

ASSESSING SOLID WASTE MANAGEMENT STRATEGY IN HIGHER EDUCATION INSTITUTIONS OF INDONESIA: A CASE STUDY OF IPB UNIVERSITY DRAMAGA-BOGOR CITY

JOSEPH RUGATIRI



NATURAL RESOURCES AND ENVIRONMENTAL
MANAGEMENT SCIENCE
GRADUATE SCHOOL
IPB UNIVERSITY
BOGOR
2021

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SUMMARY

JOSEPH RUGATIRI: Assessing Solid Waste Management Strategy in Higher Education Institutions of Indonesia: A Case Study of IPB University. Supervised by ZAENAL ABIDIN and AHYAR ISMAIL.

Globally Solid waste management is a tragedy in developing countries. Currently, the World Bank reported that the Urban cities generated 1.3 billion tons of solid waste per year, amounting to a footprint of 1.2 kilograms per person per day. Population growth, and urbanization result in a higher amount of solid waste produced with rapid economic prosperity, Solid waste generation is expected to rise to 2.2 billion tons by 2025. As the volume and difficulty of solid waste increase, the environmental risk caused by waste materials, including human health risks and environmental degradation, also increases. The solid waste management sector is facing numerous challenges in Indonesia. The increasing population, urbanization, and human activities have resulted in increased wastes production.

The objective of this study was to assess the level of awareness and respective practices' in solid waste management among IPB University students, to analyze the relationship between awareness and practices, green campus and practices, awareness and practices in terms of segregation, reduce, reuse, recycling, and disposal in solid waste management and also to find the waste generated at IPB university dormitories.

The study employed a descriptive research design with (n=108) randomly selected students. Data were analyzed and interpreted by using descriptive and inferential statistics. The study revealed that the students are highly aware of solid waste management, and also the students have good practices in terms of proper reducing and reusing, but moderately proper segregation, recycling, and disposal practices. The study found a correlation between awareness and practices, which was statistically significant (r value=0.372, n =108, P value=0.000). Also, there was a weak positive correlation between the Green campus program and practices, which was statistically significant (r value=0.283, n =108, P value=0.003) and the level of awareness of the students are influenced by their practices in waste segregation, reduction, reuse, and recycling but not influenced by their practices in terms of disposal. The study also revealed that the most waste generated in University dormitories was plastic bags, leftovers food, tissue papers, and cans waste.

Keywords: Awareness, Practices, Solid waste management

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RINGKASAN

JOSEPH RUGATIRI: Menilai Strategi Pengelolaan Limbah Padat di Perguruan Tinggi di Indonesia: Kasus Belajar dari Universitas IPB. Dibimbing oleh ZAENAL ABIDIN dan AHYAR ISMAIL.

Secara global, pengelolaan sampah padat menjadi salah satu masalah di negara berkembang. Saat ini, Bank Dunia melaporkan bahwa kota-kota perkotaan menghasilkan 1,3 miliar ton sampah padat per tahun, setara dengan 1,2-kilogram sampah per orang per hari. Dengan meningkatnya tingkat pertumbuhan ekonomi, laju pertumbuhan penduduk dan arus urbanisasi mengakibatkan jumlah sampah padat yang dihasilkan lebih tinggi sehingga jumlah sampah diperkirakan akan meningkat menjadi 2,2 miliar ton pada tahun 2025. Meningkatnya volume dan jenis sampah padat yang beragam memberi dampak pada risiko penurunan kualitas lingkungan dan kesehatan manusia. Pengelolaan sampah padat di Indonesia juga menghadapi banyak tantangan seperti jumlah penduduk yang besar, laju arus urbanisasi yang terus meningkat dan tingkat pemahaman masyarakat tentang sampah.

Tujuan dari penelitian ini adalah untuk menilai tingkat kesadaran dan praktik masing-masing dalam pengelolaan sampah di kalangan mahasiswa IPB University, to menganalisis hubungan antara kesadaran dan praktik, kampus hijau dan praktik, kesadaran dan praktik dalam hal pemilahan, pengurangan, penggunaan kembali, daur ulang, dan pembuangan dalam pengelolaan sampah dan untuk menemukan sampah yang dihasilkan di asrama universitas IPB.

Penelitian ini menggunakan desain penelitian deskriptif dengan jumlah responden mahasiswa ($n = 108$) yang dipilih secara acak. Data dianalisis dan diinterpretasikan dengan menggunakan statistik deskriptif dan inferensial. Dari data yang didapat menunjukkan bahwa mahasiswa sangat sadar akan pengelolaan sampah padat, dan telah melakukan praktik dengan baik dalam hal pengurangan dan penggunaan kembali yang tepat, sementara itu dalam hal praktik pemilahan, daur ulang, dan pembuangan yang cukup tepat. Pada studi ini didapatkan adanya hubungan antara kesadaran dan praktik yang signifikan secara statistik (nilai $r = 0,372$, $n = 108$, nilai $P = 0,000$), juga ada korelasi positif yang lemah antara program dan praktik pada program kampus Hijau, yang secara statistik signifikan (r nilai = $0,283$, $n = 108$, nilai $P = 0,003$). Tingkat kesadaran siswa dipengaruhi oleh praktik mereka dalam pemilahan sampah padat, pengurangan, penggunaan kembali, dan daur ulang tetapi tidak dipengaruhi oleh praktik mereka dalam hal pembuangan. Penelitian ini juga didapatkan informasi bahwa sampah padat yang paling banyak dihasilkan di Asrama PPKU adalah kantong plastik, sisa makanan, kertas tisu, dan sampah kaleng.

Kata kunci: Kesadaran, Pengelolaan limbah padat, Praktik



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HIGHER EDUCATION INSTITUTIONS OF INDONESIA:
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BOGOR CITY**

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**NATURAL RESOURCES AND ENVIRONMENTAL
MANAGEMENT SCIENCE
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Bogor, January 2021

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I INTRODUCTION

1.1 Background

Globally, Solid waste management is a tragedy in developing countries. Currently, the World Bank reported that the Urban cities generated 1.3 billion tons of solid waste per year (Reyes 2020), amounting to a footprint of 1.2 kilograms per person per day (Gusti 2016; Omar *et al.* 2019; Rodzi *et al.* 2019; Adenuga *et al.* 2020). Population growth and urbanization result in a higher amount of solid waste produced. With rapid economic prosperity (Abdel-shafy dan Mansour 2018; Almasi *et al.* 2019). Solid waste generation is expected to rise to 2.2 billion tons by 2025 (Lee *et al.* 2016; Wahi *et al.* 2016; Moya *et al.* 2017; Abdu *et al.* 2019; Chatterjee *et al.* 2019; Ibikunle *et al.* 2019; Adenuga *et al.* 2020; Reyes 2020). As the volume and difficulty of solid waste increase, the environmental risk caused by waste materials, including human health risks and environmental degradation (Ferronato dan Torretta 2019; Emery *et al.* 2020).

Besides, to minimize and manage the waste produced has become important methods today's worlds (Paghasian 2017). Meanwhile the main strategy adopted by different countries and institutions regarding its solid waste management (SWM) is to reduce, reuse, and recycle (3R's) program (Abdel-shafy dan Mansour 2018). Solid waste management is the collecting, transporting, treating, and disposing of unwanted material resulting from the combination of residential, institutions, industrial and commercial activities in certain areas, that is throwing away material that has helped its purpose or no longer needed (Twumasi 2017; Lalamonan dan Comighud 2020a; Ugwu *et al.* 2020). Solid waste can be categorized according to their origins like a domestic waste, industrial and agricultural, and its contents like organic, glass, metal, and plastic.

In Indonesia, the solid waste management sector faces various challenges, since the Indonesian population has grown over 265 million in 2019 and is expected to continue growing to over 285 million by 2025. In this sense, the rising population, urbanization, and human activities would increase waste production (Prajati *et al.* 2017; Wulandari *et al.* 2017; Dwi Atmanti *et al.* 2018; Brotosusilo *et al.* 2020). The common method used in solid waste management in Indonesia is collecting, transport, and disposing of in a landfill. (Wulandari *et al.* 2017) 3R's model (reuse, reduce, and recycle) is applied to solve the waste problem. Despite the methods used and several regulations and management systems, SWM issues in Indonesia have not been resolved (Audi 2019).

IPB University is one of the biggest academic institutions in Indonesia, that has launched "Green Campus" program with the target of achieving sustainable environment (Sefiani 2016). IPB has been managing solid waste through the collection, transportation, and disposal without separation (Yuwono *et al.* 2016). Solid waste produced by every unit in IPB Campus Dramaga, such as classrooms, laboratories, canteens, offices, and dormitories are transported by three labelled trucks, which are plastic, paper, and organic. However, solid waste collected from the university premises' dustbins is not sorted, thus making the SWM difficult. According to (Enrique and Ortiz-hernandez 2015; Moqbel 2018; Rahmada *et al.* 2019), higher education institutions play an important role in shaping positive behavior in society and environmental activities management. In Indonesia,



Environmental education is integrated nearly in all subjects' curriculums. The University of Indonesia, which is like IPB, also has a green campus program that emphasizes solid waste management awareness and knowledge and information teachings that enhance the University's the integration of environmental concerns with all faculties. Although students have been trained about environmental education, for a sustainable environment, they are not aware of practices for waste management concepts such as sorting, reduction, recycling, re-use, and proper disposal.

Many researchers have suggest that education is the best tool to keep the environment clean (Bautista 2019; Riastini *et al.* 2019; Reyes 2020). People think that all forms of waste are the same and should just be thrown in one container and should not be managed. Community participation is an important way to mitigate waste at the source(Brotosusilo *et al.* 2020). Also, (Singer *et al.* 2019) suggests that awareness and practices are the key components for students to participate in the proper waste management program around the universities where an effective and sustainable goal could be achieved. Therefore, this study was carried out to assess solid waste management strategy in higher education institutions of Indonesia.

1.2 Problem Statement

IPB is a university that has an ambitious goal for the green campus in 2020. The goal has come up with the plan of a waste management system strategy in which infrastructure investments have been made; however, despite these efforts, the issue of solid waste in the campus is still not well managed, but unfortunately, the waste collectors complain about collecting and disposal process mix and crush all together, and make separation a complex and difficult task to proper waste management.

The average waste generation in IPB University is increased every year because of the increasing number of students and activities, while in 2015 the students population, staffs and lecturers were 26,392 with the students growth rate by 4% per year(Sefiani 2016). In Addition to that, the methods used by IPB University are correct and related to a national standard in Indonesia(Sabarina 2016). However, waste management is increasing, making probing know whether knowledge and attitudes gained from environmental education help change behaviors towards the strategy used on solid waste management by assessing students' awareness and practices IPB Campus Dramaga. There was a need to ascertain why this situation continues to worsen despite well-established plans. Therefore, this study aimed to assess student's awareness and their respective practices in solid waste management.

1.3 Research Questions

To address the research problem, the following research questions were investigated and hypotheses tested:

1. What is the level of awareness on solid waste management of students?
2. Aware of methods practices by IPB in solid waste management?
3. Are students aware of and implement solid waste management practices?

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1.4 General Objective

The main objective of this study was to assess the solid waste management strategy in higher education institutions of Indonesia: A case study of IPB university.

1.5 Specific Objectives

1. To assess the level of students' awareness on solid waste management.
2. To identify their respective practices on solid waste management.
3. To assess awareness of the students and their practices on solid waste management.

1.6 Significance of the Study

1. To provide information as a suggestion to IPB to raise awareness and education to students' respective solid waste management practices.

1.7 Scope of the Study

1. Level of awareness based on solid waste management of students
2. focusing on to identify students' practices on solid waste management
3. Awareness of the students and their practices on solid waste management

1.8 Conceptual Framework

The conceptual framework provides the effects of the variables used in this study. That is the independent variable and dependent variable and how they affect each other. The assessment of solid waste management strategy in higher education institutions depends on practice methods and awareness, independent variables toward solid waste management. The dependent variables are negative and positive solid waste management, while intermediate variables are waste separation, collection, and disposal (Figure 1.1).



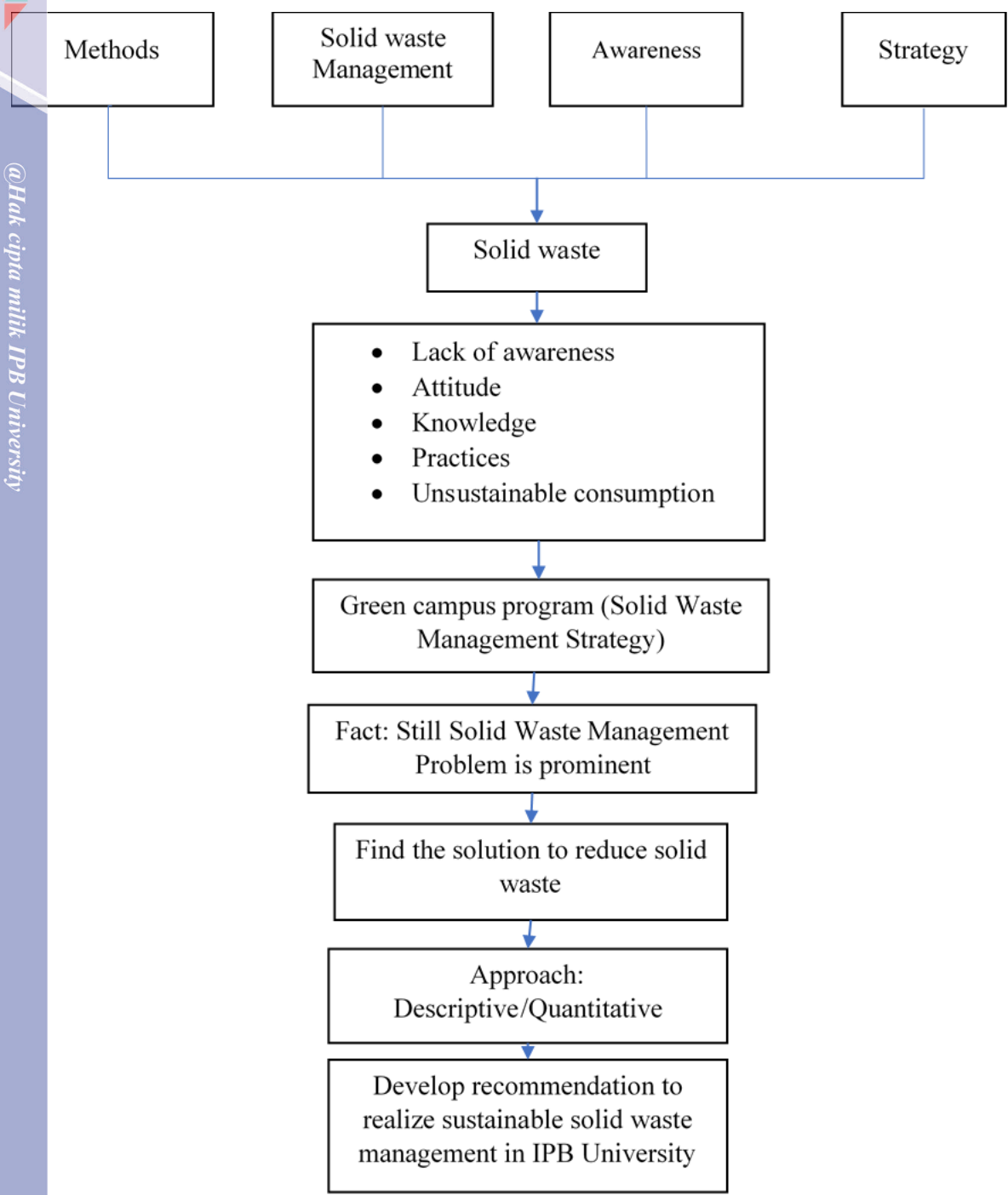


Figure 1.1 Conceptual framework

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II LITERATURE REVIEW

2.1 Theoretical Framework

Theory of reasoned action (TRA) and theory planned behaviour (TPB) were employed in the solid waste management agenda for a framework for understanding, explaining, by predicting behaviour. All theories are useful for designing intervention methods to maintain or reshape a particular behavior. The theory is based on the assumption that individual behavior intentions are directly associated with their attitudes. The theory of reasoned action views an individual's intention to perform or not perform as an immediate determinant of the action. This behavior intention has 2 determinants: 1) attitude regarding the behavior with 2) the individual norms. The beliefs associated with attitude regarding the behaviour are known behaviour beliefs while normative beliefs are for the subjective norms (Mohiuddin *et al.* 2018; Reyes 2020)

The planned behavior theory views an individual's determination as influenced by attitude, social support, and perceived behavioral control. Thus, it is best to assess human behaviour when participation decisions are voluntary and under individual management. (Shen *et al.* 2019) Therefore, this theory is suitable to predict a student's intent to participate in specific behaviour about solid waste management.

2.2 Strategic Management of Solid Waste

Strategic management is defined as the art and science of establishing, conducting, and assessing cross-functional decisions that will permit an organization to achieve its objectives. Strategic planning is essential to raise solid waste management performance to achieve sustainable development and reinforce long-term growth (Baharum *et al.* 2016).

2.3 Solid Waste Management

According to Hina *et al.* (2020), solid waste management includes the process of collecting, transporting, treating, and disposal of waste materials. Waste produced by human activities and the process is usually done to eliminate their impact on human health and the environment (Twumasi 2017). Currently, the polluted world studying the best ways for handling waste creation has become more crucial (Paghasian 2017). The consequences of waste are as old as the first man on earth, and the history of disposal can be traced to the early man as he gathered for his sustenance from farming and hunting and discarded the unwanted materials from his everyday routine resulted in the building up of filth. According to different studies, we are suffering from the mistakes of decades that, until recently, we have hardly seemed to notice what to do views as new ways of solving old problems.

2.4 Types of Solid Waste and Characteristics

Solid waste is divided into two categories biodegradable and non-biodegradable solid waste. Biodegradable wastes can be easily decomposed by natural processes ranging from food remnants to leaves from trees, cotton wool,



clothes, banana peels, and papers. While non-biodegradable wastes are those wastes that cannot be broken down or decomposed by natural processes, they can, however, be recycled or reused, and such wastes include bottles, glasses, plastics, cans, wrappings of all kinds, nylon bags, metals, needles and syringes, and woods. Solid wastes can also be classified based on their level of environmental contamination, whether they are hazardous or non-hazardous to both man and the environment (Dung *et al.* 2017).

2.5 Domestic Waste

According to (Sulistyaningsih 2018; Yunus 2020) defined garbage are the remains of materials that undergo the treatments, either because it has taken the main part or because there is no benefit, which in terms of socioeconomic has no price and terms of the environment may cause pollution or nuisance sustainability, also the Law no. 18/2008 about Waste Management, defined waste as the residual activities of human daily and/or natural processes in the form of solid. While according to (Setian and rohmat 2016), wastes are substances or objects that are not used anymore, either in the form of waste material originating from households and the factory as the rest of the industrial process.

The characteristics of waste are chemical and physical properties that are owned by the garbage. Identification of the chemical and physical characteristics of waste can provide information to determine the nature of garbage waste processing techniques are required. These characteristics vary widely, depending on the components of garbage. The specificity of garbage from various places lets gives different properties of the waste generated. According to observations in the field, characteristics of the waste can be distinguished according to some aspects, by their nature. Characteristics of the waste can be identified based on physical factors that are easy to see. Characteristics of waste need to know the proper way of handling the waste generated. Solid waste is also interpreted as the rest of the ingredients or products of human activities that are physically able to contain materials or products that can be recovered (Desa *et al.* 2012).

2.6 Impact of Solid Waste on Human Health and Environment

There is a negative impact on human health and the environment due to improper management of wastes. The direct risk is more concerned with the workers and community, who need to be served from waste contact. There are direct risks in handling wastes from any institutional-like hospital. In general public, the risks are increasing and delivered from the breeding of disease vectors and smell, rapid urbanization referred as one of the main issues which cause wastes on the environment, the accumulation of garbage results to methane gas product of the aerobic respiration of bacteria and these bacteria grow in landfill with the highest amount of moisture. The gas can reach up to 50% of the composition in landfills, and with the maximum anaerobic decomposition, also in other ways they are contributing to an increasing in the greenhouse gas effect and global climate change (Lee *et al.* 2016).

2.7 Strategies of Solid Waste Management

According to UNEP (2004), collecting, recycling, treating, and disposing of, increasing quantities of solid waste remains a major challenge for developed and developing countries. The declaration of Rio+20 (2012) highlighted and encouraged the sharing of knowledge and advanced technologies from developed countries' best practices to developing countries. Different studies described different strategies techniques methods which are most usefully by developing countries for solid waste management:

Waste Generation: includes the activities in which materials are observed as no needed at that time and are disposed of. Waste generation is daily activities that are not controlled in the future. However, it seems controlling activities to be difficult with high waste generation. Although the waste reduction is not controlled, its source affects the system evaluations to limit the quantity of waste generated. Controlling waste generation quantity is still to be challenged and difficult worldwide in developing countries (Byakodi and T 2016; Abdel-shafy and Mansour 2018). Increasing the quantity of waste generation affects the transport and management system.

Waste Handling, Sorting, Storage, and Processing at the Source: This is the process that includes waste management until they are collected in a proper storage container or dust bin. All steps are essential in handling and picking waste from the sources, an example of separating waste from its source of generation for reuse and recycling is a good way to simplify the activities. Students are becoming more aware of the importance of separating paper, plastic, and organic waste (Byakodi and T 2016), Showed that collection, storage, transport, and final disposal are still challenges for urban areas.

Separation and processing and transformation of solid wastes: the way to facilitate the waste to be recovered by the materials separated from its source includes the curbside collection, drop-off, and buy-back centers. The separation and processing wastes are separated at the source, and commingled waste always remains waste recovery facilities. Exchange combustion facilities and final disposal. This helps to provide a mandatory for recovery of recyclable waste and an extension of the working capacity of landfill sites (Aranas 2015)

The waste collection includes picking waste from its source to final disposal for treatments or landfills. This aspect also includes the curbside collection of recyclable material that technically is not waste as part of a municipal landfill diversion program. Through providing education to the people on proper practices in segregation, collection, transport, and disposal, will be essential to the minimization of waste generated (Aranas 2015).

Transportation of solid waste from households, institutions and, other generation places is a growing problem. The growing urban areas in developing countries contribute to the solid waste management problem. Most rapidly growing parts of municipalities are at the periphery of accessible settlements. These areas are becoming harder to find as the population urbanizes and municipal traffic increases, transportation of wastes becomes more time consuming, and therefore more expensive and less efficient. The transportation process is done by organic and non-organic waste to the disposal area. Many municipalities employ neighborhood-level collection points, where households are responsible for transportation to the transfer point, and the municipal or private





enterprises transport the waste from there to the final disposal location (Singh *et al.* 2014). For example, in municipal areas that are methods can be done to reduce the number of solid wastes in the urban area of the city is explicitly to transport waste to the disposal area, and the waste disposed of through landfilling becomes additionally problematic due to land paucity and high demands and the rise of land prices.

Waste disposal refers to removing and destroying or storing damaged, used or other unwanted domestic, agricultural, and industrial products and substances (solid wastes). Solid waste disposal can be carried out using several options, but three vital factors should be considered before any of these options can be adopted. Firstly, the physical characteristics of the locality as regards the topography of the area where waste management activities are to be carried out because waste disposal often requires a large parcel of land for an efficient operation, especially of the sanitary landfill is to be adopted; secondly, the character, quality, and amount of waste to be disposed of. The quantity and nature of household refuse vary greatly from region to region, and thirdly, the financial allocation available as adequate budget any allocation must be available for capital outlay and running cost. Disposal is perceived to be contradictory to sustainable development because it is inefficient in using potential resources, making energy consumption during waste collection and transportation, causing harmful effects to the environment and public health (Wan *et al.* 2019). According to the World Bank estimated that there were approximately 1.3 billion tons of municipal solid waste generated globally, and the volume is expected to reach 2.2 billion tons by 2025 (Wahi *et al.* 2016; Bandusena *et al.* 2019). Also, Globally about 71% of Solid waste is disposed of in landfills (Abdel-Shafy and Mansour 2018).

2.8 Waste Management Hierarchy

The waste hierarchy represents the progression of a product or material through the sequential stages of the pyramid of waste management and the latter parts of each product's life-cycle (Figure 2.1). The waste hierarchy is represented as a pyramid because the basic premise is to avoid and reduce waste generation. The next step is to reduce the generation of waste, i.e., by re-use, recycling, which would include composting. Re-use (without further processing) and recycling (processing waste materials to make the same or different products) keep materials in the productive economy and benefit the environment by decreasing the need for new materials and waste absorption (Popescu *et al.* 2016; Essuman 2017).

Reuse is a key component of waste prevention where it is also the second prioritized strategy for achieving sustainable development according to the waste hierarchy, reuse of products can extend products' life span and reduce the amount of waste directed to landfills or incineration (Wan *et al.* 2019)

Recycling is one of the most popular strategies adopted by universities for making campuses more sustainable. Recyclables provide economic value and further enhance the efficient use of materials. The practice also reduces the volume of waste being dumped into landfill sites or incinerated, causing less harmful effects on the environment. It involves processes that separate collected waste and convert recyclables into useable materials or new products. Recycling

is conducted by taking the materials and transforming them into new products. This is a key concept in modern waste minimization philosophy. It is about lessening the strain on the environment by minimizing the need to dispose of it fully. In our everyday living, we may already be separating paper products, aluminium soda cans, or glass bottles into different waste containers so that these could be recycled (Starovoytova 2018; Wan *et al.* 2019).

Recovery refers to the process of extracting energy or materials from the waste. For example, waste can turn into energy through thermal treatment; recovery of organic waste can be converted into energy and compost; materials recovered through recycling are of economic value. Although recovery is prioritized in a relatively low position in the waste hierarchy, the strategy contributes to sustainable development by reducing the demand for using resources and the amount of waste being buried in a landfill site. Food waste from campus canteens is a common substance used for recovery. For example, Ithaca College, USA, uses 5 tons of food waste per week to produce compost (Wan *et al.* 2019).



Source: WASTE MANAGEMENT TAGS 3R 2019

Figure 2.1 Responsible waste management hierarchy

2.9 Composting Process

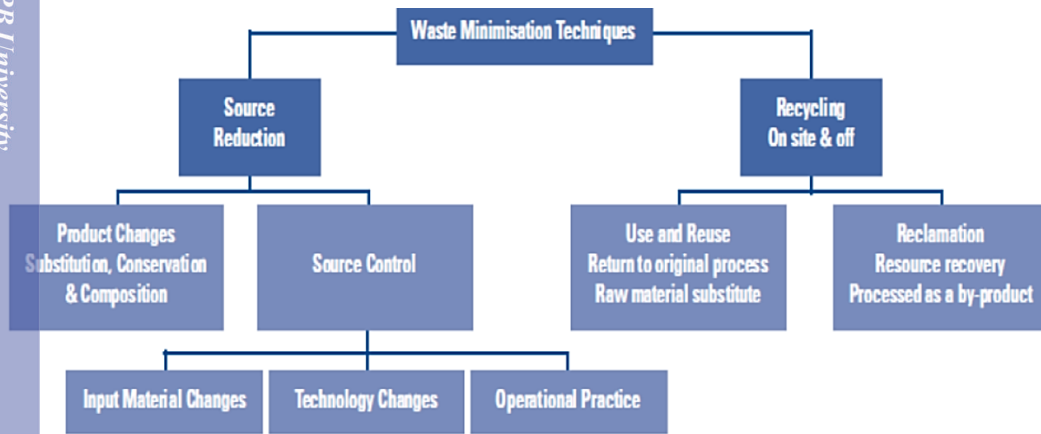
Composting is the best preferred biological degradation method of organic waste without causing harm to the environment and human health, in developing countries, composting practices is a suitable and increase practical treatment, as they can possess a large and various organic waste as raw material, also the composting has many environmental advantages like carbon sequestration, successful and sustainable organic waste processing with composting depends on the contribution from the community to adopt and practices it (Hariadi *et al.* 2018).

2.10 Waste Management Techniques

In strategies of solid waste management practice, the priority in the waste hierarchy is accorded to "reduction of waste" followed by "reuse" and "recycling." Although 3R knowledge is not essential for individual 3R practices, it explains the

intention or effort in adopting a specific behaviour (Tangwanichagapong *et al.* 2017). Respondents will be asked to prioritize the importance of "reduce," "reuse," and "recycle," and waste segregation by ranking them based on what they understood. If a respondent would make the correct selections by choosing "reduce" and waste segregation as the priority, respectively, it will be concluded that he/she understands the concept and strategies/techniques of solid waste management.

Eco-efficiency that encapsulates waste management, minimization, energy efficiency, source reduction, and waste exchange express the application of produce more from fewer or fewer resources to produce the same amount. (Figure 2.2).



Source: EPA 1988

Figure 2.2 Waste management techniques

2.11 Strategies for Solid Waste Treatment

Current treatment strategies are directed towards reducing the amount of solid waste that needs to be landfilled and recovering and utilizing the materials present in the discarded wastes as a resource to the largest possible extent. Different methods are used to treat solid waste, and the choice of proper method depends upon refuse characteristics, the land area available, and disposal cost. They are as follows:

2.12 Incineration Method of Waste Management

Incineration is a treatment method used for burning waste, and sometimes this is simply referred to as thermal treatment, as a general category of high-temperature treatment of trash material, after burning waste material change to heat, gas, steam, and ash. The advantage of the incineration method that waste can be burned by half or more, and it needs little land for usage. According to US EPA 2016 recognized that it is a good method for burning hazardous waste (such as biological, medical waste). However, incineration is a controversial method of waste treatment because of produces the emission of gaseous pollutants. Incineration is a common method for solid waste management but is the most expensive and was developed to burn hazardous waste (Popescu *et al.* 2016; Moh and Abd Manaf 2017).

2.13 Sanitary Landfills as Waste Disposal

The landfill is probably the most practiced in more areas of the world than any other method. Landfills are often old and abandoned areas. Considered the most cost-effective way of waste disposal, about 75% of the implementation cost is attributable to the collection and transportation of waste from residential and businesses to the landfills. The waste is layered in thin spreads and then compacted, with a layer of clean earth covering the waste material before more layers are added over time.

2.14 Review of Solid Waste Management Awareness and Practices in some Related Studies

Azahar Abas *et al.* (2018) reported that the Environmental Preservation Agency in the United States has agreed that all higher education institutions in their country enforce environmental protection laws and policies within the campus. As a result, many campuses in the United States have taken the initiative to reduce the negative impact of their activities on the environment, including multi-levels of communities on the campus.

According to Paghasian (2017) reported that the Philippine law mandate every educational institution should provide education to achieve effective and sustainable implementation of the proper waste management practices, awareness with participation is the key to be involved public, also include principles like segregation at source, reduction, recycling, re-use and composting to promote environmental awareness and action among the students, and the study revealed the student's awareness for solid waste management was high. Also, their practices in terms of segregation, reduction, and recycling were good, and their practices in terms of recycling and disposal were fair. Moreover, there was no influence between awareness and practices towards disposal, however, their awareness affected their practices specifically on segregation, reduce, reuse, and recycle.

A Study by Bautista (2019) shows the level of awareness and practices on solid waste management (SWM) among college students, and the results showed that the students are aware of solid waste management and most of them were aware of the policies and management of SWM. The study also revealed that the students have good practices in solid waste management in terms of properly disposing of, recycling, and reusing but moderately practice proper segregation and reducing. Results of the inferential statistics revealed that the level of awareness of the students influenced their practices on proper segregation, reduce, and recycling but no influence to their practices on solid waste management in terms of reuse and disposal and suggested that Present findings can be a basis for policy development on SWM implementation in the campus level.

In addition to that Paghasian (2017) reported that solid waste management problems are predominant in third-world countries without substantial environmental awareness programs for the community, Processes and methods of waste prevention and management necessitate collaboration and participation of all government and non-government institutions. Hence, education is an essential key to solid waste management.

Azahar Abas *et al.* (2018) reported that in Malaysia, a sustainable campus concept is more focused on reducing the number of solid wastes generated. However, this concept is a daunting task for many higher education institutions in Malaysia because of poor environmental stewardship and lack of commitment to environmental care among the campus's community and tertiary institutions in Malaysia are among the biggest contributors (>20%) of solid waste generated every year.

Coker *et al.* (2016) reported that the university is where people are educated and develop good plans and policies for society. Their expertise can raise awareness, knowledge and technology, and tools, which are essential practices within the surrounding community. However, they must also be role models in society in innovative ways to minimize waste generation.

Moqbel (2018) reported that educational institutions such as university are considered a small community that has a significant impact on the surrounding area. It has functions to shape the students to practices well in their communities towards solid waste management. Hence the surrounding community can adopt the successful approach and practices for solid waste management.

Sheau-Ting *et al.* (2016) show that the Malaysian government emphasizing waste minimization through by emphasized the reduce, reuse, and recycling (3R'S) program, which more focusing on waste separation practice and the program is more looking to reduce 40% of waste in dumpsite by 2020, and the study conducted in institutions campus shows that 84% for waste separation can emphasize more recycling, to successful each program requires practices participation of the people and its community.

Abne *et al.* (2017) reported that a university is an important area for solid waste management awareness. This institution can spread solid waste management strategies to students, revamp practices for solid waste recycling, disposal, and improve the behavior perception of the practices students by raising recycling option and their awareness.

Reyes (2020) Conducted research about assessing students' awareness attitude and practices of solid waste management. The study was revealed that the students were aware of waste management, also found that a significant relationship between awareness and practices on sex and academic level of students, also there was a significant relationship between awareness and attitude to predict practices of SWM, finally, conclude its essential to implement a program for solid waste management to reduce the problem of solid waste in the university.

A study by Desa *et al.* (2012) explained education as the best way to be provided to the students to raise their awareness of solid waste management. The study revealed that 60% of students were aware of and participated in practices and activities concerning a solid waste management program. However, there is still a need to provide awareness and education among first-year students towards solid waste management. Carefully thought-out waste education and awareness strategy must be developed to change students' behaviour to achieve this.

Lalamonan and Comighud (2020b) showed the importance of education in waste management, which should be provided to the community, and the study revealed that the practices for students in solid waste management were very high.

Also, there was a significant relationship between awareness and practices for students' and practices influenced solid waste management awareness.

Furthermore Punongbayan *et al.* (2014) suggested, awareness is the key component that should be provided to the students and is involved in waste management programs at their university and schools where the effective and sustainable implementation of good waste management practices could be achieved.

The study conducted by Sefiani (2016) explained a controlled landfill design based on solid waste generation analysis in IPB Campus Dramaga where the study shows that Bogor Agricultural University (IPB) is managing the waste transportation in open dumping without providing a proper final disposal site and suggests that a controlled landfill needs to be built in IPB.

Another survey study by Sabarina (2016) reported that the quantities of solid waste at IPB University is increasing every year, and it is the approximately average generation of 0.04 kg/capita/day. The highest amount generated solid waste was plastic, foliage, and food scrap, and the main area generating wastes are AHN buildings, Postgraduate building, and Female dormitories. Also, the waste collected from IPB university is not separated. This action will reduce the concept of a green campus.

One of the greatest challenges hinders Indonesia despite the high volume and complexity of waste produced, the waste management level is still poor. This includes updating information on waste generation amount and its composition. Furthermore, the lack of awareness, knowledge, and practice among the Indonesian community for solid waste management issues and being uneducated about the outcome of improper solid waste management has worsened the problem. Also, environmental awareness is still low in Indonesia.



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III MATERIALS AND METHODS

3.1 Time and Location

This research was conducted at Female and male student dormitories of IPB University Campus Dramaga. The research Site selection was purposefully, and the data collection started from July 2020 up to September 2020. Processing, analysis, and interpretation of data were conducted in September 2020.

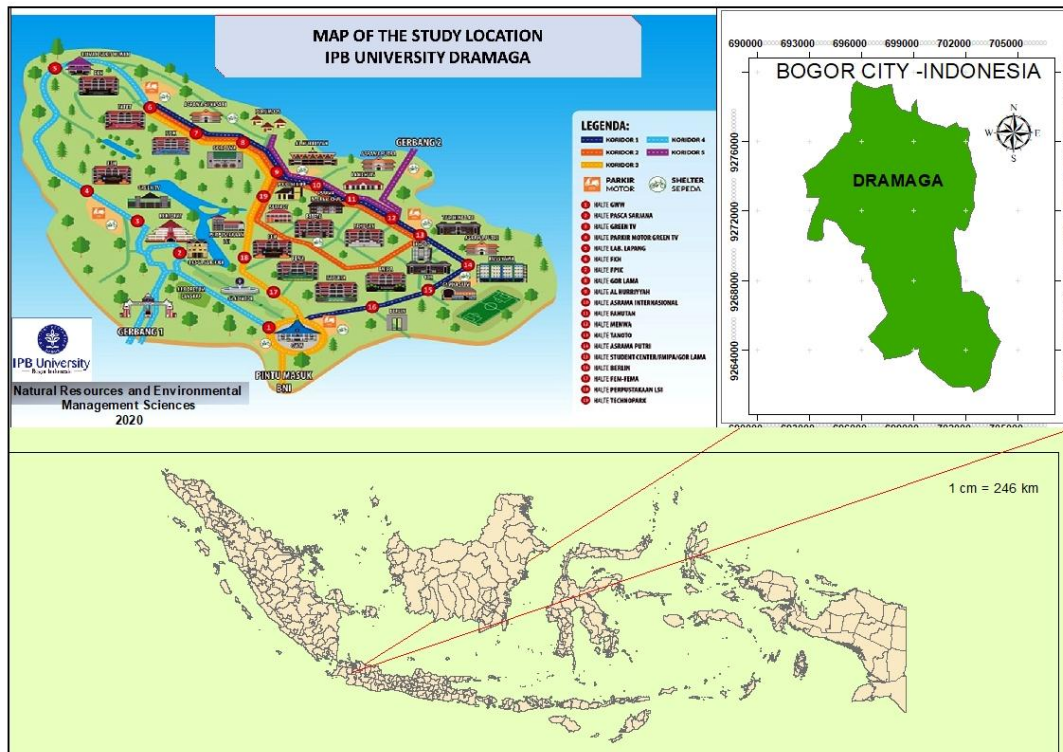


Figure 3.1 Map of the study location (IPB University, Dramaga - Bogor city).

3.1 Design of The Study

This study used the descriptive research design to assess solid waste management strategy in higher education institutions of Indonesia. To relate variables, the study was conducted at both Female and male students' dormitories of IPB University Dramaga Campus, as shown in (Figure 3.1). The sample size selected was 108 students using a simple random technique without replacement. The data were collected through Questionnaires and observation as a sample from Students IPB Campus Dramaga at the study area. A structured questionnaire with closed-ended questions was used for data collection. Likert scale was used to assess the level of awareness between Female and male IPB students' practices on solid waste management and assess the relationship between students' awareness and their practices on solid waste management.

3.2 Data Sampling

This study's respondents were the Female and male dormitories student of IPB University who constitute a greater number of populations in the IPB Dramaga Campus. Students are mainly targeted since they are regarded as the future of the nation, and universities are anticipated to develop their potential as advocates of the sustainable environment (Ahmad *et al.* 2015). Slovin's formula was used to calculate the sample size (n) given the population size (N) and a margin of error (e) (Jeffry *et al.* 2012). The sample was taken 98 simple random technique without replacement. The sample size (n) was determined by unrestricted random sampling using the formula:

$$n = N / 1 + Ne^2 \dots\dots\dots (1)$$

$$n = 3998 / 1 + 3998(0.1^2) = 98$$

whereas:

- n = number of samples
- N = total population = 3998
- e = error margin / margin of error = 0.1

3.3 Research Instruments

The study used two standardized survey questionnaires. To assess the level of awareness for students on solid waste management, a questionnaire was adopted from (Bautista 2019) was used. Meanwhile, the second part of the questionnaire surfaced of the students' solid waste management practices, which were adopted from (Paghasian 2017).

3.4 Research Procedures

Figure 3.2 shows that the procedure of this study was included in the study of literature, primary and secondary data collection, and data processing. Primary data were collected directly from Female and male dormitories students at IPB, and Secondary data were collected from the journals and reviewing some documents for solid waste management data at IPB. Distribution and retrieval were personally executed by the researcher. As agreed upon by the concerned authorities and the researcher, the data gathered was kept correctly to ensure its confidentiality and was strictly used for research purposes. The elicited quantitative data had undergone checking, scoring, analysis, and interpretation. Every item in the questionnaire was analyzed and interpreted. The researcher utilized Grand Mean to analyze and interpret the data that answered the specific problems posed in this study. Through this procedure, the level of awareness and practices of students on solid waste management were obtained.

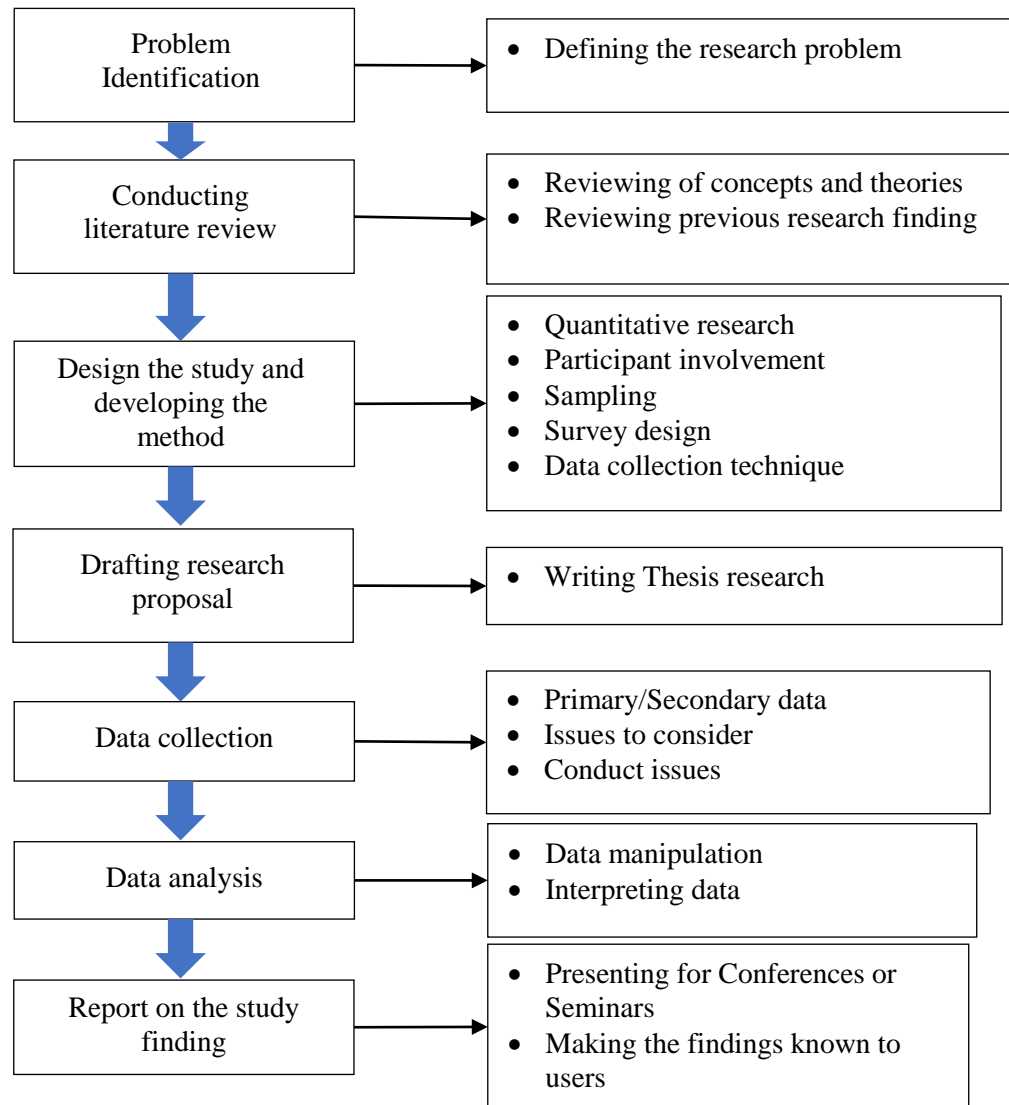


Figure 3.2 Research Flow Chart

3.5 Types and Data Sources

The types of data were primary and secondary. The primary data was collected through interviews, Questionnaires, direct field surveys, and observation as a sample from Students IPB Campus Dramaga at the study area. A structured questionnaire and interview with closed-ended questions were used for data collection. Likert scaled was used to require the respondents to indicate their level of agreement and disagreement.

The secondary data was collected from the Key respondents, literature review, reports records, journals, and IPB solid waste management authority. However, there were some limitations on using secondary data, such as outdated data and unofficial and proper data. Both primary and secondary data were focused on examining the level of awareness between Female and male of IPB students' practices on solid waste management and on assessing between the awareness of students and their practices on solid waste management.

3.6 Data Analysis

Descriptive statistics analyzed the data, percentage, standard deviation, mean, and rank were conducted using SPSS version 26 and Microsoft Excel 2016. Inferential statistics such as Pearson's *r* was used to determine the relationship between variables. The respondents' perception was measured using a five-point Likert scale with its numerical scale, statistical limits, and verbal description. For the level of awareness on solid waste management, the following was adopted: 4.20-5.00 (Very Highly Aware); 3.40-4.19 (Highly Aware); 2.60-3.39 (Aware); 1.8-2.59 (Not Aware); 1.0-1.79 (Very Unaware). In like manner, to interpret the data on the practices of the students along with solid waste management, the following was also adopted: 4.20-5.00 (Always); 3.40-4.19 (Often); 2.60-3.39 (Sometimes); 1.8-2.59 (Rarely); 1.0-1.79 (Never) and GIS technology were used as another tool for the identification of study location area map.

3.7 Percentage Distribution

The data was gathered, tallied, and recorded by SPSS statistical treatment, analysis, and interpretation. The following tools were used in the analysis of data in this study: Percentage Distribution Formula. This was used to summarize the variables under study. Formula:

$$\text{Percentage } P = \frac{f}{n} \times 100 \dots \dots \dots (2)$$

- where:
 P = percentage
 f = frequency
 n = total number of respondents

3.8 Grand Mean

Grand Mean. This was used to determine the level of awareness and practices in solid waste management of the students. Formula:

$$\bar{x} = \frac{\sum x_i}{N} \times 100 \dots \dots \dots (3)$$

- where:
 $\sum X$ = sum of the mean of all sets
 N = Total number of sets

Tabel 3.1 Summary of data collection and analysis

No.	Specific objectives	Variables	Indicators	Methods of data collection	Source of data	Data analysis
1	To assess the level of students' awareness of solid waste management	- Awareness of students	- Gender - Knowledge - Perceptions - Behaviours of student's	Questionnaires, interviews, and literature review	108 Female and male dormitories student of IPB University	Descriptive statistics (Frequency distribution, percent, mean, standard deviation, and Bar graph) Quantitative Analysis
2	To identify their respective practices on solid waste management	- Practices on Solid waste management	- Separation/ Segregation - Reduce - Reuse and - Disposal	Questionnaires, interviews, and Literature review	108 Female and male dormitories student of IPB University	Descriptive statistics (mean, standard deviation, and Bar graph) Quantitative Analysis
3	To assess awareness of the students and their practices on solid waste management	- Awareness of the students and their practices on SWM	- Separation/ Segregation - Reduce - Reuse and - Disposal	Questionnaires, interviews, and Literature review	108 Female and male dormitories student of IPB University	Quantitative Analysis

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IV RESULTS AND DISCUSSION

4.1 Sex Characteristics of the Respondents'

To determine the sex of the respondents' in the study area, a descriptive analysis of the respondents' characteristics based on gender was conducted.

Tabel 4.1 Characteristics of sex of the respondents

Gender	Frequency	Percentage (%)
Male	46	42.6
Female	62	57.4
Total	108	100.0

Table 4.1 above shows that the sex ratio (Female: male) among the overall respondents of this study was 108, with the ratio of 74.19% of all dormitory's students' where 62 (57.4%) were female respondents and 46 (42.6%) were male respondents, Male dormitories students tend to be fewer than Female, and this is the reason why they were fewer male respondents. Thus, the sex of the Respondent has implications also in this study, as it is believed that most, in many societies, females are engaging in various economic activities related to solid waste generations.

4.2 Level of Awareness for Students in Solid Waste Management

Table 4.2 below shows that the highest mean of 4.41 (SD= 0.71) corresponds with the importance of the green campus program in solid waste management in dormitories. And is interpreted as "Very highly aware," indicating that the respondents are mindful and aware that the IPB green campus programs. Thus, solid waste management is very important in dormitories and requires education for the environment. The study also shows with the least mean of 3.74 (SD= 0.99) the importance of the economic value of waste interpreted as "Highly aware." This means the students are aware of the importance of economic value and non-economic value for solid waste management. Hence, the university needs to involve the students to emphasize functions related to solid waste separation.

It also showed that with a mean of 4.34 (SD= 0.73) for waste management may increase the aesthetic value of the general competency education program PPKU dormitories, The mean of 4.29 (SD=0.82) corresponds to the importance for waste disposal at a specific area, a furthermore it shows the importance of education in SWM with the mean of 4.24 (SD=0.74) which means provision of education is very important for awareness of managing waste at dormitory, The possibility of diseases caused by unmanaged waste was shown by with the mean of 4.24 (SD=0.82), implementation of students for SWM with the mean of 4.22 (SD= 0.80), the results can be interpreted that the students are "Very highly aware", Moreover, the students are assessed as "highly aware" with a mean of 4.18 (SD= 0.72) objectives of solid waste management at PPKU dormitories. For the importance of knowledge and role in solid waste management with a mean of 4.17 (SD= 0.70). The mean of 4.04 (SD= 0.80) relates to the importance of an active role in the solid waste management. The significance of solid waste separation with a mean of 3.97 (SD=0.95). However, the Purpose of solid waste

management in the dormitories, with the mean of 3.96 (SD= 0.77). Moreover, roles and responsibility in solid waste management with a mean of 3.94 (SD=0.80), Finally the waste management discipline with a mean of 3.89 (SD=0.81). Therefore, it can be interpreted that the students are “highly aware”.

Tabel 4.2 Level of awareness of students on solid waste management

	Responses	Mean	SD	Interpretation
1	Importance of knowledge for SWM in PPKU dormitories	4.17	0.70	Highly Aware
2	Importance of playing an active role in SWM at PPKU dormitories	4.04	0.80	Highly Aware
3	Objectives of waste management in PPKU dormitories	4.18	0.72	Highly Aware
4	Purpose of the SWM in PPKU	3.96	0.77	Highly Aware
5	IPB Green Campus Program in SWM	4.41	0.71	Very Highly Aware
6	Importance of disposing of trash in a designated area	4.29	0.82	Very Highly Aware
7	Roles and responsibilities for students in SWM PPKU dormitories	3.94	0.80	Highly Aware
8	Education is an important factor in SWM PPKU dormitories	4.24	0.74	Very Highly Aware
9	Implementation will be successful and effective if concerned Students will participate	4.22	0.80	Very Highly Aware
10	Discipline in waste management at the PPKU dormitories	3.89	0.81	Highly Aware
11	Possibility of diseases that can be caused by littering waste	4.24	0.82	Very Highly Aware
12	Waste management can increase the aesthetic value of the PPKU dormitories	4.34	0.73	Very Highly Aware
13	The importance of separating waste	3.97	0.95	Highly Aware
14	The importance of economic value and SWM	3.74	0.99	Highly Aware
	Grand Mean	4.12		Highly Aware

Note: SD=standard deviation

Generally, the students are "Highly aware" of solid waste management, as evidenced by the grand mean of 4.12. This indicates that the students have the knowledge/awareness about solid waste management as a program for green campus protection and conservation of the environment. This finding is congruent with (Paghasian 2017), confirming that the Philippines students have good knowledge of SWM. Likewise, the earlier study of (Phan Hoang and Kato 2016) revealed that the students were aware of solid waste management activities. Also (Ali *et al.* 2014) showed that the students' were aware of solid waste management practices in their schools and the local environment. (Madrigal and Oracion 2018). The study shows that the respondents had a high level of awareness and attitudes and excellent extent practices in solid waste management.

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4.3 Level of Practices in Solid Waste Management

Table 4.3 displays the practices of the students in solid waste management. The highest mean of 2.82 (SD= 0.48), interpreted as "Sometimes," indicates that students fell on the practice of properly disposing of waste. The students frequently practice proper disposal by not throwing and leaving garbage anywhere and by disposing of waste in a proper dust bin by separating. The convenient access to solid waste bins may encourage the practice of reducing, reusing, and recycling (Sheau-Ting *et al.* 2016).

Tabel 4.3 Practices of students on solid waste management

Responses	Mean	SD	Interpretation
The practices of proper segregation	3.37	0.43	Sometimes
The practices of proper reducing	3.90	0.47	Often
The practices of proper reusing	4.27	0.51	Always
The practices of proper recycling	3.01	0.68	Sometimes
The practices of proper disposal	2.82	0.48	Often
Grand mean	3.47		Often

Note: SD= standard deviation

Similar to this, the students have also assessed themselves to "rarely" practice proper segregation, as evidenced by the computed mean of 3.37 (SD=0.43). This means that they can consider the importance of segregating biodegradable and non-biodegradable waste. This is Supported by (Árnadóttir *et al.* 2019) which showed that students have high knowledge about waste separation and practices positively. This was also revealed by the computed mean of 3.90 (SD=0.47). This means that the respondents occasionally practice solid waste reduction.

Table 4.3 also displayed the mean of 4.27 (SD=0.51) for the practice of proper reusing interpreted as "Always." This shows that the respondents have a good practice in solid waste management in terms of reuse. The students' common practice is to reuse washable food containers and reuse old materials than purchasing a new one. It also shows that with the mean of 3.01 (SD=0.68), the participants "sometimes" practice proper recycling. This means that students are aware of the importance of recycling solid waste materials. Part of the recycling activity they do is to make decorative materials from wastes materials.

The grand mean of 3.47 interpreted "often" along with solid waste management practices, and it generally disclosed that the respondents observe good practices in terms of proper segregation, proper reducing, proper reusing, recycling, and disposing of. According to (Ivy *et al.* 2013) findings of people's perception of using bins in segregating, reduce, and reuse for solid waste management, the results show that respondents were aware of segregating waste at the source area, also were positive to reduce and the reuse waste in the areas respectively. Also (Omar *et al.* 2019) found that the respondents have an adequate level of knowledge, have positive attitudes towards reuse, reduce, and recycling. However, their practices towards solid waste management were low (Almasi *et al.* 2019) suggested that involving the community in practices will improve their knowledge and encourage them to promote environmental activities. (Gequinto

2017) Also revealed that solid waste management practices were implemented effectively. (Desa, Abd Kadir, *et al.* 2012) determined that the students had positive attitudes towards reducing, reuse, and recycling programs, also the students have a high level of practice and responsibility in solid waste management.

4.4 The Significant Relationship Between the Level of Awareness and Practices on Solid Waste Management

Tabel 4.4 The relationship between the level of awareness and practices on solid waste management

Variables	Number of students	<i>r</i>	P-value (two-tailed)
Awareness	108	0.372**	0.000
Practices	108		

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

Table 4.4, A Pearson product-moment correlation was conducted to examine the relationship between awareness and practices in the IPB University dormitories. There was a correlation between awareness and practices, which was statistically significant (*r* value=0.372, n=108, P value=0.000). Hence, the null hypothesis is rejected. This implied that awareness and practices influence each other. Hence, as awareness increases or decreases, there is a possibility of affecting solid waste management practices. This study is similar to (Reyes 2020) which showed that there is significant relationship between awareness and practices among students towards solid waste management.

Tabel 4.5 The relationship between green campus and practices on solid waste management

Variable	Number of students	<i>r</i>	p-value (two-tailed)
Green Campus	108	0.283**	0.003
Practices	108		

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

As shown in Table 4.5, A Pearson product-moment correlation was conducted to examine the relationship between the the mportance of the Green campus program 2020 and practices in the IPB University dormitories. There was a weak positive correlation between the Green campus program and practices, which was statistically significant (*r* value=0.283, n=108, P value=0.003). Hence, the null hypothesis is rejected. This implied that practices and green campus influence each other. Hence as practices increase or decrease, there is a possibility to affect the green campus program towards solid waste management.

Table 4.6 shows the significant relationship between the level of awareness and practices on Solid Waste Management. According to the observation made to this analysis, I conclude that the calculated p-value of 0.029 and *r*-value of 0.210 shows that a significant relationship was found between the level of awareness and practices of students in solid waste management and the practice of proper segregation. Hence, the null hypothesis is rejected. It means that the level of students is oriented well about solid waste management, practically they can

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practice proper segregation of waste according to recyclable, non-recyclable waste.

Tabel 4.6 The relationship between the level of awareness and practices in terms of segregation, reduce, reuse, recycling, and disposal

Variables	<i>r</i>	P-value	Interpretation
The practice of Proper Segregation	0.210*	0.029	Significant
The practice of Proper Reduce	0.265**	0.006	Significant
The practice of Proper Reuse	0.310**	0.001	Significant
The practice of Proper Recycling	0.270**	0.005	Significant
The practice of Proper Disposal	0.112	0.250	Not significant

Note: * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)

As also seen in the Table 4.6, a significant relationship is found on the students' level of awareness between their practice of proper reducing with the computed p-value of 0.006 and *r*-value of 0.265. Hence, the null hypothesis of the study is rejected. This means that if the students have a good knowledge of solid waste management, there is a possibility that they can reduce garbage properly. Meanwhile, the computed p-value of 0.001 and *the r-value of 0.310 show a significant relationship between awareness and reuse. Hence, the null hypothesis of the study is rejected. This means that the level of awareness among the students on solid waste management affected their practice and reuse. This also would mean that the students were able to internalize the practice of proper reusing.*

In contrast, the computed p-value of 0.005 and the *r*-value of 0.270 reveal a significant relationship between awareness in recycling. Hence, the null hypothesis of the study is rejected. This clearly shows a correlation between the level of awareness of the students and their practices in terms of proper recycling. The finding shows that if the students are more aware of solid waste management, they better recycle things out of waste materials. Consequently, there is no correlation between the level of awareness on solid waste management and the practice of disposal with the computed p-value of 0.250 and an *r*-value of 0.112. This indicates that the students have moderate knowledge of solid waste management and could not practice disposal properly.

This study is in line with a previous study (Bautista 2019) which showed that there was a correlation between awareness and practices in the solid waste management for students. This influenced their practices on proper segregation, reduce, and recycling but no influence to their practices on solid waste management towards in reuse and disposal. Hence, the integration of knowledge, awareness, and attitudes was considered important in reshaping students' behavior towards environmental practices. In like manner to previous studies also contradict the relationship between environmental attitude and knowledge, (Paghasian 2017) reported that the awareness for students in solid waste management does not influence their proper practices in terms of disposal. However, their awareness affected their proper practices in segregation, reduce, reuse, and recycle. (Gusti 2016) also revealed that there is a correlation between attitudes and knowledge in sustainable waste management. (Dung *et al.* 2017)

reported a significant relationship between students' attitude and their knowledge towards solid waste management.

4.5 Waste Generated at IPB University Dormitory

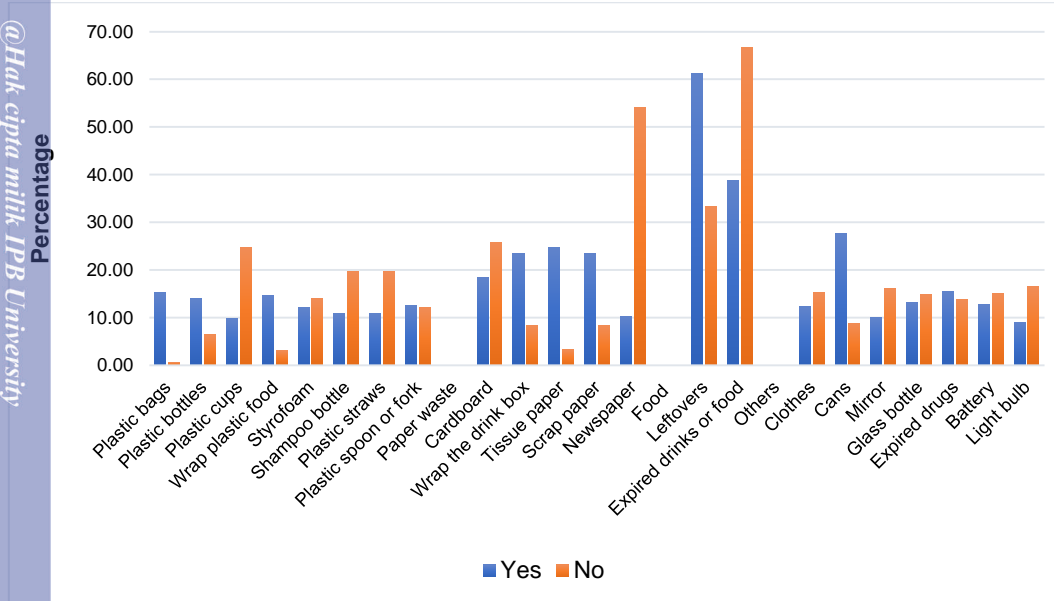


Figure 4.1 Waste generated at IPB University dormitory

Figure 4.1 shows the percentages of various types of waste which are generated at the IPB University dormitories. The results from the study revealed that the most plastic waste generated at dormitory were plastic bags (15.16%), followed by wrapped plastic food containers (14.59%), plastic bottles (13.88%), plastic spoons or forks (12.61%), Styrofoam waste (12.18%), plastic straws (10.91%), shampoo bottle (10.91%) and plastic cups (9.77%). Thus a greater number of respondents (15.16%) indicated that the most waste generated in IPB dormitory were plastic bags, and this supports by (Omar *et al.* 2019), who show that plastic waste materials are the most highly generated. Similar to (Hidayat *et al.* 2019) revealed that plastic waste is increasing in Indonesia.

The study found that the most waste produced in IPB dormitories is tissue paper (24.76%), drink box wraps (23.33%), scrap papers (23.33%), card-boards (18.33%), and newspapers (10.24%). Therefore, the study indicated that the tissue paper was the most solid waste generated in IPB dormitories, supported by the findings of (Lacang *et al.* 2019) which revealed that the composition of plastic waste, cans, papers, and glass bottles are increased. Moreover, the study revealed that food waste with the percentage of (61.24%) leftovers and (38.76%) of spoilage food are the highest food waste generated at dormitories since food is a basic need this is also argued for by (Starovoytova 2018) with a high percentage of food waste generated at the university campus, similarly, (Rodzi *et al.* 2019) show the increase of food waste at Campus.

Moreover, the study shows that there are other types of waste generated at dormitories which also need attention to be managed well, and the findings show that those types of waste were cans with the percentage of (27.60%), expired drugs (15.38%), used clothes (12.22%), glass bottles (13.12%), batteries

(12.67%), mirrors (9.95%) and light bulbs (9.05%). The previous study showed that the most solid waste generated in IPB dormitories were plastic bags, leftovers food, tissue papers, and cans waste materials, and the present results, which are supports (Shuker and Cadman 2018), shows the increase of plastic waste in Indonesia. Also, the study by (Zorpas 2020) suggested developing and apply a strategy for solid waste management to prevent food and plastic waste through enhancing recyclable, reuse and reduce, (Adeniran *et al.* 2017). The solid waste found was polythene bags, plastics, papers, organic, and others, and the management of waste was implemented to reuse, reduce, and recycle. Similar to IPB university can adopt the measure to reduce and recyclable food waste generation, this supported by (Pinto *et al.* 2018) suggested measures to be adopted to reduce and recyclable food waste in the University canteens. A Study by (A.S.Yuwono *et al.* 2016) revealed that plastic, paper, and food scrap waste were the most generated in IPB University. Also (Sabarina and Engineering 2016) determined that dormitories had a high number of plastics, paper, and food waste because it related to eating behaviour which they carry food from outside of the dormitories. Moreover, the study by (Ugwu *et al.* 2020) found that food waste was the highest amount generated at Nigerian university followed by plastics waste. This also suggest that food waste should be properly disposed-off or used to generate power in the university community. Animal feed or fertilizer can also be derived from the waste.

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V CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The student's awareness level in solid waste management is identified as high. Most of them were highly aware of the importance of the green campus program, and they had suggested that the program can increase the aesthetic value of the PPKU dormitories. Moreover, the students have good practices in terms of reducing and reusing, but moderate segregation, recycling, and disposal practices. Also, the findings revealed that the level of awareness of the students influenced their practices in segregation, reduce, reuse, and recycling but not influenced by their practices in terms of disposal.

The students were also able to reduce and reuse while they fall moderately in segregation, disposal, and recycling. Finally, there was a weak positive correlation between the students' awareness and their practices in solid waste management. The study revealed that most of the waste generated in IPB University dormitories was plastic bags, leftovers food, tissue papers, and cans waste.

5.2 Recommendation

Based on the present findings, the study recommends the following measures:

IPB University should conduct and encourage the students to participate in seminars, campaigns about solid waste management and allow them to be provided with full information. IPB University should implement effective programs by conducting seminars and meetings with the students to raise awareness of proper segregation and disposal practices to contribute to solid waste management. This may lead to the students to proper practices in segregation and disposal. Lastly, environmental education should be mandatory for all faculties to encourage students' awareness about the environments.



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APPENDICES

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Appendix 1 Respondent's Information



Questionnaire Form

Dear Respondent,

I am a student at IPB University, Indonesia, pursuing a Master's Science in Natural Resources and Environmental Management Science. As part of the academic requirements, I am conducting research on **Assessing solid waste management strategy in higher education institutions of Indonesia: A case study of IPB Campus Dramaga -Bogor City**. I am therefore requesting you to spare some time and fill this questionnaire. The information you give will be treated confidentially and anonymously to write the research report and not be used for any other purpose.

Name:.....

NIM:.....

Building:.....

Gender: Male Female

Please check the box with a checkmark (√) on one of the alternative answers you choose.

Measuring instrument of awareness about waste management by students

Understand some of the statements below, choose one of the five alternative answers according to your circumstances and habits.

- 1 = Very unaware
- 2 = Not Aware
- 3 = Aware
- 4 = Highly Aware
- 5 = Very highly aware

Awareness of Students on Solid Waste Management

No.	Statement	Choice				
		1	2	3	4	5
1	Importance of knowledge for SWM in PPKU dormitories					
2	Importance of playing an active role in SWM at PPKU Dormitories					
3	Objectives of waste management in PPKU dormitories					
4	Purpose of the SWM in PPKU					
5	IPB Green Campus Program in SWM					
6	Importance of disposing of trash in a designated area					
7	Roles and responsibilities for students in SWM PPKU					

	dormitories						
8	Education is an important factor in SWM PPKU dormitories						
9	Implementation will be successful and effective if concerned Students will participate						
10	Discipline in waste management at the PPKU Dormitories						
11	Possibility of diseases that can be caused by littering waste						
12	Waste management can increase the aesthetic value of the PPKU dormitories						
13	The importance of separating waste						
14	The importance of economic value and SWM						

Waste Management practice measurement instrument in terms of separation, reduction, reuse, and disposal.

For solid waste management practices in terms of separation, reduction, reuse, and disposal. choose one of the following four alternative answers:

- 1 = Never
- 2 = Rarely
- 3 = Sometimes
- 4 = Often
- 5 = Always

Practices of Students on Solid Waste Management

No.	Statement	Choice				
		1	2	3	4	5
SEGREGATION						
1	I separate organic waste (paper, cardboard, cardboard, and food scraps) and non-organic waste (plastic bags, plastic bottles, plastic cups, rubber bands, Styrofoam) at the PPKU dormitories					
2	I separate recycled/economic value waste (paper, cardboard, cans, shampoo bottles, plastic bottles, and glass bottles) from non-recyclable / non-economic waste (food scraps, food plastic wrappers, plastic bags) at the PPKU dormitories					
3	I separate B3 waste (hazardous and toxic materials) such as batteries, light bulbs, expired drugs, and others					
4	I mix all the garbage in one trash can					
5	I segregate items that can be recycled for reuse					
REDUCE						
6	I borrow and/or share things that are sometimes needed (plates, glasses, drinking containers)					
7	I only buy the food I need so that no leftovers can become waste					
8	I bring a place to eat when buying food to reduce food wrappers' use (plastic, rice paper, etc.)					

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9	I brought a tumbler to fill drinking water and reduce the purchase of Bottled Drinking Water (AMDK)					
10	I am cautious and responsible for every waste I produced					
	REUSE					
11	I reuse my old materials than buying a new one					
12	I keep used paper and use it as scribbles or note					
13	I reuse grocery bags					
14	I reuse washable food containers					
15	I reuse washable plastic cutlery (spoon/fork/chopsticks)					
	RECYCLE					
16	I convert or redesign waste materials into a new product					
17	I use trash to be used as decoration (room, table, or activity)					
18	I ignore the importance of recycling					
19	I invite my friends to use trash to become new items that can be used					
20	I use torn and faded clothes as rags					
	DISPOSAL					
21	I throw and left my garbage anywhere					
22	I throw waste materials in common open dumps					
23	I pile up trash in the room and when it is full, just throw it away					
24	I rarely throw trash in the designated trash can					
25	I used to take out the trash by sorting					

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Appendix 2 Types of Waste Generated

Please, answer “Yes” or “No” by ticking (✓) one of the following types of waste which are generated at IPB University PPKU Dormitories:

1=Yes

2=No

No	Types of waste generated	Choice	
		1	2
	Plastic waste		
1	Plastic bags		
2	Plastic bottles		
3	Plastic cups		
4	Wrap plastic food		
5	Styrofoam		
6	Shampoo bottle		
7	Plastic straws		
8	Plastic spoon or fork		
	Paper trash		
9	Cardboard		
10	Wrap the drink box		
11	Tissue paper		
12	Scrap paper		
13	Newspaper		
	Food waste		
14	Leftovers		
15	Expired drinks or food		
	Others		
16	Used clothes		
17	Cans		
18	Mirror		
19	Glass bottle		
20	Expired drugs		
21	Battery		
22	Light bulb		

**Thank you for your cooperation
END**

BIOGRAPHY



Joseph Rugatiri, was born on 14th April 1989 in Nyamagana-Mwanza city, Tanzania as the last child of the Philipo Rugatiri Wagora family. The author completed his Ordinary Level education from 2006 to 2009 at Lake High School. Then he joined Fisheries Education and Training Agency (FETA) in 2010, where he Completed his Ordinary Diploma in Fisheries Science and Technology (FST) in 2013. Soon after completing his Ordinary Diploma studies, the author was selected to join the Institute of Rural Development Planning (IRDP), where he pursues his Bachelor's degree in Environmental Planning and Management from 2013 up to 2016. In 2015, Tanzania's government employed the author to work in the Kigamboni Municipal Council as a Fisheries officer II up to date. In 2018 the author was selected to join Bogor Agriculture University, where he took Master's of Science in Natural Resources and Environmental Management Science.

The author has attended some international seminars as a presenter, including The 2nd International Symposium on Transdisciplinary Approach for Knowledge Co-creation in Sustainability in 2020 at IPB University, Indonesia, where his paper was published. Moreover, the author has attended The International Conference on Sustainable Cereals and Crop Production Systems in the Tropics (ICFST) at South Sulawesi Indonesia, where his paper was successfully published in their proceeding. A part of this thesis titled "Assessing Solid Waste Management Strategy in Higher Education Institutions of Indonesia: A Case study of IPB University Dramaga-Bogor City." has already been published in the Journal of IOP Conference Series Earth and Environmental Science (IOP), on November 2020.

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