IMPACT OF TRANSFORMED SOLID WASTE ON HEALTH AND ECONOMIC IMPROVEMENT: A CASE STUDY OF NDUBA CITY

A Thesis submitted in partial fulfillment of the Requirements for the Degree of Master of Business Administration (Project Management Option)

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SEPTEMBER 2019

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DECLARATION

This Thesis is my original work and has never been presented for any academic award in any University or Institution of Learning.

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RECOMMENDATION

I confirm that the work reported in this thesis was carried out by the candidate under my supervision and has been submitted with my approval.

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Date

DEDICATION

I would like to dedicate this study to my family who means a lot to me and the only who did whatever they could so that I can complete my 2 years in MBA successfully.

ACKNOWLEDGEMENTS

First of all glory be God who has protected me during my studies and gave me ability to accomplish this work in the scheduled time. I owe gratitude to my mum for his constant financial support.

To my lovely family, colleagues and all my friends who helped me, without their guidance and prayers I could not make it.

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ABSTRACT

Solid waste transformation practice is essential component in health and economic improvement in human settlements. Rapid increase in volume and types of solid waste as a result of continuous keeping environment clean is becoming a problem to ensure effective and sustainable management of Nduba site. Through transformation on useful products is one of solutions of protecting health and improve economy in Rwanda. This research entitle the Impact of Transforming Solid Waste into Useful Products on health and economic improvement in Rwanda and was guided by the following objectives: to provide the importance of transforming solid waste into useful products in health and economic improvement to Nduba site, to demonstrate the economic impact of transforming solid waste into useful products to Nduba site and Rwanda in general, to examine the health and economic improvement in Nduba site compare with other sites without dumpsite. The study was carried out in Gasabo District especially in Nduba site. It was examine the Impact of Transforming Solid Waste into Useful Products on health and economic improvement in Rwanda especially in Nduba site; it was cover a period of 4 years from 2015 to 2018. The target population was composed of the people from Nduba site, staffs of Gasabo District, the one in charge of solid waste management in Nduba site. These people were selected using a simple random sampling method. Random sampling is where all elements understudy have equal chances of being chosen. The sample after employing Slovene's formula comprises of 151 respondents. All the relevant data was analyzed and evaluated by using primary and secondary data and the results was interpreted accordingly. The frequency and percentage distribution were used to determine the demographic characteristics of the respondents. The mean and correlation was applied. The analyzed data was presented in the form of tables, descriptive were also used. The instrument of the study was self made (questionnaire) and a set of questions was formulated.

Key terms: ***Reduction of cost of importation, Reduction of disease, Reduction of unemployment, Decrease of importation taxes, Decrease of mortality, Increase of income***

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List of Abbreviations

GDP: Gross Domestic Product

STI: Science Technology and Innovation

UNESCO: United Nations Educational, Scientific and Cultural Organization

SWM: Solid Waste Management

MININFRA: Ministry of Infrastructure

UN: United Nations

UNDP: United National Development Programme

UNEP: United National Environment Programme

MFA: Material Flow Analysis

MCA: Multi Criteria Analysis

LCA: Life Cycle Assessment

SRF: Solid Reduced Fuel

BMW: Biodegradable Municipal Waste

RDF: Refuse Derived Fuel

CLO: Compost Like Output

ISWT: Integrated Solid Waste Transformation

WHO: Word Health organisation

CHAPTER ONE

GENERAL INTRODUCTION

The increasing growth of cities has implications for municipal waste management among other social services required in the urban communities. The environment where solid west are accumulated is a set of physical, chemical and biological elements as well as socio-economic, cultural, aesthetic and intellectual factors likely to have a direct or indirect, immediate or long term impact on human beings and human activities. It is a cross-cutting field and must be integrated in economic growth and social development with which it constitutes the three pillars of sustainable development (fight against poverty, long term planning and protection, and management of natural resources). Waste transformation is a process in which a waste is converted into a form that is less costly or difficult to dispose of. The 3R principles (reduction, re-use and recycling) are among the top three in the waste hierarchy and they are considered as the founding principles of sustainable waste management system.

This chapter consists of the background information, statement of the problem, research objectives, and research questions, significance of the study, Delimitation of the research, the scope of the study and limitation of the study.

1.1 Background of the study

Rwanda made the headlines in September 2008 when it became one of the first countries in the world to ban plastic bags. These have since been replaced by biodegradable bags made from materials such as cotton, banana and papyrus. Rwanda's commitment to environmental protection has not hampered growth. On the contrary, GDP grew by 5.5% on average over the past decade, according to the World Bank, including by 4.4% in 2015. This growth has benefited the population, with GDP per capita being 44% higher in 2013 ($ 1 474) than six years earlier. Rwanda is convinced that science, technology and innovation (STI) hold a key to its sustainable development (UNESCO, 2015). This conviction is embodied in the country's Vision 2020 (2000) for becoming a middle-income country by 2020 and in its National Policy on Science, Technology and Innovation, published in October 2005 with support from UNESCO and the United Nations University. There is no dedicated ministry for science and technology in Rwanda but, in 2009, the Directorate-General of Science, Technology and Research was established under the Ministry of Education to implement the National Policy on Science, Technology and

Innovation. Practices of Solid waste transformation into useful products are essential component of environmental infrastructure in human settlements. In most of African urban areas, solid waste management is ultimately a responsibility of cleaning companies, while most cases of rural areas the wastes are handled and disposed at the household level (Frank, 2006).Solid Waste Management (SWM) is major environmental issues particularly in municipalities of many developing countries that have been suffering from environmental problems. Alamgir, Donald, Roehl and Ahsan (2005) assert that urban population growth and economic development should be considered key issues for Solid Waste Management (SWM). Increasing unplanned urbanization along with user's mindset of 'out of sight out of mind' of wastes is one of the factors that make the production of solid waste to increase and though intensifying environmental pressures including unorganized waste disposal. In many cases, the, Solid West Management (SWM) is found to be a major concern for the cleaning company in towns of many countries, and Rwanda is included.

Solid Waste is increasing in Nduba-Rwanda, while a sizeable portion of it is disposed on improperly located and operated dumpsites, resulting in dire impacts on environment and health. In addition, between one-third and one-half of the solid waste in Nduba site is not used in transformation in useful products, and the consequences is about health of the population of Nduba site. The Ministry of Infrastructure further reports that solid waste management and transformation of them into useful product needs to be reinforced through national policy and regulatory framework to keep Rwanda clean and protect the environmental issues (MININFRA, 2013). It is imperative to note that the solid waste transformation in Nduba site is controlled by Nyarugenge District under the authority from Kigali City. The City and other different towns are undertaking considerable efforts to maintain the urban environment clean and plastic bags are forbidden within the country. Accordingly, Kigali town's waste contains still 70 percent of organic, biodegradable waste and in rural areas the portion of waste reach more than 95 percent. The operating dumpsite receives about 400 tons per day of solid, not sorted waste or 140,000 tons per year (MININFRA, 2013). Waste sorting, composting and recycling activities have been started at the very beginning Rwanda has invested in environmentally safe landfills. Deep seated fires, methane explosions, landslides and leakages threatening rivers and groundwater are some of the common problems of such basic dumpsites as environmental threats (Hogan, 2004). The current thinking is that poor waste management reflects largely the failure of the existing institutions to adequately address the waste problems (Yekeen, 2010). Capacity needs to be

weighed and understood at all level, formal and informal, to aid capacity building and then capacity assessment that is concerned with identifying existing capacity and what additional capacity is required to get things done (NUDB, 2008; Yekeen, 2010). In most jurisdictions, public health concerns considerations issues have been are the basis the idea the premise for solid waste management programs, as solid waste management is essential to maintaining public health. Solid waste that's not properly collected and disposed are often a piece of land for insects, vermin, and scavenging animals, and can thus pass on air- and water-borne diseases. In low- and middle-income countries, transform solid waste is often dumped in low-lying areas and land adjacent to slums. Lack of enforced regulations enables potentially infectious medical and hazardous waste to be mixed with transform solid waste, which is harmful to waste pickers and the environment. Environmental threats embrace contamination of groundwater and surface water by leachate, however as pollution from burning of waste that is not properly collected and disposed. Surveys conducted by UN-Habitat show that in areas wherever waste isn't collected often, the incidence of diarrhea is twice as high and acute respiratory infections six times higher than in areas wherever assortment is frequent (UN-Habitat, 2009).

1.1 Statement of the Problem

Solid waste has started by rescuing from citizen of Gasabo District to Nduba site which was a solution of keeping Kigali clean. But this solution became unsustainable solution because the most of the waste cannot be easily decomposed which has led to the site to become overcharged. Currently, the only available option for waste is a landfill located in Nduba site and waste is still accumulating that accumulation always bring diverse problems regarding contamination of Nduba site life population and decrease of their economic through high level of sickness which take their time and money instead of using them in their development. However failure of address solid waste transformation, will cause the related problems are expected to lead to numerous social health and economic effects and expand them to other site. This study seeks to assess the impact of Transforming Solid Waste on health and economic improvement which can be a sustainable solution to Nduba site.

1.3 Research Objectives

The main objective of this study is to assess the impact of Transformed Solid Waste on health and economic improvement.

The study was guided by the following objectives:

1. To provide the impact of transformed solid waste on health and economic improvement of Nduba site.
2. To examine the level of sickness in Nduba site with dumpsite
3. To demonstrate the level of health and economic improvement before and after dumpsite in Nduba site.
4. To determine the correlation between transformed solid waste in health and economic improvement.

1.4 Research questions

1. What is the impact of transformed solid waste on health and economic improvement of Nduba site?
2. What is the level of sickness in Nduba site with dumpsite?
3. What is the level of health and economic improvement before and after dumpsite in Nduba site?
4. Is there any correlation between transformed solid waste in health and economic improvement?

Hypothesis

H_0: There is an impact of transforming solid waste into useful product on health and economic improvement

1.5 Justification of the study

To a large extent, solid waste transformation into useful products efficiency depends on the way different actors understand the danger and the good of maintaining environment safe and their capacity but also the commitment of public and private sectors as well as the involvement and participation of the communities themselves in supporting the whole concept. It also depends on

the useful information and lessons from current best practices in the provision of this important service. Such information and lessons can be obtained only through research and studies; hence this research can assist in the improvement and performance of solid waste transformation into useful products in Nduba and to identify opportunities for future strategic development in the field of solid waste transformation. Particularly, this study is useful to the different stakeholders including planners, administrators and private waste collectors, and in one way or the other contributes to future policy interventions in solid waste transformation in Nduba of Gasabo District and Rwanda in General.

1.6 Delimitation of the research

1.7 Scope of the study

The study was carried out from Gasabo District especially in Nduba Site. It examined solid waste collection, transportation and final disposal by criticizing magnitude problems of solid waste and then designs the strategies of how challenges could be overcome as the increase of solid waste production which is in considerations. Rwanda contains a capital referred to as national capital town, covering a district of 730 km² within the central a part of African nation, serves concerning one,223,000 people, Kigali's population density is 1600.

The study was carried out from Gasabo District especially in Nduba site. It was examine solid waste collection, and transformation them into useful products by criticizing magnitude problems of solid waste and then design the strategies of how challenges could be overcome as the increase of solid waste production which is in considerations. The study was carried out from Gasabo District especially in Nduba site. The study was conducted locally, in Kigali City, Gasabo District, specifically in Nduba site-Rwanda. It was covered a period of 3 years.

1.8 Definition of key terms

Reduction of cost of importation: Cost reduction is to be understood as the achievement of real and permanent reduction in the unit cost of goods manufactured or services rendered without impairing their suitability for the use intended or diminution in the quality of the product.

Reduction of disease: is an Elimination of a disease refers to the deliberate effort that leads to the reduction to zero of the incidence of infection caused by a specific agent in a defined

geographic area. A disease can be eliminated from a specific region without being eradicated globally.

Reduction of unemployment: Fiscal policy can decrease unemployment by helping to increase aggregate demand and the rate of economic growth. Also, with higher aggregate demand and strong economic growth, fewer firms will go bankrupt meaning fewer job losses. Keynes was an active advocate of expansionary fiscal policy during a prolonged recession.

Decrease of importation taxes: Tax cuts are reductions to the amount of citizens' money that goes toward government revenue. Tax cuts occur in many different forms. Congress can cut taxes on income, profits, sales, or assets. They can be a one-time rebate, a reduction in the overall rate, or a tax credit.

Decrease of mortality: The term all-cause mortality is utilized in reference to a disease or a harmful exposure such as to radiation or dangerous chemicals—in a statistical context. It is typically expressed as the total number of deaths due to that condition during a specific time period

Increase of income: Income is increases in economic benefits during the accounting period in the form of inflows or enhancements of assets or decreases of liabilities that result in increases in equity, other than those relating to contributions from equity participants.

CHAPTER TWO
LITERATURE REVIEW

This chapter presents the reviewed literature in relation to solid waste transformation, magnitude of the problem solid waste transaction and strategies to overcome challenges in solid waste transformation.

2.1 Theoretical review

City or town authority in the world is responsible for setting up a waste processing and disposal facility, and for preparing an annual report regarding the collection and improvement there under. The central governments and districts administration have the overall responsibility for enforcement of the provisions of the rules and regulations within territorial limits of their jurisdiction. In most African cities and urban centers solid waste accumulation is estimated at 0.5 kg per capita/day with a density ranging from 205 to 370 kg m-3 and in other cities where the population is 3.5 million people, research reveals that one million m3 of solid waste is generated per year In developing nations and African nations in particular, solid waste generation from the households, commercial centers, institutions, hotels and health facilities are the most sources of solid waste (Palczynski, 2002; Hayal, Hailu and Aramde, 2014).

Despite of limited infrastructures and man power capacity, attempts to collect and transport solid waste to disposal sites on a daily basis have been put in place but some cities have distant disposable sites that often hinder such attempts. (Henry, Yongsheng, Jun, 2006) note that different places of the cities have very often less frequent collection systems such as door –door, curbside, set out, the block collection system and the sweeping of street. This is because the workers do not feel that they are being supervised neither do they have what to use during the process. As an existing solid waste collection, (Hardoy, Mitlin and Satterthwaite, 2001) remark that in collecting solid waste, the commonly used method is door to door collection as applied to various households in urban areas. They noted that in most cities and suburbs, each house owner puts wastes in baskets, sacks, plastic bags or other suitable materials at the door side so that the collectors pick up and bring wastes using the pushcarts to common temporary storage points for the trucks to pick up them to the disposal site. Some of the storage areas could be street sides and pedestrian walkways. According to Mohammed and Elsa (2003), the frequencies and regularity

of solid waste collection are not always maintained due to the less number of laborers with their low payment. Besides, very few cities and towns have implemented this approach of waste management.

According to Shivashankara and Rekha (2005), enormous solid wastes are collected from three major sources in the process of cleaning the cities and making the environment clean: door -to-door, institutions through private companies and street sweeping. Indeed large amount of wastes is collected by micro and small enterprises and the remaining by private companies and employees from the city administration or the local administration as employed to do so. The contribution of private companies in solid waste collection and management within the suburbs is still low. This because most city councils and local governments normally perceive the collection and transportation of solid waste a road to perpetuate corrupt tendencies on their budgets. This has been common among developing nations with East Africa leading in such practices (Guerrero, Maas and Hogland, 2013).

2.1.1 Challenge in solid waste transformation

One of the challenges found in most cities and urban areas of Africa have been shortage of waste containers despite efforts by various authorities to rectify the challenge and cause the negative effect to citizen who stays around solid waste, because normally hinders of collection of solid wastes render improper to the citizens and people in the area. The central governments normally increase impetus to the cause; the (UNDP, 2004) reveals that international donors have been financing activities to increase effort to clean the city but all have remains at the grassroots level since the people are not sensitized.

Rathana (2009) supports the view that the collection system in most developing nations such as Africa does not fully cover all residences, commercial centers and institutions especially those that are distant from the center. This was one of the cardinal roles for this study to assess the extent how Gasabo District manages to reach even far distant institutions for the cause. Recycling and composting are yet another existing approach in collection of solid wastes. Medina (2000) emphasizes that recycling is regarded as a self-employment activity for the low income population or for the individuals. These are employed by the city authorities to work for the city in order to maintain the environment clean. Composting is a controlled natural process of decomposition of organic waste material. Recycling and composting are beneficial in terms of

taking up less land and leads to low rate of pollution in the congested areas where solid waste are increasing daily due to increased population. Although it is most used in most developing countries, the African Development Bank (2002) reveals that little research is available on its importance to the city and its extent to which solid waste can be cleared out from the city when used in isolation.

Land filling is also used in the process of managing solid waste in various cities. Many landfills operate as dumps on open sites, wetlands or lands with water near the surface. The sites are usually not protected therefore waste pickers use the chance to visit the sites and sort valuable materials for selling or for their own consumptions (Achankeng, 2003). Notably in many situations landfill is the only municipal solid waste management option available after municipal solid waste is collected. Landfill operation mostly depends on the administration and management of the municipal solid waste management system. Types of landfills include uncontrolled open dumps, controlled dumps and secure sanitary landfills. Uncontrolled open dumps are the least effective disposal of municipal solid waste in relation to appropriate local health and environmental standards. Land filling is mentioned as the least preferred option in the integrated waste management hierarchy however it has been a common disposable practice in most African countries and Rwanda being one of them. Most landfills are operated below the standards of sanitary practice leading to air and water pollution. Though incineration is a better option to land filling, the high operation and maintenance costs associated with it and the organic content remain to be the limiting factors to this option. The practice of reusing plastics, paper, metals and other materials is a good recycling approach which is among the preferred methods for an integrated waste transformation practice. (Achankeng, 2003)

2.1.2 The problems with the solid waste

Hina and Devadas (2007) insinuate that solid wastes are classified into different forms or types, depending on their source: municipal waste; industrial waste as hazardous waste, and biomedical waste or hospital waste as infectious waste. In principle, the term waste means garbage and their problematic magnitude is observed onto plants, water supply and air pollution. On the hand, disposal means discharge and dumping of solid waste or hazardous waste into or any land or water so that such solid wastes, hazardous wastes, or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters, from community activities. In such circumstances, Blaser and Schluep (2012) find the magnitude

to which they are problematic. In cities, towns, urban areas and municipalities; solid waste are found on outskirts of the urban areas, turning into the child sources of contamination due to the incubation and proliferation of flies, mosquitoes, and rodents; that, in turn, are disease transmitters that affect population's health, which has its organic defenses in a formative and creative state. This situation has gastrointestinal, dermatological, respiratory, genetic and several other kind of infectious diseases. Chakrabrati, Majumder (2009) indicate that dumping areas or sites have high risk to the public health and few governments of developed world have estimated this in relation to human health but the developing countries and African in particular have never thought of such with action. They apprehended that groups at risk from unscientific disposal of solid waste include the population in areas where there is no proper waste disposal method, especially the pre-school children; waste workers; and workers in facilities producing toxic, and infectious material. These are common in most developing nations and Rwanda inclusive. According to Kumar (2006), open dumpsites or open disposal areas are the major problem to the environment, especially on the air that the people inhale.

Dumpsites emit obnoxious odors and smoke that cause illness to people living in, around, or closer to them. This argument is supported by Liyala (2011) who contends that dumpsites are the source of airborne chemical contamination via off site migration of gases and the particles and chemicals adhering to dust, especially during the period of active operation of the site. The two are in congruent that the contamination of soil and groundwater may lead to direct pollution of indoor air. Matete and Trois (2008) went further to assert that in some sites, volatile organic chemicals have been detected in odored air of homes nearby dumpsites. They also posit that in a number of a wide range of health problems, including respiratory symptoms, irritation of the skin, nose and eyes, gastrointestinal problems, psychological disorders, and allergies, have been discovered. The (UNEP, 2004) further mentions unattended wastes lying around the enticing places where rats and other creatures found a playing ground during their free time. In most cases it is the wet waste that decomposes and releases a bad odor which has never been pleasant to the health of mankind. Oberlin (2011) bespeaks that the bad odor affects the people settled next to the dumpsite and this has been an indication showing that the dumpsites have serious effects to people settled around or next to them. He also mentions that the wastes from agriculture and industries cause serious health risks. Other than this, co-disposal of industrial hazardous wastes with municipal wastes can expose people to chemical and radioactive hazards.

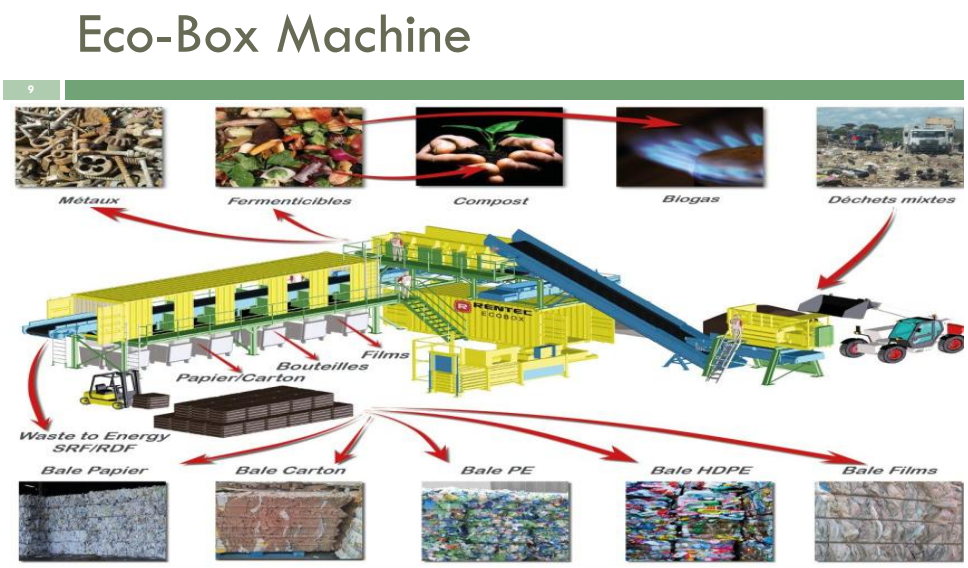
Further, he states that uncollected solid waste can also obstruct storm water runoff, resulting in the forming of stagnant water bodies that become the breeding ground of disease. Wastes dumped near water source contaminates the water body or the ground water source while direct dumping of untreated wastes in rivers, seas and lakes, result into the accumulation of toxic substances in the food chain through the plants and animals that feed on it (Medina, 2002)

2.1.2 Solid Waste transformation strategies

Waste transformation strategies the most strategy that is followed and used around the world has been the classical method that is normally called landfill. The 3R principles (reduction, re-use and recycling) are among the top three in the waste hierarchy and they are considered as the founding principles of sustainable waste management system. In the European Union Waste Framework Directive 2008, the "3R" principles have been extended to five steps of the waste hierarchy: prevention (avoidance), re-use, recycling, recovery (including energy recovery), and disposal. A number of approaches have been identified in various studies such as eco-design, responsible shopping behavior, etc., in relation to solid waste re-use or transformation. Solid Waste transformation is one of the most important issues in zero solid waste and it requires collective social awareness and knowledge on solid waste and innovative manufacturing and business models. Awareness and transformative knowledge are often believed to motivate behavior change in relation to pro-environmental lifestyle choice. Responsible and sustainable consumer behavior is another important issue in waste prevention. Collaborative consumption increases efficiency in resource consumption and enhances social collaboration. The collaborative ownership or collaborative consumption model promotes service-based business and waste prevention. Therefore, re-circulation (circulate the materials in the supply chain for a repetitive use) of post-consumer products through re-use and re-sell is important and it boosts the circular economy and enhances social capital. (Florence, 2013).

Oberlin and Sza´nto (2011) talk of various assessments like Life Cycle Assessment (LCA), Material Flow Analysis (MFA), Multi Criteria Analysis (MCA) and Extended Producer Responsibility manage e-waste but the best method of reduction is designing eco-friendly devices and well-organized collection, recovery, recycling and spreading awareness amongst communities. Waste management and treatment technologies are used in solving waste problems for more than centuries. Zero waste takes the position that technology alone cannot solve the waste problems sustainably, as it requires community participation, service infrastructure,

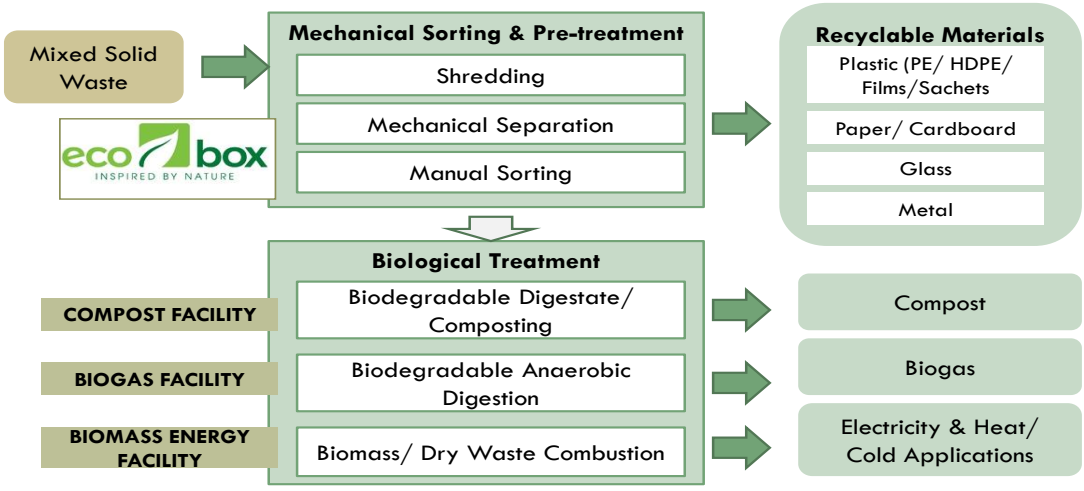
regulatory policy and environmentally friendly treatment technology, will be also needed and Eco-box machine will be used. (Oberlin and Sza´nto, 2011)



Source: *Agruni Ltd, 2017*

1. **Shredder machine** – mixed waste is shredded smaller
2. **Filter machine** with 100 mm – filtering small waste, mainly biodegradable
3. **Biodegradable Mix Band –** collecting the bio waste
4. **Metal Magnet Band** – pulling out small metals from biodegradable waste.
    - Metals are sold to metal production industries
    - Biodegradable waste is collected and transported to either Compost Facility or Biogas Facility
5. **Recyclables Sorting Band** –up to 12 people manually sorting 4 types of recyclables. The remainder can be used as Biomass (SRF-Solid Reduced Fuel)
6. **Compact Machine** – compress /compact and package in pellet. Shipping out and sell to production industries or used as Biomass.

Technology Method:
Mechanical Biological Treatment (MBT)



Source: *Agruni Ltd, 2017*

MBT plants may be configured in a variety of ways to achieve the required recycling, recovery and biodegradable municipal waste (BMW) diversion performance. some typical aims of MBT plants include the: Pre-treatment of waste going to landfill; Diversion of non-biodegradable and biodegradable MSW going to landfill through the mechanical sorting of MSW into materials for recycling and/or energy recovery as refuse derived fuel (RDF); Diversion of biodegradable MSW going to landfill by: Reducing the dry mass of BMW prior to landfill; - Reducing the biodegradability of BMW prior to landfill; Stabilisation into a compost-like output (CLO) for use on land; Conversion into a combustible biogas for energy recovery; and/or Drying materials to produce a high calorific organic rich fraction for use as RDF.

Composting Facility (1)

13

Source: *Agruni Ltd, 2017*

Location size: 6 hectares at Nduba

Inputs: Biodegradable waste from Ecobox

The recent upsurge suggested of interest in composting the organic fractions of Nduba dumpsite are the following approaches such as:

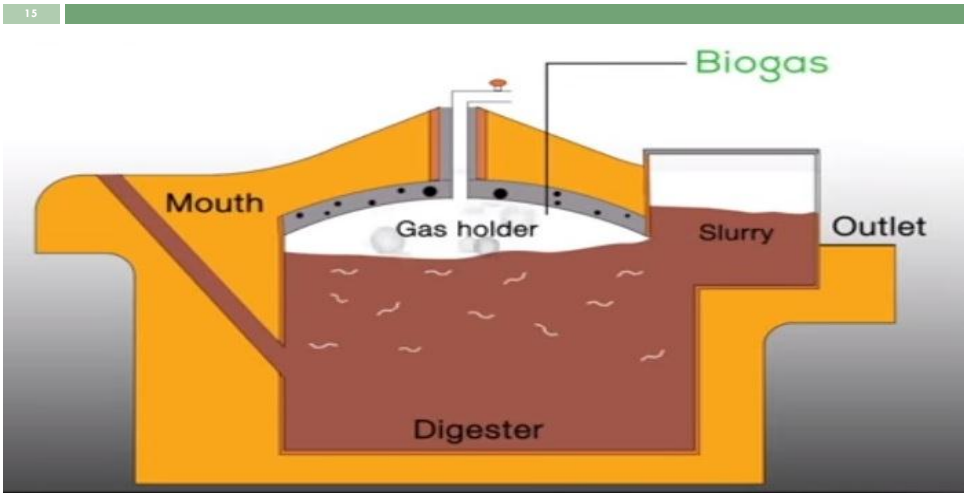
Step1: Lay **Waste in Windrows** Piles outside

1. If needed add starters/Accelerators, special blend additives to speed up the breakdown of waste
2. Cover with special blankets/layer to keep the heat in

Step 2: **Monitor** (4 – 6 weeks)

1. Oxygen level – using a Compost Turning Machine or manually turning compost (cheaper), to induce air in the pile and redistribute microorganisms
2. Moisture – spray water preventing microorganisms and nutrients from dying out
3. Temperature– using thermostats to check if pile is heating up properly. Add brown/dry bio waste (if temp is too low) or green bio waste (if temp. Is too high)

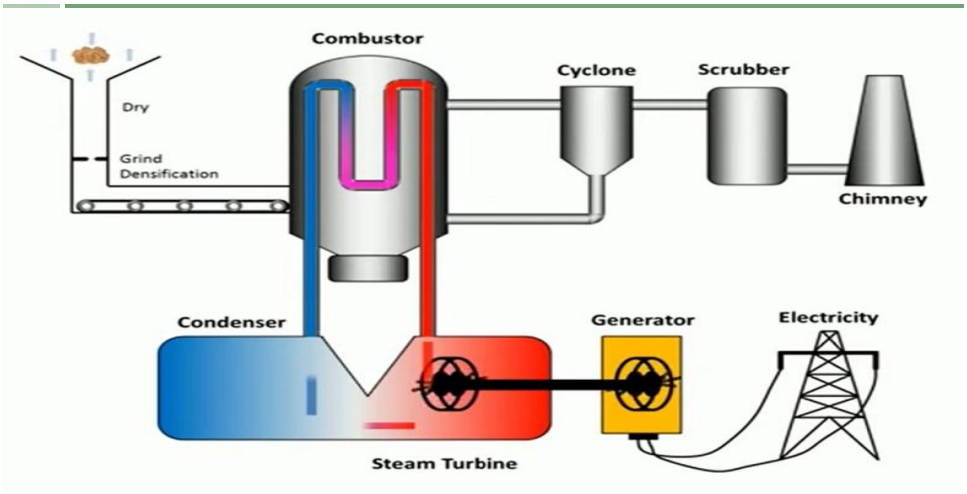
Biogas Facility



Source: *Agruni Ltd, 2017*

Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Biogas is primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulfide (H_2S), moisture and siloxanes. The gases methane, hydrogen, and carbon monoxide (CO) can be combusted or oxidized with oxygen. This energy release allows biogas to be used as a fuel; it can be used for any heating purpose, such as cooking. It can also be used in a gas engine to convert the energy in the gas into electricity and heat.

Source: *Agruni Ltd, 2017*



Source: *Agruni Ltd, 2017*

Among the renewable energy sources, biomass offers some benefits due to its low cost and presumed zero-carbon emission when compared with fossil fuels. However, the moisture content of biomass is often high that lowers its heating value, reduces the combustion temperature and causes operational problems. Because of these, when burning biomass for power generation, biomass is often dried prior to the combustion. To lower the drying cost or to maximize the power output of a biomass power plant, proper heat integration in between the steam power plant

and the drying process has to be considered. The following are the types of converting of biomass such as:

- types of Methods of Conversion
  - Gasification (Biogas to Heat/Electricity)
    - Inputs: All Solid waste
    - Machine: Gasifier Furnace
  - Incineration (Dry Waste Combustion)
    - Inputs: Dry waste
    - Machine: Combustion machine (including Dryer as waste must be dried)
- Heat/ Thermal Applications:
  - Furnace; Hot air generators; Dryers; Boilers; Heaters; Ovens
- Power/ Electricity Applications:
  - Irrigation; Village electrification; Captive Power; Grid fed power.
  - Residual/ By-products: Ashes which can be used as fertilizer
- Possible Clients: Breweries (SKOL); Cimenteries (CIMERWA)

Apart from the above methods, conventional methods like aerobic and anaerobic digestion prove useful in the process. While the later yields biogas (250-710 meter cube/tone of waste) with energy efficient; it is of several types (wet, dry, thermophilic, mesophilic, batch, continuous, single-stage and multi-tage). The production of hydrogen is controlled by monitoring types of co-substrate, type of pre-treatment, pH, and fermentation temperature (jesignhaus, J., 2000). This study was therefore carried out from Gasabo District to find whether such methods are or can be used and the extent how they can be effective in such duties.

2.1.3 Solid Waste and Health

In most jurisdictions, public health concerns have been the basis for solid waste management programs, as solid waste management is essential to maintaining public health. Solid waste that is not properly collected and disposed can be a breeding ground for insects, vermin, and

scavenging animals, and can thus pass on air- and water-borne diseases. Surveys conducted by UN-Habitat show that in areas where waste is not collected frequently, the incidence of diarrhea is twice as high and acute respiratory infections six times higher than in areas where collection is frequent, UN-Habitat (2009).

In many developing nations, dumpsites serve several purposes in addition to being a place to deposit domestic, medical and industrial wastes. For many urban poor, dump sites are places of work for waste pickers, waste collectors using push-cart to dump refuse on waste sites, waste buyers who sell them to recyclers and re-users, among others. Integrated solid waste transformation (ISWT) reflects the need to approach solid waste in a comprehensive manner with careful selection and sustained application of appropriate technology, working conditions, and establishment of a 'social license' between the community and designated waste management authorities (most commonly local government). ISWT is based on both a high degree of professionalism on behalf of solid waste managers; and on the appreciation of the critical role that the community, employees, and local (and increasingly global) ecosystems have in effective SWT (Supriyadi, Kriwoken, Birley, 2000).

According to Nguyen many cities in developing countries face serious environmental degradation and health risks due to the weakly developed municipal solid waste management system. Several studies have been conducted in order to examine the health and environmental effects arising from waste dumps. Such studies showed that a link exists between the two. The conclusion from this and other studies has led to an increasing interest of researchers in the study relating to environmental pollution as well as its effects on plants and animals. Few of these studies examined the environmental and health implications of solid waste disposal to people living in close proximity of wastes dumpsites. The ever-increasing consumption of resources results in huge amounts of solid wastes from industrial and domestic activities, which pose significant threats to human health. However, the ills of inappropriately disposed municipal solid wastes are quite numerous to be mentioned. Health deterioration, accidents, flood occurrences, and environmental pressures are just a few of the negative effects. In many developing countries, solid waste disposal sites are found on the outskirts of urban areas. These areas become children's sources of contamination due to the incubation and proliferation of flies, mosquitoes, and rodents. They, in turn, are disease transmitters that affect population's health, which has its organic defenses in a formative and creative state. The said situation produces gastrointestinal,

dermatological, respiratory, genetic, and several other kind of infectious diseases, (Nguyen P. T.,2011)

According to Medina, pollution major environmental effect of dumpsites, is not directly transferred from land to people, except in the case of dusts and direct contact with toxic materials. Pollutants deposited on land usually enter the human body through the medium of contaminated crops, animals, food products, or water. Also, the dumpsite has smelly and unsightly conditions. These conditions are worse in the summer because of extreme temperatures, which speed up the rate of bacterial action on biodegradable organic material. Disposal sites can also create health hazards for the neighborhood. Medina also highlighted that in a number of health surveys a wide range of health problems, including respiratory systems, irritation of the skin, eyes and nose, gastrointestinal problems, psychological disorders, and allergies, have been discovered. In addition, dumpsites closer to residential areas are always feeding places for dogs and cats. These pets, together with rodents, carry diseases with them to nearby homesteads. This paper therefore sought to present findings of a study carried out in Freetown municipal area in Sierra Leone to determine the environmental and health impact of solid waste disposal at Granville Brook dumpsite on its surrounding human settlements. We suggested new insights concerning the dumpsite in order to reduce the high prevalent rate of malaria and other diseases in the city. The findings presented could be of relevance for many municipal cities in developing countries and waste management researchers. Medina, M., (2002)

2.1.4 Solid Waste and social economic

The Minimum Requirements for Waste Disposal by Landfill, Second Edition (DWAF, 1998) stipulates the need to identify the necessity for a landfill and to select the most acceptable landfill site based on economic criteria and the willingness of the public to accept the site. This means that preference should be given to the landfill that minimizes costs where costs includes both financial costs (site development and transportation costs) and the social and environmental costs to the community related to the site: The need criteria refer to the high possibility of illegal/unregulated dumping and the associated high public health costs to the community in case of the no-project option, Economic criteria in the context of the document refer to the costs of obtaining, developing and operating a landfill, including an evaluation of transportation costs. Factors such as economies of scale, the distance of the landfill to waste generation areas, access to the landfill, soil quality and acquisition costs play a role, the public acceptance criteria involve

issues such as the impacts on public health, local land, property values and negative economic impacts on land-uses adjacent to the landfill.

Greening the waste sector and following an appropriate MSW management approach leads to employment generation where more employees will be required to successfully maintain a new management system.

Table 1 Solid Waste and social economic

Type of operation	**jobs**
Product Reuse	
Computer Reuse	296
Textile Reclamation	85
Miscellaneous durable Reuse	62
Wooden pallet repair	28
Recycling-based Manufacturers-average	25
Paper Mills	18
Glass product manufacturers	26
Plastic product manufacturers	93
Conventional materials recovery facilities	10
Composting	4
Landfill and incineration	1

2.2 Empirical framework

Oberlin (2011) declares gasification as another technique used for solid waste transformation and it is commonly used among the developed nations of the world. In fact, residual wastes are included and hence it controls landfill disposal and is within emission limits. The production of hydrogen is controlled by monitoring types of co substrate, type of pre-treatment, pH, and fermentation temperature (Florence, 2013). Another classic but effective method of getting to the bottom of this issue is composting. Centralized composting and composting using verm ibeds of

Eisenia foetida are developed from the basic principles of composting. Tukahirwa (2011) argues that the latter yields elements like calcium, nitrogen, phosphorus, potassium and sulphur, Phytocapping is an alternative for landfill remediation where, the waste is buried under a cover of trees. It was successfully carried out in Australia and can be thick capping (1400mm of soil) and thin capping (700mm of soil). In most areas where it has been applied, a cover of 21tree species is found to intercept 30 percent rainfall, have a transpiration rate of 2 mm / day. It also lowered methane emission by 4-5 times compared to adjacent non-vegetated landfill. A simulation known as HYDRU ID simulation showed a percolation rate of 16-7mm /yr in thick capping or 23-8mm/yr in thin capping. They also minimize percolation of water through buried waste. Waste can cause serious dangers for fauna and flora. For example, a fire can be triggered by the magnifying effect on a piece of glass, or small mammals can get trapped in bottles. The substances found inside batteries are also a health risk as they contaminate groundwater (Hoornweg, 2005).

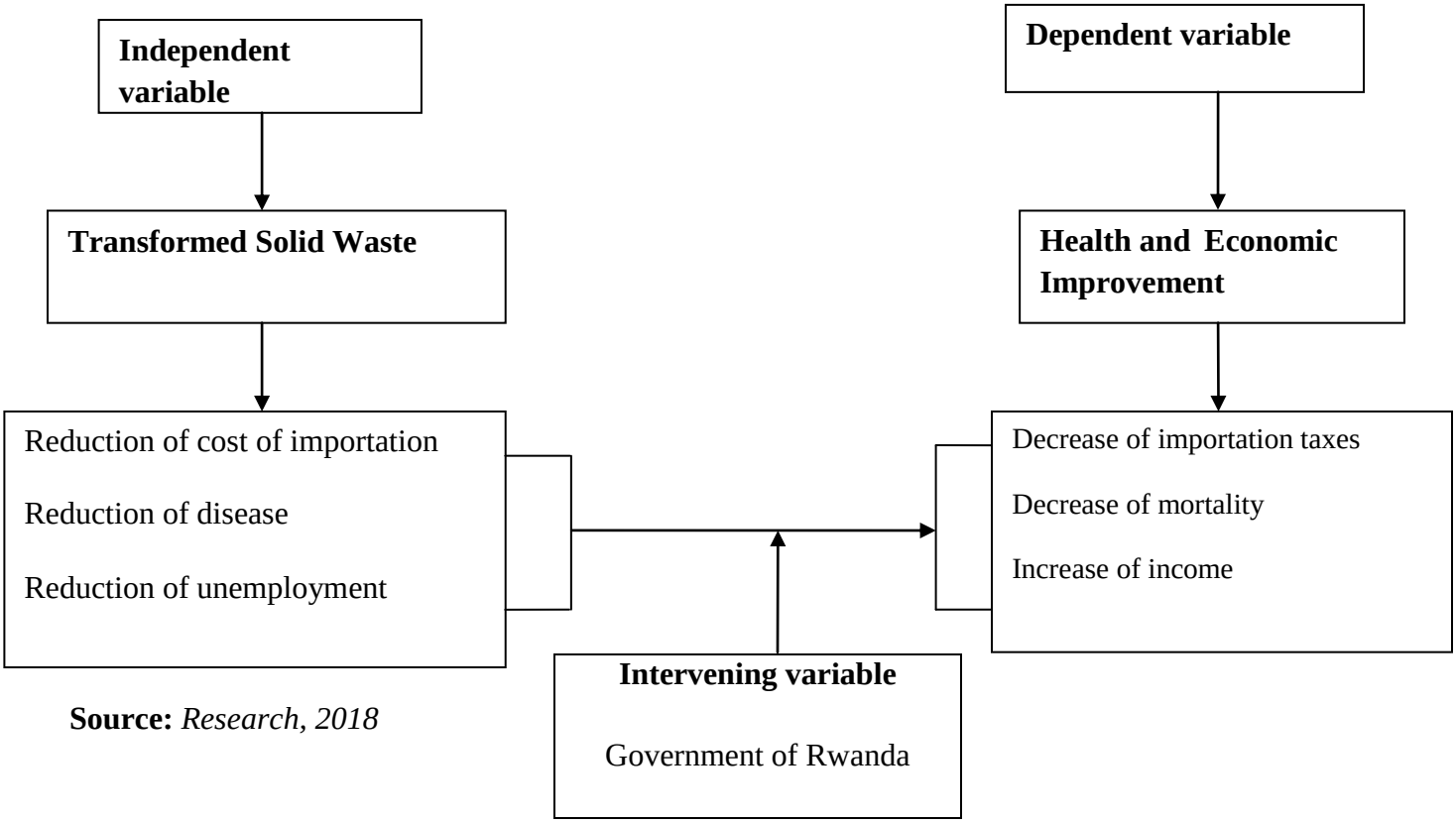
At landfills, the jumbled mess of waste is compressed which results in the anaerobic decomposition of organic matter, a phenomenon that produces leachate and biogas. Directly flowing into the lakes and rivers, leachate can be severely harmful to wildlife and it can poison animals drinking such polluted water. Even though landfills should meet air-tight requirements to prevent soil and water pollution, leakages into the environment are an unfortunate inevitability.

For all of these reasons, it's important that we carefully manage our waste. Thanks to the recovery of recyclable materials and the reuse of organic waste, we can significantly lower the volume of landfilled materials, thus reducing the adverse effects on the environment. As well as reducing the quantity of waste headed for the landfill, recycling helps lower the use of natural resources to make different products. For instance, a ton of recycled cardboard helps save 2500 kg of wood, each sheet of recycled paper helps save 1 liter of water, and 700 kg of crude oil is spared for each 1000 kg of plastic materials (Ashwath and Venkatraman, 2010).

2.3 Conceptual frame work

This conceptual framework concerns the key concepts used in this study and that need to be defined and clarified

Figure 1 Conceptual framework



Source: *Research, 2018*

2.3 Summary and Gap

This chapter talked about the fundamental transformation of existing systems requirements and its concluded that the solid waste transformation goals may not be achieved without a closed-loop production system in place, wide application of responsible consumption practices, conservative solid waste, health and economic improvement through monitoring and assessment of waste transformation performance. The waste is still accumulating and is putting pressure on the infrastructure and has resulted in many complex problems regarding contamination of Nduba site life population and decrease of their economic through high level of sickness which take their time and money instead of using them in their development. while developing local and

national waste transformation strategies is still a critical part which consequently leads to release of toxic pollutants into the atmosphere. The findings of this study are important and contribute to the knowledge of waste transformation process, the social economic impacts, and health impact. Therefore, beneficial for local authorities to consider is to propose the strategic elements. The practice of land filing poses certain risks to the surrounding community detrimental effects on groundwater, surface water, air quality and vector transmitted pathogen-related health issues, high cost of importation related to economic issues and this transformation of solid waste will be a sustainable solution.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter describes the research design and the methodology of the study, that is: research design, target population, sampling design and sample size, research instruments, data collection procedures, validity and reliability of the research instruments and data analysis techniques.

3.1 Research design

According to Kenneth (1987), a research design is the total plan that use to aid in answering research questions, and it is the entire process of study, problem formulation through dissemination of findings. In this study descriptive research methods was used. Descriptive research method was used to collect information from people of Nduba site. Descriptive study was used to attempts to gather quantifiable information that can be used to statistically analyze a target audience or a particular subject.

3.2 Study population identification

Population refers to all events, things or individuals to be presented in an investigation Richard (1990). According to Kenneth D. B. (1978), population is defined as a group or category of human beings, animals, and other things that have one or more characteristics in common as the target population of the universe.

Cohen, (2000) argue that a sample size is a way determined by the style of the research. In a survey study, there would be need for a representative sample of the population for generalization of the study findings (Krejcie and Morgan, 1970).

Randomly, the target population was devised into stratum. The target population was composed Nduba site people equal to 200 people (21-45 years and above), staffs of Gasabo District equal to 14 staffs of infrastructure department (21-45 years and above), the one in charge of solid waste management in Nduba dumpsite equal to 29 people (21-45 years and above) all of them totalling 243 respondents. These people were selected using a simple random sampling method. Random sampling is where all elements understudy have equal chances of being chosen.

Simple Size

A sample was a portion of the population selected to achieve the objectives of the study. This study was implemented a Sloven's formula to determine the minimum sample size. The simple size determination, according to (Morgan, 2005), says that when the respondents are under 100 respondents you ask all of them, when the respondents are over than 100 respondents you apply a formula to determine a simple size.

Sloven's formula: $n = \frac{N}{1+Na^2}$

Where:

n = sample size

N = Population size

a = level of significance (0.05)

n= 243/1+243(0.05)^2= 243/1+243*0.0025=243/1.6075= 151

The sample after employing Slovene's formula comprises of 151 respondents. This sampling technique was adopted because it helped this study in achieving greater precision because the strata have been chosen so that members of the same stratum was as similar as possible in respect of the characteristic of interest. Also it provided administrative convenience as each stratum was understood and dealt with in detail and this was even assist in later stages of Analysis. To calculate proportionate sample size the researcher used cross multiplication. This mean that through the formula above sample size equal to 151 respondents from 243 respondents.

Nduba population: 151/243*200=124

Gasabo District Staff: 151/243*14=9

People in charge of solid waste: 151/243*29=18

Table 2 Categories of respondents

Stratum	Population	Proportionate Sample size
Nduba population	200	124
Gasabo District Staff	14	9
People in charge of solid waste	29	18
Total	**243**	**151**

Source: primary data, 2019

3.3 Data collection

To make this research successful, the data collected included both primary and secondary data.

Primary data

According to (Bailey 1987), primary data are eyewitness accounts written by people who experienced a particular event or behaviour. The collection of primary data entailed provision of questionnaire.

Secondary data

The collections of secondary data include reports, magazines, articles as well as textbooks and internet documentation.

3.3.1 Data Collection techniques

Various methods and instruments enable the researcher to collect significant data of the study. Three main methods namely questionnaire, interview and observation was used to gather necessary data for the research.

Data collection was based primary and secondary data. Additionally, various journals and reports were also consulted for the study with the literature review from where the secondary data was collected.

Data being collected on basis of questionnaire are raw materials in form. Therefore, they deserve to be edited appropriate and meaningful for interpretation. During analysis the following code was used:

SA : Strongly Agree

A : Agree

D : Disagree

SD : Strongly Disagree

Respond code: SA=1; A=2; D=3, SD=4

This method also was used to validate and compare information collected from both interview schedules and questionnaires. This involved accurate watching of the reaction of the respondents and critical observation of the extent of the problem.

3.3.2 Data Processing and Analysis

Data being collected on basis of questionnaire are raw materials in form. Therefore, they deserve to be edited appropriate and meaningful for interpretation. It is at this end that basing on the study objectives namely general and specific, the researcher realized data processing. It involved editing, codifying, tabulation, so as to make the analysis and interpretation of findings. The linker scale was also used to analyze questions. As the analysis method, the researcher used descriptive statistics (frequencies, tables and percentages), and cost analysis for comparison of costs (as of standard with actual or for a given period with another or country with another) for the purpose of disclosing and reporting on conditions subject to improvement For large samples ($n > 70$), the formula range/4 gives the best estimator for the variance (Gupta S. Verma R. 2008).

Mean	**range**
3.26 – 4.00	Very low
2.51 – 3.25	Low
1.76 – 2.50	Moderate
1.00 – 1.75	High

Correlation coefficient/ positive Label/positive or negative	
r=1	Perfect linear correlation
0.9<r<1	Positive strong correlation
0.7<r< 0.9	Positive high correlation
0.5<r<0.7	Positive moderate correlation
0<r<0.5	Weak correlation
r=0	No, relationship

Interpretation of standard deviation (SD)

$SD \leq 0.5$ Respondents' homogeneity of perception

$SD \geq 0.5$ Respondents' heterogeneity of perception

Source: *Agresti and Franklin, (2009)*

Standard deviation	Level spreading
$\sigma < 0.5$	Homogeneous
$\sigma > 0.5$	Heterogeneous

Source: (Saunder, 2008)

The interpretation of results followed the analysis so as to draw conclusions and recommendations about the findings.

3.4 Operational definition of variables

3.4.1 Solid waste transformation

Mugambwa and Kizito, (2009) define solid waste transformation as practices used for collection, transportation, processing, recycling or disposal of garbage. It ought to be appreciated that solid waste transformation practices differ for developed and developing countries, for urban and rural areas, and for residential and industrial producers. The volumes and types of solid waste in the different sources of waste justify the difference in the solid waste transformation practices. It therefore implies that the methods appropriate in one setting may be different from another

setting. (Felix, 2010) points out some key elements of Solid Waste transformation as waste generation, waste storage, and collection.

3.4.2 Wastes

This study uses the definition by (UNEP, 2002) which defines wastes as substances or objects, which are disposed or are intended to be disposed or are required to be disposed by the provisions of national law. This definition is also in congruence with what Mugambwa and Kizito (2009); use that wastes refer to items, materials or substances which individuals consider useless at a given time and place. Usually, the definition of waste depends on types or categories and characteristics of waste under consideration. Some of the dominant types of waste include: municipal waste, solid waste, hazardous waste and electronic waste (UNEP, 2002).

3.4.3 Solid waste

For the purpose of this study, solid waste are referred to as garbage; they are organic and inorganic waste materials that are normally solid produced by households, commercial, institutional and industrial activities that have lost value in sight of the initial users (Mukisa, 2009).

3.4.4 Health

As defined by World Health Organization (WHO), it is a "State of complete physical, mental, and social well being, and not merely the absence of disease or infirmity." Health is a dynamic condition resulting from a body's constant adjustment and adaptation in response to stresses and changes in the environment for maintaining an inner equilibrium called homeostasis.

3.4.5 Economic improvement

Economic improvement is the process by which the economic well-being and quality of life of a nation, region or local community are improved. The term has been used frequently in the 20th and 21st centuries, but the concept has existed in the West for centuries. "Modernization", "Westernization", and especially "industrialization" are other terms often used while discussing economic development. Whereas economic development is a policy intervention endeavor aiming to improve the well-being of people, economic growth is a phenomenon of market

productivity and rise in GDP. Consequently, as economist Amartya Sen points out, "economic growth is one aspect of the process of economic development".

3.5 Methods of Data Analysis

For data analysis, the Statistical Package for the Social Sciences (SPSS) was used for data analysis to evaluate and present the information that has been collected; with SPSS it predicts with confidence what is to happen next so that you can make smarter decisions, solve problems and improve outcomes. Tables and graphs were also used to present the analysed data. Some other statistical measurements such as percentages have been used for interpretation and descriptive approach to present collected data.

According to Richard (1990) coding is a technical procedure by which data are collected. It is carried out by grouping data in logical categories.

Maser and Karton (1971) assert that the aim of coding surveys is to classify the answers to questions in the meaningful categories in order to bring out their acquired patterns while conducting this research, answers acquired was categorized and therefore tabulation was established.

3.6 Ethical Consideration

To ensure that ethical standards are observed in this study as well as utmost confidentially for the respondents and the data provided by them, the following were done: (1) coding of all questionnaires; (2) the respondents were requested to sign the informed consent; (3) authors mentioned in this study were acknowledged within the text; (4) findings were presented in a generalized manner.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

This chapter discusses the theories related to the topic understudy. The aim of this chapter is to review the available literature; both published and unpublished related to the topic "Impact of Transform Solid Waste into Useful Products on health and economic improvement" case of Nduba Site This was done under the guidance of objectives of the study which were: To provide the importance of transforming solid waste into useful products on health and economic improvement to Nduba site, to demonstrate the economic impact of transforming solid waste into useful products to Nduba site and Rwanda in general, to examine the level of health and economic improvement in Nduba site compare with other sites without solid waste.

4.1 Demographic characteristics of respondents

Demographic characteristics of respondent were analyzed to assess the percentage composition of different categories as well as the proportion of males and females in the sample. The assessment was also made to understand the sample age, structure, gender, qualification and nature of the respondents held. This helps us to know the relevance of the information given in relation with the research.

Table 3 Respondents' background characteristics

		Frequency	Percent
Respondents' gender	Male	135	89
	Female	16	11
	Total	**151**	**100**
Respondents' age group	Between 21-28 Years	61	40
	Between 29-36 Years	75	50
	Between 37-44 Years	10	7
	45 Years and above	5	3
	Total	**151**	**100**
Respondents' educational background	Primary level	80	53
	Secondary level	28	18
	Bachelors degree	12	8
	Masters degree	5	3
Respondents' occupation	PhD level	4	3
	Other levels	22	15
	Total	**151**	**100**
Respondents' marital status	Married	35	23
	Single	98	65
	Widow	18	12
	Total	**151**	**100**

***Source**: Primary data, 2019*

Gender

As indicated by results in table 2 majority of the respondents in this study were male with135 respondents with 89% of total number of respondents and 16 respondents with 11% of total number of respondents were female which shows gender balance in this research.

Age

The same table shows that 61 respondents with 40% of total of total number of respondents have between 21-28 years old, 75 respondents with 50% of total number of respondents have between 29-36 years old, 10 respondents with 7% of total number of respondents have between 37-

44years old, and 5 respondents with 3% have 45 years old and above. This shows the different categories of respondents in terms of years in this research.

Level of Education

The same table shows that 80 respondents with 53% of total number of respondents have primary school level, 28 respondents with 18% of total number of respondents have secondary school level, 12 respondents with 8% of total number of respondents have bachelors degree, 5 respondents with 3% of total number of respondents have Masters degree, 4 respondents with 3% of total number of respondents have PhD level and 22 respondents with 15% of total number of respondents have other levels.

Marital Status

The same table shows that 35 respondents with 23% of total number of respondents is married, 98 respondents with 65% of total number of respondents is single, and 18 respondents with 12% of total number of respondents is widow.

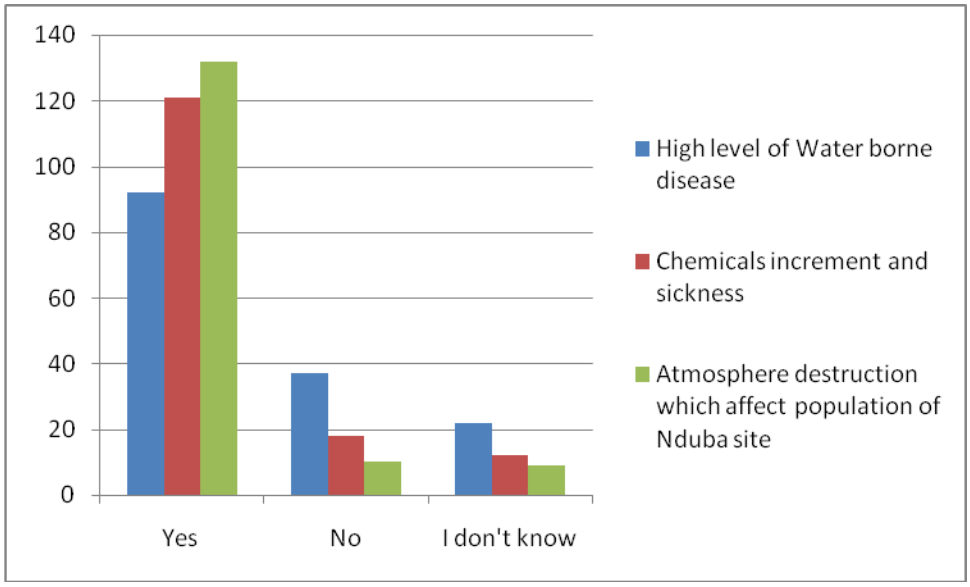
Table 4 Perception of respondents on health of population of Nduba site

	Y	**N**	**D**
High level of Water borne disease	61	24	15
Chemicals increment and sickness	80	12	8
Atmosphere destruction which affect population of Nduba site	87	6	6

Source: *Primary data, 2019*

The table 4.7 shows that 61% of total numbers of respondents agree that in Nduba site there is a high level of Water borne disease and 24% disagree it, 80% of total number of respondents agree that there is Chemicals increment and sickness, 12% disagree it and 87% of total number of respondents agree that there is atmosphere destruction which affect population of Nduba site and 6% of total number of respondents disagree it.

The graph below indicates the level of health of population of Nduba site compare with other sites far from Nduba site as it's indicated in table 4



The result on this graph indicates that the majority of respondents agreed that the level of health of population of Nduba site is very critical compare with other sites far from Nduba Dumpsite. As it's indicated above the critical health of the population of Nduba is stimulated by Nduba dumpsite.

Table 5 Health level in Gasabo District 2002-2012 before Nduba Dumpsite

Gasabo District	**Level of Health**
Bumbogo	7.8%
Gatsata	5.4%
Gikomero	2.9%
Gisozi	12.9%
Jabana	5.2%
Jali	2.9%
Kacyiru	0.6%
Kimihurura	-1.3%
Kimironko	4.9%
Kinyinya	9.8%
Ndera	7.6%
Nduba	5%
Remera	5.1%
Rusororo	4.1%
Rutunga	2.8%
Average level in Gasabo District	**5.2%**

Source: *Statistic Rwanda*

The table above indicates that health level in different sectors in Gasabo District according to their population. Nduba District has level of 5% before Nduba Dumpsite compare with it population of 35,760 which shows a high level of bad health in Nduba site.

Table 6 Health level in Gasabo District 2014-2018 after Nduba Dumpsite

Gasabo District	**Level of Health**
Bumbogo	3.2
Gatsata	3.9
Gikomero	0.1
Gisozi	1.5
Jabana	0.4
Jali	3.6
Kacyiru	3.5
Kimihurura	2.1
Kimironko	1.4
Kinyinya	3.2
Ndera	2.5
Nduba	6.5
Remera	0.1
Rusororo	2.2
Rutunga	3.5
Average level in Gasabo District	**2.5**

Source: *Statistic Rwanda*

The table above indicates that health level in different sectors in Gasabo District according to their population. Nduba District has level of 6.5% after Nduba Dumpsite compare with it population of 35,760 which shows a in creament level of bad health in Nduba site after dumpsite.

Table 7 Level of health problem of NDUBA site from 2015 to 2018

Level of sickness in NDUBA site, year 2015 (35,760 Population)

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	%
Entamoeba histolytica	37	37	34	18	29	58	88	26	50	72	98	144	**1.9**
Entamoeba coli	79	0	0	0	0	0	0	0	0	0	0	0	**0.2**
Giardia	8	8	24	9	13	21	6	46	8	22	41	63	**0.7**
Ascariasis	17	17	4	5	8	7	7	0	14	0	1	0	**0.2**
Ankylostomiasis chookworms	5	5	0	1	11	0	0	0	0	2	0	0	**0.06**
Diarrhoea no dehydration	3	3	13	34	51	41	25	62	38	116	24	6	**1.1**

Source: *Secondary data, 2019*

The table 4.10.1 indicates the level of health problem in Nduba site in 2015. The population of Nduba site is 35,760 and level of level of entamoeba histolytica is 1.9% entamoeba coli is 0.2%, giardia is 0.7%, ascarisis is 0.2% ankylostomiasis chookworms is 0.06% and diarrhoea no dehydration is 1.1%. When the researcher analyse the population number of Nduba site with the percentage sickness in 2015 he conclude by saying that the level of sickness is high. This indicates that the cause of this level of sickness is dumpsite which is across of the population of Nduba site.

Table 8 Level of sickness in Nduba site, year 2016

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	%
Entamoeba histolytica	162	128	128	127	123	126	112	75	133	99	32	44	**3.6**
Entamoeba coli	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Giardia	55	42	42	43	36	25	10	30	33	32	0	24	**1**
Ascariasis	3	2	2	0	2	2	0	1	1	1	0	0	**0.03**
Ankylostomiasis chookworms	0	1	1	0	0	3	0	0	0	0	0	0	**0.01**
Diarrhoea no dehydration	26	12	5	10	18	15	20	19	27	54	55	22	**0.7**

Source: *Secondary data, 2019*

The table 4.10.2 indicates the level of health problem in Nduba site in 2016. The findings indicates that entamoeba histolytica has 3.6%, entamoeba coli has 0%, Giardia has 1%, ascarisis

has 0.03% ankylostomiasis chookworms has 0.01 and diarrhoea no dehydration has 0.7%. This indicates that in Nduba site, there is a high level of sickness compare with its population because of dumpsite which is across where the population of Nduba are staying.

Table 9 Level of sickness in Nduba site, year 2017

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**%**
Entamoeba histolytica	50	52	54	33	56	60	60	33	55	60	42	59	**1.7**
Entamoeba coli	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Giardia	8	21	20	16	26	47	30	21	22	26	23	17	**0.7**
Ascariasis	14	2	0	0	0	1	1	0	1	2	0	0	**0.05**
Ankylostomiasis chookworms	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Diarrhoea no dehydration	16	19	27	28	15	31	36	25	57	85	18	35	**1**

Source: *Secondary data, 2019*

The table 4.10.3 indicates that in 2017 in Nduaba site entamoeba histolytica has 1.7%, entamoeba coli has 0%, giardia has 0.7%, ascariasis has 0.05% ankylostomiasis chookworms has 0% and diarrhea no dehydration has 1% which shows a high level of sickness according to the population of Nduba site. This indicates that the high level of sickness in Nduba site as indicated by the table above is caused by the dumpsite across its population.

Table 10 Level of sickness in Nduba site, year 2018

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**%**
Entamoeba histolytica	59	96	86	90	120	111	81	48	49	91	106	67	**2.8**
Entamoeba coli	18	0	0	6	0	0	0	0	0	0	0	0	**0.06**
Giardia	0	40	38	35	42	48	40	13	20	24	23	13	**0.9**
Ascariasis	0	0	0	2	1	0	1	0	0	2	1	1	**0.02**
Ankylostomiasis chookworms	0	0	0	0	0	1	0	0	0	0	1	1	**0.008**
Diarrhoea no dehydration	13	9	9	243	290	381	167	30	38	44	38	43	**3.6**

Source: *Secondary data, 2019*

The table 8 indicate that in 2018 entamoeba histolytica has 2.8%, entamoeba coli has 0.06%, giardia has 0.9%, ascariasis has 0.02% ankylostomiasis chookwrms has 0.008% and diarrhoea no

dehydration has 3.6% which shows that the sicknesses in Nduba site are in high level according to its population. This indicates that the high level of sickness in Nduba site caused by the dumpsite which across the population of Nduba, and this is a cause of the high level of sickness in Nduba site in 2018 when we compare with it population.

Table 11 Mortality report between Nduba site

Fosa	**2015**	**2016**	**2017**	**2018**
Nduba	**0.0%**	**0.0%**	**0.9%**	**0.0%**

Source: *HC Nduba*

The table 13 indicates that mortality level is very low, not because dumpsite doesn't cause sickness or death to Nduba site but because Rwanda have facility to all Rwandese in health treatment through Mutuel.

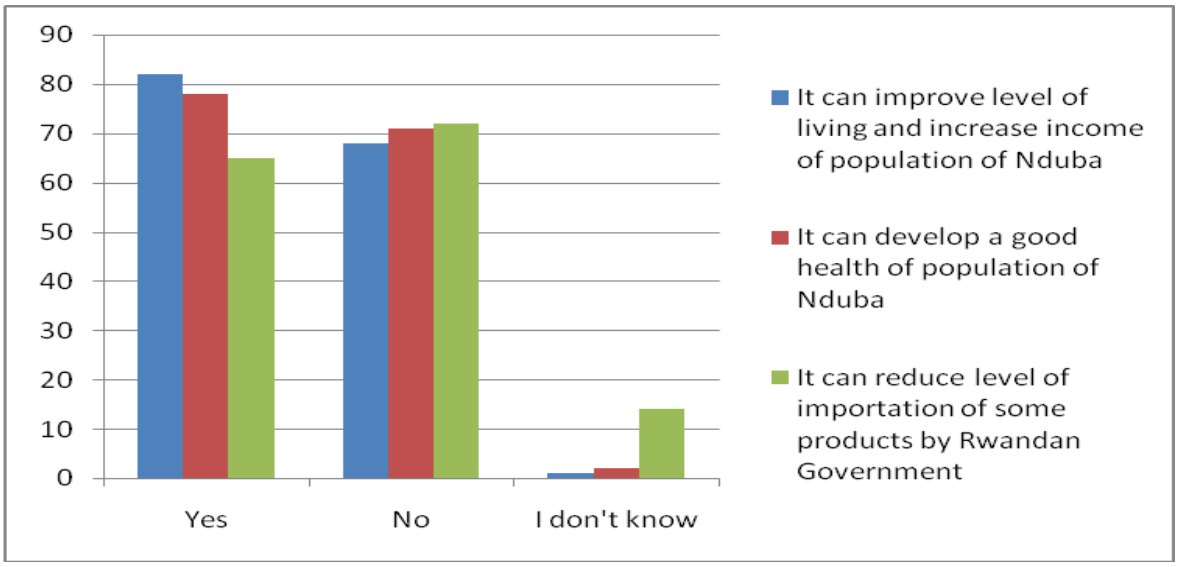
Table 12 Perception of respondents on the impacts of transforming solid waste on economic improvement to Nduba dumpsite

	Y	**N**	**D**
It can improve level of living and increase income of population of Nduba	54	45	1
It can develop a good health of population of Nduba	52	47	1
It can reduce level of importation of some products by Rwandan Government	43	48	9

49 ***Source:*** *Primary data, 2019*

The table 14 shows that the 54% of total number of respondents agree that there is importance of transforming solid waste into useful products in health and economic improvement to Nduba dumpsite and 45% of total number of respondents disagree it, 52% of total number of respondents agree that there is a development good health of population of Nduba and 47% of total number of respondents disagree it and 43% of total number of respondents agree that it can reduce level of importation of some products by Rwandan Government and 48% of total number of respondents disagree it.

The graph below demonstrate the level of Perception of respondents on the impacts of transforming solid waste on economic improvement to Nduba dumpsite



Source: *Primary data, 2019*

As it seen in the graph above, the majority of respondents agreed that transforming solid waste into useful products in health and economic improvement to Nduba dumpsite is important, however the government need to introduce the factories transforming the waste in Nduba site in purpose of protecting health and improve the economy to the population of Nduba site.

Table 13 Poverty and economic activity level in Gasabo District 2002-2012 before Nduba Dumpsite

Gasabo District	Poverty index	Poverty Level	Gasabo District	Economic activity
Bumbogo	38.18	3	Bumbogo	15.5%
Gatsata	11.45	1	Gatsata	20.256%
Gikomero	58.63	5	Gikomero	6.071%
Gisozi	12.39	1	Gisozi	24.406%
Jabana	37.65	3	Jabana	14.578%
Jali	44.43	4	Jali	10.914%
Kacyiru	7.08	1	Kacyiru	20.551%
Kimihurura	7.90	1	Kimihurura	11.962%
Kimironko	6.18	1	Kimironko	30.834%
Kinyinya	17.09	1	Kinyinya	29.140%
Ndera	33.18	3	Ndera	19.367%
Nduba	48.18	4	Nduba	10.037
Remera	8.18	1	Remera	24.351%
Rusororo	35.27	3	Rusororo	15.505%
Rutunga	57.18	5	Rutunga	6.603%

Source: *Statistic Rwanda*

The table above indicates Poverty and economic activity level in different sectors of Gasabo District. In Nduba site, the level of poverty is 48.18 indexes before Nduba Dumpsite with poverty level of 4 which is low compare with other sectors. Its indicate also level of economic activity which is 10.037 which low compare with other sectors.

Table 14 Poverty and economic activity level in Gasabo District 2014-2018 after Nduba Dumpsite

Gasabo District	Poverty index	Poverty Level	Gasabo District	Economic activity
Bumbogo	38.18	3	Bumbogo	15.5%
Gatsata	12.45	1	Gatsata	24.256%
Gikomero	58.63	5	Gikomero	6.071%
Gisozi	12.39	1	Gisozi	24.406%
Jabana	37.65	3	Jabana	14.578%
Jali	44.43	4	Jali	10.914%
Kacyiru	8.08	1	Kacyiru	20.551%
Kimihurura	7.90	1	Kimihurura	11.962%
Kimironko	6.18	1	Kimironko	30.834%
Kinyinya	17.09	1	Kinyinya	29.140%
Ndera	33.18	3	Ndera	19.367%
Nduba	58.5	5	Nduba	6.037
Remera	8.18	1	Remera	24.351%
Rusororo	35.27	3	Rusororo	15.505%
Rutunga	57.18	5	Rutunga	6.603%

Source: *Statistic Rwanda*

The table above indicates Poverty and economic activity level in different sectors of Gasabo District. In Nduba site, the level of poverty is 58.5 indexes after Nduba Dumpsite with poverty level of 5 which is low compare with other sectors. Its indicate also level of economic activity which is 6.037 which low compare with other sectors.

Table 15 Perception of respondent on economic impact of transforming solid waste to Nduba site and Rwanda in general

	Mean	Std. Deviation
Increase income and reduce poverty	1.8146	.62614
Increase business formation, expansion and retention	1.8013	.49017
Create jobs that add country's economic base	1.7086	.51107
Encouraging people's health	1.8146	.54655
Promote self employment	1.7947	.56942
Valid N		

Source: *Primary data, 2019*

The table 15 shows that the impact of transforming solid waste to Nduba site environment are: Increase income and reduce poverty with mean of 1.8146 which is moderate, Increase business formation, expansion and retention with mean of 1.8013 which is moderate, Create jobs that add king country's economic base with mean of 1.7086 which is high, Encouraging people's health with mean of 1.8146 which is moderate, and Promote self employment with mean of 1.7947 which moderate. The average mean is 1.7867 which is moderate.

Increase income and reduce poverty has standard deviation of 0.62614 which shows respondents heterogeneity of perception, Increase business formation, expansion and retention with has standard deviation of 0.49017 which shows respondents homogeneity of perception, Create jobs that add king country's economic base has standard deviation of 0.51107 which shows respondents heterogeneity of perception, Encouraging people's health has standard deviation of 0.54655 which shows respondents heterogeneity of perception, and Promote self employment has standard deviation of 0.56942 which shows respondents heterogeneity of respondents.

As illustrated, the modelling provides estimates for waste arisings to 2030. It estimates average annual growth rates of 2.3% in the industrial sector and 1.9% in the commercial sector. From the combination the colored (actual data) and grey/black bars (model estimates), it is possible to assess the model's predictive performance in recent years. The model overestimates the waste

raisings from the sector (by around 15 million tons in 2009), indicating that the modelled relationship between economic output and waste arisings is not accurately specified. Assuming that the waste intensity of production does not increase significantly over time, the forecasts to 2020 and 2030 are also likely to be large overestimates of waste arisings. Extrapolating based on regional data (central forecast) (Florence, 2013). It seen that the impact of transforming solid waste is moderate which needs to be improved in high level trough introducing many factories of transforming waste in Nduba site and allow the investors in Rwanda to produce the raw materials.

Table 16 Perception of respondents about Recycling Plants

	Mean	**Std. Deviation**
Market for Output	1.8079	.78073
Prices Offered	1.7682	.78692
Profitability	2.0066	.87557
Economy in Cost of Production	1.8874	.82092
Technology Used	1.6225	.65056
Quality of Service	1.6291	.73590
Valid N		

Source: *Primary data, 2019*

The table 16 shows that recycling plants are Market for Output with mean of 1.8079 which is moderate, Prices Offered with mean of 1.7682 which is moderate, Profitability with mean of 2.0066 which is moderate, Economy in Cost of Production with mean of 1.8874 which is moderate, Technology Used with 1.6225 which is high and Quality of Service with mean of 1.6291 which is high. The average mean is 1.7869 which is moderate. Market for Output has standard deviation of 0.78073 which shows respondents heterogeneity of perception, Prices Offered has standard deviation of 0.78692 which shows respondents heterogeneity of perception, Profitability has standard deviation of 0.87557 which shows respondents heterogeneity of perception, Economy in Cost of Production has standard deviation of 0.82092 which shows respondents heterogeneity of perception, Technology Used has standard deviation of 0.65056 which shows respondents heterogeneity of perception and Quality of Service that has standard deviation of 0.73590 which shows the respondents heterogeneity of perceptions. Existing data

indicates a declining trend in overall C&I waste arising, especially since 2006. This is driven initially by sharp declines in industrial waste raisings, although the decline in volumes from 2008 to 2009 is driven entirely by a decrease in commercial waste arising. There is a need to exercise caution in interpreting the 2009 results as these were recorded in the midst of recession, and therefore are likely to be depressed below trend. As with household waste, two approaches are taken to forecasting C&I waste Input-output model (Supriyadi, Kriwoken, Birley, 2000). As it seen in the result of table 4.9, the level of recycling plants is still low according to its mean and needs to be improved to high level to make sure that Rwanda can produce enough useful products and can satisfy it market.

Table 17 Cost analysis of materials transformed from solid waste in Rwanda compare to other countries

Cost analysis is a ccomparison of costs (as of standard with actual or for a given period with another or a country with another) for the purpose of disclosing and reporting on conditions subject to improvement.

Type	Rwandan Price/frw	China price/frw	Ugandan price/frw	Kenyan price/frw
wheelbarrow	35,000	15,000	12,000	18,000
Metal tube	1,800/kg	270/kg	585/kg	1,080/kg
Nail	1,100/kg	700/kg	700/kg	700/kg
Tiles	5100/piece	3,000/piece	3,000/piece	3,000/piece
Plastic tables	10,000/piece	6,000/piece	9,000/piece	9,000/piece
Plastic Chair	6,500/piece	3,500/piece	3,500/piece	3,500/piece
Plastic Tube	5,700/piece	3,500/piece	3,500/piece	3,500/piece
Tents	28,000/roll	1,260/roll	1,100/roll	1,100/roll

Source: *Primary data, 2019*

The table 17 indicates the cost of different material made in different countries of east Africa. The cost indicates that the price of the products made in Rwanda is still high because Rwanda doesn't have enough factories to transform solid waste and what they have; they always import the raw materials abroad. To reduce the cost of useful products in Rwanda the government of Rwanda need to put many factories that transform solid waste in Nduba site, allow the investors

who can produce what they need in their factories which will help Rwanda to reduce imports and increase the exports, also it will reduce the level of unemployment because those factories and investors will create jobs to the population of Rwanda.

Table 18 Importation taxes of raw materials from outside of country

The table below is one of examples of Rwandan factories that make plastic material by importing some raw materials in abroad.

SL NO	DATE	SUPPLIER	GOODS	QTY	A.A	DMC	FOB / CIF PORT	PORT TO KGL (FREIGHT)	INSURANCE	CIF KIGALI	DUTY	VAT PAID IN CUSTOM 18%	IMPRIMES & DTI	AFRICAN UNION FEES (AUO) 0.2%	QIF (0.2%)	IDL (1,5%)	CLEAR	TOTAL
1	20/9/2019	BAMBERGER POLYMERS (CANADA) CORP.	HDPE BAPOLENE 2035	960 BAGS	0	C1992	29.026.164	1.888.059	309.1	31.223.365		5.664.487	3000	62.447	61.828	468350	50000	$35,285
		TOTAL					29.026.164	1.888.059	309.1	31.223.365		5.664.487	3000	62.447	61.828	468350	50000	

Source: Rwacom, 2018

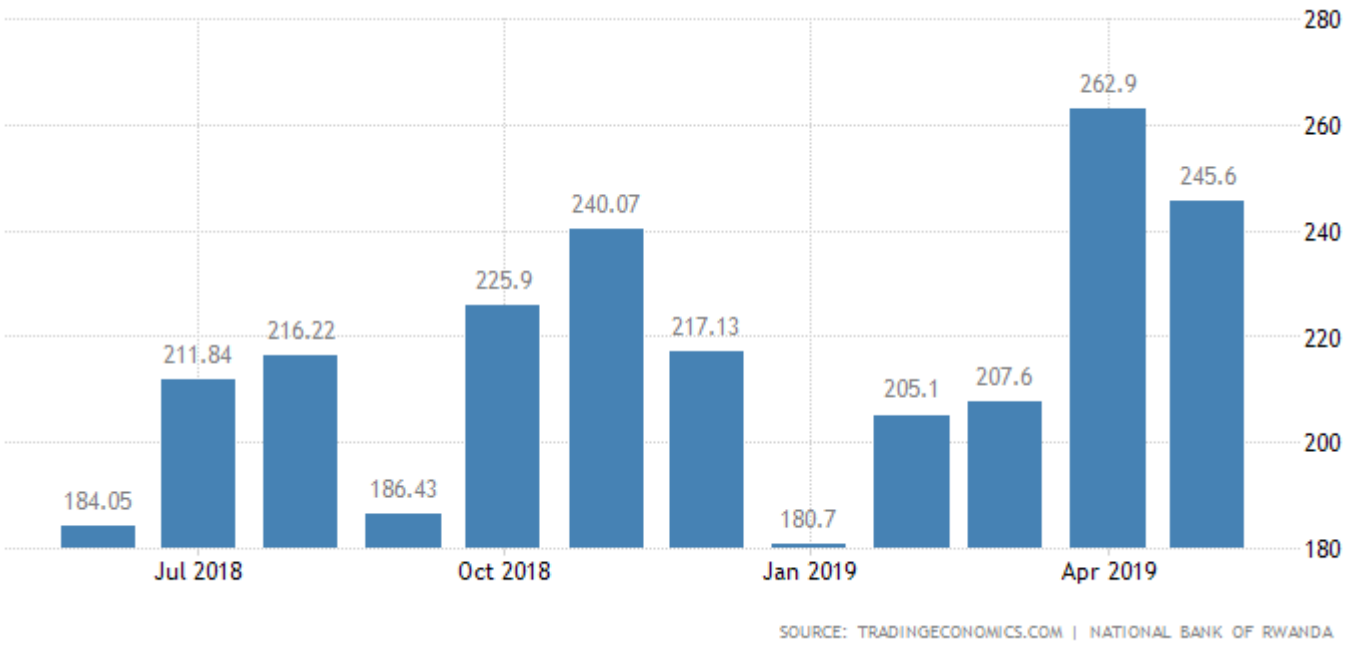
The table above interpret the cost indicated in table 17 which indicating the cost analysis of the materials from solid waste in deferent countries. This indicates that raw material from abroad are not expensive from the countries where they make them, but because of taxes and transport they reach Rwanda with a high price which is one of the reason that products transform from Rwanda become expensive compare to the products transformed completely from abroad.

4.2 Market competitiveness for useful products transformed in Rwanda

As it seen in table 4.12, the researcher fund out that the reason why the price of different products in Rwanda is always high is that factories of Rwanda are still few and young. The Government of Rwanda is always apply the taxes on the raw materials to use in Rwandan factories from abroad, and where they import them is not to the factories that make them but from the store of business man's who bought them from factories and sell them with interest. That is the reason why the price of products made in Rwanda is always high because of that marketing chain. The researcher recommended by saying that is better to make store in Rwanda so that pricing of the products made in Rwanda become less.

4.3 Demonstration of the variation of construction materials price in Rwanda

The graph below indicate the variation (increase and decrease) of price in Rwanda for construction materials products transformed by Rwandan industries caused by high level of importation and few industries of transformation in Rwanda.



As it seen in the figure above the pricing in Rwanda according to different months has variation. Between July, 2018-october, 2018 the price varied between 184.05 and 186.43, between October, 2018- January, 2019 the price vitiate between 186.43 and 180.7, between January,2019-April,2019 the price vitiate between 180.7 and 245.6. This variation indicates the increase and

decrease caused by few industries of transforming solid waste and high level of importation. To make the price stable will need to reduce the level of importation and increase the number of factories that transform solid waste into useful products which will help Rwanda to increase the economy and reduce level of unemployment. The result above made a researcher to confirm $\mathbf{H_0}$ that says there is an impact of transformed solid waste on health and economic improvement.

4.4 Benefits and Costs of greening the Solid Waste on Employment Generation

Activities related to MSW management very widely and offer direct and indirect roles, as depicted. The new job roles generated by greening the waste sector will bring about a more skilled pool of labourers that's considered a value added as well especially for developing countries. Table 1 shows the estimated number of jobs created per 10000 metric tonnes of waste for each operating strategy. It is obvious that moving up in the waste hierarchy, more jobs can be created. In addition, new sectors have emerged, sush as GIS/IT enabled services. More job Creation is maintained through scavenging in developing countries. The lack of adequate MSW collection and separation in developing countries gives good opportunities for scavengers (informal sector) to be engaged in such business. This creates a large need for informal scavengers and offers more income among the poor. This might help to eradicate extreme poverty and hunger as a goal of the SDGs (Medina, 2000).

Table 19 Correlation between transform solid waste into useful products and health and economic improvement

		Decrease of importation taxes	Decrease of mortality	Increase of income
Reduction of cost of importation	Pearson Correlation	1	.873**	.719**
	Sig. (2-tailed)		.000	.000
	N	151	151	151
Reduction of disease	Pearson Correlation	.873**	1	.834**
	Sig. (2-tailed)	.000		.000
	N	151	151	151
Reduction of unemployment	Pearson Correlation	.719**	.834**	1
	Sig. (2-tailed)	.000	.000	
	N	151	151	151

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

The table 19 indicates that correlation between values of waste recycled and cost of importation is 1 which is perfect linear correlation, Value of waste recycled and Reduction of disease has correlation of 0.873 which is positive high correlation and Value of waste recycled and Reduction of unemployment has correlation of 0.719 which is positive high correlation. Correlation between land to use and cost of importation is 0.873 which is positive high correlation, land to use and reduction of disease has correlation of 1 which is perfect linear correlation and land to use and reduction of unemployment has correlation of 0.834 which positive high correlation. Correlation between Waste transformation and Cost of importation is 0.719 which is positive high correlation, Waste transformation and Reduction of disease has correlation of 0.834 which is positive high correlation and Waste transformation and Reduction of unemployment has correlation of 1 which is perfect linear correlation.

According to the research made by Department for Environment, Food and Rural Affairs Nobel House 17 Smith Square London SW1P 3JR, data and information on C&I waste is less robust

than on household and local authority-collected waste. The results of a recently concluded national survey were published in early 2011. Prior to that, the last national survey was in 2002/03, and there have only been regional studies and the Defra waste statistics team's own estimates between then and now. Existing information on arising from the national survey's of 98/99, 02/03 and 09/10, and from Defra waste statistics estimates.The correlation result in table 4.13 indicates that there is significant relationship between transform solid waste into useful products and health and economic improvement which made a researcher to confirm $\mathbf{H_0}$ that says that there is an impact of transforming solid waste on Health and economic improvement.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

In this chapter, the conclusions from the study and the recommendations made are presented. The study used both qualitative and quantitative methods of analysis. The summary of findings, conclusion and recommendations are based on the objectives of the study: To provide the impact of transformed solid waste on health and economic improvement of Nduba site. to examine the level of sickness in Nduba site with dumpsite, to demonstrate the level of health and economic improvement before and after dumpsite in Nduba site, to determine the correlation between transformed solid waste in health and economic improvement.

5.1 Summary of the findings

Different researches have been conducted on Impact of Transform Solid Waste into Useful Products on health and economic improvement. Before data analysis, a pilot test was conducted for validity and reliability of the questionnaire. Cronbach alpha coefficient has been used to test the validity of Questionnaire before analysis and a coefficient was greater than 0.5 which was confirmed the adequacy of the study.

5.2 The summary of findings on the impact of Transforming Solid Waste into Useful Products on health and economic improvement

The findings indicated that that 61% of total numbers of respondents agree that in Nduba site there is a high level of Water borne disease and 24% disagree it, 80% of total number of respondents agree that there is Chemicals increment and sickness, 12% disagree it and 87% of total number of respondents agree that there is atmosphere destruction which affect population of Nduba site and 6% of total number of respondents disagree it.

The findings indicated that the level of health problem in Nduba site in 2015. The population of Nduba site is 35,760 and level of level of entamoeba histolytica is 1.9% entamoeba coli is 0.2%, giardia is 0.7%, ascarisis is 0.2% ankylostomiasis chookworms is 0.06% and diarrhoea no dehydration is 1.1%. When the researcher analyse the population number of Nduba site with the percentage sickness in 2015 he conclude by saying that the level of sickness is high. This indicates that the cause of this level of sickness is dumpsite which is across of the population of Nduba site.

The findings indicated the level of health problem in Nduba site in 2016. The findings indicates that entamoeba histolytica has 3.6%, entamoeba coli has 0%, Giardia has 1%, ascarisis has 0.03% ankylostomiasis chookworms has 0.01 and diarrhoea no dehydration has 0.7%. This indicates that in Nduba site, there is a high level of sickness compare with its population because of dumpsite which is across where the population of Nduba are staying.

The findings indicated that in 2017 in Nduaba site entamoeba histolytica has 1.7%, entamoeba coli has 0%, giardia has 0.7%, ascariasis has 0.05% ankylostomiasis chookworms has 0% and diarrhea no dehydration has 1% which shows a high level of sickness according to the population of Nduba site. This indicates that the high level of sickness in Nduba site as indicated by the table above is caused by the dumpsite across its population.

The findings indicated that in 2018 entamoeba histolytica has 2.8%, entamoeba coli has 0.06%, giardia has 0.9%, ascariasis has 0.02% ankylostomiasis chookwrms has 0.008% and diarrhoea no dehydration has 3.6% which shows that the sicknesses in Nduba site are in high level according to its population. This indicates that the high level of sickness in Nduba site caused by the dumpsite which across the population of Nduba, and this is a cause of the high level of sickness in Nduba site in 2018 when we compare with it population.

The findings indicated that mortality level is very low, not because dumpsite doesn't cause sickness or death to Nduba site but because Rwanda have facility to all Rwandese in health treatment through Mutuel. It also indicated that the 54% of total number of respondents agree that there is importance of transforming solid waste into useful products in health and economic improvement to Nduba dumpsite and 45% of total number of respondents disagree it, 52% of total number of respondents agree that there is a development good health of population of Nduba and 47% of total number of respondents disagree it and 43% of total number of respondents agree that it can reduce level of importation of some products by Rwandan Government and 48% of total number of respondents disagree it.

The findings indicated that the impact of transforming solid waste to Nduba site environment are: Increase income and reduce poverty with mean of 1.8146 which is moderate, Increase business formation, expansion and retention with mean of 1.8013 which is moderate, Create jobs that add king country's economic base with mean of 1.7086 which is high, Encouraging people's

health with mean of 1.8146 which is moderate, and Promote self employment with mean of 1.7947 which moderate. The average mean is 1.7867 which is moderate.

The findings indicated that recycling plants are Market for Output with mean of 1.8079 which is moderate, Prices Offered with mean of 1.7682 which is moderate, Profitability with mean of 2.0066 which is moderate, Economy in Cost of Production with mean of 1.8874 which is moderate, Technology Used with 1.6225 which is high and Quality of Service with mean of 1.6291 which is high. The average mean is 1.7869 which is moderate.

The relationship between transformed solid waste and health and economic improvement showed that correlation between values of waste recycled and cost of importation is 1 which is perfect linear correlation, Value of waste recycled and Reduction of disease has correlation of 0.873 which is positive high correlation and Value of waste recycled and Reduction of unemployment has correlation of 0.719 which is positive high correlation. Correlation between land to use and cost of importation is 0.873 which is positive high correlation, land to use and reduction of disease has correlation of 1 which is perfect linear correlation and land to use and reduction of unemployment has correlation of 0.834 which positive high correlation. Correlation between Waste transformation and Cost of importation is 0.719 which is positive high correlation, Waste transformation and Reduction of disease has correlation of 0.834 which is positive high correlation and Waste transformation and Reduction of unemployment has correlation of 1 which is perfect linear correlation.

5.3 Conclusion

Based on the findings, the result indicates that dumpsite of Nduba doesn't have any importance to the population of Nduba because there is no any factory located in Nduba which can generate jobs to them. However the factories that transform solid waste from Nduba are located to other sides of Rwanda. Those factories have importance to the population of those sides when Nduba accumulate the consequences of dumpsite. In order to reduce the amount of solid waste and improve the transformation of solid waste, it needs to be noted that as the city expands, dire consequences are obvious and it is the duty of the state and the people themselves. If materials such as metals, paper, glass and plastics are recovered from solid waste, they become source of valuable raw materials to industries, thereby reducing foreign importation for countries dependent on those materials, while excess production could be exported. There is need to

increase community understanding and capacity building on transformation of solid waste in order to increase the national incomes and unemployment in Nduba site and Rwanda in general. The findings above made a researcher confirm $\mathbf{H_0}$ that says that there is an impact of transformed solid waste on Health and economic improvement.

5.4 Recommendations

To succeed in adoption of sustainable methods of transformation of solid waste by the communities, it can be done by making awareness programmers simple and accessible to change the mindset of Nduba site residents to perceive solid waste as resource of their development. Based on the result of health, poverty and economic activity in Nduba before and after Dumpsite, its indicates that there is an increment of critical life, increment of poverty and low of economic activity. There is a need for political support for such initiatives of transformation of solid waste strategies to succeed by increase the number of factories in Rwanda which will reduce the high price of products made in Rwanda.

The government of Rwanda needs to increase the number of factories that transform solid waste so that it can influence the reduction of importation of some products and reduce also the number of unemployment. The government of Rwanda needs also to allow the investors who produce raw materials they need to invest in Rwanda so that they can reduce the level of importation, which will reduce also the high pricing of useful products in Rwanda. Lastly, Researcher cannot claim that this research is exhaustive. Several issues, associated with the limitations inherent in this study, require further research considerations. The similar study could be done in other organizations within the country in order to augment the findings on transformation of solid waste.

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APPENDIX

Questionnaires

My name is **NDAYIKEZE Yolaine** carrying out a research study on **Impact of Transform Sold Waste into Useful Products on health and economic improvement** I request my kind respondents to answer the entire questionnaire by exhausting their opinions; therefore every answer is correct. Thank you very much for your assistance.

Please tick the appropriate box or explain where necessary.

SECTION A: Respondents background information

In order to answer the following questions, put a right sign (x) in the boxes that located in front your identification:

1) **Gender / Igitsina**

( ) Male/ Umugabo ☐

( ) Female/ Umugore ☐

2) **Age/ imyaka**

( ) 21 – 28 ☐

( ) 29 – 36 ☐

( ) 37 – 44 ☐

( ) 45 years – above/ kuzamura ☐

3) **Level of education/ Amashuri**

( ) primary school/ Amashuri abanza ☐

( ) Secondary school/ Amashuri yisumbuye ☐

( ) Bachelor's Degree/Icyiciro cya 1 cya kaminuza ☐

( ) Master's Degree/ Icyiciro cya 2 cya kaminuza ☐

( ) PhD level/ Icyiciro cy'ikirenga cya kaminuza ☐

( ) Other levels/specify/ Andi mahugurwa ☐

4) **Marital status/ icyiciro**

( ) Married/ uwashatse ☐

( ) Single/ utarashaka ☐

( ) Widow/ baratandukanye ☐

SECTION B: Perceptions of Respondents/ ibitekerezo by'abaturage

1. **Perception of respondents of population of Nduba site/ ibitekerezo byabaturage ba tuye Nduba**

Please respond to the questions of your choice by using the corresponding letter(s) as guided;

SA : Strongly Agree/ Yego cyane

A : Agree/ Yego

D : Disagree/ Oya

SD : Strongly Disagree/ Oya cyane

Response code: SA=1; A=2; D=3, SD=4

Perception of respondent on economic impact of transforming solid waste to Nduba site and Rwanda in general

	SA	**A**	**D**	**SD**
Increase income and reduce poverty/ kongera umutungo no kugabanya ubukene				
Increase business formation, expansion and retention/ kongera amahugurwa mubikorwa, kwaguka na inyungu				
Create jobs that add king country's economic base/ guhanga akazi mukuzamura iterambere ryigihugu				
Encouraging people's health/ gushishikariza abantu kubaho				

Promote self employment/ guteza imbere kwikorera				

Mark your preference by a tick mark in the box provided, Y stands for Yes, N for No and D for Don't Know

Perception of respondents on the impacts of transformed solid waste on economic improvement to Nduba dumpsite

	Y	**N**	**D**
It can improve level of living and increase income of population of Nduba/ Ishobora guhindura urwego rw'ubuzima ndetse kongera umutungo kubaturage ba Nduba			
It can develop a good health of population of Nduba/ Ishobora kongera imibereho myiza kubaturage ba Nduba			
It can reduce level of importation of some products by Rwandan Government/ Ishobora kugabanya urwego rw'ibyinjira mugihugu cy'Urwanda			

Mark your preference by a tick mark in the box provided, Y stands for Yes, N for No and D for Don't Know

Perception of respondents on health impact of population of Nduba site compare with other sites without solid waste

	Y	**N**	**D**
High level of Water borne disease/ urwego rwo hejuru rw'indwara zituruka kumazi mabi			
Chemicals increment and sickness/ kwiyongera kw'inrwara nuburozi			
Atmosphere destruction which affect population of Nduba site/ gusenyuka kw'ikirere bigira ingaruka kuri Nduba			

Perception of respondents on Health Problems

My family is suffering from diseases	**Yes**	**No**
Entamoeba histolytica		
Entamoeba coli		
Giardia		
Ascariasis		
Ankylostomiasis chookworms		
Diarrhoea no dehydration		
Tricomnas		
Tenia		
Skin Diseases		
Congenital Abnormalities		
Dengue Fever		
Malaria		

SECTION C: Interview

1. What is the method of transformation solid waste we can use to protect population health of Nduba site?

2. What is the economic impact of transformation solid waste to Nduba site population?

3. What are challenges Gasabo District can face during transforming of solid waste?

4. What are the measures to use to maintaining population's health and life control in Nduba site through transformation of solid waste?

A. FRAME OF WORK

	Dec	Jan	Feb	Mach	Apr	May	Jun
Approval of title	→						
Proposal writing		→	→				
Designing questionnaire				→			
Data collection				→			
Data analysis					→		
Report writing						→	
Submission of dissert							→

B. BUDGETING FOR RESEARCH

ITEMS	USD	RWF
Subsistence	35	24,500
Research assistance	5	3,500
Travelling	100	70,000
Secretly services	50	35,400
Equipment and stationeries	20	14,700
Data analysis	10	7,000
Data access to binding	10	7,000
Sub total	230	161,000
Contingents 10%	23	16,100
Total	**253**	**226,435**

Types of Solid waste in Nduba dumpsite

Figure1

Source: *Nduba site, 2019*

The figure above shows the site of Nduba where they accumulate the waste of different types from different areas.

Figure2

Source: *Nduba site, 2019*

The figure above shows the solid waste in plastic and how they cover them and transport them for transformation in other useful products.

Figure3

Source: *Nduba site, 2019*

The figure above shows the waste in soft plastic (tents) and how they cover them and transport them for transformation in other useful products.

Figure4

Source: *Nduba site, 2019*

The figure above shows the machine they use to cover the waste ready to be transported to the area where they can transform them into useful products.

Figure5

Source: *Nduba site, 2019*

The figure above indicates glass solid waste in Nduba site that need to be transformed into useful products.

Figure6

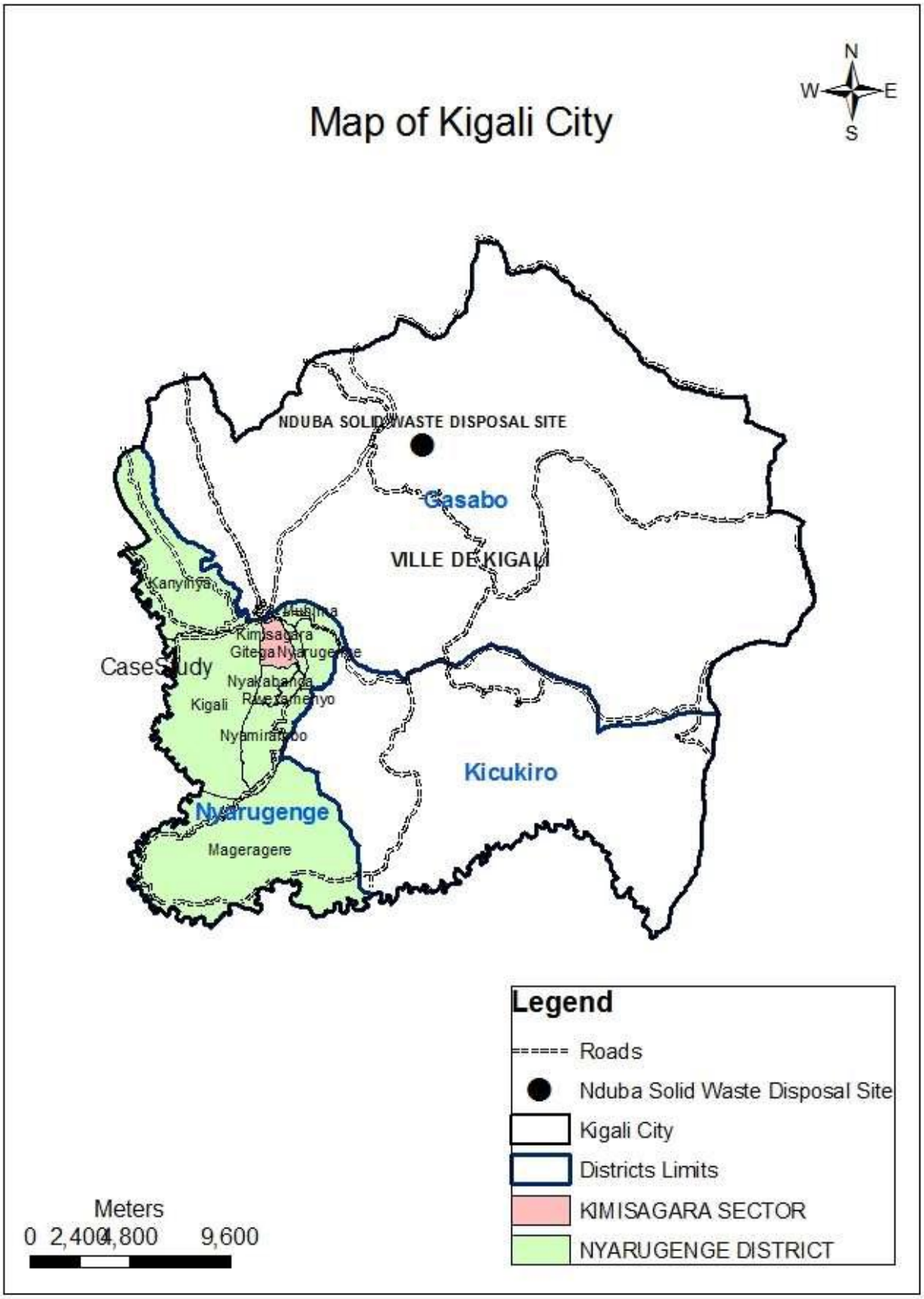
Source: *Nduba site, 2019*

The figure above indicates the waste in soft plastics (sack) that will be transported to area where they can be transformed into useful products.

Figure7

Source: *Nduba site, 2019*

The figure photo above indicates the waste in carton, covered and ready to be transported for transforming them into useful products.


Map of Kigali City
N
W
E
S
NDUBA SOLID WASTE DISPOSAL SITE
Gasabo
VILLE DE KIGALI
Kanyinya
Kimisagara
Gitega
Nyarugenge
Case Study
Nyakabanda
Rwezamenyo
Kigali
Nyamirambo
Kicukiro
Nyarugenge
Mageragere
Legend
Roads
Nduba Solid Waste Disposal Site
Kigali City
Districts Limits
KIMISAGARA SECTOR
NYARUGENGE DISTRICT
Meters
0 2,400 4,800 9,600