to incinerators or landfills without any separation. Households with suspected or positiveCOVID-19 cases are suggested to limit the use of separate waste collection systems. Consequently, it increases the generation of mixed wastes. However, the implementation of the proposed waste management practice is still challenging, not simple, and needs excellent coordination among health authorities and the waste service sectors. In most developing countries, solid wastes including MSW are discharged in open dumping or in unsanitary landfills where waste scavengers without wearing personal protective tools are working for collecting recyclable materials (Nzediegwu and Chang, 2020). Besides, it is well-known that poorly managed landfills are recognized as a "food source" for livestock e.g., cows, goats, and dogs which may increase the spread of diseases including COVID-19. Inadequate decontamination and disposal of plastic bottles used for packaging drinks in healthcare and quarantine facilities may be another potential source of virus transmission in developing countries.

2.9 COVID-19 Awareness

The public adherence regarding diverse measures about the COVID-19 differs from country to country, and while the nature of the pandemic changes, it is important that the information and advice remains constant. Mostly noted in the early stages of the pandemic, and in some cases even in countries that were being hit hard by it, it was possible to notice some people roaming freely without following precautionary measures such as social distancing, and wearing masks (Alanezi et al., 2020). Margraf et al. (2020) proceeded with a social analysis which showed that COVID-19 safety measures acceptability depends in a big way on how each country faces this threat. In this same study the authors give the example of countries like Germany and France, which from the beginning established mandatory lockdowns and frequently tried to educate their population on how to behave.

In these two countries, 77,4% of the participants rated the high level governmental measures as useful and 91,7% reported adherence to them, where in countries that showed ambivalent attitudes towards the measures and where people felt particularly left alone and not well supported, like in Russia and Poland, adherence was lowest (Margraf et al., 2020). Margraf et al. (2020) assume that the perception of constructive public communication by governments and authorities predicts a higher usefulness evaluation of the measures and greater adherence. They also find it important that the introduced measures should not be perceived as 17 an annoying obligation enforced by the authorities, without any or few concerns towards the population and their needs and rights.

Economic factors are also taken into consideration in this study, as many individuals were economically affected by the lockdowns and these might disagree with the measures and might question them as they are being negatively affected, therefore show fewer adherences. Another factor that Margraf et al. (2020) considered to be important regarding the acceptance of imposed or suggested measures is the mortality ratio in countries and individual medical history. They concluded that individuals who are predisposed to health problems show better adherence to preventive measures and countries with higher mortality ratio also show higher acceptance since there is a clear understanding that their vulnerability is higher. Tsukiji et al. (2020) have defined some training and capacity building actions to be helpful towards increasing COVID-19 awareness in society.

Such actions are based on principles like enforcing education and training programs for healthcare professionals, regarding safe waste handling procedures and raising awareness on developing a healthy working environment for healthcare waste workers, for example: all workers must be trained on risks of exposure to the virus; strategies to reduce human interaction and ensure distance between workers at work; implementing precautionary measures such as demanding that sick employees stay at home (prior to receiving a positive or negative COVID-19 test) and employees notifying their company if a family member is sick. Awareness raising for the public is also very important and could show positive results in terms of lowering the infection ratio. Tsukiji et al. (2020) consider the following measures to be required:

- Development of guidelines on handling, treatment and disposal of waste generated during the quarantine of a COVID-19 patient.

- Development of media for hygiene practice and safe handling of waste management.
- Disposal must be in designated places only, to avoid formation of uncontrolled dumpsites. Assuring a flow of proper communication, regarding ways to deal with the virus will also help to reduce the infection ratio.

This concern is shown by Margraf et al. (2020), stating that effective communication by national governments and authorities, provide proper and credible information on the seriousness of the virus. 18 Although it is important to ensure a flow of information regarding the developments of the virus and the pandemic, it is also important to mind the credibility of the information, to avoid any possible negative impacts. Alanezi et al. (2020) believed that it is very important that accurate and reliable information is disseminated to the public through verified sources and the spread of any misinformation must be effectively contained to prevent any loss. Alanezi et al. (2020) also found that creating public awareness regarding diseases such as COVID-19 is one of the effective approaches for controlling the spread of this virus.

They also stated that because the information about this virus the precautionary methods and treatment may vary, therefore it is important to have timely updates about the pandemic and the preventive care to be disseminated among the public in order to contain the transmission of infection. Acquiring some simple knowledge about the virus will also help to further process more complicated information. For example, in a study in Saudi Arabia, 86.31% of the participants identified the incubation period to be ranging from 5 to 14 days, while 12.68% stated they did not know, and 6% stated to be 21 days, and finally, 18% of the participants believed that there are certain myths circulating online, which are not officially confirmed or declared by the governments or healthcare organizations (Alanezi et al., 2020).

These simple to understand facts will only bring more positive results within our society, as information such as this serves its purpose of not letting people take certain risks by being misinformed or uninformed. Each country is subject to different scenarios facing this pandemic, since the outcome of the spreading depends on multiple factors, such as population density and distribution, geographical display,

and economical capacity. While healthcare facility workers are mostly accustomed to handle hospital and healthcare centers waste, additional capacity building and awareness rising is urgently needed for households.

2.10 Reviews on Previous Studies

Many studies of applied and theoretical research concerning hazardous waste management have been conducted to find challenges and practices during Covid-19 pandemic. There are many research papers about waste management.

Dwi Hantoko, Xiaodong Li, Agamuthu Pariatamby, Kunio Yoshikawa, Mika Horttanainen, Mi Yan (2021) studied challenges and practices on waste management and disposal during COVID-19 pandemic. The finding shows that the ways the operation of those facilities must be improved to cope with the challenge of handling medical waste, as well as working around the restrictions imposed due to COVID19. The study also highlights the need for short, mid, and longer-term responses towards waste management during the pandemic. Furthermore, the practices discussed in this paper may provide an option for alternative approaches and development of sustainable strategies for mitigating similar pandemics in the future.

Besides, Abdul Mohammad Rafiq Khan, Zehra Raz (2011) examined Socio-Economic Impact of Improper Hospital Waste Management on Waste Disposal Employees. The findings show that the improper disposal of hospital waste lead to disease in 45 hospital waste collectors. Eighteen waste collectors were infected with respiratory diseases, 14 with skin infection, 7 with tuberculosis and 6 with hepatitis. Only 8 workers were provided with special clothes by the hospital management. The chances of getting infection was high in those who were not provided with special clothes like, gowns, gloves and shoes as compared to those who were provided with these. The total cost of recovery for these diseases also varied with an amount of Rs. 68,340 for the treatment of hepatitis, Rs. 3,150 for tuberculosis, Rs. 1,500 for respiratory diseases and Rs. 1,000 for skin infection. Only 12 workers were given a small remuneration ranging from Rs. 100-400 per month as compensation from the hospital administration. Use of protective clothing by the hospital waste disposal collectors can significantly reduce their exposure to the diseases.

Joao Machado Ferreira (2021) highlighted the impact of COVID-19 on waste management: Societal responses to waste during the pandemic. The findings showed that municipal governments and their respective countries are subject to factors like geographic limitations, population density and social diversity, which directly affect the process of waste management, however there are similarities in the approaches followed. It was also noted that the way to obtain positive results in this waste management process does not depend unilaterally on the intervention of the government nor the social behavior, but the cooperation between both parts. Lastly it was also noted that all the countries must invest in environmental education and conscientization, so the citizens can understand from early on, the impacts that their habits can have on the environment.

Minas Minoglou, Spyridoula Gerassimidou and Dimitrios Komilis (2016) explored healthcare waste generation worldwide and its dependence on socio-economic and environmental factors. The findings showed that the examination of the normality of the data and the formation of linear multiple regression models to further investigate the correlation between those indices and HCW generation rates. Pearson and Spearman correlation coefficients were also calculated for all pairwise comparisons. Results showed that the life expectancy, the HDI, the mean years of schooling and the CO2 emissions positively affect the HCW generation rates and can be used as statistical predictors of those rates. The resulting best reduced regression model included the life expectancy and the CO2 emissions and explained 85% of the variability of the response.

Krishnaswamy Kanagamani, P. Geethamani and M. Narmatha (2011) examined hazardous waste management. The findings show that hazardous waste is the waste that poses substantial or potential threats to public health and the environment. Rapidly growing industrial sector has contributed to the generation of large quantity of hazardous waste material. Therefore, to reduce environmental hazard, proper attention is required during storage, segregation, transportation and disposal of hazardous waste, because it cannot be disposed as off in the environment. This study explains about hazardous wastes, types and management.

Khaing Zar Yee (2019) examined overview of health care waste management in Myanmar. The findings show that the main challenges hindering the current solid waste management system in Myanmar include landfill relocation and limited data,

inadequate enforcement of laws, weak public participation, and economic and technological aspects. Along with the challenges, the private sector is participating significantly, which helps encourage life style changes towards more sustainable practices.

Currently, there are no other studies that have integrated on the challenges and practices for hazardous waste management during Covid-19 pandemic in Nay Pyi Taw. The purpose of this academic work is to study hazardous waste management in Nay Pyi Taw and to analyze the challenges and practices on hazardous waste management during Covid-19 pandemic. Thus, this study will help hazardous waste management of Nay Pyi Taw Development Committee.

CHAPTER 3

OVERVIEW ON HAZARDOUS WASTE MANAGEMENT IN ZABUTHIRI TOWNSHIP

3.1 Profile of Zabuthiri Township

The Naypyitaw Union Territory is an administrative division in central Myanmar and 70,571 km2 in area. It contains Naypyitaw, the capital city of Myanmar. The Naypyitaw Union Territory consists of 2 districts and 8 townships. They are

(1) Ottara District

- Ottarathiri Township
- Pobbathiri Township
- Tatkone Township
- Zeyarthiri Township

(2) Dekkhina District

- Dekkhinathiri Township
- Lewe Township
- Pyinmana Township
- Zabuthiri Township

Zabuthiri Township is located in south of Mandalay Region. The official name of the city was announced on 27th March 2006. It is 9.5 miles long from east to west and 4.4 miles long from south to north. Zabuthiri Township was bounded East of Pyinmana Township and south and west of Dekkhinathiri Township, and north of Ottarathiri Township and Pobbathiri Township.

Zabuthiri Township was organized in the former of Pyinmana and Lewe, that included 12 wards, and 2 village groups. In Zabuthiri Township, forest conservation land reforms have been conducted by Landscaping groups for greening in Nay Pyi Taw, maintenance works watershed to prevent water shortages in pools for the Township. According to Nay Pyi Taw Council report (2019), 8851 houses, 26332 households, 12 wards are in urban area. 1339 houses, 1338 households,2 village

groups and 4 villages are in rural area. Totally, there are 10190 houses, 27670 households, 12 wards, 2 village groups and 4 villages in Zabuthiri Township

The population of Zabuthiri Township was 99,617 in 2018-2019 fiscal years. Male and female ratio is 1:1 in 2018-2019. Zabuthiri is one of the economic development townships where 59.73 percent of residents have been working as civil servants, 2.94 percent as services, 2.26 percent as agriculture, 0.17 percent as livestock, 3.68 percent as trading, 1.96 percent as industry,and 26.07 percent as fisheries and odd-job as 3.19 percent. In 2017-2018 fiscal years, the per capita income of the township was 2,500,779 kyats. In that area, there are 99,617 populations and 8,100 of them are using phones which are made up of 8.13% of total phone usage and the poverty rate is 2.38%. In Zabuthiri Township, the number of people who could work is 87,179 workers and 81,506 workers in the workforce. The unemployment rate is 6.53 percent as there is 5,631 unemployed people. The garbage production in Zabuthiri Township is 21.45 tons per day. The rate of household garbage production is 2.585 kg in Zabuthiri Township.

3.2 The Naypyitaw Development Committee (NPTDC)

The Naypyitaw Development Committee is the administrative body of Naypyitaw, the administrative capital of Myanmar. NPTDC is separate from the Naypyitaw Council. NPTDC was established by State Peace and Development Council, under the Naypyitaw Development Law, which was issued on 29 December 2009. This Law gave NPTDC a ministerial status as well as a wide range of duties and responsibilities, including urban planning, urban sanitation and environment in Naypyitaw. It is the principal agency responsible for planning, development, infrastructure provision and operation of municipal services in Naypyitaw. Consisting of 5 to 9 members, it is led by a Chairman who acts as the Mayor, and a Vice-Chairman who acts as the Vice-Mayor.

The Naypyitaw Development Committee is organized with (21) Departments, as followings:

(1) Mayor Office

(2) Administration Department

(3) Budget and Accounts Department

(4) Inspection Department

(5) Co-ordination Department

(6) Assessor Department

(7) Revenue Department

(8) Markets Department

(9) Veterinary and Slaughter House Department

(10) Pollution Control and Cleansing Department

(11) Engineering Department (Roads and Bridges)

(12) Engineering Department (Buildings)

(13) Engineering Department (Water and Sanitation)

(14) Motor Transport and Workshop Department

(15) Central Stores Department

(16) Playgrounds, Parks and Gardens Department

(17) Department of Health

(18) Security and Disciplinary Department

(19) City Planning and Land Administration Department

(20) Public Relations and Information Department

(21) Production Department

In addition, there are three organizations under control and management of NPTDC, which are Zabuthiri Specialist Hospital, Cement Factory (Naypyitaw) and Brick Factory (Naypyitaw).

Under NPTDC, Pollution Control and Cleansing Department undertakes the responsibilities for environmental quality management within Naypyitaw area including waste management according to the Naypyitaw Development Law (2009). By-law regarding the environment conserving and cleansing work within the border in the Naypyitaw Development Area, the rules and regulations for management control are promulgated on 21 March of 2016 with notification 44/2016.

3.3 Duties and Responsible of Pollution Control and Cleansing Department

The Pollution Control and Cleansing Department is responsible for keeping the city clean and tidy. The duties and responsible of that Department are as follows:

(1) Sweep, collect and transport the waste from roads and streets in the townships that have to pay tax accuracy of waste within the boundary area of the Nay Pyi Taw Union Territory.

(2) Plan and manage suitable waste collection systems for disposing waste in taxed townships and wards.

(3) Designate disposal places, construct brick tanks and keep waste bins in order to carry out the designated collection systems regularly.

(4) Guide to clean the waste in non-tax accuracy of government buildings, compounds and campus, and to discard the waste in designated places.

(5) Manage to dispose the collected waste at final disposal sites.

(6) Open the advanced public toilets with charges.

(7) Designate and manage cemeteries for burial and cremation systematically.

(8) Supervised and monitor necessary preventive ways for water pollution, air pollution, soil pollution and noise pollution, and directive for essential additional conducts and take action with current Laws and Regulations in order to prevent environmental pollution.

(9) Submit to buy necessary equipment, garbage trucks and international standard dust bins, to maintain, use and record them systematically. Take action for irresponsible dumping according to Laws, By-laws and directive.

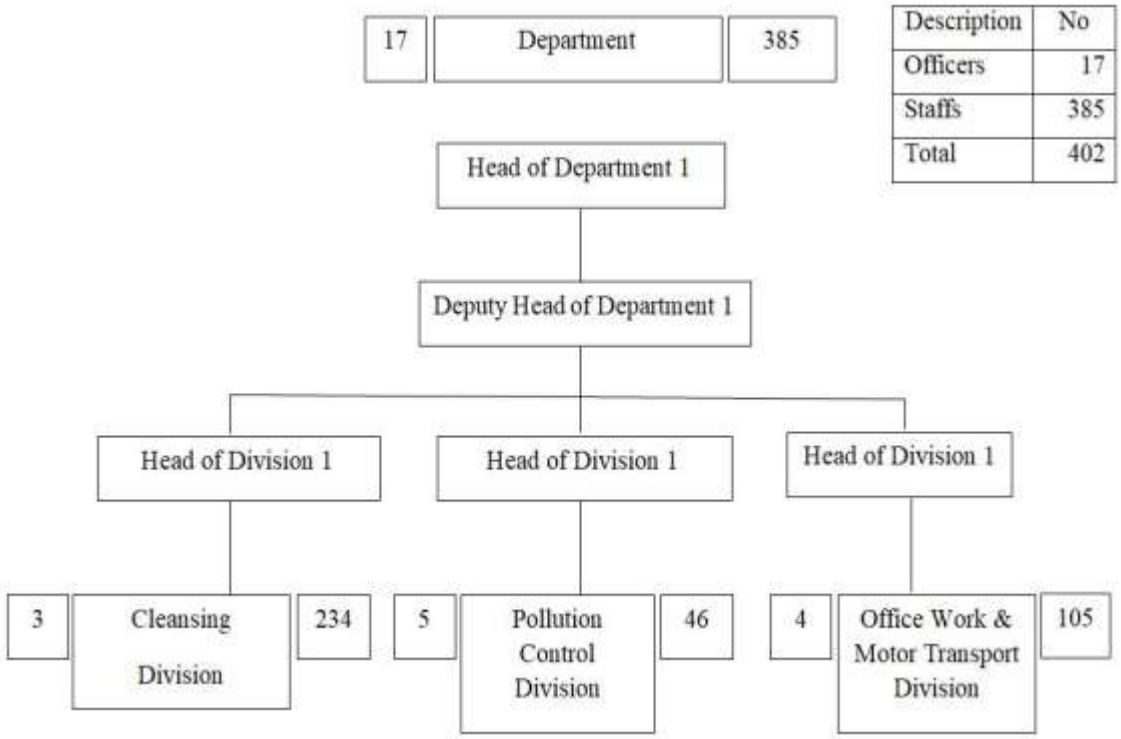
(10) Give public information, campaign, awareness to discard waste systematically and to obey the system of discarding the waste separately such as dry waste and wet waste.

(11) Supervise the enterprises which can make department's income.

3.4 Organizational Structure of Pollution Control and Cleansing Department

Under the NPTDC, Pollution Control and Cleansing Department (PCCD) is the responsible agency for waste management in Nay Pyi Taw. Organizational structure of PCCD in NPTDC is shown in Figure (3.1).

Figure (3.1) Organizational Structure of PCCD in NPTDC



Description	No
Officers	17
Staffs	385
Total	402

Source: Nay Pyi Taw Development Committee (2021)

There are one head of department, one deputy head of department and three head of division. Director General supervises all the staffs and divisions of Pollution Control and Cleansing Department (PCCD). Moreover, there are 237 staffs in cleaning division, 51 staffs in pollution control division and 109 staffs in office work and motor transport division. Totally, there are 17 officers as well as 385 staffs in Pollution Control and Cleansing Department (PCCD).

3.5 Tax and Fee Collection System

Pollution Control and Cleansing Department collects two types of waste collection: waste tax system and waste collection fee. Waste tax system is based on the percentage of properties tax and properties tax is levied depending on the type of

building and location. However, fees for waste are charged based on the volume of waste. Kitchen waste from households is collected by waste tax system. Assessor Department of Nay Pyi Taw Development Committee is collected waste tax once a year and it is assessed and collected according to the system based on the percentage of properties tax.

Pollution Control and Cleansing Department collects waste collection fee in on-call system. An on-call system is a system in which residents or business men who want to dispose of their waste can call the relevant department with the phone or in person. It is a system that collects waste collected by the department and pays fee for the collection of waste. Oil and labor costs will be charged by the renters for the collection of waste according to on-call system. Fee rates collected by the Pollution Control and Cleansing Department through on call system are shown in Table (3.1).

Table (3.1) Fee Rates Collected by the Pollution Control and Cleansing Department through On Call System

Sr. No.	Categories	Fee Rates (Kyats)
1	Restaurants, Hotels, Motels and Other Businesses	30000
2	Government Departments	20000
3	Hospitals and Clinics	
	(a) Public Hospital (Hazardous Waste)	35000
	(b) Public Hospital (Normal Waste)	20000
	(c) Private Hospital (Big)	35000
	(d) Private Hospital(Small)	30000
	(e) Clinic and Laboratory	15000

Source: Nay Pyi Taw Development Committee (2021)

3.6 Waste Disposal Management System

Public awareness is an important tool for increasing public participation in sustainable hazardous waste management programs. It is the key to successful hazardous waste management and considered a critical component in any hazardous

waste management program apart from appropriate legislation, strong technical support, and adequate funding. Having a proper waste management can result in the availability of valuable materials to reuse. This can save money while potentially creating new jobs and business opportunities. Reducing, reusing and recycling waste are important for the environment, but it can also be profitable.

In general, the current waste collection system includes primary and secondary collection. The primary waste collection system (door-to-door collection) is particular labor-intensive activity making use of bell ringing method while secondary collection system is the collection of waste from secondary waste collection stations performed mainly with tipper trucks (dumpers), garbage trucks and arm-roll trucks. There are bell ringing systems conducted by garbage vans in all wards and townships of Naypyitaw Union Territory. PCCD department collects the kitchen wastes daily by bell ringing system. A solid waste collection truck with one or two workers for handling waste moves along a predetermined route, at regular hours in making its daily rounds of collection and disposal. At the signal of the Restricted Restricted 14 bell, the households discard the kitchen wastes from their homes to the garbage truck when it arrives. The handling workers load the wastes onto the vehicle. When the truck is full, it takes off to the dumping site.

The wastes of households in the civil servants' quarters are collected in every evening office day and in the morning of holidays. These are collected every morning in the other. Collection waste system is performed by 125 vehicles as shown in Table (1). Road sweepers are used for cleansing of main roads in Naypyitaw Union Territory. Bin containers are placed in the crowded places such as Thazin/Thabyay Hostels, crowded wards such as Mingalar Theikdi, Dana Theikdi, Bala Theikdi, Nyarna Theikdi, Thukha Theikdi, Wanna Theikdi, Bawga Theikdi and Pyinyar Theikdi, Pyinmana Township, Lewe Township, Takkone Township, and Sibin Housings. Distribution of waste bins by PCCD is described in Table (2). Hotels, supermarkets, restaurants, companies, cinemas, nongovernment organizations and offices pay the renting fees the vehicles fixed by on call system at PCCD when they need to collect the garbage separately. Photographs of conducting solid waste management by PCCD of NPTDC can be seen in Appendix.

NPTDC is carrying out to dispose the waste separating as dry waste and wet waste from Sibin Housings and Kantkaw Housings, the civil servants' housing

compounds, in Naypyitaw Union Territory. Wet waste means kitchen wastes (food waste, vegetables and meat) are collected every day. Dry waste such glass Restricted Restricted 15 bottles, iron/metal boxes, variety of plastic and paper wastes are collected every Sunday, Wednesday and Friday. Although NPTDC conduct Solid Waste Management collection vehicles, residents of staff housings and wards discard the garbage on the places of the streets for not having a chance to keep waiting the collection vehicles coming to collect wastes. The resident citizens are responsible to inform the department, so that in section can be made by responsible officers from PCCD, collecting the illegal wastes daily from where those are disposed.

Easily-decayed wastes from markets, vegetables pieces are collected, separately and generated to reuse swapping into natural fertilizers by naturally breed system (earthworm). Market wastes are daily disposed in the Arm roll containers and collected as secondary waste collection system. In Naypyitaw Union Territory included Zabuthiri Township, Pobbathiri Township, Ottarathiri Township, Dekkhinathiri Township, Zeyarthiri Township, Pyinmana Township, Lewe Township and Tatkhon Township, wastes from hospitals and clinics are transported by paying fees for collection. There are (11) Public Hospitals, (12) Private Hospitals, (45) Clinics and (12) Laboratories which have been waste-collected by On Call System in Naypyitaw Union Territory. In (11) Public Hospitals, a general hospital (1000 bedded), a general hospital (300 Restricted Restricted 16 bedded), a general hospital (200 bedded), two general hospitals (100 bedded) and others (6) hospitals include.

PCCD collects medical waste from every hospital , clinic, laboratory and medical shop on a daily basis by two special waste vehicles for medical waste while kitchen waste from those are collected daily by normal garbage trucks. Sharp wastes from hospitals such as needles, bottles, and syringes are incinerated at final disposal site in Pobbathiri Township. Remaining of those wastes like ashes is dumped in concrete waste collection tanks. The general wastes are buried (by means of landfill method) in final disposal site, while hazardous wastes such as bandages and laboratory wastes are burned in Gwaytgyi cemetery.

There is 500-700kg per week sharp waste from healthcare facilities which has incinerated systematically in final disposal site by Incinerator (Inciner-8, M250) imported from England since December 2021. Though there is inadequate information on the current level of hospital and health clinic waste generation in the

country, PCCD of NPTDC estimates that the average waste of those health care facilities generally comprises of 30-45 tons per month and 360-540 tons per year in Naypyitaw Union Territory. The garbage production in Naypyitaw Union Territory is 282 tons per day. The 520 cleansing workers are servicing with 125 garbage trucks and annual Restricted Restricted 17 income is 243,058,550 kyats. The rate of household garbage production is 2.585 kg. Table (3) summarized the waste generation and collection in Naypyitaw Union Territory.

Naypyitaw Environmental Conservation Department investigated and estimated the type and amount of recyclable waste collected by randomly selected 23 informal recycling shops in Naypyitaw in May 2020 by using face to face interview. According to the results, the average estimated total waste amount collected by 23 recycling shops per day was 1,798kg including plastic (28%), cardboard (11%), metal (16%), paper (8%), Aluminum (1%), glass (33%), tins and cans (2%), and e-waste (1%). Only the garbage collection work costs 55.3 million kyats per month for 8 townships which is estimated by PCCD of NPTCD. Generally one ton of garbage costs about 7500 kyats (excluding costs for vehicles and machineries). There are 243 million kyats and 665 million kyats of revenue and expenditure respectively in the work of garbage collection.

There are 247 part-time employees and 112 permanent employees for waste collection and disposal in the township. 32 cars are used to collect waste during the Covid-19 pandemic, 2 of these are used for hazardous waste and hospital waste.

CHAPTER 4

ANALYSIS OF CHALLENGES ON PRACTICES TOWARDS HZARDOUS WASTE MANAGEMENT

This chapter presents an analysis and discussion of the study. There are six sections in this chapter. They are survey profile, characteristic of respondents, awareness and practices concerning with hazardous waste management, analysis of affecting factors and practices on hazardous waste management, correlation analysis of affecting factors and practices on hazardous waste management and multiple regression analysis of affecting factors and practices on hazardous waste management.

4.1 Survey Profile

Many people produce hazardous waste and it's vital that it is properly disposed of in order to prevent potentially damaging effects. Hazardous waste poses a threat to humans, wildlife and our environment. Therefore, hazardous waste management is important to have an effective waste management. The process typically begins with transport, when waste is sent to a separate facility or company for management. Transport is carefully monitored, and many countries require careful documentation every step of the way. Next, waste is often treated to reduce the quantity, prepare it for recycling and/or to lower toxicity levels. Treatment methods are diverse, and may include burning, chemical reprocessing, bacterial biodegradation or physical solidification, among other methods. This survey was mainly carried out commercial restaurants in Zabuthiri Township. There were collected 150 among 359 staffs and workers of Pollution Control and Cleansing Department under Nay Pyi Taw Development Committee (NPTDC) will be selected and asked by questionnaire to assess the challenges and practices on hazardous waste management. The questionnaire consists of three sections. The first section focuses on the respondents' personal information and the second section is awareness and practices concerning with hazardous waste management. The last section is challenges and practices on hazardous waste management.

In this section, the survey analysis is mainly focused on the analysis the challenges and practices on hazardous waste management during Covid-19 pandemic. In this chapter, initially, respondents' personal information is interpreted to broadly understand the different characteristics of a population with 150 respondents. Before analyzing the data, the reliability test is undertaken by using the SPSS software. Then, the first section of this chapter covers the descriptive analysis of the respondents' general information. In the second section, Pearson's correlation coefficient is tested to measure the statistical relationship between the independent variables and the dependent variable. Lastly, regression analysis is conducted to mathematically sort out the challenges and practices on hazardous waste management during Covid-19 pandemic.

4.2 Characteristic of Respondents

This section of the questionnaire includes respondent's characteristics of respondents such as gender, age group, marital status , occupation, education, average monthly income, work experience, type of accommodation, type of commercial, monthly business income, number of family number, age of family number, total monthly income of family and condition extra income are presented. Table (4.1) presents personal information of the respondents.

Table (4.1) Personal Information of the Respondents

Particular	Number	Percentage
Gender		
Male	61	40.7
Female	89	59.3
Total	150	100.0
Age (Years)		
Up to 20	5	3.3
21 to 30	37	24.7
31 to 40	78	52.0
41 to 50	26	17.3
Over 50	4	2.7
Total	150	100.0

Marital Status		
Single	54	36.0
Married	86	57.3
Window	6	4.0
Divorce	4	2.7
Total	150	100.0
Occupation		
Staff	102	68.0
Worker	48	32.0
Total	150	100.0
Education		
Illiterate	53	35.3
State school student	15	10.0
College / University	2	1.3
Graduate	75	50.0
Postgraduate	5	3.3
Total	150	100.0
Average monthly income		
Up to 150,000 Ks	45	30.0
150,001 Ks to 250,000 Ks	90	60.0
250,001 Ks to 350,000 Ks	14	9.3
350,001 Ks to 450,000 Ks	1	.7
Total	150	100.0
Work Experience		
Under 1 year	6	4.0
1 year to 5 years	46	30.7
6 years to 10 years	29	19.3
11 years to 15 years	46	30.7
16 years to 20 years	13	8.7
Over 20 years	10	6.7
Total	150	100.0

Number of Family Member		
None	12	8.0
1 to 5	123	82.0
Over 5	15	10.0
Total	150	100.0
Age (Years) of Family Member		
None	39	26.0
Under 18 Years	21	14.0
Above 18 Years	90	60.0
Total	150	100.0
Number of People who Work in Family		
None	24	16
1 to 3	113	75.3
Over 3	13	8.7
Total	150	100.0
Total Monthly Income of Family		
None	2	1.3
Up to 200,000 Ks	24	16.0
200,001 Ks to 400,000 Ks	83	55.3
400,001 Ks to 600,000 Ks	27	18.0
Over 600,001 Ks	14	9.3
Total	150	100.0
Condition of Extra Income		
Yes	31	20.7
No	119	79.3
Total	150	100.0
If there have extra income, kind of job		
Nothing	119	79.3
Part –time job	27	18.0
Shopkeeper	4	2.7
Total	150	100.0

If there have extra income, the amount of extra income		
Nothing	119	79.3
50,001 Ks to 150,000 Ks	21	14.0
150,001 Ks to 300,000 Ks	10	6.7
Total	150	100.0

Source: Survey Data, (2022)

As shown in Table (4.1), the gender of respondents is categorized into two groups such as male and female. 40.7% of the respondents are male and 59.3% are female. It can be seen that the number of female respondents is larger than male respondents.

The age group of respondents is categorized into five groups such as Up to 20 years, between 21 and 30 years, between 31 and 40years, between 41 and 50 years and over 50years. The majority of the respondents are between 31 and 40years old, representing 52.0%. The second largest group contains 21 to 30 years which represent 24.7% followed by 17.3% of those from 41 to 50and up to 20 years and over 50 years have 3.3% and 2.7%. Therefore, the majority of the respondents are young adults aging between 31 and 40years.

According to the marital status, the majority of the respondents are married, representing 57.3%. The second largest group is single which represents 36.0% followed by 4.0% of those is window and 2.7% of respondents are divorce. It can be seen that the number of married respondents are over a half of all respondents.

Concerning occupation of the respondents, there are categorized into two groups. 68.0% of respondents are staffs and they represent the largest group. The second-largest groups are workers, and they represent 32.0% respectively.

Regarding education level, there are categorized into five groups such as illiterate, state school student, college / university and graduate and postgraduate. 50.0% are graduate level and they contribute the largest portion. Illiterate level is the second-largest portion with 35.3%. College / University level is the least portion with 1.3%. These data represent the respondents are involved of a large number of educated. Most of respondents earn monthly salary between 150,001 Ks and 250,000 Ks.

In terms of monthly income, 60.0% earn monthly salary between 150,001 Ks to 250,000 Ks as the largest group, 0.7% earn monthly salary from 350,001 Ks to

450,000 Ks as the smallest group. 30.0% earn monthly salary Up to 150,000 Ks and 9.3% earn monthly salary from 250,001 Ks to 350,000 Ks respectively. Over half of respondents earn between 150,001 Ks and 250,000 Ks.

Regarding work experience, the largest groups of respondents are 1 year to 5 years and 11 years to 15 years with 30.7%. 4.0% of respondents have the work experience less than 1 year, 19.3% are from 6 years to 10 years, 8.7% are from 16 years to 20 years, and 6.7% are Over 20 years of their work experience.

The Number of Family Member of respondents is categorized into three groups such as none, from 1 to 5 people and over 5 people. The maximum group is from 1 to 5 people in their family representing 82.0%. The minimum group is the respondents who have no any family members representing 8.0%.

According to age of family member, 60.0% are above 18 years. It is the largest group, 40.0% of respondents are under 18 years. According to number of people who work in family, 75.3% of respondents have 1 to 3 people and 8.7% of respondents have over 3 people. There is no work among family members.

According to total monthly income of Family, the majority of the respondents earn from 200,001 Ks to 400,000 Ks, representing 55.3%. The second largest group contains from 400,001 Ks to 600,000 Ks which represent 18.0% followed by 16.0% of those Up to 200,000 Ks. 9.3% of respondents earn over 600,001 Ks. 1.3% of respondents have monthly income of family.

Concerning condition of extra income, 79.3% of respondents have no extra income and they represent the largest group. The second-largest groups have extra income, and they represent 20.7% respectively.

18.0% of respondents work part-time job and 2.7% of respondents are shopkeeper. 79.3% of respondents have no extra income.

14 % of respondents earn from 50,001 Ks to 150,000 Ks and 6.7% of respondents earn 150,001 Ks to 300,000 Ks. 79.3% of respondents have no extra income.

4.3 Awareness and Practices Concerning with Hazardous Waste Management

Condition of awareness and practices concerning with hazardous waste management are stated by main information sources.

4.3.1. Respondents by Main Information Sources

The respondents by main information sources are classified into six groups such as local newspaper, TV, radio, social media, trainings from departments and campaigns. These categories are shown in Table (4.2).

Table (4.2) Respondents by Main Information Sources

Sr. No.	Types of Information Source	No. of respondents	Percentage
1	Local Newspaper	2	1.3
2	TV	30	20.0
3	Radio	5	3.3
4	Social Media	67	44.7
5	Trainings from Departments	17	11.3
6	Campaigns	29	19.3
	Total	150	100.0

Source: Survey Data, (2022)

According to the Table (4.2), it is found that majority of the respondents get the awareness for hazardous waste from social media, representing 44.7%. The second majority of the respondents receive from TV, representing 20.0%. 1.3% of respondents get information from local newspaper. It can be concluded that nearly half of the respondents receive Main information sources for awareness concerning with hazardous waste management from Social Media like Twitter, Instagram, Facebook and LinkedIn. Nowadays, some people do not watch TV, instead of this; they use mobile phone and search information in social media.

4.3.2 Key Factors for Respondents in Awareness Campaigns

Key factors which can promote action in awareness campaigns are classified into six groups such as Wash your hands regularly using soap and water, Scrub with alcohol based hand sanitizer, cover your nose and mouth with your elbow or a tissue, sterilize and safely dispose of the tissue immediately, Stay at least one meter (3 feet) away from people who are coughing, and Avoid crowded places. These categories are shown in Table (4.3).

Table (4.3) Key Factors for Respondents in Awareness Campaigns

Sr. No.	Awareness Campaigns	No. of respondents	Percentage
1	Wash your hands regularly using soap and water or scrub with alcohol-based hand sanitizer	80	53.3
2	If you cough, cover your nose and mouth with your elbow or a tissue.	7	4.7
3	Sterilize and safely dispose of the tissue immediately	3	2.0
4	Stay at least one meter (3 feet) away from people who are coughing	12	7.9
5	Avoid crowded places	48	32.1
	Total	150	100.0

Source: Survey Data, 2022

According to the Table (4.3), it is found that 53.3% of the respondents follow the regulation; “Wash your hands regularly using soap and water”, they represent the largest group. 32.1% of the respondents follow the regulation; “Avoid crowded places”, they represent the second largest group. 2.0% of the respondents follow the regulation; “Sterilize and safely dispose of the tissue immediately”, it is least group.

4.3.3. Respondents by Condition of Following Covid-19 Regulation

The respondents by condition of following covid-19 regulation are classified into six groups such as Wash your hands regularly using soap and water, Scrub with

alcohol based hand sanitizer, cover your nose and mouth with your elbow or a tissue, sterilize and safely dispose of the tissue immediately, Stay at least one meter (3 feet) away from people who are coughing, and Avoid crowded places. These categories are shown in Table (4.4).

Table (4.4) Respondents by Condition of Following Covid-19 Regulation

Sr. No.	Awareness Campaigns	No. of respondents	Percentage
1	Wash your hands regularly using soap and water or scrub with alcohol-based hand sanitizer	86	57.3
2	If you cough, cover your nose and mouth with your elbow or a tissue.	5	3.3
3	Sterilize and safely dispose of the tissue immediately	2	1.3
4	Stay at least one meter (3 feet) away from people who are coughing	10	6.7
5	Avoid crowded places	47	31.3
	Total	150	100.0

Source: Survey Data, 2022

According to the Table (4.4), it is found that 57.3% of the respondents follow the regulation; “Wash your hands regularly using soap and water”, they represent the largest group. 31.3% of the respondents follow the regulation; “Avoid crowded places”, they represent the second largest group. 1.3% of the respondents follow the regulation; “Sterilize and safely dispose of the tissue immediately”, it is a least group.

4.3.4 Respondents by Disposal Frequency during Covid-19 Pandemic

The respondents by disposal frequency are classified into three groups such as 1 to 2 times, 3 to 4 times and 5 to 6 times. These categories are shown in Table (4.5).

Table (4.5) Respondents by Disposal Frequency during Covid-19 Pandemic

Sr. No.	Awareness Campaigns	No. of respondents	Percentage
1	1 to 2 times	52	34.7
2	3 to 4 times	63	42.0
3	5 to 6 times	35	23.3
	Total	150	100.0

Source: Survey Data, 2022

According to the Table (4.5), it is found that 42.0% of the respondents are disposed from 3 to 4 times per week during Covid-19 period. 34.7% of the respondents are disposed from1 to 2 times per week and 23.3% of the respondents are disposed from 5 to 6 times per week.

4.3.5 Respondents by Condition of Separation on Hazardous Waste

The respondents by Condition of Separation on Hazardous Waste are shown in Table (4.6).

Table (4.6) Condition of Separation on Hazardous Waste

Sr. No.	Condition of Separation on Hazardous Waste	No. of respondents	Percentage
1	Yes	140	93.3
2	No	10	6.7
	Total	150	100.0

Source: Survey Data, 2022

According to the Table (4.6), it is found that most of the respondents are separated on hazardous waste; on the other hand, 6.7 % of respondents are not separated hazardous waste.

4.3.6 Types of Hazardous Waste

The types of hazardous waste disposal in common are classified into five groups such as infectious waste, pathology waste, human tissue or fluid, body parts, blood, and body fluids, sharps, chemical waste and pharmaceutical waste. These categories are shown in Table (4.7).

Table (4.7) Types of Hazardous Waste

Sr. No.	Awareness Campaigns	No. of respondents	Percentage
1	Infectious waste	113	75.3
2	Pathology waste, human tissue or fluid, body parts, blood, and body fluids	3	2.0
3	Sharps	26	17.3
4	Chemical waste	6	4.0
5	Pharmaceutical waste	2	1.3
	Total	150	100.0

Source: Survey Data, 2022

According to the Table (4.7), it is found that 75.3% of the respondent response that Infectious waste are common in hazardous waste. 17.3% of the respondent response that Sharps are common in hazardous waste. 1.3% of the respondent response that Pharmaceutical wastes are common in hazardous waste, they represent the least respondents group. It is assumed that waste collection workers have to collect a lot of Infectious waste during covid-19 pandemic.

4.4 Analysis of Affecting Factors and Practices on Hazardous Waste Management

To analyze the influencing factors on practices on hazardous waste management, the mean values of the selected influencing factors (Health Situation, Economy of Households) are calculated by using descriptive statistics. In this study, 150 respondents were asked by structured questionnaire. For each factor, several statements were measured by five-point Likert-scale ranging from 1 to 5 for 1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree and 5. Strongly Agree. Before the interpretation of hazardous waste management, reliability test is carried out.

4.4.1 Reliability Test

The reliability test is conducted for the purpose of ensuring consistent measurement through different statements in the questionnaire set. Cronbach's alpha ranges in value from 0 to 1 and is used to describe the reliability of factors extracted from questionnaires. If the result in the calculation of Cronbach's Alpha value is above 0.7 or equal to 0.7, all questions are consistent and reliable to be applied as the research instrument for this study. If this value is less than 0.7, which means the data results are unreliable, and greater than 0.7, which indicates that the data results are reliable. The closer Cronbach's alpha coefficient value is to 1.0, the greater the internal consistency of the questionnaire sets in the study. Results from Reliability Test are shown in table (4.8).

Table (4.8) Results from Reliability Test

Sr. No.	Variables	Number of Items	Cronbach's Alpha
1	Health Situation	12	.783
2	Economy of Households	10	.807
3	Practices on Hazardous Waste Management	11	.899

Source: Survey Data, (2022)

Table (4.8) describes the reliability of these study instruments and the Cronbach's Alpha value is found in the study for Health Situation, Economy of Households and Practices on Hazardous Waste Management. Cronbach's alpha values for all variables in the table are greater than 0.7. Hence, all the questions are trustworthy and acceptable to be applied as the study instrument for this research, and all the respondents are appropriate and willing to answer for this study. It expresses the analysis result of Cronbach's alpha for each variable, whereas the overall variable of the questionnaires has been accomplished with consistency and stability.

According to Best (1977), the mean values of five-point Likert scale items are interpreted as follows:

The score among 1.00 – 1.80 means strongly disagree.

The score among 1.81 – 2.60 means disagree.

The score among 2.61 – 3.40 means neutral.

The score among 3.41 – 4.20 means agree.

The score among 4.21 – 5.00 means strongly agree

Standard deviation (S.D.) is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean of the set, while a high standard deviation indicates that the data points are spread out over a wide range of values (Bland & Altman, 1996). The standard deviation is commonly used to measure confidence in statistical conclusions.

4.4.2 Challenges for Health Situation

Health Situation of staffs and workers in Pollution Control and Cleaning Department is one of important issues. To find out Challenges for Health Situation during Covid-19 pandemic, twelve structural questions are constructed and data collected from 150 respondents.

Table (4.9) Challenges for Health Situation

Sr. No.	**Statement**	Mean	Standard Deviation
1	I am worry concerning with my family members during Covid-19 pandemic.	4.45	.51209
2	Health care for employees is good.	4.27	.52669
3	Foods, medicines, masks for welfare are also available.	4.22	.54181
4	My health is good during covid-19.	4.14	.51852
5	Covid-19 regulations can be safe social life.	4.19	.47341
6	Social distancing can be barrier in social life.	4.16	.71494
7	Education for children is slightly delayed during Covid-19 pandemic.	4.21	.55061
8	Hazardous waste transportation is not easy.	4.16	.40268

9	It would be beneficial to follow regulations regarding Covid-19.	4.30	.51488
10	When you hold hazardous wastes, I feel a cough.	4.31	.54276
11	When you hold hazardous wastes, it causes skin irritation.	4.20	.63457
12	When you hold hazardous wastes, I occasionally feel a fever.	4.00	.79427
	Overall mean	4.22	

Source: Survey Data, (2022)

Table (4.9) describes Challenges for Health Situation in Pollution Control and Cleaning Department. As per survey results, the statement that "I am worry concerning with my family members during Covid-19 pandemic." has a higher mean value than other variables, and it can be seen that the mean value is 4.45. This means that most of the respondents are worried for their family because they work all day time with many people. Staffs and workers are exposed to hazardous waste on a daily basis while the people stays at home and social distancing in accordance with Covid-19 regulations, Thus, it makes them more susceptible to infection and their families are more worried. They can be affected by Covid-19, besides; they do not want to be transmitted person in their family. The statement that "When you hold hazardous wastes, I occasionally feel a fever." is the lowest mean value, which is 4.00. Employees under the Environment and Pollution Control Department store garbage with protective measures, but sometimes get infected with the virus and get sick. Therefore, respondents sometimes feel a fever when they hold hazardous wastes but most of respondents are good in health. They wear masks, cover and gloves when they hold hazardous wastes. The overall mean value of challenges for health situation is 4.22 with strongly agree level of respondents. It can be assumed that respondents in Pollution Control and Cleaning Department have some challenges for health situation during Covid-19 pandemic because foods, medicines, masks are not enough and they feel cough, a fever, skin irritation etc. during Covid-19 pandemic.

4.4.3 Challenges for Earnings of Households

Earnings of Households for staffs and workers in Pollution Control and Cleaning Department are essential. To find out challenges for earnings of households

during Covid-19 pandemic, ten structural questions are constructed and data collected from 150 respondents.

Table (4.10) Challenges for Earnings of Households

Sr. No.	**Statement**	Mean	Standard Deviation
1	Expenses are higher than normal condition during Covid-19 pandemic.	4.29	.50946
2	During the Covid-19 period, I received some government subsidies.	4.29	.60575
3	Covid-19 regulation can prevent the economy of the family.	4.20	.47769
4	There are more cost because of health service, medicine and masks.	4.24	.48715
5	Social interaction has been vulnerable by Covid-19 regulations during Covid-19 period.	4.17	.52350
6	Covid-19 can spread more from hazardous waste.	4.13	.51379
7	Medical things are too expensive during Covid-19 pandemic.	4.28	.46516
8	I have enough money for the health care, if I get infected with the Covid-19 virus.	4.16	.76921
9	Various difficulties especially in food and medicine are being faced in the period of lock down.	4.22	.43148
10	Daily income is decreased because my home is lock down area during Covid-19 period.	4.33	.52669
	Overall mean	4.23	

Source: Survey Data, (2022)

Table (4.10) describes challenges for earnings of households in Pollution Control and Cleaning Department. As per survey results, the statement that “Daily income is decreased because my home is lock down area during Covid-19 period.” has a higher mean value than other variables, and it can be seen that the mean value is 4.33. This means that most of the respondents live mostly in lock down area and they cannot get their daily income regularly, especially for workers. The more lock down period is long, the lesser their daily income is. The statement that “Covid-19 can

spread more from hazardous waste." is the lowest mean value with 4.13. Sometimes, spreading Covid-19 from hazardous waste is happened, but, it can be controlled and prevented by following rules and regulations of Covid-19. The workers who collect and storage hazardous waste are affected than other workers. The overall mean value of challenges for earnings of households is 4.23 with strongly agree level of customers. It can be assumed that respondents in Pollution Control and Cleaning Department have some challenges for earnings of households during Covid-19 pandemic because medical things such as face shield, masks, hand gel and other medicines are expensive and rare in the market. If there is a person who are affected Covid-19 in a house, other people in the house have high possibility of affected. As a result, expenditures are high and incomes are decreased.

4.4.4 Summary of Respondents Perception on Affecting Factors

The mean values of affecting factors on practices on hazardous waste management are described in Table (4.11). There are two affecting factors on practices on hazardous waste management.

Table (4.11) Summary of Respondents Perception on Affecting Factors

Sr. No.	Particulars	Mean
1	Health Situation	4.22
2	Earnings of Households	4.23

Source: Survey Data, 2022

According to Table (4.11), overall mean values are calculated for health situation and earnings of households. The overall mean values obtained are 4.22 and 4.23 respectively. Health Situation gained the overall mean value with 4.22. Earnings of households gained the overall mean value with 4.23. But all mean values are at the strongly agree levels of respondents. It can be concluded that health situation and earnings of households are provided in practices on hazardous waste management.

4.4.5 Practices on Hazardous Waste Management

To explore practices on hazardous waste management of staffs and workers during Covid-19 pandemic, fourteen structural questions are constructed and data collected from 150 respondents.

Table (4.12) Practices on Hazardous Waste Management

Sr. No.	**Statement**	Mean	Standard Deviation
1	I fully comply with the government's policies and restrictions regarding Covid-19.	4.23	.48351
2	I attend training and awareness programme related to hazardous waste management during the Covid-19 period.	4.35	.53075
3	I wear PPE (such as gloves, masks, coats) during my working time.	4.21	.56267
4	I collected and damaged hazardous waste separately.	4.27	.47298
5	I always make awareness to public for the disposal of waste.	4.21	.44249
6	I have challenges for the implementation of hazardous waste management.	4.20	.41773
7	I have plan short term and long responses.	4.39	.50217
8	Pollution Control and Cleansing Department usually gives training for awareness.	4.28	.45050
9	I got enough the cover things such as masks, face shield, gloves and PPE during the Covid-19 period.	4.41	.54461
10	There are preparations concerning with Covid-19 pandemic in NPTDC.	4.29	.45372
11	Hazardous waste is collected daily by Pollution Control and Cleansing Department.	4.31	.46265
	Overall mean	4.29	

Source: Survey Data, (2022)

Table (4.12) describes practices on hazardous waste management of staffs and workers. As per survey results, the statement that 'I got enough the cover things such as masks, face shield, gloves and PPE during the Covid-19 period.' has largest mean value than other variables, and it can be seen that the mean value is 4.41. This means that Pollution Control and Cleansing Department supports adequate cover things such as masks, face shield, gloves and PPE during the Covid-19 period. There are many programs and aids for staffs and workers during the Covid-19 period. The statement that "I have plan short term and long responses." has a second largest mean value than other variables, and it can be seen that the mean value is 4.39. This means that there are many plans in Pollution Control and Cleaning Department to protect Covid-19. There is a slogan that "Preventing is better than treatment". Food plans, allocation on quarantine center, treatment plans are some of short term and long term programs.

The statement that "I have challenges for the implementation of hazardous waste management" is the lowest mean value, which is 4.20. At first, staffs and workers faced many difficulties such as cover things, right discipline, avoidable methods, Oxygen. Moreover, most of respondents are serving their duties every day and workers collect and storage the hazardous waste every day thus they have many chances to be affected by Covid-19 virus than other people. The overall mean value of practices on hazardous waste management is 4.29 with strongly agree level of respondents. It can be assumed that respondents in Pollution Control and Cleaning Department have practices on hazardous waste management during the Covid-19 period.

4.5 Correlation Analysis of Affecting Factors and Practices on Hazardous Waste Management

Correlation is the statistical technique that can show whether and how strongly pairs of variables are related. Correlation coefficient ranges from -1.0 to +1.0. If the value is positive, it means that as one variable gets larger, the other gets larger. If the value is negative, it means that as one variable gets larger, the other gets smaller. The results of the correlations of the measured variables are shown in Table (4.19). Correlation is an effect size and it can describe the strength of the correlation using the guide and suggests like that

The absolute value of r among 0.1 - 0.4 means weak

The absolute value of r among 0.5 - 0.7 means moderate

The absolute value of r among 0.8 – 0.9 means strong

Table (4.13) Correlation Analysis of Affecting Factors and Practices on Hazardous Waste Management

Sr. No.	Variables	Pearson Correlation Coefficient	P-Value
1	Health Situation	.756***	0.000
2	Economy of Households	.717***	0.000

*** Correlation is significant at the 0.01 level (2-tailed).

Source: Survey Data, (2022)

According to the Pearson correlation analysis results shown in Table (4.13), the affecting factors have positive relationship with practices on hazardous waste management. Health situation and economy of households have strong correlation with practices on hazardous waste management. It can be concluded that when the affecting factors are strong, the practices on hazardous waste management are successful.

4.6 Multiple Regression Analysis of Affecting Factors and Practices on Hazardous Waste Management

The multiple regression analysis was conducted to test the proposed objectives of the effect of affecting factors (health situation and earnings of households) on dependent variables (practices on hazardous waste management).

The proposed model is:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_i$$

Where:

Y_i = practices on hazardous waste management

β_0 = Constant (Intercept)

β_1, β_2 = Coefficients

X_1 = Health situation

X_2 = Earnings of households

ε_i = Random Error

The results of the multiple regression analysis are described in the following Table (4.14).

Table (4.14) Multiple Regression Analysis of Affecting Factors and Practices on Hazardous Waste Management

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.745	2.672		1.776	.078
Health Situation	.506***	.073	.498	6.921	.000
Earnings of Households	.399***	.080	.358	4.979	.000
R2					0.633
Adjusted R2					0.628

Source: Survey Data, (2022)

Note. *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Dependent Variable: Practices on Hazardous Waste Management

According to Table (4.20), the results of multiple regression analysis provided that health situation and earnings of households have positive and significant effect on practices on hazardous waste management at 0.01 level (b=0.506, t=6.921, p<0.01) and (b=0.399, t=4.979, p<0.01). Earnings of households have the strongest effect on practices of hazardous waste management. The estimated model is:

$\hat{Y} = b_0 + b_1X_1 + b_2X_2$

Practices on Hazardous Waste Management = 4.481 + 0.506 Health Situations + 0.399 Earnings of Households

As presented in Table (4.20), the R^2 value is 0.633, and the adjusted R^2 value is 0. 628. This model explains that health situation and earnings of households have a

positive effect on practices on hazardous waste management. As a result, health situation has a positive effect on practices on hazardous waste management at a 1% significant level and earnings of households have a positive effect on practices on hazardous waste management at a 1% significant level.

According to the standardized coefficient (Beta), it is indicated that the increase in health situation and earnings of households can cause practices on hazardous waste management. Accordingly, the increase in health situation by 1 unit will also increase the practices on hazardous waste management by 0.506units. Similarity, the increase in earnings of households by 1 unit will also increase the practices on hazardous waste management by 0.399 units. According to the findings of the study, the majority of respondents are practised hazardous waste management in accord with Covid-19 regulations. Therefore, it can be concluded that increasing health situation and earnings of households positively affects practices on hazardous waste management in Zabuthiri Township.

CHAPTER V

CONCLUSION

5.1 Findings

The first objective of this study is to study hazardous waste management in Nay Pyi Taw. The second objective is to analyze the challenges and practices on hazardous waste management during Covid-19 pandemic.

The health situation, earnings of households and practices on hazardous waste management are analyzed based on 150 respondents. The target respondents are staffs and workers of Pollution Control and Cleansing Department under Nay Pyi Taw Development Committee (NPTDC). Most of the respondents actively participated by answering structural questionnaires, and all data was analyzed by using multiple linear regression in SPSS software.

It is discovered that 89 of the 150 respondents are female. Mostly, the age group between 31 and 40years old answered for this study. Over a half of all respondents are married. Most of respondents are staffs and graduate level. They mostly earn monthly salary between 150,001 Ks and 250,000 Ks and work experience is between 1 year and 5 years. Mostly have from 1 to 5 family members. The majority of the respondents earn from 200,001 Ks to 400,000 Ks as total monthly income of family. However, most of respondents have no extra income.

According to awareness and practices of hazardous waste management, majority of the respondents get the awareness for hazardous waste from social media. Most of the respondents practice the campaign; “Wash your hands regularly using soap and water” and follow that regulation. They disposed waste from 3 to 4 times per week during Covid-19 period and separately disposed on hazardous waste. Infectious waste is common in hazardous waste.

In the analysis of affecting factors (health situation, earnings of households) and practices on hazardous waste management, all the questions are trustworthy and acceptable to be applied as the study instrument for this research. All the respondents are appropriate and willing to answer for this study. It expresses the analysis result of Cronbach’s alpha for each variable, whereas the overall variable of the questionnaires has been accomplished with consistency and stability. Most of respondents are worry

concerning with their family members during Covid-19 pandemic. On the other hand, their daily income is decreased because their home is lock down area. Pollution Control and Cleansing Department supports cover things such as masks, face shield, gloves and PPE during the Covid-19 period.

According to correlation analysis of affecting factors and practices on hazardous waste management, the affecting factors (health situation and earnings of households) have positive relationship with practices on hazardous waste management. Health situation and earnings of households have moderate correlation with practices on hazardous waste management.

As multiple regression analysis of affecting factors and practices on hazardous waste management, health situation and earnings of households have positive and significant effect on practices on hazardous waste management. The majority of staffs and workers are accepted having challenges for health situation during Covid-19. Earnings of staffs and workers' households have positive and significant effect on practices on hazardous waste management.

5.2 Suggestion

Based on the findings from the previous sections, some relevant suggestions and recommendations for the PCCD are provided to stimulate the influencing health situation, earnings of households and practices towards hazardous waste management.

According to the awareness and practices of hazardous waste management, majority of the respondents get the awareness for hazardous waste from social media. Therefore, PCCD should give information and awareness by posting on Facebook, Twitter, Instagram, YouTube etc. Moreover, NPTDC should be updated news in the NPTDC website for the respective fields. As most of the respondents create the campaign and follow the regulation. Therefore, NPTDC should create campaigns and should be encouraged to follow rule and regulations of Covid-19.

According to the findings on analysis of affecting factors (health situation, earnings of households) and practices on hazardous waste management, the results highlight that most of respondents are worried concerning with their family members during Covid-19 pandemic and their daily income is not enough. Thus, NPTDC should practice welfare program for staffs and workers. Pollution Control and

Cleansing Department supports cover things such as masks, face shield, gloves and PPE during the Covid-19 period. That condition should be continuing.

According to the multiple regression analysis of affecting factors and practices on hazardous waste management, health situation and earnings of households have positive and significant effect on practices on hazardous waste management. Consequently, NPTDC should be careful concerning with the health condition, earnings of households of staffs and workers. Furthermore, if health condition and earnings of household are emphasized, the practices on hazardous waste management will be better than before condition. Therefore, NPTDC should create the better chance for health care services and should provide aids and other food and medical things.

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APPENDIX

MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY ON THE CHALLENGES AND PRACTICES FOR HAZARDOUS WASTE MANAGEMENT DURING COVID-19 PANDEMIC IN ZABUTHIRI TOWNSHIP

Survey Questionnaire Form

Thank you for taking part in this survey. All data and information collected from this survey will follow the highest standards of confidentiality. Your responses will contribute valuable information. Participation in the survey is entirely anonymous and the information you provide will remain strictly confidential and will not be shared with anyone. All information will be collected and number of respondents will be identified in the results of this questionnaire.

Section (A) Personal Information

Please tick (✔) one appropriate answer for each of the following questions. Each question should only have ONE answer.

1. Gender

   ☐ Male

   ☐ Female

2. Age (Years)

   ☐ Up to 20
   ☐ 21 to 30
   ☐ 31 to 40
   ☐ 41 to 50
   ☐ Over 50

3. Marital Status

   ☐ Single
   ☐ Married
   ☐ Window
   ☐ Divorce

4. Occupation

- ☐ Staff
- ☐ Worker

5. Education

- ☐ Illiterate
- ☐ State school student
- ☐ College / University
- ☐ Graduate
- ☐ Postgraduate

6. Average monthly income

- ☐ Up to 150,000 Ks
- ☐ 150,001 Ks to 250,000 Ks
- ☐ 250,001 Ks to 350,000 Ks
- ☐ 350,001 Ks to 450,000 Ks
- ☐ Over 450,001 Ks

7. Work Experience (Years)

- ☐ Under 1 year
- ☐ 1 year to 5 years
- ☐ 6 years to 10 years
- ☐ 11 years to 15 years
- ☐ 16 years to 20 years
- ☐ Over 20 years

8. Number of Family Member

- ☐ None
- ☐ 1 to 5
- ☐ Over 5

9. Gender of Family Member

- ☐ Male Number ----------
- ☐ Female Number ----------

10. Age (Years) of Family Member

- ☐ Under 18 Years Number ----------
- ☐ Above 18 Years Number ----------

11. Number of people who work in Family

- ☐ None
- ☐ 1 to 3
- ☐ Over 3

12. Total Monthly Income of Family

- ☐ None
- ☐ Up to 200,000 Ks
- ☐ 200,001 Ks to 400,000 Ks
- ☐ 400,001 Ks to 600,000 Ks
- ☐ Over 600,001 Ks

13. Do you have extra income?

- ☐ Yes
- ☐ No

14. If you have extra income, what kind of job do you work?

- ☐ None
- ☐ Part –time job
- ☐ Shopkeeper
- ☐ Owner of business

15. If you have extra income, how much do you get as extra income?

- ☐ None
- ☐ Up to 50,000 Ks
- ☐ 50,001 Ks to 150,000 Ks
- ☐ 150,001 Ks to 300,000 Ks
- ☐ Over 300,001 Ks

Section (B) Awareness and Practices concerning with Hazardous Waste Management

16. Main information sources of acquiring waste related information

- ☐ Local Newspaper
- ☐ TV
- ☐ Radio
- ☐ Social Media (eg: Facebook)
- ☐ Trainings from Departments
- ☐ Campaigns

17. State the main point that can promote actions in awareness campaigns.

- ☐ Wash your hands regularly using soap and water
- ☐ Scrub with alcohol based hand sanitizer.
- ☐ If you cough, cover your nose and mouth with your elbow or a tissue.
- ☐ Sterilize and safely dispose of the tissue immediately.
- ☐ Stay at least one meter (3 feet) away from people who are coughing.
- ☐ Avoid crowded places.

18. Which facts concerning with Covid-19 regulation released occasionally are you mainly followed?

☐ Wash your hands regularly using soap and water or scrub with alcohol-based hand sanitizer.

☐ If you cough, cover your nose and mouth with your elbow or a tissue.

☐ Sterilize and safely dispose of the tissue immediately.

☐ Stay at least one meter (3 feet) away from people who are coughing.

☐ Avoid crowded places.

19. Hazardous waste disposal frequency per week during Covid-19 pandemic.

☐ 1 to 2 times

☐ 3 to 4 times

☐ 5 to 6 times

20. Is hazardous waste separated?

☐ Yes

☐ No

21. What types of hazardous waste disposal in common?

☐ Infectious waste

☐ Pathology waste, human tissue or fluid, body parts, blood, and body fluids

☐ Sharps (needles, scalpels, knives, and blades, etc.)

☐ Chemical waste

☐ Pharmaceutical waste (eg. expired drugs)

☐ Electronics (computers, televisions, cell phones)

☐ Car batteries

☐ Radioactive wastes

Section (C) Challenges and Practices on Hazardous Waste Management

In answering part (C), you can choose only one for each statement that you think the most appropriate one among the columns 1 to 5 by making a tick (✔).

1 = strongly disagree 2 = disagree 3 = neither agree nor disagree

4 = agree 5 = strongly agree

I. Challenges for Health Situation

Sr. No.	Statement	1	2	3	4	5
1	I am worry concerning with my family members during Covid-19 pandemic.					
2	Health care for employees is good.					
3	Foods, medicines, masks for welfare are also available.					
4	My health is good during covid-19.					
5	Covid-19 regulations can be safe social life.					
6	Social distancing can be barrier in social life.					
7	Education for children is slightly delayed during Covid-19 pandemic.					
8	Hazardous waste transportation is not easy.					
9	It would be beneficial to follow regulations regarding Covid-19.					
10	When you hold hazardous wastes, I feel a cough.					
11	When you hold hazardous wastes, it causes skin irritation.					
12	When you hold hazardous wastes, I occasionally feel a fever.					

II. Challenges for Economy of Households

1 = strongly disagree 2 = disagree 3 = neither agree nor disagree

4 = agree 5 = strongly agree

Sr. No.	Statement	1	2	3	4	5
1	Expenses are higher than normal condition during Covid-19 pandemic.					
2	During the Covid-19 period, I received some government subsidies.					
3	Covid-19 regulation can prevent the economy of the family.					
4	There are more cost because of health service, medicine and masks.					
5	Social interaction has been vulnerable by Covid-19 regulations during Covid-19 period.					
6	Covid-19 can spread more from hazardous waste.					
7	Medical things are too expensive during Covid-19 pandemic.					
8	I have enough money for the health care, if I get infected with the Covid-19 virus.					
9	Various difficulties especially in food and medicine are being faced in the period of lock down.					
10	Daily income is decreased because my home is lock down area during Covid-19 period.					

III. Practices on Hazardous Waste Management

1 = strongly disagree 2 = disagree 3 = neither agree nor disagree

4 = agree 5 = strongly agree

Sr. No.	Statement	1	2	3	4	5
1	I fully comply with the government's policies and restrictions regarding Covid-19.					
2	I attend training and awareness programme related to hazardous waste management during the Covid-19 period.					
3	I wear PPE (such as gloves, masks, coats) during my working time.					
4	I collected and damaged hazardous waste separately.					
5	I always make awareness to public for the disposal of waste.					
6	I have challenges for the implementation of hazardous waste management.					
7	I have plan short term and long responses.					
8	Pollution Control and Cleansing Department usually gives training for awareness.					
9	I got enough the cover things such as masks, face shield, gloves and PPE during the Covid-19 period.					
10	There are preparations concerning with Covid-19 pandemic in NPTDC.					
11	Hazardous waste is collected daily by Pollution Control and Cleansing Department.					

(Thanks for your answers)