



Palestine Polytechnic University
College of Engineering and Technology
Mechanical Engineering Department
Automotive Engineering
Graduation Project

Possible Revenue by Waste Management in Higher Education Institutions

Project Team

Mohammad Abusnineh & Moath shatrit

Project Supervisors

Dr. Diya Arafah

Dr. Momen Sughayyer

Hebron, January 2021

Palestine Polytechnic University
College of Engineering and Technology
Mechanical Engineering Department
Automotive Engineering
Hebron –Palestine

**Possible Revenue by Waste Management in
Higher Education Institutions**

By

Mohammad Abusnineh

Moath shatrit

Submitted to the College of Engineering and Technology
In partial fulfillment of the requirements for the
Bachelor degree in Mechanical Engineering

Supervisors Signatures

.....

Testing committee Signatures

.....

Chair of the Department Signature

.....

August, 2021

DEDICATION

To whom do I prefer it over myself, and why not; You sacrificed for me

She did not always spare any effort to make me happy, (My dear mother).

We walk the paths of life, and everyone remains who controls our minds in every way we take it

The owner of a kind face, and good deeds.

He did not spare me all his life, (My dear father).

To my friends, and everyone who stood next to me and helped me with everything they owned, in many ways

I offer you this research, and I hope it satisfies you.

ACKNOWLEDGMENTS

In the Name of Allah, the Beneficent, the Merciful. And blessings and peace be upon Muhammad, his servant and his Messenger.

We owe a deep debt of gratitude to our university for giving us an opportunity to do a graduation project.

I am grateful to our supervisors Dr. Diya Arafah and Dr. Momen Sughayyer for their guidance throughout this study.

Special thanks to the College Administration for their support and for allowing us to implement the project the campus.

We highly appreciate the efforts made by the faculty in the Engineering Program at Palestine Polytechnic University especially Dr. Jalal Salaymeh and Dr. Hasan Sawalha.

We thank all the personnel that assisted us in retrieving the information needed from the Municipality that was very critical in this study.

Abstract

Comprehensive solid waste management programs are one of the greatest challenges to achieving campus sustainability. Conducting a waste characterization study is a critical first step in successful waste management planning and advancing the overall sustainability of an institution of higher education. This project on waste characterization study was conducted at the campus of Palestine Polytechnic University. Palestinians from West Bank and Gaza generated about 1.59 Million tons or nearly 4,356 tons/ day in 2018. Average production per capita is about 0.9 kg/day². Most of municipal waste (94%) is collected by municipalities, the UNRWA and JSCs. The JSCs collect about 65% of the municipal waste; the remaining waste is taken care off by the previously mentioned service providers and the private sector. The aim of the study was to determine the amount and composition of waste generated within key campus operational areas and to provide recommendations to senior university administration on strategies for waste minimization, higher rates of recycling and composting and improving the overall sustainability of the campus waste management program, and to estimate the amount of revenue possible after organizing the waste while also using different applications to do so. Because of the lack of information regarding the estimation of the quantities of the different type of waste generated, we use two previous studies that have evaluated the amount of waste generated regarding the different type of waste so we can evaluate the closer estimation in applying the study on our university because a study like this hasn't happened before on our university Palestine Polytechnic University (PPU).

Content

Dedication	2
Acknowledgments	3
Abstract	4
List of Tables	7
List of Abbreviations	8
Chapter One Introduction	9
1.1 Introduction	10
1.2 Research Problem	11
1.3 Goal and Objective	11
1.4 Research methodology	12
1.5 Implementation Plan	13
Chapter Two Literature Review	14
2.1 Introduction	15
2.2 Types of waste in Higher Education Institutions	15
2.2.1 Plastic Waste	15
2.2.2 Paper Waste	16
2.2.3 Glass Waste	16
2.2.4 Food Waste	16
2.2.5 Metal Waste	16
2.2.6 Waste Paint & Art Supplies	16
2.3 Strategies of waste management in HEI	17
2.3.1 St Pious X Degree and P.G College for Women, Nacharam, Hyderabad	17
2.3.2 Universiti Kebangsaan Malaysia (UKM)	18
2.4 Benefits of Recycling	19
2.5 University Ranking for Waste Management	20
2.5.1 University College Cork	20
2.5.2 Newcastle University	20
2.5.3 University of Dundee	21
2.5.4 University of Eastern Finland	21
2.5.5 University of Aberdeen	21
Chapter Three Waste Management and Revenue In Palestine Polytechnic University	22
3.1 Introduction	23
3.2 Waste Generated in College Campus	24
3.3 Quantities of Types of Waste Generated	24
3.4 Comparison of Quantities of Types of Waste Generated	26

3.5 Revenue from Waste Management	26
3.5.1 Revenue from Paper Waste Management	27
3.5.2 Revenue from Plastic Waste Management	27
3.5.3 Revenue from Metal Waste Management	28
3.5.4 Revenue from Glass Waste Management	28
3.5.5 Revenue from Food Waste Management	28
3.6 Conclusion	29
Chapter Four Execution Changes, Calculation and Discussion	30
4.1 Introduction	31
4.2 Plan and Mythology Change	31
4.2.1 Spreading Knowledge	31
4.2.2 Distribute Questionnaires	33
4.2.3 Values from the Municipality	34
4.2.3.1 Amount of Waste Generation	35
4.2.3.2 Estimation of Types of Waste Generated	35
4.3 Revenue from Waste Generated	36
4.3.1 Amount of Waste types Generated	36
4.3.2 Revenue from Generated Waste types	37
4.4 Conclusion	37
4.5 Recommendations	37
List of references	38

List of Tables

Chapter One

Table 1.1 Action plan	13
------------------------------	-----------

Chapter Three

Table 3.1 Sources and Type of waste generated from various sources	24
---	-----------

Table 3.2 Types of waste quantities categorization according to Malaysia	25
---	-----------

Table 3.3 Types of waste quantities categorization according to (UAEM)	25
---	-----------

Table 3.4 Comparison of quantity research between Malaysia and (UAEM)	26
--	-----------

Table 3.5 Revenue from Waste by the Two Studies	29
--	-----------

Chapter Four

Table 4.1 Value of Waste Generation	37
--	-----------

Table 4.2 Amount of Waste Generation	38
---	-----------

Table 4.3 Revenue from Waste Generation	39
--	-----------

List of Abbreviations

Abbreviations	Name
PPU	Palestine Polytechnic University
HEIs	Higher Education Institutions
HE	Higher Education
UK	United Kingdom
UoS	University of Southampton
EPA	Environmental Protection Agency
ASTM	American Society of Testing and Material standard
CO2	Carbon dioxide
SDGs	Sustainable Development Goals
UCC	University College Cork
PPA	power purchase agreement
WWF	World Waste Federation
NIS	New Israeli Shekel
UAEM	Autonomous Morelos State University

Chapter One Introduction

1.1 Introduction

In this study our aim is to collect data related to the amount of waste generated on the campus of Palestine Polytechnic University, and then convert it into something that can be tangibly used or as a material return for our university.

Solid waste generation is the common basis for active data estimation. Solid waste generation rates are various and the composition varies from country to another depending on the economic condition, Industrial structure, waste management regulations and cultural habits. Moreover, the availability and quality of data on solid waste generation additionally varies to post-processing from one country to another, Statistics of waste generation and treatment have improved significantly in many countries during the last decade but data is required to estimate the disposal of waste on campus and to acquire a suitable waste management system.

First of all, what is waste management? It is the activities, actions and procedures taken to manage waste from the initial position or product it starts from to its final destination of disposal.

Waste management or as it is also called recycling should be mandatory for everyone in general even in colleges and universities, waste management activities should be integrated into a comprehensive solid management plan for the campus to achieve the best results possible.

Recycling strategies should be implemented anywhere waste is generated: classrooms, in administrative offices, libraries, dining halls, dormitories, etc. Each area may focus on a particular collection of different recyclable materials (e.g., computer paper in offices; beverage containers, magazines and newspapers in dorms; glass and metal containers in cafeterias, etc.), involve different collection approaches, and require different recycling behaviour on the part of program participants.

And in the process of waste management we will be able to estimate the amount of waste that is produced throughout the institution, including the different department, work quarter and campus (e.g., offices, labs, cafeterias and workshops).

Finally, the hardest part of our study is to transform that estimated amount of waste that we are attempting to manage to revenue which is unconsidered available that can be used on different aspects to develop and insure the progress and evolution of our institution.

1.2 Research Problem

Waste management (recycling) plans have complicated approaches to really strike an impact on the campus itself, but that's not even the hardest part, the real struggle that we are going to face is the implication of the strategies themselves.

Developing a comprehensive campus waste prevention program is a challenge; the program doesn't implement itself. Pulling together an effective program will involve many people in many areas of the campus.

As waste management programs can be found online and are improved, campuses have to work to make containers and collection systems "fit" wherever possible. Often the result is based on whatever physical setup happens to exist. The best solution is to consciously incorporate recycling facility designs into the construction and planning of new and rehabilitated buildings and facilities. [1]

After being able of choosing an appropriate plan we hope we are able of answer the following:

- 1- What is the amount of waste that is properly sorted on the campus of our university?
- 2- Are we able to change the outcome of waste managed by executing recycling plans?
- 3-Which is the most effective technique for waste management?
- 4-How much revenue are we capable of acquiring?

1.3 Goal and Objective [2]

The general objective of the project is to minimize the amount of waste that is distriputing all around the campus of our Higher Education Institution.

The specific objectives of the project include:

1. To determine the type and nature of the waste.
2. To estimated volumes of waste to be generated.
3. To recommend appropriate waste handling and disposal measures accordance with the current legislative and administrative requirements.
4. To categories waste material where practicable for disposal considerations.
5. To analyse the amount of revenue possible from waste management.

1.4 Research Methodology

The first research problem is that the waste amount in Palestine Polytechnic University has not been measured, and therefore the amount of waste in Palestine Polytechnic University is unknown. The second problem is the lack of awareness of waste management on the campus of the university. Therefore, many student and participants that come to the campus mistreat the surrounding and quarters, but awareness is not enough.

To solve these problems, this study will address overarching question: Are we able to change the outcome of waste managed by executing recycling plans?

To answer this question we will follow the following methodology:

Initially, we will contact the proper officials to have multiple seminar and gatherings to spread awareness on the matter of waste management through pamphlets and social media platforms and in that time.

In the next stage, questionnaires will be distributed around the university campus to measure the amount of waste that was developed through periods of time.

After completing the samples collection, work will **start on our software**:

We will calculate the amount of waste collected though the time of our research and mathematically calculate the response of the individuals that participate on the grounds of Palestine Polytechnic University, There for calculating the amount of revenue possible according to the study.

1.5 Implementation Plan

An introduction to the project will be carried our plan as shown in the tables (1.1)

Table 1.1 Action plan

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Active																
Planning the appropriate approach				Active	Active	Active										
Gathering the values and readings from the Municipality							Active	Active	Active							
Spreading awareness about waste management and taking questioners									Active	Active	Active	Active	Active	Active		
Writing the final report														Active	Active	Active

Chapter Two Literature Review

2.1 Introduction

Higher Education Institutions (HEIs) are often the size of small municipalities. Worldwide, the higher education (HE) sector has expanded phenomenally; for example, since the 1960s, the United Kingdom (UK) HE system has expanded sixfold to >2.4 million students. As a consequence, the overall production of waste at HEIs throughout the world is very large and presents significant challenges as the associated legislative, economic and environmental pressures can be difficult to control and manage.

This study critically reviews why sustainable waste management has become a key issue for the worldwide Higher Education sector to address and describes some of the benefits, barriers, practical and logistical problems. As a practical illustration of some of the issues and problems, the four-phase waste management strategy developed over 15 years by one of the largest universities in Southern England – the University of Southampton (UoS) – is outlined as a case study.

The UoS is committed to protecting the environment by developing practices that are safe, sustainable and environmentally friendly and has developed a practical, staged approach to manage waste in an increasingly sustainable fashion.

Good practice and useful resources that other institutions – both nationally and internationally – can access are provided. As a result of the strategy developed at the UoS, from 2004 to 2008 waste costs fell by around £125k and a recycling rate of 72% was achieved. The holistic approach taken provides a realistic, successful and practical example for other institutions wishing to effectively and sustainably manage their waste.

This chapter reviews methods for improving waste management and their types in gap of existing knowledge.

2.2 Types of waste in Higher Education Institutions

Waste that is produced in the vicinity of the university can be categorized by the following:

2.2.1 Plastic Waste

Accumulation of plastic objects (e.g. plastic bottles, bags and office appliances) in the Earth's environment that adversely have negative effects on wildlife, wildlife habitat, and humans.

Plastics that act as pollutants are categorized into micro-, meso-, or macro debris, based on size. The chemical structure of most plastics renders them resistant to many natural processes of degradation and as a result they are slow to degrade. [3]

2.2.2 Paper Waste

Paper is a versatile material with many uses, including printing, packaging, decorating, writing, cleaning, filtering, toilet tissue and a number of industrial and construction processes. The amount of paper waste generation comes mainly from used notebooks and printings. It is especially high during the exam season, but in general The United States Environmental Protection Agency (EPA) has found that paper is causes 35% of water pollution and 74% of air pollution. [4]

2.2.3 Glass Waste

Glass wastes in university campus are mainly jars, bottles, lab glass, windowpanels and mirrors. Appropriate disposal of laboratory glass minimizes hazards to laboratory workers, custodians, and solid waste disposal employees.

2.2.4 Food Waste

There are many sources of food and other bio chemical substances. Food waste that ends up in landfills produces a large amount of methane – a more powerful greenhouse gas than even CO₂. For the uninitiated, excess amounts of greenhouse gases such as methane, CO₂ and chlorofluorocarbons absorb infrared radiation and heat up the earth's atmosphere, causing global warming and climate change.

2.2.5 Metal Waste

Among all the pollutants, heavy metals have received a paramount attention to environmental chemists due to their toxic nature. Heavy metals are usually present in trace amounts in natural waters but many of them are toxic even at very low concentrations. [5]

2.2.6 Waste Paint & Art Supplies

Some paints and other art materials contain hazardous waste which, when not properly handled, pose both safety and environmental hazards.

2.3 Strategies of waste management in HEI

When we are thinking of waste management plans and strategies we can see that there is a various amount of conditions that change from place to another and as a result so does the plans that were put to be executed in that specific area or compound, so some of the methods throughout the world can be described.

2.3.1 St Pious X Degree and P.G College for Women, Nacharam, Hyderabad

The first step in waste management is to gain an understanding of the waste types being generated in order to design appropriate collection and disposal strategies, starting with the steps to identify the sources of waste generation in the college campus and then to assess the amount and types of waste generated in the college.

Identifying the Sources of Waste Generation; the various sources of waste generated in the campus should be sorted in a table, Segregation of waste; waste characterization consists of collecting waste at its source and directly sorting it out into types of materials.

The waste was collected on a daily basis from various sources in the college and was brought to the common area in the ground for further segregation by category, The collected waste was separated into dry waste and wet waste, dry waste was then segregated into recyclables (paper and cardboard; plastic and pet bottles; glass, metals) and non-recyclables.

Weighing of different categories of waste; the different waste categories segregated were then weighed using a weighing machine and respective weights were noted down. The procedure was repeated on a daily basis for a month. The average per day weight of each category waste and total waste generated was calculated. [6]

2.3.2 University Kebangsaan Malaysia (UKM)

The samples were obtained from four categories which are offices, dormitories, student affairs and faculties. Sampling was carried out for a week starting from 24th February 2009 till 2nd March 2009. The sampling and segregation adopted referred to the American Society of Testing and Material standard (ASTM), where solid wastes are sorted into two main groups; recyclable and non-recyclable materials.

Solid wastes were collected in a 660 litre MGB container outside the buildings. This is to ensure the total daily generation waste is collected together before the segregation process.

Next, daily solid waste generation were weighed with analogy weighing machine and data were recorded. The solid wastes were separated according to plastic, paper, aluminium, glass, e-waste, food waste and others.

Then, each category of the waste are weighed and recorded while samples were taken for further analysis at the laboratories, The determination of the total moisture content was done according to ASTM Standard of Total Moisture Test Method, hence, once the waste were sorted, the samples were weighed and sent to the laboratory for further analysis. The samples were weighed initially to determine if there was any moisture lost during the compactor truck unloading the sample during sorting session. If there is moisture lost/gained then it will be accounted for in the total overall moisture content of the sample.

The analysis to determine the pH value was referred to Carnes Compost pH Characteristics . At least 10 gram sample of organic waste is poured into 500 ml distilled water and stirred vigorously for 3 to 5 minutes. Then, when the mixture is settled pH measures with a pH meter (Model Sension1) was taken.

Density of solid waste is done according to —Standard “Metode Pengambilan dan Pengukuran Contoh Timbunan dan Komposisi Sampah Perkotaan”. Firstly, a 50cm×50cm×50cm box was prepared. Then, the weight of the box was measured and recorded. After that, a bag of refuse was selected from the research area. All refuse was poured from the bag to the box. The waste from the refuse bag was ensured to occupy almost the designated height of the box (50cm). Then, the box was free dropped from the height of 20cm from the ground level for 3 consecutive times.

Next, the volume of the box was measured (after 3times free drop). The weight of the box was measured together with the compacted waste. Finally, the density of waste was calculated.

C/N (Carbon/Nitrogen) ratio analysis was carried out using the CHNS-O analyser; this gave results for carbon, hydrogen, oxygen, nitrogen, and sulphur content in the waste. Analysis of the samples was done not only for the individual components but also for the commingled samples. This approach allows for comparison of results from the individual component analysis, calculated overall characteristics. [7]

2.4Benefits of Recycling

Here are some reasons why you might want to care about the dirty waste that students and staff leave behind:

- ✓ Our university can save money, by paying less for waste going to landfill or incineration, and it might even earn money, by selling cardboard, glass, metal or plastic.
- ✓ When throwing away garbage our university, Students and staff immediately see if a recycling system is in place or not. If we want people to care about environmental issues, then improving recycling is a good way to avoid common complaints that our university doesn't do enough on sustainability.
- ✓ Litter can spoil beautiful campus gardens, incineration contributes to climate change, as well as seagulls and fish suffocate from plastic. University recycling can help us to reduce our university's environmental impacts.
- ✓ The resources that go into the goods, buildings and gadgets that make our modern life so convenient are limited. Finding ways to use less material inputs for products and to re-use materials in a circular economy is necessary for long-term prosperity. [8]

2.5 University Ranking for Waste Management

University students have high expectations for the institutions they attend when it comes to sustainability: 87% want to see it actively promoted; while just over half believe that sustainability should be included in their coursework.

Times Higher Education has ranked universities around the world on how they are committing to some of the United Nations' Sustainable Development Goals (SDGs).

Based on that analysis, here are the top five universities for recycling and sustainability.

2.5.1 University College Cork

In 2007, students at University College Cork (UCC), in the Republic of Ireland, set up a Green Campus programme to improve recycling facilities and address waste management around the grounds.

Since then, UCC has cut its carbon emissions by 36%, planted 2,500 trees on campus, and increased the number of people cycling by 90%. Its library, one of the most energy-intensive buildings on campus, has seen a 9% reduction in energy use and a 700% increase in recycling through its own sustainability programme.

The university was the first in the world to be awarded a Green Flag from the Foundation for Environmental Education – a global organization that embeds sustainability throughout the education process.

2.5.2 Newcastle University

Newcastle University has a Sustainability Team sitting within its estates department. It's responsible for environmental management across the campus – helping to reduce energy use and emissions and promoting sustainable travel options.

Newcastle is one of 20 UK universities that has recently signed a power purchase agreement (PPA) to collectively buy \$64 million of renewable wind energy.

In April 2019, the university issued a climate emergency statement committing to reducing its greenhouse gas emissions in line with the Paris Agreement on climate change, promising to work towards achieving net zero emissions by 2040.

2.5.3 University of Dundee

Through its environmental and sustainability policy, the University of Dundee has committed to less waste, more recycling, and better use of recycled and recovered materials.

An example of this is its use of the Warp-it platform, which finds homes for used furniture from the estate, reducing waste and landfill.

The university also sells recycled goods in its campus shops and offers students recycling points to spend for every plastic bottle they return.

2.5.4 University of Eastern Finland

The University of Eastern Finland is aiming to be a paperless campus; using only electronic internal communication and avoiding printing wherever possible.

Its administration offices have been granted a Green Office label by the WWF for a commitment to the promotion of sustainable development.

Staff and students are encouraged to reuse as much as possible, including ink cartridges and furniture.

The university is also committed to increasing recycling and minimizing landfill waste.

2.5.5 University of Aberdeen

At the University of Aberdeen, students, staff and local residents are encouraged to donate damaged electrical items for recycling. The university also follows Scotland's Zero Waste Plan, which, by 2025, wants to reduce total waste in Scotland by 15% against 2011 levels.

It has reduced its water usage by more than 100,000 tonnes a year thanks to refitted plumbing systems. And it has a five-year carbon management plan that it projects will reduce emissions by over 8,500 tonnes and save nearly \$2.2 million by the end of 2021. [9]

Chapter Three Waste Management and Revenue
According to Palestine's Finance

3.1 Introduction

Palestine Polytechnic University (PPU) has witnessed quantum leaps in a short three-decade time during which it had been developed from a community college with few scattered buildings and limited programs to a full entrepreneur University with several colleges offering graduate and undergraduate programs.

The University's diversified academic programs were not only tailored responding to the community needs, but they have also been developed qualitatively to compete in national and regional dimensions. Development on the level of research and community services provided have also been witnessing major leaps in the establishment of several multi-disciplinary centres of excellence that possess quality-certified laboratories and facilities that are capable of providing professional standardized testing and consultancies to various national development sectors.

We have accomplished a lot, but the future challenges that lie ahead require us to keep developing our entrepreneur initiatives and innovative solutions. Such creativity, on one hand, serves our community development sectors' needs and, on the other hand, contribute to the process of knowledge generation that serves the scientific development in large.

In order to face future challenges, we need to develop interim strategies that maintain our competitiveness, and to support the leadership of the University and its graduates' competitiveness in the national and international job market. The University and academic environments are at the heart of the future challenges that we are going to face and develop.

There is no doubt that these are significant challenges given the complexity of the unstable political and economic conditions. However, we must keep evolving and make strategies that can benefit our college for the future, that's the importance of waste management in our university.

3.2Waste Generated in College Campus

In the university campus there is various places that waste is generated and in each place there are many type generated, we categories waste generation in table (3.1).

Table 3.1

Sources and Type of waste generated from various sources

S.No	Source	Type of waste generated
1.	Class rooms	Paper, plastic (Polythene covers, PET bottles, Wrappers-chocolate and chips), aluminium foil, pens, disposable cups, metal cans, Charts, Cardboards.
2.	Laboratories	Paper, plastic (polythene covers, plastic bottles), Glass (slides, cover slips, glass bottles, blotting papers, tissues, syringes.
3.	Staffrooms	Paper, plastic(polythene covers, plastic bottles, disposable containers)
4.	Office	Paper and plastics
5.	Canteen	Paper, plastic, wrappers, paper boxes, disposal cups, PET bottles, metal cans, glass bottles.
6.	Library	Paper and plastics
7.	Toilets	Paper, plastic, and sanitary napkins

3.3Quantities of Types of Waste Generated

All sorts of waste is generated on college ground, our main objective in the following paragraphs is to estimate the quantities of different types of waste in the campus of the college from former studies.

Knowing that estimations change from one source to another we are assuming that 200 grams of waste is generated per person each day, also knowing that we have about 6800 students enrolled in our programs, and assuming we attend 80 days in the semester.

Estimation of types is categories according to the study in Malaysia in table (3.2) [7], and according to the study in Autonomous Morelos State University (UAEM) in Mexico in table (3.3) [10].

Table 3.2

Types of waste quantities categorization according to Malaysia

Categories	Offices	Faculties	Student Affairs	Avg.
Papers	12.0%	17.7%	25.5%	18.4%
Plastics	12.7%	13.3%	10.9%	12.4%
Metals	0.9%	0.4%	1.5%	0.9%
Glass	0.6%	1.8%	0.1%	0.9%
Food Waste	57.8%	56.4%	53.7%	55.9%
e-Waste	0.2%	0.3%	0.3%	0.2%
Others	15.8%	10.1%	7.9%	11.3%
Total	100.0%	100.0%	100.0%	100.0%

Table 3.3

Types of waste quantities categorization according to (UAEM)

Categories	Avg.
Papers and Cardboard	31.2%
Plastics	44%
Metals	1.95%
Glass	5.43%
Food Waste (Organic Waste)	17.42%
Total	100.0%

❖ Theories used in calculating waste type generation

*amount of waste per person per day * percentage of waste type*
 = *amount of waste type generated per person per day*

*amount of waste type generated per person per day * No. of students*
 = *amount of waste type generated per day*

*amount of waste type generated per day * No. of days in semester*
 = *amount of waste type generated per semester*

3.4 Comparison of Quantities of Types of Waste Generated

Because of the different life style that are lived in different parts of the world the accumulation of waste categories are different, and because this study has never been applied on universities in Palestine our estimation are taken between two studies one in a university Malaysia and the other in a university in Mexico and are shown in the table (3.4).

Table 3.4

Comparison of quantity research between Malaysia and (UAEM)

Categories \ Reference Study	Malaysia (Kilogram/Semester)	(Mexico) (Kilogram/Semester)
Papers and Cardboard	20,019.2	33,945.6
Plastics	13,491.2	47,872
Metals	979.2	2,121.6
Glass	979.2	5,907.84
Food Waste (Organic Waste)	60,819.2	18,952.96
Total	96,288	108,800

3.5 Revenue from Waste Management

In a broad sense, recycling is part of an ethic of resource efficiency – of using products to their fullest potential. When a recycled material, rather than a raw material, is used to make a new product, natural resources and energy are conserved. This is because recycled materials have already been refined and processed once; manufacturing the second time is much cleaner and less energy-intensive than the first. For example, manufacturing with recycled aluminium cans uses 95 percent less energy than creating the same amount of aluminium with bauxite.

The collection of recyclable materials is the first - the most critical link in a chain of economic activity. Investment in local collection infrastructure pays great dividends in supporting significant downstream recycling economic activity. Importantly, many of these recycled products may even gain revenue to our college.

3.5.1 Revenue from Paper Waste Management

Our University consumes a large amount of paper each day, we can recycle paper and use it after it is processed in many applications:

1. Brochures for the new students in the beginning of the semester.
2. Introductory banners for the university.
3. Chimerical paper.
4. Paper bags to replace the plastic bags being used; because paper is friendlier to the environment.

Nowadays in the west bank there are very few to none industries that recycle paper and cardboard, so most of them compress it and sell it to companies in Israel for about 1000 NIS for each ton of compressed paper and cardboard so the price is about 1 NIS for each kilo, according to the study in Malaysia there would be a revenue of 20,019 NIS and according to the study in Mexico there would be revenue of 33,945 NIS.

3.5.2 Revenue from Plastic Waste Management

Plastic is an essential product we use in campus therefore there is a large amount of it in our university so we have many methods to use, mainly:

1. Trading the collected plastic material to recycling factories for essential office equipment and utilities in return.
2. Selling the plastic material collected.

When selling the plastic material we can get revenue of about 1 NIS for each kilogram of plastic, so in our estimation the university's revenue from plastic will be 1 NIS time the amount generated in the semester witch will equal 13,491 NIS according to the amount estimated from the study in Malaysia and 47,872 NIS according to the study in Mexico.

3.5.3 Revenue from Metal Waste Management

There is a large amount of metal used in the university campus that can be sold or traded for other essential equipment, for example the metal could be traded for other bars that are used in construction.

Other than that and most importantly metal can sold in different categories:

1. Raw material is sold for 0.5NIS per kilo.
2. Coco cola cans and other caned drinks cans could be sold for 1 NIS for each 10 cans.
3. XL and BLU cans are sold for 1 NIS for each 4 cans.

Assuming our collected material is going to be sold as raw material the revenue for our university is 0.5 NIS times the amount estimated witch will equal 488 NIS each semester according to the study in Malaysia and according to the study in Mexico there would be revenue of 1,060 NIS.

3.5.4 Revenue from Glass Waste Management

When we are dealing with glass we see that it is a breakable material and the only application we can get revenue from it is to sell it to glass manufacturing companies.

From our research we found out that glass material could be sold for 0.5 NIS per each kilo, assuming we sold our estimated glass amount, the revenue from it would be 488 NIS each semester according to the study in Malaysia and according to the study in Mexico there would be revenue of 2,952 NIS.

3.5.5 Revenue from Food Waste Management

Food waste is the largest amount generated in our university so it is one of the most important aspects we should deal with and the most effective and efficient to deal with it is to turn it into fertilizer and sell it or use it in our gardens.

There is a method of treating food compost by digging a large hole in the ground and putting the collected food waste in it, in this method the mass of the compost according to former studies losses 30-50% of its mass and is sold for 10 NIS for each 15 kilos.[13]

Assuming that the compose lost 50% of its mass and was sold for 10 NIS for each 15 kilo, according to our estimations the university will be able to achieve revenue of 18,244 NIS each semester waste generated according to the study in Malaysia and according to the study in Mexico there would be revenue of 12,622 NIS.

We can see the difference in revenue between the two studies in table (3.5).

Table (3.5)

Revenue from Waste by the Two Studies

Categories \ Reference Study	Malaysia (NIS/Semester)	(Mexico) (NIS/Semester)
Papers and Cardboard	20,019	33,944
Plastics	13,490	47,872
Metals	488	1,060
Glass	488	2,952
Food Waste (Organic Waste)	18,244	12,622
Total	52,728	98,450

3.6 conclusion

Waste is any garbage or rubbish which includes domestic, commercial and industrial wastes. Improper handling of waste and indiscriminate disposal in open spaces give rise to numerous potential risks to the environment and to human health. To reduce their effect on health, the environment or aesthetics waste management should be undertaken.

Waste segregation at the source should be adopted to avoid a mixing or pollution of the different waste fractions, which could be an obstacle to easy recycling. Moreover, direct handling/ sorting of garbage or waste by the waste workers and the rag pickers results in chronic diseases. Thus waste sorting / segregation at source ensure and promote recycling and reuse of segregated materials And also helps to minimize the waste (Dry non recyclables) that needs to be disposed in landfills and thus reduce the environmental impact of disposal sites and we can acknowledge that the waste we recycle can have a great economic benefit to the university that is using those strategies

**Chapter Four Execution Changes, Calculation
And Discussion**

4.1 Introduction

This chapter is going to be the summary of all the work that has been done the past few months, and for that particular reason there will be a lot of Discussions and explanations of the various interactions that took place in this study.

As it was introduced in the beginning of this study that there are uncountable waste management system taking place all around the world, all depending on various variables that also depend on the surrounding situation and that will be explained further in this chapter and their will also be many studies and articles use to acquire information for us to be able to complete our project.

4.2 Plan and Methodology Change

Due to the occurring events corresponding to the Corona pandemic our initial plan was to take place on the campus of Palestine Polytechnic University to get an actual reading on the amount of waste generated in the facility and to also be able to spread knowledge about waste management for the particular reason the not all the students were able to come and live their daily college lives on campus and because of the caution of using or reacting with anything for the reason of fear that it might be contaminated with the virus.

So for the following, other procedures had to be taken place to acquire the useful information to complete and spreading the knowledge, to keep on going in this study social media networks and other mean were used for these steps to compare with the existing data:

4.2.1 Spreading Knowledge

For this part pamphlets were given out while also post and sharing information about the accruing waste issue, the way use was by trying to be interesting for the reader by writing various “Did You know” sentences so each individual will read the whole page and for the information would stick to the reader and could be remembered every time they are interacting with waste,

This is the following page of information used in our attempt to spread awareness in our study and can be shown in (appendix A)

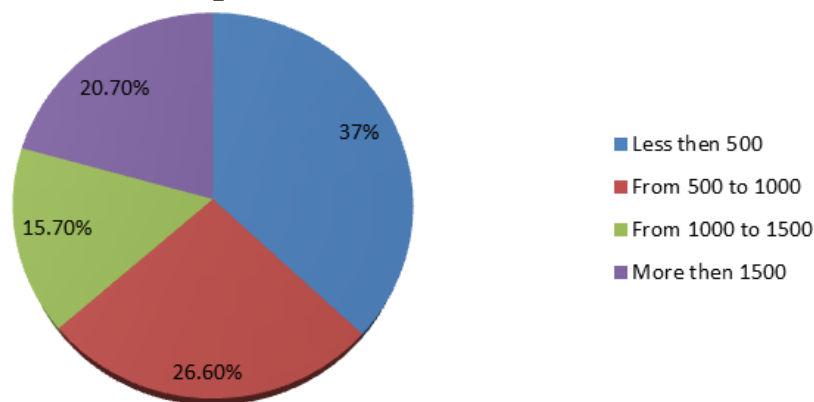
4.2.2 Distribute Questionnaires

At this step, the method of questionnaires was used to collect information from a portion of the students that were available in these times of counteraction of online and face to face teaching due to the Corona virus pandemic, and we were able to get the estimation of how much waste is generated from the proportion of the student witch was about 5% of the total student number that attend the to the campus.

The questionnaire had a variety of questions to get the feedback from the student and the results were positive for the change of the way waste is managed in the University for the Better, the questionnaire was like this in (appendix B)

From this questionnaire we were able to estimate the amount of waste generated in the campus from the main question how much does each student estimate the amount generated, the value was taken and the amount was about 874.95 grams per person per week according to graph(4.1), so if we divide that by the number of day that the students attend the campus which is 5, the amount of waste generated in gram per person per day is 174.99.

Graph4.1 Questionnaire Results



4.2.3 Values from the Municipality

This step was very important for our study for the particular reason of not being able to get accurate vales from working on and studying the campus's waste generation due to the circumstance we were in.

After contacting various sources we were able to obtain two very important factors, the first was the amount of estimate waste generation value that the municipality has concluded through the interaction of waste in the site and our city.

Second, was the estimated value that the municipality had put for each type of waste that is generated in the university and the whole district, so now there is a value that can be used to approximate the amount of waste each type is disposed of.

4.2.3.1 Amount of Waste Generation

The value of waste generation has been estimated in tons per person annually, and the value that has been recorded for our district is 0.3285 ton/person/year, so if we want to get a number that we can use in our calculations we need to convert the value from ton/person/year into gram/person/day, that is by converting the tons into grams by multiplying it with 10^6 , and to convert the year into days we are going to multiply the number by the number of day in the year which is 365.

After doing all those calculations we get a value of 900 grams per person per day, but that calculation isn't accurate enough for us to use in a facility that is not open 24 hours a day.

To acquire an appropriate value we estimate that the university is only open for 8 hours a day, so if we divide the number that was taken from the estimations from the municipality by 3, which means only a third of the day is used on campus grounds the value that we acquire is 300 grams/person/day (12).

4.2.3.2 Estimation of Types of Waste Generated

From former studies taken in Palestinian grounds there is an estimation of the amount of each types of waste is generated in 2018, and was catalogued in a table like this: (table 4.1)(12).

(Table 4.1) Value of Waste Generation

Waste type	Waste Generation Value
Organic	45.9 %
Plastic	26.4 %
Paper/ Cardboard	11.1 %
Glass	1.3 %
Metal	4.9 %
Others	10.6 %

4.3 Revenue from Waste Generated

After obtaining values that can be worked with we are going to put the final values that this study is going to be based on, starting with the fixed values which are the number of students enrolled in the university (6800 students), then there is the number of days in the semester which is assumed to be around 80 full working semester days.

Moving on to the new values obtained from the research and from the values from the questionnaire the two values were 300 grams/person/day and from the questionnaire the value was estimated to be 175 grams/person/day, to even up the numbers we are going to take an average value which will round up to be almost 237.5 grams/person/day of the semester days in the university life.

4.3.1 Amount of Waste types Generated

From the previous assessment it is now possible to estimate a more accurate value for the amount for each type of waste using the laws that were put and it will all be put in (table 4.2).

(Table 4.2) Amount of Waste Generation

Waste type	Amount of Waste Generated in Malaysia (Kilo/Semester)	Amount of Waste Generated in Mexico (Kilo/Semester)	Amount of Waste Generated in PPU (Kilo/Semester)
Organic	20,019.2	33,945.6	59,302
Plastic	13,491.2	47,872	34,108
Paper/ Cardboard	979.2	2,121.6	14,340
Glass	979.2	5,907.84	1,679
Metal	60,819.2	18,952.96	2,871
Others	96,288	108,800	13,694

4.3.2 Revenue from Generated Waste types

And according to the previous assessment it is now possible to estimate a more accurate value for the revenue for each type of waste by multiplying the amounts with the price it is sold for and it will all be put in (table 4.3).

(Table 4.3) Revenue from Waste Generation

Waste type	Revenue from Generated Waste (NIS/Semester)
Organic	19,767
Plastic	34,107
Paper/ Cardboard	14,340
Glass	840
Metal	1,435
Total	70,490

4.4 Conclusion

As it has been shown by the results the amount of waste types generated is different from one region to another and that is for the particular reason of cultural habits, the normal work hours of each university and the availability of using the campus, the services that is offered on university grounds, the infrastructure of the university and the way people live in each place.

So the results here are based on our region which is Hebron, West Bank and our university Polytechnic Palestine University, and throughout this study we hope one day there is a possibility to achieve these results.

4.5 Recommendations

To keep moving forward and evolving this study can help by being the initial steps so we recommend the student to the application on their campus grounds and to focus on specific materials to work on and the spreading of awareness of waste management throughout universities and the world.

List of references

- 1) "Enthusiasm is the mother of effort, and without it, nothing great was ever achieved" ~ Ralph Waldo Emerson.
- 2) "United Nations Statistics Division - Environment Statistics". *unstats.un.org*. Retrieved March 2020.
- 3) Le Guern, Claire (March 2018). "When The Mermaids Cry: The Great Plastic Tide". Coastal Care. Archived from the original on December 2020.
- 4) MacFadden, Todd; Michael P. Vogel (June 1996). "Facts About Paper". Printers' National Environmental Assistance Center, Montana State University.
- 5) Herawati N, Suzuki S, Hayashi K, Rivai IF, Koyoma H. Cadmium, copper and zinc levels in rice and soil of Japan, Indonesia and China by soil type. *Bulletin of Environmental Contamination and Toxicology*. 2000;64:33-39
- 6) Sreedevi, S., 2015. Solid Waste Generation and its Management-A Case Study. *Int. Res. J. Environ. Sci*, 4(1), pp.90-93.
- 7) Standard Metode Pengambilan dan Pengukuran Contoh Timbunan dan Komposisi Sampah Perkotaan. Departemen Perkerjaan Umum. Yayasan LPMB, Bandung Indonesia. 1991.
- 8) Lounsbury, M., 2001. Institutional sources of practice variation: Staffing College and university recycling programs. *Administrative science quarterly*, 46(1), pp.29-56.
- 9) Visited on December 2020 : <https://www.timeshighereducation.com/student/best-universities/best-universities-recycling-and-sustainability>
- 10) E. SÁNCHEZ-SALINAS*, M. L. ORTIZ-HERNÁNDEZ*, A. RODRÍGUEZ* AND M. L. CASTREJÓN-GODÍNEZ** *Centro de Investigación en Biotecnología, Av. Universidad 1001, Col. Chamilpa, C.P. 62209. Cuernavaca, Morelos, México. Universidad Autónoma del Estado de Morelos, Mexico*
- 11) Thöni, V. and Matar, S., 2019. Solid waste management in the occupied Palestinian Territory-West Bank including East Jerusalem & Gaza Strip. Visited on December 2020 : <https://www.env-news.com/in-depth/studies-researches/1201>

معلومات حول قضية المخلفات

إدارة النفايات في فلسطين من الركائز الأساسية في مرحلة الإعمار القادمة؛ إذ إن الحفاظ على البيئة سليمة حاجة أساسية للمواطن.

اليكم بعض المعلومات المفيدة حول موضوع ادارة النفايات

هل تعلم ان كمية النفايات المولدة في فلسطين عام **2019** كان حوالي **1.65** مليون طن و ذلك يعني ان يوميا انتاج النفايات كان ما يقارب **5000** طن.

هل تعلم ان الاحصائيات تقول ان تزايد نسبة كمية النفايات تكون من **1.5** الى **3%** كل عام.

هل تعلم ان بقينا على هذا الحال انه خلال **15** عاما ستكون كمية النفايات **2.5** مليون طن.

هل تعلم ان المكبات و المدافن تمتلئ و خلال **30** عام لن يكون هناك مكان للتخلص من النفايات غير عن طريق البحر.

هل تعلم ان العبوة البلاستيكية الواحدة تستغرق حوالي **40** عام للتحلل.

هل تعلم ان الذهاب الى استخدام الاكياس والعبوات الكرتونية بدلا من البلاستيكية يقلل نسبة وقدرها من تراكم النفايات.

هل تعلم ان تزايد كميات النفايات يعني استخدام اراضي صالحة يوجد فيها حياة بريه متكامله وانواع كبيره من الحيوانات والنباتات.

هل تعلم ان معظم الامراض و الاوبئة مصدرها و بدايتها قلة النظافة و انتشار المخلفات.

هل تعلم ان كل شخص عليه تاثير في المجتمع و يمكن ان يساعد في نشر التوعية و المساعدة في الحفاظ على البيئة

يمكن ان نفعل ذلك!!



Appendix B :

1-عزيزي الطالب ما هو تقريبا مجموع عدد الساعات اليومية التي تقضيها في الحرم الجامعي ؟
اقل من ساعتين - من ساعتين الى 4 ساعات - من 4 ساعات الى 6 ساعات - أكثر من 6 ساعات
2-عزيزي الطالب ما هو نوع مشروبك المفضل (اختر اكثر من اجابة اذا اردت ذلك) ؟
عصائر (عبوات زجاجية) - مشروبات غازية (عبوات معدنية) - شاي و قهوة (كاسات كرتون)
3- هي مأكولاتك المفضلة المتوفرة في الجامعة (اختر اكثر من اجابة اذا اردت ذلك) ؟
ساندويش (شنيتسل, فلافل, الخ...) - مسليات (شيبس, بسكويت, الخ..) - كعك (عاجوت مغلف)
4- عزيزي الطالب في حال كان عدد ساعات دوامك كثيرة هل تقوم بتناول اكثر من ساندويش واكثر من مشروب ؟
نعم - لا
5- هل يمكنك الإفصاح عن عدد المرات التي تتناول بها الطعام و الشراب في اليوم داخل الحرم الجامعي؟
مرة واحدة - مرتين - اكثر من مرتين
6- هل سبق لك وان قمت بشراء الطعام ولم تقم باكماله (اي القائه في القمامة في الحرم الجامعي)؟
نعم - لا
7-هل يمكنك تقدير وزن النفايات التي تنتج من عملية الاستهلاك في الاسبوع الواحد في داخل الحرم الجامعي؟ (اوزان يمكن البناء عليه : متوسط وزن العبوة الزجاجية 80 غرام و متوسط وزن العبوة المعدنية 40 غرام) ؟
اقل من 500 غرام - من 500 الى 1000 غرام - من 1000 الى 1500 غرام اكثر من 1500 غرام
8- هل تحرص على ترك النفايات في الاماكن المخصصة حتى لو لزم منك الامر مشي مسافة للوصول للحاويات ؟
نعم - لا
9- برايك ما نسبة الطلاب الذين يقومون برمي النفايات بمكانها المخصص ؟
%25-0 - %50-25 - %75-50 - %100-75
10- في حال تم وضع صناديق فرز النفايات في الجامعة ... كيف ترى نسبة استجابة الطلاب لذلك ؟
%25-0 - %50-25 - %75-50 - %100-75
11- هل لديك اي نصائح لتساعدونا لتطوير الجامعة من الناحية البيئية ؟