

USED DIAPER DISPOSAL PRACTICES BY MOTHERS SERVICED BY ROSENKRANTZ CLINIC IN
GA-MATLALA, LIMPOPO PROVINCE

BY

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DISSERTATION SUBMITTED IN FULFILMENT OF THE DEGREE OF

MASTER OF SCIENCE IN GEOGRAPHY

IN THE

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES,

SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES,

FACULTY OF SCIENCE AND AGRICULTURE,

UNIVERSITY OF LIMPOPO

SOUTH AFRICA

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2023

DECLARATION

I, Ramokone Sarah Lamola declare that this dissertation and the research undertaken to do it, is my own pursuit and an investigation undertaken by me alone. Where the foundational work of others was used to substantiate methods, former occurrences, or to compare the observations of others, such as where literature was reviewed, this is duly referenced and acknowledged in the text.

Ms. Lamola R.S **31/09/2022**

ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to the following:

- The Lord, I could not have achieved this without you. Thank you for giving me strength to complete this research.
- Prof. MR Ramudzuli, my supervisor, for guiding the work, providing valuable comments and encouragement throughout the study period.
- Cuzette du Plessis, from Rural Development and Innovation Hub, for her valuable insight.
- My family, for their patience, encouragement and constant support throughout this study.

ABSTRACT

The promotion of clean environment by the public has a positive impact in the reduction of waste in communities. Disposable diapers are part of solid waste that has its own management challenges as their consumption is increasing due to population growth. Disposable diapers offer convenience however they take centuries for their plastic components to decompose after disposal which poses risks to the public and environmental health.

This study sought to investigate how mothers of infants dispose soiled diapers in rural areas of Ga-Matlala in Limpopo province. The study followed a mixed-method research approach that used a survey questionnaire, interviews and field observations. Purposive and convenience sampling techniques, respectively, were used to select respondents.

It was established that the majority of respondents use disposable diapers compared to cloth diapers. Most of the respondents are aware of the negative impacts on the environment resulting from improper disposal methods of soiled diapers. The study also found that the mothers are willing to work with the municipality to keep their environment safe and clean. The local municipality does not render the refuse collection services to 75% of all settlement in their jurisdiction. The study found that they have low budget and poor infrastructure such as roads to deliver the basic needs to the communities.

This study recommends that there should be participation and strong partnership between the local municipality and community members to educate with proper disposal of soiled diapers. The results of this research could encourage further research on how policy application, as well as the formulation of acts and regulations, including municipal by-laws, could be streamlined within municipal responsibilities, as municipalities generally lack these frameworks.

Keywords: Disposable diapers, solid waste, plastic components, decompose, environmental health

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LIST OF ABBREVIATIONS AND ACRONYMS

USEPA	United States Environmental Protection Policy
WHO	World Health Organization
BLM	Blouberg Local Municipality
CDM	Capricorn District Municipality
MSW	Municipal Solid Waste
UNDP	United Nations Development Programme
MSWM	Municipal Solid Waste Management
FEPA	Federal Environmental Protection Agency
SAP	Superabsorbent Polymer
IWMP	Integrated Waste Management Plan
EPWP	Expanded Public Works Programme
NWMS	National Waste Management Systems
NEMA	National Environmental Management Act

CHAPTER 1

CONCEPTUAL BACKGROUND OF THE STUDY

1.1 Introduction

Modern society has experienced increased production and consumption of various goods since industrialization commenced in the 1700s-1800s (Marsh and Grossa, 1996). Generated waste unfortunately ends up entering the terrestrial and aquatic environment as pollutants. Dirty sanitary nappies are an example of such waste. They are clothes worn by infants and the elderly who are unable to control their bowel and urinary systems (Rahat et al., 2014). They are convenient undergarments that allow urinating or defecating without the use of toilet facilities as they absorb or retain waste, which prevents the contamination of clothes on outer layers, and also that of the external environment (Mutowo and Mzengi, 2015). The first nappies were made of cloth, but they caused a lot of inconvenience when people were traveling and during bad weather. Plastic diapers were invented later and their use started in the 1940s when women started going to work, which limited their time available for chores like washing and processing cloth diapers (Krafchik, 2016). The invention of the first model of disposable diapers is credited to Marion Donovan, an American professional-turned-homemaker, and Paulistrom, a Swede (Krafchik, 2016; Dyer, 2005). There are several ways to manage nappy removal. In areas with municipal waste collection services, soiled nappy parts are removed from the litter, packed in plastic bags and placed in bins. Plastic bags are collected by municipal vehicles and taken to designated points for disposal. In some rural areas, nappies are wrapped and buried in waste pits. At present, in some areas, illegal dumping sites have been observed.

1.2 Problem statement

Disposable soiled diapers form part of solid waste and since their invention; their consumption has increased immensely and along with their increased use, come numerous management challenges and subsequent environmental consequences as there is a trend of discarding them illegally (Remigios, 2014). The main challenge regarding their use is that even though they are convenient, disposable diapers do not biodegrade readily after they are discarded into the environment (Mutowo and Mzengi, 2015). Tsiko (2011) indicates that it takes between 400 and 1000 years for the plastic component of diapers to break down. In addition, excreta from soiled nappies may have harmful micro-organisms like bacteria that may contaminate the immediate soil and water surroundings (United States Environmental Protection Agency (USEPA), 1990).

The use of disposable diapers is increasing by the day, but it takes the planet centuries for disposable diapers to decompose therefore, every single plastic diaper that is produced has the potential to cause serious harm to the environment.

Mutowo and Mzengi (2015) identify the sustainable promotion of a clean environment identified as a public health intervention which can likely considerably contribute to reducing solid waste in communities. According to Vidanaarachchi *et al.* (2006), the public consider waste management as local authorities' responsibility and duty, and they therefore cannot be required to contribute to it. This idea is dominant in urban areas, whereas an opposing argument is that the public and other stakeholders need to be involved and to participate in decisions relating to sound waste management, for a healthy, safe and clean environment to be maintained (Mutowo and Mzengi, 2015); especially so in rural areas where waste management is often overlooked (Hugo, 2015). Therefore, the focus is on mothers who still have children using nappies in rural areas. It is of academic interest to examine their practices and environmental awareness with regards to the disposal of diapers. The identified study area is a rural village called Ga-Lamola in the Blouberg Local Municipality of Limpopo Province.

1.3 Rationale

Today disposable baby diapers are used as part of daily wear for infants who still need potty training in both developed and developing countries, despite their original intention for convenience, particularly when travelling (Remigios, 2014). A report by Odio and Friedlander (2000) indicates that approximately 90% of used diapers are disposable. The use of disposable diapers is also becoming popular in the developing world because of their convenience to use, as they are perceived to offer more advantages than traditional cloth diapers (Rai *et al.*, 2009). Environmental experts have not reached an agreement on what is the most environmentally friendly ways to dispose of disposable plastic diapers, this justifies the need for more academic research to be undertaken to come up with the most environmentally effective methods of managing this solid waste matter, relating to the disposal of diapers made mainly from plastic materials.

Most users of disposable diapers do not know the risks that the product has on the environment (Marshall, 1972). What is concerning is that there are many illegal dumping sites full of diapers in the study area (see Figure 1.1).



Figure 1.1: Illegal dumping site of disposable diapers, photo taken at Ga-Lamola village. Date : 19 August 2020. Source: Researcher.

Improper disposal of diapers made mainly from plastic has the potential to increase drainage water being contaminated, which can later lead to waterborne diseases (Kimani, Muchiri and Makindi, 2015). Disposable nappies also release harmful methane gas (NH_4) in landfill sites, because of the anaerobic environment (Saleem, 2017). This greenhouse gas is more effective in trapping heat in the atmosphere, which leads to more global warming (Africa, 2018). In addition, illegal dumping of diapers forms trash that pollutes the clean environmental surroundings. The potential for environmental contamination from the use of disposable diapers made mainly from plastic components is too high for academics to ignore. Global population is expected to continue rising and therefore the use of disposable diapers will correlate with the hike in global population levels. The management of the potential environmental threat posed by the disposal of diapers made from plastic components is one of the key challenges that modern-day solid waste managers and experts have to deal with throughout the world, both in the developed or developing countries.

In order to minimize the above challenges, it is necessary that appropriate control systems be set up and implemented in our communities, while mitigation measures such as waste reduction and recycling should also be improved (Kimani, Muchiri and Makindi, 2015). Waste reduction encompasses that products be re-designed, or that society's patterns of consuming, using and generating waste be altered so that less waste is created, while health and environmental effects of waste that is produced should be reduced (USEPA, 1990). The major disposable diaper manufacturers have a responsibility to find alternative materials to use during the manufacturing process, which will lead to a decrease in negative impact on the environment when disposing the diapers. The major producers of disposable diapers must also take it upon themselves to educate the end consumer on the most environmentally sustainable methods of disposing of disposable plastic diapers.

Several scholars (Kimani, Muchiri and Makindi, 2015; Khoo *et al.*, 2019; Muia, 2018; Remigios, 2014) have conducted the studies on the practices and policies regarding the disposal of diapers. Their

studies, however, focused mainly on urban areas, while this study intends to bridge the literature gap relating to how local communities and municipalities manage soiled disposable diapers in rural areas within my study area. It will also address the issue of creating awareness among communities in rural areas on more appropriate ways to dispose of soiled diapers in more environmentally benign ways; a practice that will help to minimize environmental despoliation and possibly lead to the reduction of water and soil contamination. There is therefore a potential for this study to subsequently influence decisions and policies by the local municipality on how to manage soiled disposable diaper waste, because to date no similar research has been undertaken in the selected study area.

1.4 Research questions

The main aim of the study was to determine what practices or methods mothers of infants use to dispose their soiled disposable diapers. This flowed to the following questions:

1.4.1 Why do people dump soiled disposable diapers in an improper manner?

1.4.2 Do people know and understand the environmental and health impacts associated with soiled disposable diapers?

1.4.3 Are there policies that are set to manage soiled disposable diapers as part of solid waste?

1.5 Study area

The study was undertaken at Rosenkrantz Clinic situated in Ga-Lamola Village, Limpopo Province. Ga-Lamola is one of the villages that falls under the tribal territory of Ga-Matlala area in the Blouberg Local Municipality (BLM) of the Capricorn District Municipality (CDM). The village is located 73km northwest of Polokwane and 32km southeast of Senwabarwana.

The clinic provides its services to the surrounding villages of Ga-Sebotse, Pinkie, Leokaneng, Cooperspark/Ga-Manhlodi and Burgwal. The clinic provides services such as maternal and childcare, immunization, promotion of proper nutrition, control of prevalent disease, family planning, health education and treatment of common health conditions.

The targeted participants were mothers who bring their babies, of the ages of 0 to 3 years to the Rosenkrantz clinic for post-natal services. The post-natal service is provided days and weeks following childbirth. It includes maternal care, immunization and well-child check-ups such as weighing and feeding. The area of my study is depicted in Figure 1.2, below, showing the relative location between the Rosenkrantz Clinic and the surrounding villages it serves.

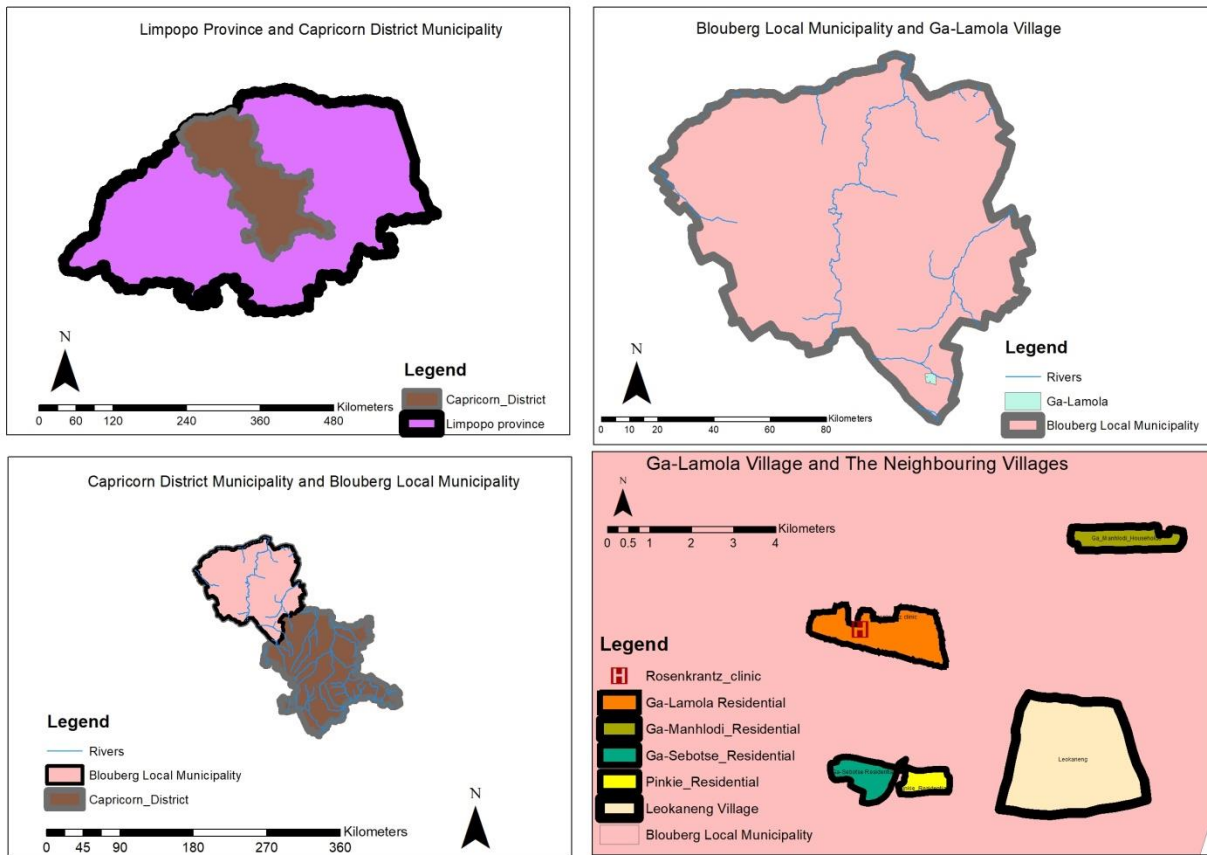


Figure 1.2: Study area map. (Source: Author's creation using Google earth and ArcMap)

1.6 Aim

This study aims to examine the practices of disposing of soiled disposable diapers by the mothers of infants and toddlers who gets post-natal services at Rosenkrantz Clinic in the Blouberg Local Municipality.

1.7 Objectives

In the light of the above aim, specific objectives were to:

- a) Profile the demographic attributes of Ga-Matlala mothers who use the post –natal services of Rosenkrantz clinic.
- b) Establish the use of disposable diapers by mothers of infants at Ga-Matlala area.
- c) Investigate the methods that families use to dispose soiled disposable diapers.

- d) Determine the awareness and perception of diaper users on health and environmental risks that are linked to improper disposal methods of soiled disposable diapers.
- e) Capture GPS (Global Positioning System) coordinates of unauthorized dumping sites.
- f) Investigate the methods of disposing of soiled diapers within the solid waste management processes of Blouberg Local Municipality.

1.8 Structure of the study

This dissertation is organized as follows:

Chapter 1 outlines the background of the study, gives the statement of the problem and rationale. It sets out the aim, objectives and research questions.

Chapter 2 presents a review of relevant literature. In this chapter the theoretical background of waste and waste generation, waste collection methods, the legal framework applicable to waste management, the use of disposable diaper, components of disposable diaper, disposal methods and the health and environmental impacts caused by disposed soiled diapers are discussed.

Chapter 3 motivates the methodology that was followed in conducting this research. In it, the mixed-method approach is outlined, as adopted to attain the specific research objectives. A survey, structured interview and non-participant observation were used to gather data. Limitations of the approach and constraints faced during the data collection are also discussed.

Chapter 4 analyzes and presents the data collected in the study area. The similarities and differences in different data sets are examined and interpreted, whereafter the results are discussed and interpreted.

Chapter 5 presents a synopsis of the findings, draws conclusion and makes recommendations.

1.9 Conclusion

This chapter outlined the background of the research study and emphasized the problem statement and rationale for the study – as well as pinpointing the research aim and objectives. This chapter also included the structure of this study. The literature review follows in the next chapter.

CHAPTER 2

LITERATURE REVIEW: THEORETICAL FRAMEWORK

2.1 Introduction

The literature reviewed related to waste and disposable diapers is provided in this chapter. Reviewed items include an overview of waste and waste generation, waste collection methods and legal frameworks that are applicable to waste management. In addition, this chapter also presents a discussion on history of disposable diapers, components of disposable diapers, use of diapers, practices that are used to discard soiled diapers and the health and environmental impacts that are caused by improper handling or discarding of soiled diapers. The discussion is presented below.

2.2 An overview of waste generation

2.2.1 Waste and waste generation

Currently, the trends toward consumer economies, population growth and technological advances in material development and manufacturing have contributed towards the generation of unwanted or unusable products (Marsh and Grossa, 1996). These are referred to as waste. Waste is “*any substance which is discarded after primary use and [which] is of no use*” (Demirbas, 2011). The World Bank defines waste as *a material that is discarded by the owner or manufacturer after use without expecting to be rewarded* (Arlosoroff, 1985). The National Environmental Management Waste Act (Act no 59 of 2008) of South Africa, refers to the concept of waste as “*any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance.*” This may range from small to large items such as cigarette buds, abandoned automobiles, appliances and even spacecraft (Schultz *et al.*, 2013).

The rapid increase in the realm of waste is associated with the current human civilization of consumerism and population growth. In their comment, Marsh and Grossa (1996) indicate that the character of consumerism is mainly found in developed countries that have massive economies founded on ‘quick to use and quick to discard’ consumer habits. When waste is not handled, stored, collected and disposed of in a proper way, it can contaminate or pollute various components of the natural environment with resultant health risks. The health risks can come from bacteria, roaches and rats as litter can be breeding ground for small animals. Since humans are the main culprits who litter, it is therefore important to comprehend their reasons for this, and to find ways to discourage this behavior.

Depending on the sources, waste can take many different forms either solid, liquid or gas and each of them are treated or discarded differently (Miller and Spoolman, 2011). Accordingly, it may refer to *liquid waste* which encompasses oil, grease, wash water, dirty water and waste detergents that have been discarded. These liquids are found in both households and industries and could be hazardous and toxic to the environment. *Solid waste* is any refuse, garbage and sludge found in commercial and industrial locations. In terms of composition, solid waste constitutes metals and tins, discarded paper and cardboards and rubble from construction sites, as well as glass and ceramics, and plastic waste from homes. *Gaseous waste* refers to carbon dioxide, sulfur oxide, nitrogen oxides, hydrocarbons, aerosols, carbon monoxide, methane and greenhouse gases such as chlorofluorocarbon (CFC). This huge volume of gaseous waste that comes into the environment is due to rise in factories, manufacturing zones and an increase in the number of cars (Nagayama, 2010; Botkin and Keller, 2011). What is regarded as waste however might be a resource to others as some of the waste can be reused and recycled (Naidoo, 2009).

World Bank research estimates that world cities generate 1.3 billion tons of solid waste per year, (Hornweg and Bhada-Tata, 2012). The total amount of municipal solid waste (MSW) generated has increased rapidly in China from 1.3 million tons in 1980 to 2.2 million tons in 2006 (Zhen-shan *et al.*, 2009), where approximately 660 cities produce solid waste amounting to roughly 190 million tons annually, making up 29% of global municipal solid waste (Suocheng *et al.*, 2001). Hornweg and Bhada-Tata (2012) project that solid waste generation will be nearly 2, 6 billion ton per annum by 2025.

It is also reported that India generates the highest amount of waste compared to other countries, as it has the second highest population in the world (Pandey *et al.*, 2016). India produces the most waste in the world, amounting to nearly 277.1 million tons annually (Hornweg and Bhada-Tata, 2012). Turkey generates about 28,9 million tons of municipal solid waste annually, which translates to 390 kilograms per capita annually. Hasnine *et al.* (2016) predict that by 2025, Turkey's solid waste generation will reach over 35-40 million tons annually.

In his study of waste generation in sub-Saharan Africa, Mathako (2019) indicates that over half of the population of the subcontinent resides in cities; he projects the increase in daily waste generation to close on 1.0 kg per capita. This statement is supported by Ogola, Chumuka and Tshivhase (2011) findings; it has been observed, however, that waste generation tends to be much lower in rural areas reported than in 2001, where "the amount of general waste produced throughout South Africa was reported to increase annually due to population growth, economic growth and increased standard of living" (Ogola, Chimuka and Tshivhase , 2011: 94). However, according to Hornweg and Bhada-Tata (2012), waste generation tends to be much lower in rural areas as it is perceived that rural areas are generally poor and as such communities purchase fewer store-bought items and the level of reuse and recycling is high. The

State of Environmental Report (2003) for the City of Johannesburg indicated that the greater city-region with a population of 2, 98 million people generated a total of 1, 56 million tons of waste per year (Mathako, 2019). Poorly managed waste is contaminating the world's oceans, clogging drains and causing flooding, transmitting diseases, increasing respiratory problems from burning, harming animals that consume waste unknowingly, and affecting economic development, such as through tourism.

Waste generation is still increasing uniformly with population growth; the rate of consumption and economic growth and hence the environmental costs associated with the disposal of waste that is generated also increases. Thus, there is a need of effective waste management at all stages from waste production to disposal (Mazzanti & Zoboli, 2008). Municipal solid waste management is vital as it makes it easier for the municipality to render other services such as health, education and transportation (Arlosoroff, 1985).

2.2.2 Waste collection methods

Waste collection is important as it maintains public health and clean environment worldwide from the source where it is produced (residential, industrial, commercial institution) to the point where it is treated or disposed of. Collected waste can be separated or mixed, contingent on local municipal regulations. Hoornweg and Bhada-Tata (2012) reported that the amount of waste that is collected varies from region to region and it is collected in different ways. The ways include self-delivered, delegated services and contracted modes – and encompass individual home-to-home collection, community bins or kerbside collection. Where waste collectors collect garbage from individual houses, it is labelled “*house-to-house waste collection*”, where the generator of that waste typically pays for this service. When members of the community collectively bring their garbage to fixed points in the neighborhood where bigger collection bins are provided, the garbage in these “*community bins*” is then collected by the municipality on a set programme or routine. “*Kerbside pick-up*” is a method used by many communities where individuals leave their garbage directly outside their homes to be collected on a schedule set by the local authorities; this method is common in most regions, although it has a problem of informal recyclers that open the bags before they are collected and they produce litter as they do not close them the way they found them (Matete, 2009). The “*self-delivered*” method is used by generators of waste to bring the waste to transfer stations or disposal sites directly, by their own means. Lastly, contracted or delegated services take place when businesses hire collection contractors or and either the waste generators (firms) or the municipality arrange the collection schedules for these contractors (Hoornweg and Bhada-Tata, 2012).

The provision of waste collection services to all its residents is recognized as a key constraint in many areas, as local authorities are either not capable or not willing to render this service (Al-Khatib *et al.*, 2010). The percentage of municipal solid waste (MSW) which is collected differs nationally and

regionally: in higher income countries, collection is efficient and frequent, and collection rates typically exceed 90%, although their MSW management is allocated lower budget. In low or middle income countries collection services' budget is as high as 80 to 90%, but their collection rates tend to be lower, affecting efficiency and frequency (Fourie, 2006; McBean *et al.*, 2005). By contrast, Parizeau *et al.* (2006) contend that up to half of all urban residents of low- and middle-income countries, on average, have no collection services at all.

Ogola, Chimuka and Tshivhase (2011) consider the collection and transportation of solid waste to be the most expensive aspects of local waste management systems. Most countries have a similar collection approach: individual households collect their daily or weekly garbage into a container, which is then placed in front of their erven or on the kerbside on a scheduled basis (daily or weekly), which is collected and transported to a common waste collection point or a waste disposal (or landfill) site. According to Vidanaarachchi's (2006) survey of waste collection in Sri Lanka, half of local authorities in the country daily collect under 2 tons of waste, while less than a quarter of households in the country's southern province enjoy waste collection services; accordingly, Sri Lanka's rural areas experience waste collection of under 2%.

In China, the MSW is collected and transported by the local Sanitary Bureau, but not all generated waste in both rural and urban areas is collected and transported due to the limited collecting ability of the relevant department (Mian *et al.*, 2017). According to Zhuang *et al.* (2008), the MSW in China is collected firstly by local individuals and stores it at a specific point, therefore the stored wastes are collected by waste cars and transferred to the treatment point then the treated waste is transferred to the disposal sites. The collection system differ from city to city and also different areas within the same city.

Hasnine *et al.* (2016) report that 95 per cent of local authorities in Turkey collect and transport solid waste, this proves that their collection and transportation system is largely well organized. The country's municipal areas have two types of waste collection systems: The first system, which operates in its inner cities, is kerbside pick-up, where waste is collected once or twice daily. Their second system is the community bin system, as practiced in poorly developed peri-urban areas and in smaller settlements. Here the bins are typically collected and replaced, or emptied up to three times a week by selected municipalities using their own vehicles (Turan *et al.*, 2009).

In Malaysia, urban centres like Kuala Lumpur have up to 90% of the generated MSW collected, but its rural settlements do not have organized services of waste collection, which has enabled the proliferation of illegal dumping sites at which waste is disposed of (Arlosoroff,1985). The door-to-door collection system is used mostly in the country, while waste separation is not commonly practiced, as in many countries, leading to all waste types being mixed in one bin (Aja and Al-Kayiem, 2014).

In South Africa the responsibility to collect and transport waste rests with municipalities or local authorities. The vehicle types to collect and transport waste vary among municipalities, as it depends on financial resources available to them. For example, metropolitan municipalities such as Cape Town, Durban and Johannesburg use rear end loaders and rota-press trucks that transport waste from curb-side collection points to landfill sites (Mega-Tech In, 2004; Mathako, 2019). In low income urban areas, waste collection is carried out by community based contractor, most contractors use light duty vehicles to transport waste to landfill sites (Marshall, 2005). In rural municipalities which have less financial resources than metropolitan municipality, they use tractor-trailer to collect and dispose waste at their disposal sites and the method of collection that most rural municipalities use is community bins (Matete, 2009).

2.3 Legal frameworks applicable to waste management

Best-practice waste management uses a holistic approach (prevention/minimization, material recovery, incineration or landfill), which deals with waste from cradle to grave, i.e., in a manner that is environmentally responsible from its source (*where* it is generated) to where it is ultimately disposed of (*grave*). Most countries use this approach in developing their Municipal solid waste management (MSWM) systems. However, the approach has variations between countries, based on factors such as environmental regulations, population and demographic dynamics, socioeconomics, and transportation infrastructure and policies. It is chiefly the manufacturing sector in which the principle of waste prevention is targeted and focused. Most often, it is either industry or governmental policies that drive the avoidance of waste production, with its major focus on reducing the costs of managing the waste stream. This approach also aims to change public perceptions of and attitudes toward consumption, whereby consumers would turn to purchasing products that are environmentally friendly and of higher quality and which can be re-used, recovered or recycled (Sakai *et al.*,1996).

An example of a holistic legal approach that was successfully implemented is the German “*Law on the Prevention and Disposal of Waste*” (1986), and the subsequent “Closed Loop Economy Law”. The objective of the latter is to support the circular economy toward protection of natural resources, aiming to ensure that waste is properly disposed of. This law also puts the responsibility on the producer of the product for its disposal (i.e., it applies the “Producer Pays” as well as the “Cradle to Grave” principles); therefore, this encourages the producer to already consider, at the design and production stage of their product, the final destination and fate of the product (Vehlow, 1996).

The United States passed their “*Pollution Prevention Act*” in 1990, through which they established the *waste management* concept or approach. The Act included waste minimisation initiatives through production process design and modernization, product reformulations, substitution of raw materials, and in-plant recycling. Eighmy and Kosson (1996) ascribe the success of the Act on its being based

on the collaboration of industry and government, the implementation of incentive schemes like providing training programmes and technical assistance.

In Nigeria the Federal Environmental Protection Agency (FEPA) was established through the country's innovative *Federal Legislation on Environmental Protection* (no. 58 of 1988). FEPA's role in solid waste management is to investigate which systems are most reliable and appropriate for industrial, domestic and local wastes; to produce specifications for waste disposal sites which would guarantee the safety and integrity of surface and groundwater systems; to create and administer standards for acceptable sanitary facilities where human and other solid wastes can be safely disposed of in rural as well as urban areas; to set up programmes to monitor approved waste disposal sites and their environs and to establish monitoring stations to control and limit leachate contamination (from landfill sites) to groundwater and surface water systems (Imam *et al.*, 2008).

South Africa has a waste management system with characteristics of both developing and developed countries. As a result, waste management services differ across provinces and within communities located in the same municipal area (Viljoen *et al.*, 2021). Most low income areas, whether rural areas or informal urban have characteristics of developing countries as such that recycling of waste takes place and the end result is monetary benefits associated with such practice. Rural households tend to reuse much of suitable waste products like crop residues, livestock dung, sawdust and wood as heating or energy source (Mihai and Taherzadeh, 2017). The reuse of recyclables is preferable because it causes a decline in the use of natural resources, it reduces pollution, and it results in savings in energy expenditure (Birhanu and Berisa, 2015). Matete (2009) finds that in remote and rural areas domestic waste is often poorly managed, and these regions have deficient waste management infrastructure and facilities. This gives rise to illegal dumping, storing and abandoning of waste, higher levels of littering, burning and burying of waste. Waste management at rural areas is a proof that waste management is not the concern of municipalities alone, but that citizens have co-responsibility.

Section 24 of the Constitution of the Republic of South Africa (Act No. 108 of 1996), states that "Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures which help to prevent pollution and ecological degradation."

The National Environmental Management Act (Act No.107 of 1998) (NEMA), states that the State must respect, protect, encourage and meet the social, economic and environmental rights of

everybody and strive to meet the basic needs of previously disadvantaged communities. The Act also outlines the principle that waste should be avoided and where it cannot be avoided, it should be minimized, re-used or recycled where possible and otherwise disposed of in a responsible manner (i.e., the waste management hierarchy). It also requires that those harming the environment should pay the costs to remedy environmental degradation and pollution and its resulting negative health effects (the polluter pays principle); and should prevent, control or minimize further environmental harm, pollution and adverse health effects.

The National Environmental Management: Waste Act (Act No.59 of 2008) (NEMWA), which falls under the NEMA environmental framework legislation, outlines that where waste generation cannot be avoided, the waste holder must minimize the amounts and toxicity levels of waste that is generated; he is also obliged to reduce, re-use, recycle and recover waste. It is also required that if waste has to be disposed of, it must be treated and disposed of in environmentally acceptable ways; and that waste should be managed in a way that does not endanger the environment, human health or cause a nuisance through noise, odour or visual impacts. NEMWA also requires a municipality to practice its executive authority in delivering waste removal, waste storage and waste disposal services. In providing these services, the municipality should adhere to all applicable national and provincial norms and standards; and it should integrate its waste management plans (IWMPs) with its integrated development plans (IDPs) to ensure everyone's access to such services at rates they can afford, in alignment with their own tariff policy. Regarding solid waste collected as part of the municipal service, or that is disposed of at a municipal waste disposal facility, the municipality may furthermore set local standards for separating, compacting and storage of such wastes.

The National Water Act (Act No.36 of 1998) is also linked with NEMA in the sense that it promotes safe and clean water, and prescribes the standards and principles to conserve the environmental resource of water (in all its states). The act states that "the owner of land, an occupant or user of the land, or a person in control of the land, on which any activity or process is or was performed which has caused or is likely to cause water pollution, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. The measures referred to include controlling any act or process causing the pollution; complying with any prescribed waste standard management practices; preventing the movement of pollutants; removing any source of the pollution; and remedying the effects of the pollution and the effects of any disturbance to the banks of a watercourse."

The *Integrated Pollution and Waste Management Policy* (2000) advocates for a holistic and integrated waste management system to prevent pollution, to minimize waste at point sources, to manage the impact of pollution and waste on the environment and to remediate damaged environments. To achieve this policy's objectives, legislation as to be strengthened (enforced) and public education awareness should be promoted. This policy applies to all government institutions and to society; as

Well as to all activities that cause pollution and require the management of waste. In 2001, representatives of all three tiers of government, the business community and civil society participated in the first National Waste Summit in Polokwane on the 26th-28th September. The *Polokwane Declaration* (on Waste Management) that was issued emphasized the need for urgent action to reduce, reuse and recycle waste in order to protect the environment. This would be achieved through engagement of all public and private persons to initiate inventive waste management programmes, and to promote and participate in safe and healthy waste recovery programmes. Furthermore, they recognized the reliability of achieving the vision and goal contained in the declaration. The vision was to implement a waste management system contributing to sustainable development and improvement of the quality of life. The goal was to stabilize waste generation and reduce disposal by 50% by 2012 and develop a plan for zero waste by 2022 (Taiwo, Otieno and Venta, 2008).

2.4 The use of disposable diapers

Consumers value the vast advantages of disposable diapers over the cloth diapers they have replaced, due to its ease of use, increased comfort, better hygiene and low cost (Mutowo and Mzengi, 2015). Disposable diapers have become an essential for most mothers especially when they are travelling as they are less bulky and have high absorbency ability compared to cloth diapers that need frequent changing, and big volumes of water and detergent to clean them (Bachra et al., 2020). Ever since they have entered the market, disposable diapers have hardly been considered a luxury, and have become to be accepted as a necessity (Ntekpe et al., 2020). Bender and She (2017) estimated that in the United States 27.4 billion disposable diapers are utilized every year, which creates in excess of 3.4 million tons of used diaper waste annually. A study by Shanon et al. (1990) in Ottawa, Canada, shows that 82.3% of parents use disposable diapers, while only 2% of parents interviewed prefer using cloth diapers.

In African countries, the use of disposable diapers has overtaken cloth diapers due to their affordability and disposal after one-time use. As cited by Muia (2018), study by Magadza (2016) found that 28% of Zimbabwean mothers use disposable diapers only, while 58% use both cloth and disposable diapers; and that only 22% make use of cloth diapers exclusively. A similar study in Nigeria indicated that 45% of mothers use disposable diapers compared to only 10% that use cloth diapers (Eke and Ibo Opara, 2013). In addition, a report by Mutowo and Mzengi (2015) found that women in Kenya used disposable baby diapers in preference over cloth diapers, as the disposable type were not adversely influenced by cloudy and rainy weather because they need not be washed and dried after use. In South Africa, about 80% of families that have babies use disposable diapers and 20% of some families use both disposable diapers and cloth diapers (Berrian et al., 2016). These statistics show that disposable diapers are utilized in many parts of the developing and developed world as a replacement of cloth diapers. It has been determined that a child uses 6 to 8 disposable diapers a

day, which adds up to nearly 5500 diapers before potty training which takes place from 18 months up to 30 months (see figure 2.1) (Ntekpe *et al.*, 2020; Ali *et al.*, 2017).



Figure 2.1: Window display comparing disposable diaper and cloth nappies: The quantity of disposable diapers needed for one year and the quantity of cloth napkins needed for 3 years. Source: <https://www.modernnaturalbaby.com>

2.5 Components of disposable diapers

Disposable diapers are designed to collect, absorb and keep urine and faecal waste from babies who are not yet potty trained (Sasikumar *et al.*, 2014). The invention of disposable diapers was made possible by the discovery of superabsorbent polymer (SAP) (Mutowo and Mzengi, 2015), which made possible a vast improvement in the performance of diapers due to its high absorbency and weight reduction (Khoo *et al.*, 2019). Disposable diapers are generally manufactured from plastic-based materials. The component parts of the disposable diapers are discussed below (see figure 2.2):

- The top sheet is the layer that is made up of hydrophobic non-woven material which allows liquids to pass through to the absorbent core to be stored 'deeper' inside the fabric and thereby keep the baby's skin dry (Bachra *et al.*, 2020; Sachidhanandham and Priyanka, 2021).

- Underneath the top sheet lies the absorbent core, or primary part of the disposable diaper structure. This layer consists of Superabsorbent Polymer (SAP) and fluff pulp that helps in absorbing liquids in a few seconds (Sachidhanandham and Priyanka, 2021). SAP material has resulted in an performance improvement of scale in diapers with high absorbency, as the SAP can absorb water up to 100 times its weight, for example, 1 gram of SAP can absorb up to 100 gram of water (Kamat and Malkani, 2003). However, the fluff pulp could contain fragments of tributyl-tin (TBT) used in the wood pulp mills as an antifungal agent (Ali *et al.*, 2017).
- The back sheet is the outer part of the diaper and is made up of polyethylene and polypropylene inner wrap (which are non-recyclable plastics (Nkepe *et al.*, 2020)), preventing liquids from dirtying the baby's clothing and providing softness and comfort (Bachra *et al.*, 2020).
- There are additional elements that guarantee a good diaper fit for babies such as fastening straps, flexible elastics and adhesives. The fastening straps help the diaper to fit securely to the baby (Bachra *et al.*, 2020). The flexible elastics are on both side of the absorbent core body, they are used to improve the diaper's fit and to allow more comfort and movement to avoid skin rashes (Sasikumar *et al.*, 2014; Bachra *et al.*, 2020). The adhesives are used to sticking the disposable diaper's components together such as the sheets and elastics to prevent leaks (Sasikumar *et al.*, 2014).

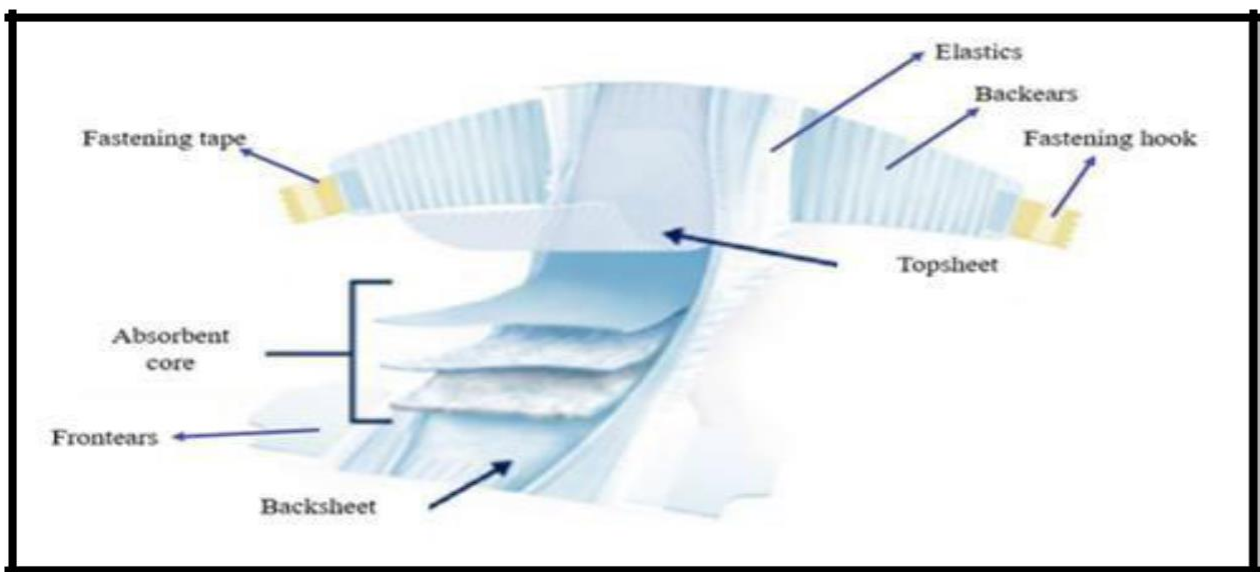


Figure 2.2: Typical structure of a disposable diaper (Counts *et al.*, 2017).

2.6 History of disposable diapers

Most people have been aware of the need of diapering for containment of excreta. Before cloth diapers were used, various methods and materials were used as diapers contingent on the tradition,

culture and geography of the people involved (Krafchik, 2016). In colder regions, parents used blankets to cover their babies for warmth, but they also acted as basic diapers, while in warmer regions, diapers or any covering were rarely in use, as mothers tried to anticipate their baby's bowel movement and took them outside to avoid soiling the house (Dyer, 2005). This was also a common practice in China (Krafchik, 2016). According to Khoo et al. (2019), native societies in South America used peat moss with an animal skin covering to cover the baby's bottom to absorb urine and others placed dried grass in a piece of old cloth to absorb some of the urine. When the peat moss and the grass got soiled they were immediately changed and discarded to decompose in a natural way.

During World War II women joined the workforce alongside men and were left with limited time for managing the task of washing cloth diapers at home. This gave rise to a need for diaper laundry services; this era also saw a shortage in the supply of cotton used in conventional diaper manufacturing (Sachidhanandham and Priyanka, 2020). It was during this time where most mothers were looking for an alternative item for cloth diaper (Krafchik, 2016). Disposable diapers were developed between 1930s and 1950s in both Europe and North America (Dyer, 2005). The Swedish paper company Paulistróm Bruk offered a two-piece combination of a disposable cellulose tissue insert and a reusable rubber pant until 1942 (Sachidhanandham and Priyanka, 2020). Shortly thereafter in 1946, the Westport, United States, housewife named Marion Donovan invented the first plastic covering for traditional cloth diapers which was made of shower curtain plastic and layers of tissues as an absorbent material (Kakonke *et al.*, 2019). The other development of disposable diapers was made by Mr. Vic Mills who was the Director of the Proctor and Gamble Company, who observed how difficult it was to diaper a newborn in his home. His team developed a simple one-piece disposable diaper consisting of an absorbent tissue glued to a plastic back core; they introduced the first commercial diaper in 1956 after a series of trials and errors (Dyer *et al.*, 2004; Sachidhanandham and Priyanka, 2020). Competition among manufacturers resulted in a stable stream of innovations and improvements in diapers, which became better fitting and easier to use. The competition also helped in the affordability and made the product easily accessible to consumers in low-income households (Krafchik, 2016). Other factors that positively affected disposable diaper sales is attributed to rising cost of national health care in the United States, as well as a growing awareness of infant health care and the role of advertising (Khoo *et al.*, 2019).

2.7 Disposal methods for soiled disposable diapers

Dirty disposable nappies are considered solid waste and are accordingly discarded or disposed of using the usual solid waste disposal methods (Ntekpe *et al.*, 2020), namely burning, disposal at landfills and open dumping (Colón *et al.*, 2011). The most common methods identified by Remigios *et al.* (2014) is dumping in open spaces and burning the diaper waste. However, the most used method which is dumping in open spaces is illegal in most countries. When soiled disposable diapers

are burned at home, paraffin is often used as a catalyst as the diapers take time to be consumed by fire due to high levels of moisture after use (Muia, 2018). The burning of soiled diapers at home cannot meet air pollution standards, owing to not being done under controlled conditions as provided by incinerators (Ntekpe *et al.*, 2020).

The advanced technologies available for controlling air pollution and incineration in developed countries can be harnessed to convert waste products to energy (Kumar and Samadder, 2017). Incineration technology was adopted in waste management to treat highly flammable waste materials and significantly bring about a reduction in the quantity of waste through burning and turning waste into ash (Kumar and Samadder, 2017). Hoornweg and Bhada-Tata (2012) contend that Japan treats 74% of its total municipal solid wastes through incineration. Moreover, Sweden and Switzerland, where half of the total municipal waste stream is used for energy generation, prefer incineration. Despite these three developed countries' successes, many other western countries have limited their use of incinerators due to high operating costs and air pollution which makes it unpleasant to use (Khoo *et al.*, 2019).

Owing to the non-collection of refuse, soiled disposable diapers are sometimes buried in the soil, after holes have been dug holes within users' yards (Remigios *et al.*, 2014). Most disposable diapers that are co-disposed with household garbage are collected by local municipalities and ultimately taken to the municipal landfill where waste is dumped according to the programmes and schedules, and then compacted and covered with soil at day's end (Tembo and Chazireni, 2017). The challenge associated with this method of disposal is that diapers are made with materials and components (see figure 2.2) that need about 500 years to degrade fully (Ntekpe *et al.*, 2020). The faeces or human waste in used diapers also remains in the landfill for extended periods as most users do not clean the diapers before disposal (Khoo *et al.*, 2019). Landfills continue to be the best option for most municipalities and most of the used diapers end up in landfill sites.

In some instances, disposable diapers are more likely to be dumped in open spaces which are not approved by local municipalities for use (Colón *et al.*, 2011), mainly in rural areas. This is mostly due to local authorities failing to collect waste on a daily basis, while in other areas there is no refuse collection at all (Remigios, 2014). Even at collection points where communal refuse containers have been made available, the garbage dumped into such containers is sometimes not removed for long periods. Therefore, people in deficient waste collection areas tend to store their household waste, including soiled diapers, in plastic bags, which are then disposed of on undeveloped land near their homes (Wambui *et al.*, 2015). Mutura (n.d.) reports that this practice prevails in both rural and urban communities in Nigeria. Some Nigerian rural communities share the belief that infant faeces, if disposed in the bush, blesses their farms – which promotes the disposal of used disposable nappies onto vacant plots, as the users (polluters) are unaware of the materials used in manufacturing these diapers (Ntekpe *et al.*, 2020).

Mutowo and Mzengi (2015) conducted a study on practices regarding disposal of soiled diapers in poor resource urban settings in Zimbabwe. The majority of their respondents (43 or 91%) wrapped their diapers and disposed of them in garbage bins. 19 (40%) respondents burnt the disposable diapers after use and only 2 (4%) disposed of them in pits. These authors recommended that the local authority should provide more refuse collection bins to avoid littering challenges faced with improper disposal of diapers that are caused by unpredictable refuse collection. A similar study by Remigios (2014) on the environmental and health implications of disposable diapers use and disposal in the Senga suburb in Gweru City, Zimbabwe, observed that “there was no system in place to cater for diaper disposal. Information from interviews with the municipal health department showed that Gweru City Council, as local authority in a developing country, had insufficient capital to efficiently run its waste disposal system as it could not afford to provide bins to encourage separation of waste at source. Instead, the Council encouraged households to put disposable diapers in plastic bags which were then tied and placed in bins;” this means that the soiled diapers were mixed with other solid waste. There is little to no literature on how soiled disposable diapers should be disposed in environmentally sustainable manner.

2.8 Environmental and health impacts associated with disposable diapers

Diapers are a necessity for children as they are still young to be able to control their bowel and urinary systems. The adverse environmental impact is not: rather, their environmental impact is disturbing. As it was mentioned in section 2.4, the average newborn baby uses 2400 diapers for their first year of life; which means that diaper waste is more in the first year. Disposable diapers contribute to an astounding volume of environmental waste, making up a big proportion of non-recyclable landfill waste, but in addition, these diapers are manufactured from various chemicals that are harmful and which end up being released into the environment upon disposal.

The different methods of disposal of soiled diapers have several environmental and health impacts, which include the concerns of generation of waste, depletion of natural resources, human exposure to harmful chemicals, pathogens; as well as the negative aesthetic effect on the landscape (Ntekpe et al., 2020:3-5). The US Environmental Protection Agency report (USEPA) (1990), considers disposable diapers as the third largest household items ending up in landfills just after newspaper and bottles, adding to over 3.5 million tons of waste annually in the United States. Soiled disposable diapers make up 50% of household waste and it is a growing problem at landfill sites, as they remain for a long period due to plastic and super absorbance gel. Some studies reported that every five minutes, around 200 000 soiled disposable diapers end up in landfills and they take centuries to decompose even when they are exposed to sunlight and air (Colón *et al.*, 2011; Sachidhanandham and Priyanka, 2020). Figure 2.3 shows images of disposable diapers that had remained in the landfill for several years but they have not decayed.



Figure 2.3: Soiled disposable diapers after three years in the landfill (Ntekpe *et al.*, 2020).

In terms of space required for their disposal, literature indicates that the most noticeable environmental impact of disposable diapers is that they are discarded, piling up garbage daily (Meseldzija *et al.*, 2013). Where waste collection services are not in place, or are erratic, consumers resort to disposing waste like diapers in self-dug pits in the ground. This has far-reaching adverse impacts on water resources via seepage and infiltration, as the leachate will ultimately contaminate groundwater sources, releasing pathogens like viruses and bacteria into drinking water sources (Mangizvo and Wiseman, 2012). Even where disposable diapers are collected and disposed at unlined landfills, the faecal contents can leach out into groundwater, since most parents do not wash the diapers first before throwing them away.

Some people choose to dispose of soiled diapers into storm water and natural drainage channels, causing blockages in the free flow of runoff water. This practice may give rise to flooding, and the surrounding areas can be adversely affected by both flood damage and the spread of pathogens (Ntekpe *et al.*, 2020). Chinyama and Toma (2013) observed in their study on understanding the poor performance of urban sewage systems in Chinhoyi in Zimbabwe that nappies were amongst the solid waste dumped in sewers that added to storm water blockages. These scholars asked in their questionnaire why the respondents dump their solid waste in sewers, 9% responded that it was a right thing to do while 34% did not want to pile garbage at their homes due to non-collection of refuse by the responsible parties, 40% were not aware that their garbage causes blockage and 17% did not have a reason as to why they dump their garbage in sewers.

The incineration or burning of soiled diapers causes them to emit dioxins and furans and other toxic greenhouse gases, carbon monoxide and toxic ash smokes (Ali *et al.*, 2017). The ash that remains after fire contains toxic contaminants that could leach into the soil or dissolved by runoff water; or

be spread by wind and which may be inhaled leading to respiratory problems such as asthma (Mutura, n. d).

The manufacturing of disposable diapers also contributes to environmental impacts and depletion of natural resources. It is reported that approximately 137 kg (kilogram) of wood, 23 kg of petroleum feedstock and 9 kg of chlorine are used to produce the diapers (Kakonke *et al.*, 2019). The estimated trees that are cut down to manufacture the baby diapers is 1 billion trees per year and this reduces trees faster than they can be replanted, which causes deforestation (Meseldzija *et al.*, 2013). The main component of diapers is plastic, which is manufactured from of petroleum, i.e, it has crude oil as its origin. Diaper manufacture therefore creates demand for more oil to be brought up from the ground, with its serious impact on the natural environment: soil and water pollution; driving climate change, and the disruption of the natural environment and biodiversity (Parker, 2022).

Many disposable diapers disposed at landfills and on open spaces are leaching dangerous chemicals such as dioxin, tributyl-tin (TBT), phthalates into the soil and water (Rai *et al.*, 2009). Dioxin has been listed as of the most toxic cancer-related chemicals. Even when it is supplied in small quantity it has the potential to cause cancers (breast cancer in both females and males), endometriosis, skin diseases, liver disease and genetic damage; consistent with adverse health outcomes recognized in laboratory and wildlife species (Anderson and Anderson, 1999). DeVito and Schechter (2002) tested and found dioxins in all samples of the four makes of tampons and diapers which they tested, but in much lower concentrations. This nonetheless is a concern as the most carcinogenic chemicals are found in baby diapers. Kakonke *et al.* (2019) consider *Tributyl-tin* (TBT) an environmental pollutant that is highly toxic and resistant to degradation; it also persists in the environment and in food chains (Ntekpe *et al.*, 2020). TBT is also known to trigger fat-promoting genes, which can result in human obesity. The TBT contamination source is the “fluff pulp” at the core of the diaper; its origin is from the paper mills where it is used as an antifungal agent wood pulp (Kakonke *et al.*, 2019). The plastic used in all disposable diapers contains *phthalates*. Phthalates are plastic softeners in common use, but which were recently banned from toys and infant’s teething rings owing to their toxicity (Ntekpe *et al.*, 2020). The health risk of phthalates is that they are endocrine disruptors – which mimic human hormones, sending false signals to the body. Both the respiratory and reproductive systems are affected by phthalate toxicity - while phthalate is also known to be implicated in cancer formation processes and autism disorder (Przybylinska and Wyszowski, 2016).

The dangerous dioxin, tributyl-tin (TBT) and phthalates that leach from nappies and end up in aquatic environments such as dams and river systems may be stored in fish and other edible biota, which can result in bioaccumulation and biomagnifications in these organisms (Ntekpe *et al.*, 2020).

Anderson and Anderson's (1999) study of childhood respiratory problems like asthma found that these problems may be correlated to smoke inhalation from burning disposable nappies, in particular the chemicals emitted during incineration of these products. Their study thus identified the following chemicals in various makes of disposable diapers, some of which are carcinogenic, while others are skin and respiratory irritants: m-xylene, p-Anisaldehyde, ethylbenzene, styrene, isopropylbenzene, dipentene, m-methoxybenzaldehyde, methylcinnamate, Toluene, Trichloroethylene, 1-Methylcyclopentylamine, and 1, 2, 3, Trimethylcyclopentane. In addition, a used disposable diaper is potentially a health hazard due to the baby feces it contains. Meseldzija *et al.* (2013) contend that human infant excreta contain more than 120 different types of enteric and entero viruses, and also live vaccines from immunization regimes received in hospitals. Ali *et al.* (2017) argue that such viruses can survive for many months in excreta and they can thus spread in landfills, where the warm, moist environment is conducive to their multiplication. For this reason, Ntekpe *et al.* (2020) hold that waste from diapers must be cleaned or washed out, before the diapers are disposed of; however, most parents or care-givers usually deposit soiled diapers in household garbage without cleaning or further processing after changing diapers. Viruses in infant excreta can potentially cause a wide array of diseases: ascariasis, cholera, dysentery, gastroenteritis, hepatitis B, meningitis, polio, salmonellosis and typhoid fever. Further risks of discarded nappies are that surrounding communities could contract diseases because rodents, birds, flies, and other insects attracted to landfill sites can pick-up the virus and spread it (Ramaswamy and Sharma, 2011). Uncovered dumping and wastes at both illegal dumping sites and formal landfills attracts waste pickers. These people eke out a livelihood on waste sites by retrieving usable material from dumped waste, often using their bare hands, increasing the likelihood of coming into contact with soiled diapers. This increases their risk of enteric and entero viruses (Remigios, 2014).

Because soiled diapers are usually discarded without first being cleaned of excreta, their odour attracts dogs, rodents and flies; dogs would often tip over garbage cans to get to the diapers – or access dumped nappies in the landscape. Dogs transport the soiled diaper elsewhere, to homes, or they dump them again elsewhere – thus spreading the nuisance of odour, aesthetic hindrance and, of course, disease (Ramaswamy and Sharma, 2011). Dried-out diapers are easily carried away by wind from illegal dumping sites as well as unfenced landfills, creating nuisance and health risks in surrounding communities (Remigios, 2014).

Where disposable diapers do reach landfills, they occupy valuable space, but also emit methane, which contributes to atmospheric warming more than 20 times by volume than carbon dioxide. Parker (2022) argues that methane is responsible for nearly 30% of global warming from the early 1700s to the present. Disposable diapers also release chlorofluorocarbons (CFCs) that deplete ozone.

Ozone is a layer of oxygen particles in the middle atmosphere that protects earth by absorbing some solar radiation, and absorbs UVB rays.

2.9 Conclusion

The studies relating to the disposal practices of soiled disposable diapers are mainly focused in urban areas and do not conclude the picture of the rest of the world, especially rural areas of South Africa. Therefore, this study is intended to fill the literature gap related to how people dispose soiled diapers in rural Limpopo. In addition, this study intends to determine the factors affecting the management of solid waste in Ga-Matlala area. The methodology of this study follows in the next chapter.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The research approach and the methodology adopted in the study on disposal practices of soiled disposable diapers are presented in this chapter. A detailed explanation is given of the research design and methodology followed to collect and analyse data of the phenomena being investigated. It covers the step-by-step procedures used in collecting mothers' data about their perceptions and level of awareness of the environmental risks inherent in the improper disposal methods of soiled nappies. This chapter also provides a logical flow of the data collection process, but it also gives a detailed description of the mixed-method approach as it was implemented. This chapter is important for the reason that it collects data to answer the primary study objectives and research questions outlined in chapter 1. A full description of how data was collected and analyzed is provided in detail in the sections that follow.

3.2 Research design

Bhattacharjee (2011:35) defines research design as “...a study plan that outlines how data will be collected and it must specify at least three processes namely; the data collection, the instrument development and sampling process”. Durrheim (2004) describes it as a conceptual framework for action that connects research concerns to the implementation of the research strategy. The goal of the research design in this study is to provide trustworthy findings on how parents dispose of their infant children's soiled disposable diapers in the Ga-Matlala area.

In order for this study to achieve its stated objectives, the researcher followed a mixed method approach that includes the triangulation of quantitative and qualitative research designs. This research approach was adopted to facilitate better understanding of the research problem, as it is essential to answer the research questions (Creswell & Creswell, 2017; Denzin, 2017). Bowen *et al.* (2017) state that in a mixed method approach, “the researcher collects both quantitative and qualitative data, analyses them separately, then compares the results to see if the findings confirm or disconfirm each other”. In this approach the collection of data starts out from acknowledging and recognising that each method (i.e., both quantitative and qualitative approaches) has its weaknesses; thus collecting the two types of data simultaneously will enhance the validity and dependability of the data collected.

The quantitative research approach is normally grounded on a post-positivist philosophical assumption where data is collected, analysed and displayed in numerical format rather than narrative form (Rahi, 2017). In addition, quantitative data also helps researchers to collect accurate and precise data on a particular phenomenon under investigation in a controlled environment. This approach has been used to obtain numeric data from mothers whose babies are provided with post-natal care at Rosenkrantz clinic. Data collected in a quantitative form can include experimental and non-experimental studies, which also comprises content analysis and surveys. Most of the data for this study were collected through surveys. The survey technique as a research design in quantitative research is favoured by social scientists “to empirically and scientifically study and provide information about people and social phenomena” (Creswell & Creswell, 2017). Visser *et al.* (2000) define a survey as “a means of gathering information about the characteristics, actions, or opinions” from a selected portion of a well-defined population and the findings are later generalized back to the population. Surveys can assume various forms, as dictated by the kind of information in which the researcher has in mind. For instance, it can be done by interviewing persons, by the distribution of questionnaires, or through making visual records of phenomena.

The accuracy of the data being collected is also further strengthened by the reliable design of the questionnaire (as data collection instrument), as well as the accurate design of the survey through a precise selection of sample and sample size. Survey research quantitatively describes particular aspects of a target population; and the examination of the relationship between variables is how these aspects are often analysed (Glasow, 2005). It is also used to understand the participants and to know about their views. In this way, the participants are able to share their views and experiences of the research problem (Babbie, 1995; Terre-Blanche & Durrheim, 1999); in this case their views and experiences of how disposable diapers are used and disposed of in the study area.

A qualitative research approach provides an opportunity for the researcher to make sense of circumstances and ideas about the study population (McKeown, 1999). The process of the qualitative approach involves collecting data at the participant’s setting, from which the researcher makes interpretations to make data meaningful. The final report which writes up the data analysis and inferences has a flexible structure. The qualitative research approach was considered well suited to this study because it allowed the researcher to capture the role and experiences of Blouberg Local Municipality Waste Manager relating to the disposal of disposable nappies in the municipality. The relevance of this design or method was to also understand the parents’ and tribal leader’s opinions and awareness relating to the management of diaper waste in rural settings.

3.3 Population and sampling

Population is defined as all people with the same characteristics that the researcher wishes to study (Bhattacharjee, 2011:65). The population of this study is made up of mothers that take their babies to Rosenkrantz clinic for post-natal services. The targeted population reside at rural areas of Ga-Lamola, Ga-Sebotse, Pinkie, Leokaneng and Cooperspark/Ga-Manhlodi of Blouberg Local Municipality within the Limpopo province.

3.3.1 Sampling methods

A sample is a subgroup of the target population used in a study with the aim of making inferential generalizations about the targeted population. Clifford et al. (2010:230) states that “sampling is necessary because it is often not possible, practicable or desirable to obtain information from the entire population”. The size of the sample was 112 respondents who brought their babies to the clinic for post natal services such as immunizations and well check-ups. The study included both females and males aged 17 and above. The study questionnaires were distributed only to the people that came to the clinic and they all participated. Interviews were conducted with the 6 subsample participants, the tribal leader and one waste management officer of the Blouberg Local Municipality.

- **Convenience sampling**

The convenience sampling approach was employed to select the study respondents. This type of sampling is a “non-probability or non-random sampling where members of the target population that meet the practical criteria such as accessibility, geographical proximity, availability at given time or willingness to participate are included for the purpose of the study” (Dörnyei, 2007). Convenience sampling frequently assists in overcoming a variety of research constraints such as going from household to household only to discover that they have no children that still wear diapers. Therefore, it would be time-consuming to collect data in such manner in this study.

- **Purposive sampling**

Purposive sampling is another non-probability sampling method that was also used in order to acquire important information from waste management officer. The waste management officer was chosen based on his experience of the issue under the study and his willingness to participate. The advantage of purposive sampling is that the researcher can select

individuals that possess information that is relevant to the research problem and cannot be obtained from other types of sampling (Etikan *et al.*, 2016).

3.4 Data collection

The process of carefully obtaining the information needed to answer the research questions is what is called 'data collection'. Two types of data are usually identified: primary and secondary data. Primary data are freshly gathered by a researcher for the first time – i.e., new data are collected. Secondary data have been collected and compiled by someone else in the past – and the researcher now makes use of this already available data to do her analysis. Secondary data are usually accessible to the public.

3.4.1 Primary data collection tools

The collection of primary data can be done through a variety of methods, including interviews, focus groups, surveys, and so forth. The techniques and methods for the collection of primary data are discussed below.

- **Questionnaire**

The foremost resource or techniques in the collection of primary data is the questionnaire. Data “can be collected in a standardized way so that it is consistent and rational for analysis” (Roopa and Rani, 2012). In my study, a set of structured questionnaires were presented to the parents at the clinic every Wednesday (during data collection period) as it was their scheduled day to bring babies for post-natal services. The questionnaires were delivered physically to the respondents in the morning after the clinic administrator introduced the researcher; this was a routine before the questionnaires were distributed. Everything was clarified to them where they encountered problems. Consent forms were also given to those who were interested in participating.

- **Key informants' interview**

Structured interviews were used to collect primary data on the municipal waste management strategies and bylaws from the waste management officer of Blouberg Local Municipality. The researcher also interviewed the tribal leader and six participants that were part of respondents that filled the questionnaire. Questions were posed to

them in order to contextualise the research. The interviews helped the researcher to obtain information that could not be collected by other methods.

- **Field observation**

As cited by Zandamela (2016), Bechhofer and Paterson (2000: 49) state that “field work is an important form of data collection and observation enables a researcher to establish a close acquaintance with respondents.” However, this study employed non-participant observation. Field visits were made and open dumps were identified in the five villages where the survey respondents reside. Photographs were taken and the locations where the dumps sites are were recorded in a form of GPS coordinates. Other findings were recorded on the observation checklist (Appendix 3).

3.4.2 Secondary data collection tool

Secondary data refers to data collected by someone other than the primary user, which offers the researcher a bigger pool of data, not possible to collect on her own. Literature about the research was checked through secondary data collection that includes books, internet papers and journals. In order to achieve the study objectives, reliable, valid, relevant and adequate secondary data were used.

3.5 Methods of data analysis and interpretation

For the mixed method approach, the analysis of the data was carried out concurrently for both quantitative and qualitative data collected from parents, tribal leader and municipality representative who are involved with waste generation and management. In the current research, data collected through the survey questionnaire were analyzed using the Statistical Package for Social Sciences (SPSS) version 28.0.1.1. This has been done to summarise the data frequencies and to also plot graphs that reflect the responses. This study also analyzed quantitative data using the statistical tests such as chi-square and Pearson correlation tests in order to establish aspects such as association and relationship among variables and if they influence one another.

Thematic data analysis was selected as the best qualitative data analysis technique for answering the research questions of this research project. This process helped the

researcher to continuously get a much better understanding of respondents' views with regard to the disposal of soiled nappies. In addition, Braun and Clarke (2006) define thematic analysis as the "method of identifying, analysing and reporting patterns (themes) within qualitative data". Boyatzis (1998) also stated that thematic analysis methods enable the researcher to identify and report on patterns found in data while drawing relationships between these themes. Interview questions were designed in such a manner as to reflect the concepts found in the literature review (Chapter 2) and the survey questionnaire. In the fulfilment of the study objectives, different data presentation methods such as frequency tables, different types of graphs and a map were used and interpreted to provide a clear understanding of the gathered data.

3.6 Reliability

- **Reliability of the survey questionnaire**

According to Bhattacharjee (2011:56) "reliability is the degree to which the measure of a construct is consistent or dependable". Reliability was determined by the administration of a second batch of questionnaire to a small subsample at the clinic after concluding with the first batch of the questionnaire. This helped to verify the findings and gave assurance that the results were correct and reliable as they were the same.

- **Reliability of the interviews**

Reliability of the interview was assessed through the interview process by restarting a question in a slightly modified form at a later point. The interview was then evaluated by comparing it to the results of the survey. This made it easy to question the credibility of the interview findings.

3.7 Ethical Considerations

The University of Limpopo Turfloop Research Ethics Committee (TREC/218/2021: PG) provided ethical clearance since the study involved human participation. The Provincial Department of Health and the Department of Social Development in Polokwane granted permission to conduct research at one of their clinic. The permission letters were then presented to the clinic's manager. Permission was also granted by the Blouberg Local Municipality's manager to interview one of their staff.

The researcher's identity was shared and accurately presented. Prior to filling in the questionnaires, the participants were informed of the purpose of the study and that their participation was voluntary, they were not coerced into taking part in the study and they were informed of their right to withdraw at any time should they wish to stop participating or when they felt uncomfortable to share any information. The questionnaire did not require their names or any information that could reveal their identity, all the participants remained anonymous. The questionnaires were kept in a secure safe place that only the researcher had access to.

3.8 Conclusion

This chapter presented the research methodology employed to conduct the study. The tools that were used to gather primary and secondary data were discussed. In addition, the chapter detailed the sampling methods as well as the analysis methodologies used to comprehend the collected data. The following chapter presents and analyses the data collected.

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The previous chapter discussed the research design and approach adopted in this research. This chapter focuses on the presentation of results such as the demographic profile of respondents; the type of diaper that the respondents use on their babies; disposal methods of soiled diapers; the perceptions of participants on health and environmental impacts caused by disposable diapers; and factors affecting sustainable waste management of the local municipality. The results presented in this chapter are from the data collected from the survey questionnaire and key informant interviews and was analysed both qualitatively and quantitatively. Data analysis is a process of bringing order, structure and meaning to the mass of collected data. The results are structured thematically into two broad topics which are then sub-divided into sub-themes based on the pattern of collected data. The presentation of data is in line with the objectives of the study.

4.2 Demographic profile of respondents

The identified respondents for this study comprised of mothers and fathers of infants who are serviced by the clinic, official from the municipality and traditional leader.

4.2.1 *Gender of the respondents*

The total number of the respondents was 112. Of these, 110 (98.2%) were females and 2 (1.8%) were males. The study established that there were more females than males; this was expected given the cultural background that women take care of the babies whilst men go to work. However, it was different with the 2 males that brought their babies to clinic; they said that the children's mothers were not available due to work.

Table 4.1: Gender of the respondents

Variable	Frequency	Percentage
Female	110	98.2%
Male	2	1.8%
Total	n=112	100%

4.2.2 Age of the respondents

The ages of respondents were divided into three categories; namely, 16-26, 27-37, and 38-47 categories respectively. The results of the study reveal that more respondents fall between the 27-37 age category with a percentage of 53.6, followed by those that fall under age range of 16-26 years with a percentage of 40.2. Table 4.2 shows the age categories.

Table 4.2: Age of respondents

Age range	Frequency	Percentage
16-26	45	40.2%
27-37	60	53.6%
38-48	7	6.3%
TOTAL	112	100%

4.2.3 Educational status of the respondents

With regard to educational status, the majority of respondents, 77 (68.8%), had secondary education, only 4 (3.6%) had primary education and 31 (27.7%) had college or university education respectively (See table 4.3). This implies that the respondents are literate and they can be expected to provide reliable information on how to use and dispose of soiled diapers.

Table 4.3: Educational status of the respondents

Education Level	Frequency	Percentage
Primary	4	3.6%
Secondary/ High school	77	68.8%
College/University	31	27.7%
TOTAL	n=112	100

4.2.4 Origin of respondents of the respondents

Since the Rosenkrantz clinic services community members from different surrounding villages, it was of importance to establish the origins of the respondents. With regard to this aspect, it was established that of the surveyed respondents, 49 (43.8%) were found to be residing at Cooperspark, followed by Ga - Sebotse 27 (24.1%) and the lowest number of respondents reside in Ga-Lamola and Leokaneng both with 8.9% respectively (See table 4.4). These villages are five of twelve areas that were demarcated into Blouberg Local Municipality in 2016 as the results of disestablishment of Aganang Local Municipality due to shortage of resources to fully operate and provide services to the surrounding villages.

Table 4.4: Origin of respondents

Location	Frequency	Percentage
Ga-Lamola	10	8.9%
Ga-Sebotse	27	24.1%
Pinkie	16	14.3%
Leokaneng	10	8.9%
Cooperspark/Ga-Manhlodi	49	43.8%
TOTAL	n=112	100

4.2.5 Number of children brought to the clinic for post-natal services per respondent

The 102 (91.1%) majority of respondent brought only one child to the clinic for the post-natal services (see table 4.5). All the respondents had children that use diapers as they were still young.

Table 4.5: Number of children brought to the clinic per parent.

Variable	Frequency	Percentage
1	102	91.1%
2	10	8.9%
Total	n=112	100%

4.3 Preferred types of diapers by respondents

There are different types of nappies that mothers use and their preference is influenced by varied reasons. There are two known types of diapers namely cloth and disposable diapers. It was also of interests to find out about the type of diapers respondents prefer for their babies.

From the survey, it was established that most of the participants 111 (99.1%) prefer using disposable diapers. Their reasons for using this type of diapers is that they absorb more liquid and do not require frequent changes, they do not need to be washed as they are designed to be disposed after use, therefore they are not spending more money buying washing powder and they are easier to use as there is no need to fold and use of pins to make sure that it is intact compared to cloth diapers. In addition, participants stated that disposable diapers do not cause inconvenience during the rainy weather days as they do not require being washed and dried as compared to cloth diapers.

The only 1 (0.9%) respondent that use cloth diapers as a preferred type stated that they use them because they are affordable unlike disposable diapers that need to be bought every month or when they are finished. The respondent said that they do not use washing powder but sunlight green bar soap as they believe that it removes the stains and retains the color of the diapers and it is cheaper. In addition, they stated that they prefer cloth diaper as they are durable and reusable, hence they spent less money on diapers.

These findings correspond with those of Shanon *et al.* (1990) in Ottawa, Canada, who established that disposable diapers were used by 97.3% parents and only 2.7% of parents interviewed prefer using cloth diapers. A similar study by Eke (2013) in Nigeria, found that 45% of mothers make use of disposable diapers for their babies, while only 10% of them made use of cloth diapers. In addition, a report by Mutowo and Mzengi (2015) found that women in Kenya preferred the use of disposable diapers over cloth diapers for their babies, as disposable diapers - unlike conventional cloth diapers - were not affected by adverse weather (cloudy and rainy conditions) because they are discarded and need not be washed and dried after use.

A Chi-square test was run to find if an association exists between respondents' level of education and preference on the use of diaper types. The results suggested that there was no significant statistical relationship between the participants' education level and the type of diaper that they prefer (P -value=0.653). This suggests that an increase in education level does not have an influence on the diaper use preference. Therefore, the two variables are independent of each other.

4.4 Disposal of soiled diapers

4.4.1 Soiled diaper disposal practices

The study sought to investigate the method of disposing soiled disposable diapers. It was observed that only 0.9% of the respondents sampled used cloth diapers and accordingly the mode of diaper disposal did not apply to them. The pie chart below (figure 4.1) displays that 69.4% of the respondents' burn their disposable diaper waste, 14.4% throws them in their pit toilet, 4.5% buries soiled diapers, 9.9% dump them in open spaces and 1.8% of the respondents use all of the practices mentioned.

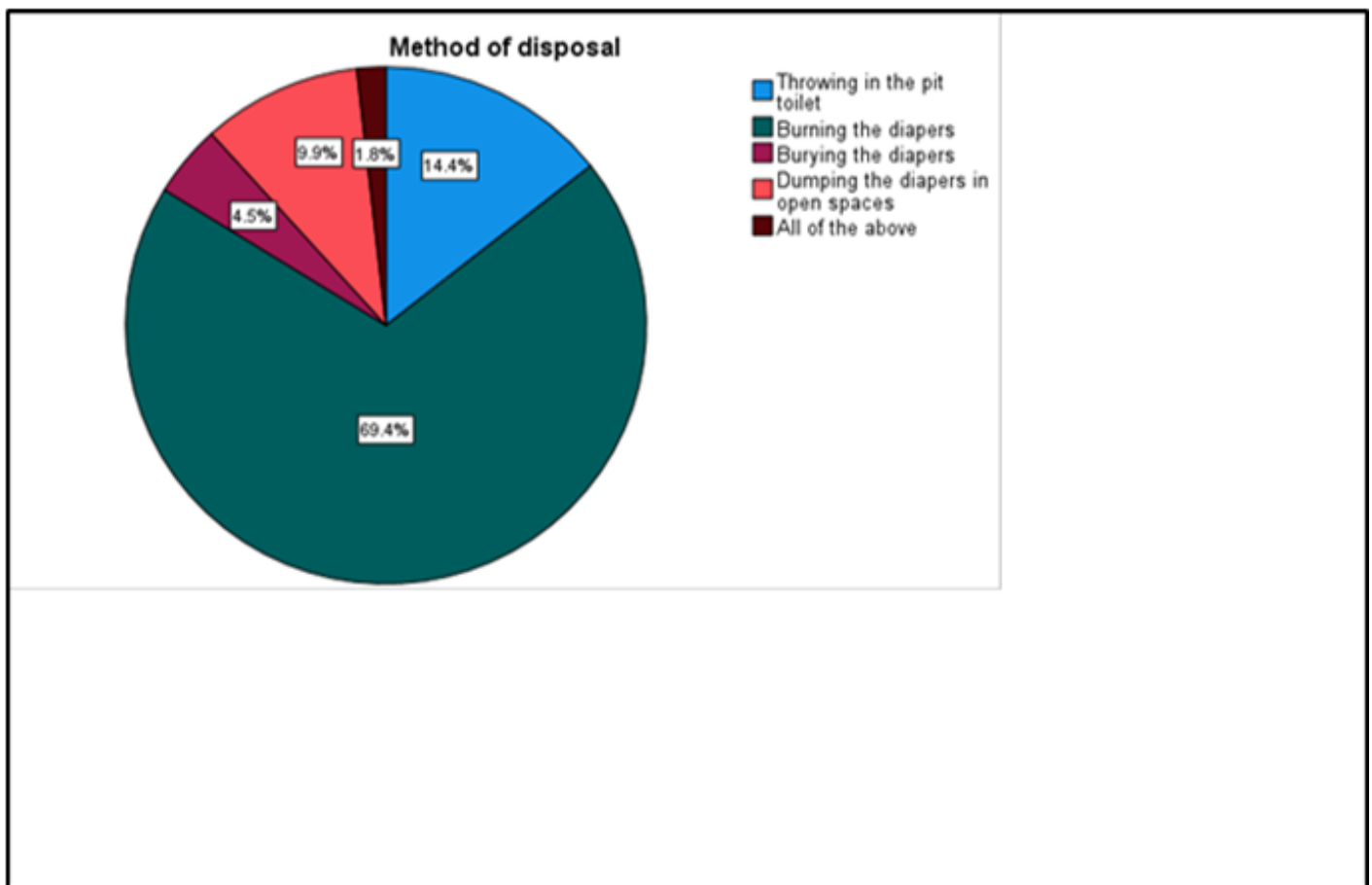


Figure 4.1: Methods of disposal of soiled diapers.

Respondents were asked of their reasons for using the particular mentioned methods. The majority of the respondents that dispose soiled diapers by burning them stated that they use this method as they do not want garbage pilling up in their yards and they do not have other options that they can use as the municipality does not collect waste at their settlements. Burning of the diapers takes time as they dry the diapers first (figure 4.2) and use candle wax or paraffin to start the fire. Some of the respondents revealed that they take out the gel that is

inside the diaper and dry it separately from the rest of the components so that it dries faster and catch fire easier when they burn them.



Figure 4.2: Drying of wet disposable diapers.

Those that throw soiled disposable diapers in the toilet stated that they opted not to burn them as it takes time and not feasible when it is cloudy or raining as they have to be dried first. Some added they are not worried that their pit toilets will be full as they believed that the hole is big enough to accommodate diapers for the first two years after the child is born. Some stated that they use chemicals to reduce pit toilet waste in order to make space for the soiled diapers.

The respondents that use the method of burying diaper waste stated that it is easier and faster to dispose of soiled diapers in this manner. They stated that they dig holes in their yards where they dispose of diapers and household waste, and after some time they cover the waste with soil and dig another hole. This method pollutes underground water through seepage as the disposables diapers are not cleaned first before the disposal and burial.

The respondents that use all of the mentioned methods stated that they use different methods for the reason that they sometimes have conditions that do not favor other methods such as burning. They burn their waste and bury the residue when they have time and when the weather is favorable to dry the soiled diapers first. Sometimes they dispose at pit toilets but they stated that they do not like this method as they believe that the diaper waste will fill their pit toilets.

One of the respondents said that they use black plastic bags to store diaper waste and dispose it in skip bins at Tibane mall and Kgabo Park; on their way to town (see figure 4.3 and figure

4.4). The participants were also asked if there instructions provided by the manufacturers on how to dispose the disposable diapers, they said there is only one instruction written on the package “do not dispose in flushing toilet, dispose soiled diaper properly in waste bin”, another manufacturer wrote that soiled diapers should be disposed with household waste. The parents indicated that these instructions were not catered for them who stay in rural areas as they do not have flushing toilets and waste bins, therefore they are using their own disposal methods that they see suitable for their soiled diapers’ waste.

The findings of this study have similarities to that of Mutowo and Mzengi (2015), who carried a study on practices regarding disposal of soiled diapers in poor resource urban setting, Zimbabwe. About 40% of the sampled population burnt the disposable diapers after use and only 4% disposed them in pits. In Kenya, a study by Kimani, Muchiri, and Makindi (2015) established that in Nakuru County, 73.6% of caregivers dispose of soiled diapers with other household garbage while 18.9% dispose of in pit latrines with 0.7% disposing of in compost pits. These results shows that most soiled diapers are disposed in the wrong places that leads to environmental contamination and health effects.



Figure 4.3: Skip bin placed at Kgabo park village.



Figure 4.4: Waste skip bin placed at Tibane Mall

4.4.1.1 Fieldwork findings

The study collected some of the data using observation check-list in all the five villages as some of the respondents dispose of their soiled diaper waste on vacant spaces. The respondents that dump their soiled diaper waste in open spaces stated that they use this method because they do not want diaper waste in their yards and they do not receive refuse

collection or removal services; therefore they rather take their waste to the bushes or vacant spaces where it is no longer their problem and they believe that the open spaces are big enough to accommodate their waste. The researcher observed and captured GPS coordinates of some of the locations where people dispose their diaper waste in vacant spaces (see figure 4.5). It was observed that people dispose diaper waste near the main roads (see figure 4.6) and water stream. Some of the diapers are disposed with household waste in maize meal bags (see figure 4.8) and plastic bags (figure 4.9).

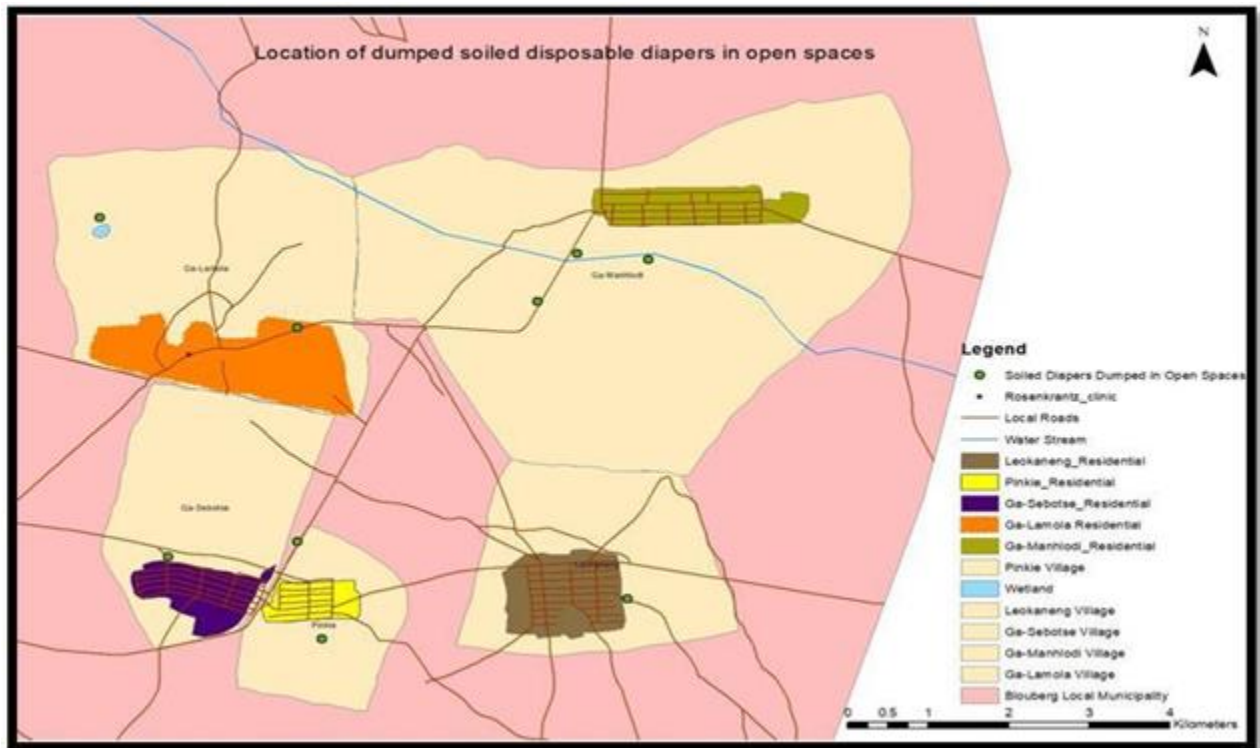


Figure 4.5: Map showing location of dumped diapers in open spaces.



Figure 4.6: Disposable diapers dumped at Cooperspark and Ga-Sebotse main road.



Figure 4.7: Soiled diapers disposed with household waste in maize meal bags.



Figure 4.8: Soiled diapers in plastic shopping bag.

4.4.2 Response from Blouberg Local Municipality

The legislative framework of waste management as stated in National Environmental Management Act No. 107 of 1998 states that sectors of government from nation to local levels “should provide co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, and to provide for certain aspects of the administration and enforcement of other environmental management laws; whereas everyone has a right to an environment that is not harmful to his or her health or wellbeing; the State must respect, promote and fulfill the social, economic and environmental rights of everyone and strive to meet the basic needs of previously disadvantaged communities.” It was therefore necessary in this study to find out about status of waste management in the municipality, and to also establish their awareness regarding the illegal dumping of diapers in their area.

With regard to waste management programs, the municipality indicated that there are no established by-laws set for managing waste or systems in place to cater for general waste and diaper disposal. According to the Blouberg Local Municipality (BLM) Integrated Waste Management Plan (IWMP), by-laws need to be compiled “to set local waste service standards for waste separation, compacting of waste, management and disposal of solid waste” (2019:15).

What happens in their jurisdiction is that the municipality renders a waste collection service in both urban and rural areas, but with a backlog of 75% which is caused by budget constraint and by the fact that most areas under the municipality are in remote locations; this limits the municipality’s ability to service all the areas even the areas that were demarcated into BLM due to poor infrastructure such as roads, lack of resources and personnel.

The municipality’s waste collection service is provided weekly in only ten settlements that are surrounding the municipality, while the towns of Alldays and Senwabarwana receive a daily service. Alldays is the mining town within the municipality, while Senwabarwana is the administrative and economic capital.

The BLM has two landfills situated in Senwabarwana and Alldays; and one transfer station in Taaibosch. Both the landfills do not accept hazardous nor medical waste, but they accept disposable diapers although it is still debated to be general or medical waste. The municipality plans to build other waste transfer stations in every ward for temporary storage of waste as per the roll out plan to enable expansion of services to areas where waste is not presently collected.

The municipality is aware of the problem of illegal dumping of disposable diapers therefore, through waste and environment unit they conduct educational awareness through cleaning campaigns and utilizes Expanded Public Works Programme (EPWP) to manage illegal dumping sites. They conduct these awareness campaigns monthly to areas identified as hotspots for illegal dumping sites, but in this case the educational awareness and cleaning campaigns are not provided to the selected study area or the five villages that are included in the study. The areas identified as hotspots are Witten and Taaiboschgroet villages although these are areas where they collect waste on a weekly basis.

4.4.3 Responses from the Ga-Lamola traditional leader

The study interviewed the traditional leader of Ga-Lamola village regarding their awareness on illegal dumping of soiled diapers in open fields and about their envisaged solution to the problem.

The traditional leader stated that he is aware that there are people who dispose their babies' soiled diapers in vacant spaces. The leader does not dispute the fact that the village has a lot of open field but that does not give the community members the right to dispose their waste on vacant spaces. He further explained that it is wrong to discard waste in such a manner although the village and other surrounding villages do not receive municipal waste refuse collection nor do they have waste skip bins unlike in the townships. This method of disposing waste in open fields is dangerous as many households has livestock that graze on the same open fields where there is diaper waste and that might pose threats to the livestock should they consume soiled diapers. The traditional leader also mentioned that people should be mindful of dumping in open fields as some dump their soiled diapers near the lake where most of the cattle drink water from, he stated that the soiled diapers might end up in the lake which will pollute the available water, and in return the livestock owners will have to provide water from their taps.

The traditional leader's solution to the improper dumping of soiled diaper in vacant spaces is that the municipality should intervene by providing clear instructions on how to discard used diapers in rural areas that does not have refuse collection and they should at least provide the community with a skip bins that they can collect on weekly-basis. Secondly, if the municipality is not able to

provide with educational campaigns on proper disposal and skip bins, the leader suggested that people should burn their soiled diapers in their homes. He further stated that there is no communication nor partnership with their municipality, therefore people choose what works for them which is taking their waste in the open fields and it is no longer their problem. The Galamola traditional leader would like to have a partnership with the Blouberg local municipality to deal with issues that they have in their village which needs the municipality's intervention as they are more knowledgeable and experienced.

4.4.4 Respondents' opinions regarding the environmental and health risks associated with improper disposal of soiled disposable diapers

The reviewed literature indicates that improper disposal of soiled disposable diapers has various environmental and health impacts such as when they are disposed in pits or in landfills without cleaning the diapers first, the fecal content can leach out into groundwater; while if disposable diapers are burned, dioxins, furans and other toxic greenhouse gases are emitted by these diapers, including carbon monoxide and toxic ash smoke that can cause asthma. Therefore it was the study's interest to find the respondents' knowledge about the environmental and health risks associated with improper disposal of soiled disposable diapers. The respondents were presented with a Likert-scale to indicate their level of agreement with statements on the survey questionnaire.

The data on the level of awareness on the environmental and health risks of poor soiled diaper disposal were analyzed using a 5-point Likert Scale: 1 = strongly disagree, 2 = disagree, 3 = unsure, 4 = agree, 5 = strongly agree. According to figure 4.10; most respondents agreed that burying the soiled diapers can pollute underground water and those that bury their diaper stated that they do not dry or wash the soiled diapers first before burying them.

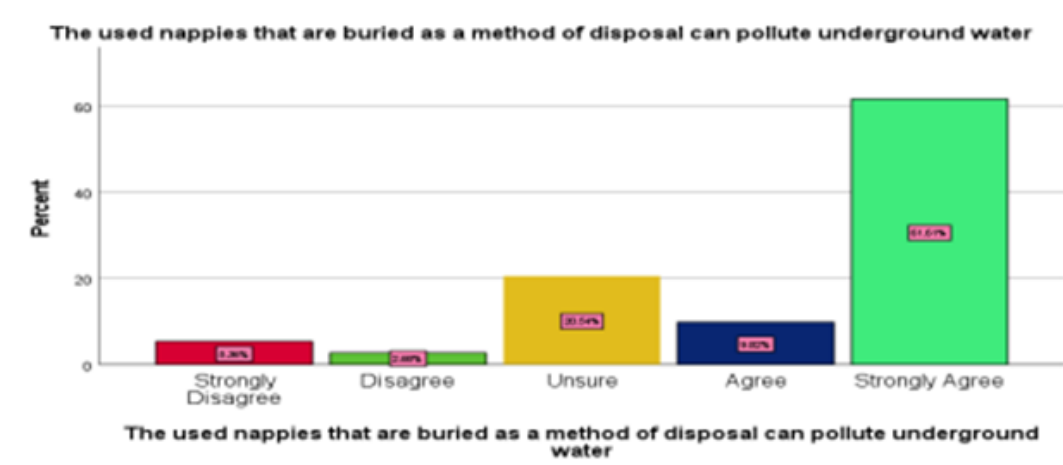


Figure 4.9: The level of agreement with the statement “the used nappies that are buried as a method of disposal can pollute underground water.”

It is observed in figure 4.10 that 91.9% of the respondents disagree with the statement “it is not wrong to dispose soiled nappies in open fields”. They stated that it is wrong to dispose on vacant spaces as it causes aesthetic nuisance and some have livestock which they revealed that they are at risk should they consume garbage that they find in open fields which is not good as they can gradually be killed by plastics or any other type of waste that is harmful.

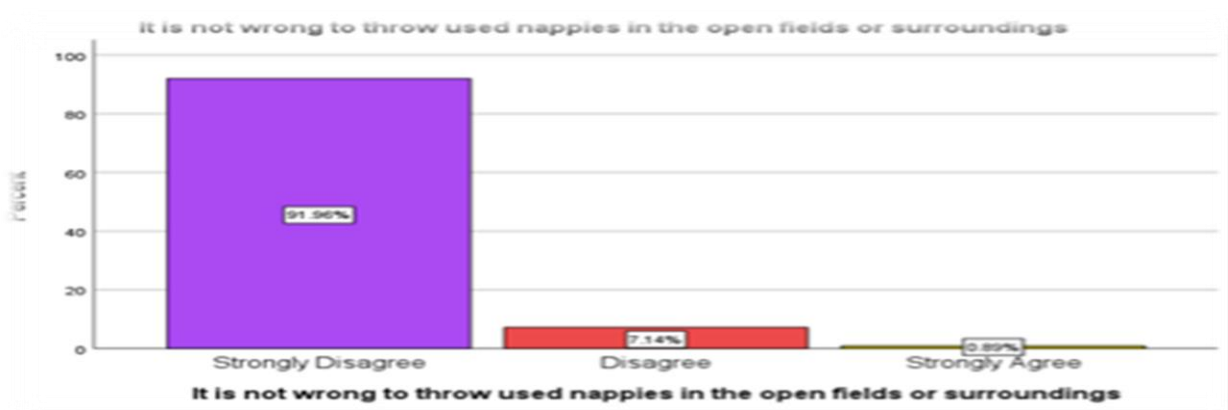


Figure 4.10: Shows the percentage of agreement for the statement “it is not wrong to dispose used nappies in

However, the respondents had no information on the likelihood that burnt diapers can cause respiratory problems and that they can affect the atmosphere (see figure 4.11). They stated that diapers are too small to cause respiratory problems and that they burn them far from their houses, therefore they do not inhale the smoke that comes from burning the soiled diapers.

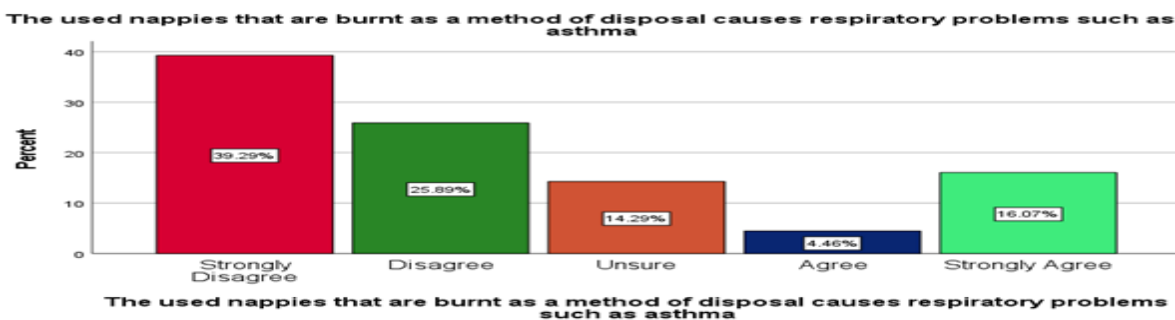


Figure 4.11: The level of agreement with the statement “the used nappies that are burnt as a method of disposal causes respiratory problems such as asthma.”

With regard to figure 4.12, most respondents strongly agreed that the management of soiled diapers is the responsibility of the municipality; nonetheless they are willing to work with the municipality as they agreed that there should be an awareness programme to educate them about proper diaper disposal methods that they should implement to keep their environment clean and safe for their livestock.

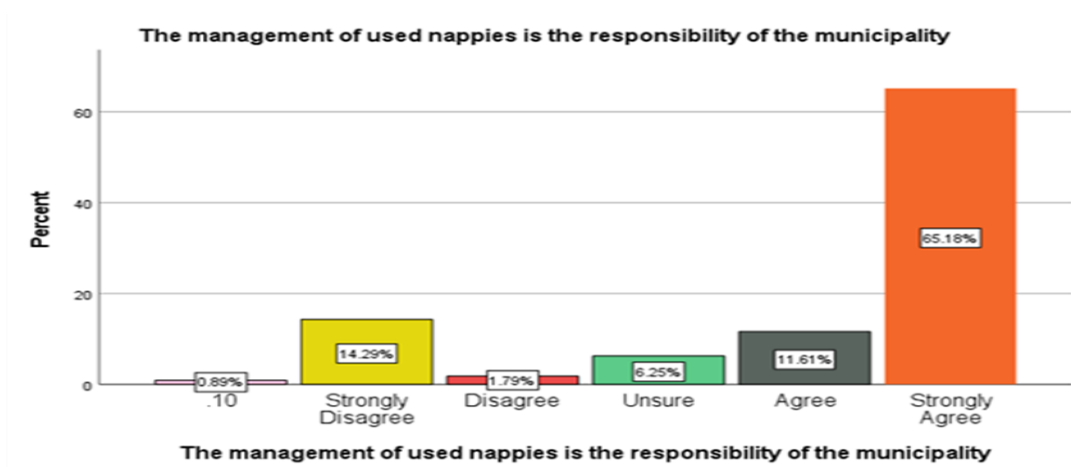


Figure 4.12: The percentage for the statement ‘the management of used nappies is the responsibility of the municipality’

4.4.5 Willingness to take diaper waste to skip bins

The respondents indicated that they are willing to work with the municipality to learn about proper practices that they should use to discard their diaper waste; therefore the study included a question about their willingness to dispose their waste in skip bins if they were provided by the BLM. The following figure shows the results to the question.

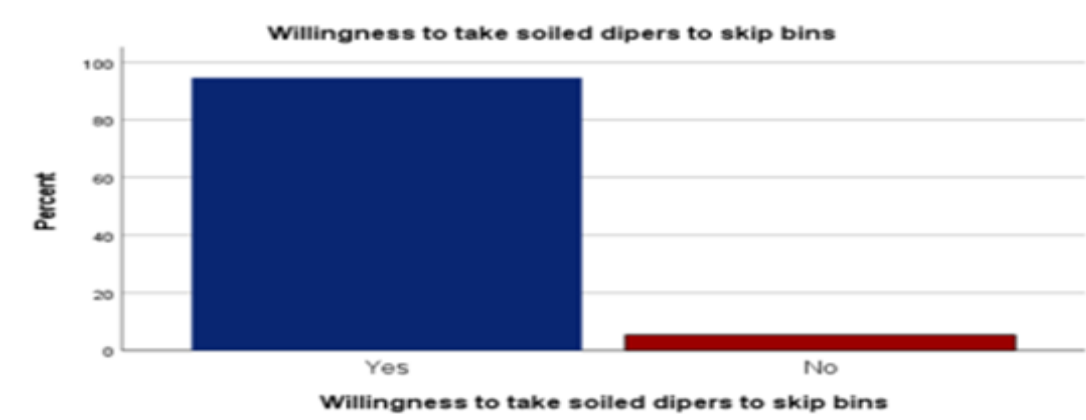


Figure 4.13: Bar graph showing willingness to take soiled diapers to skip bins

According to the bar graph (figure 4.13), the majority 77 (92.8%) are willing to take their waste to communal skip bins. They believe it would help with disposing their waste instead of disposing it in their own manner. The respondents revealed that they are willing to work with their municipality to keep their environment clean. The 6 (7.2%) are not willing to take their diaper waste to skip bins, they stated that the municipality must provide them with household bins and collect their waste door-to-door per week as they do in suburbs or townships and they were asked if they are willing to pay for such service, they stated that it should be free as they cannot afford to pay for waste refuse collection services. To date, the municipality charges R42, 50 per month for one removal per week for residential refuse collection. According to the waste

management officer, people who cannot afford to pay for refuse removal services can apply to receive free basic refuse removal that is 100% subsidized. The service entails a waste collection service at least once per week or the removal of a bulk refuse container placed within an area. This is applicable to households that have a joint income of not more than R3 560 per month.

A Pearson correlation test was run to determine the relationship between the respondents' age, educational level and the willingness to take soiled disposable diaper waste to skip bins. The correlation test between the respondents' age and willingness to take soiled disposable diaper waste to skip bins gave a P-value of 0.004 which shows that there is a significant statistical relationship between the respondents' age and the willingness to take soiled diapers to skip bins. An increase in age increases the probability of taking diaper waste to skip bins for collection. However, there is no significant statistical relationship between the participants' educational level and the willingness to take their soiled diaper waste to skip bins (mean=1.7048, P-value=0.31). The participants' education level does not influence their decision to take their diaper waste to communal skip bins if they are to be provided. This result is different from the study by Kimani, Muchiri and Makindi (2015), whereby their respondents were asked if they are willing to take their diaper waste to collection centre. There was significant statistical relationship between the education level and the willingness to take diaper waste to collection centre with a P-value of 0.033. People with more education were more likely to be willing to take their diaper waste to a collection centre compared to those with low or no formal education at all.

4.5 Conclusion

This chapter presented and analyzed the data collected. The aim of this study was to examine the practices of disposing soiled disposable diapers by the parents of infants who gets post-natal services at Rosenkrantz clinic at the Blouberg Local Municipality. The next chapter which is chapter 5 concludes the study and makes recommendations for improved solid waste management by the BLM, manufacturers of disposable diapers and future research.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents conclusion drawn from the findings based on specific research objectives of the study. It also presents recommendations based on the findings.

5.2 Synthesis

Specific objectives

- *Establish the use of disposable diapers by parents of infants at Ga-Matlala area.*

This study confirmed that there are more people who use disposable diapers compared to cloth diapers. The majority of the participants in this study use disposable diapers and there was only one participant who use cloth diaper on their babies. According to the respondents, both of their preferred diaper has their own advantages; those that use disposable diapers stated that they provide them with convenience as they are easier to use and dispose after one-time use. The stated reason for using cloth diaper is that it is reusable and durable

- *Investigate the methods parents use to dispose soiled disposable diapers*

The majority of the participants dispose the soiled disposable diapers by burning them as they do not know proper management of soiled diapers. The second highest percentage is of participants that dispose their diaper waste in pit toilets as it is readily available. They revealed that they do not know any better or proper method to use. Disposing soiled diapers in pit toilets requires less energy and time unlike drying the diapers first and burning them. Moreover, a small percentage of respondents dispose their diaper waste in open spaces, which could lead to the contamination of surface water resources, especially when it rains. All of the methods used signify a lack of awareness and education about appropriate methods of disposal.

- *Determine the awareness and perception on health and environmental risks associated with poor disposal of soiled diapers*

The results of this study imply that the majority of the participants are aware that buried soiled diapers has the potential of contaminating underground water and that it is wrong to dispose diaper waste in open spaces as it pollutes the environment and can pose risks to domesticated animals. Furthermore, the results imply that most participants are have limited awareness regarding the health and environmental impacts of burning soiled diapers. Many respondents stated that they do not inhale the smoke that comes from burning diapers but burning of disposable diapers releases carbon monoxide, dioxins and other toxic greenhouse gases and the ash can be dispersed by wind to the direction of their houses and they would end up inhaling the contaminants that could pose threats to their respiratory systems. Most participants agreed that that the management of soiled diapers is the responsibility of the municipality, but they are willing to partner with the municipality to dispose their waste in a proper approved manner. Lastly, the results show that the people who are older are more likely to partner and work with the municipality by taking their waste to skip bins should they be provided.

➤ *Investigate the method of disposing soiled diapers as part of solid waste by the local municipality*

The BLM does not manage diapers separately; they are categorized as general waste. The study confirmed that the municipality does not collect waste at the five villages where the participants of this study reside. This is due to that these villages have been demarcated into the municipality and there is also lack of capital, resources and personnel to deliver the waste collection services to all of the municipality's jurisdictional areas. The available personnel and tractors are not enough to meet the demand. The two landfills that are designed for the municipality does not accept both medical and hazardous waste, this implies that they do not have incinerators to burn hazardous waste. The municipality is operating without by-laws for waste management; the National Waste Management Systems (NWMS) are not applied within the BLM. The community members and the traditional leader are willing to work with the municipality to manage their waste in a proper manner to provide a safe and clean environment for themselves and their livestock.

5.3 Recommendations

Disposable diapers pose threats to the environment from day one of production to their lasting life cycle as they are non-biodegradable. Therefore this study recommends that the companies that manufacture disposable diapers should be encouraged to make diapers that are

biodegradable or that can be recycled to minimize their impacts on the environment. These companies should further include information leaflets detailing how to dispose soiled diapers in both urban and rural areas where there is no refuse collection removal by the municipality or any private firm.

The BLM should budget to purchase waste skip bins to place them in their jurisdictional areas where there is no refuse collection. In addition, the municipality should develop by-laws pertaining to waste management. This action should be complemented by information and education campaigns on how to use the bins to avoid dumping on the ground around the bins. Waste management education should be provided about proper methods that should be used to dispose soiled diaper waste. These educational campaigns should include information about the environmental and health risks that the communities expose themselves to by mishandling their solid waste. This study further recommends that the educational awareness campaigns should be provided at schools and clinics as there is always available and large audience that can implement what they have learned at their homes and pass it down to the next generation and other members of the community.

The study recommends that there should be future research studies on the community's perception and willingness to manage disposable diaper waste in rural areas of South Africa as there is always lack of refuse removal services. The study also recommends that future research studies be carried out on the application of policies, acts and regulations as there is lack of these frameworks by municipalities.

5.4 Conclusion

This chapter presented the synthesis of the findings and made recommendations for future research and solid waste management by the BLM and manufacturers of disposable diapers to minimize the health and environmental impacts caused by improper disposal of soiled disposable diapers.

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APPENDICES

Appendix 1: Consent form

USED DIAPER DISPOSAL PRACTICES SURVEY BY RAMOKONE SARAH LAMOLA

As part of my Master's in Geography programme at the University of Limpopo, I am conducting a survey that investigates the '**Used diaper disposal practices by people who are serviced by Rosenkrantz clinic in Ga-Matlala, Limpopo Province**'.

The targeted respondents are mothers who have infants that still go for post-natal services at the clinic.

There is no right or wrong answers in your responses and your responses will be treated confidentially and your name will be replaced by a code. Please think carefully about each question and answer truthfully as you can, because the study only asks few people to answer these questions. Your completion of the survey is very important.

CONSENT

Name of the Researcher/ Surveyor

Date

I (Name of the participant)

_____ freely agree to participate in the research project titled "**used diaper disposal practices by mothers serviced by Rosenkrantz clinic in Ga-Matlala, Limpopo province**". My participation is voluntary and I acknowledge that I may withdraw at any time. The project has been satisfactorily explained.

Date

Appendix 2: Survey questionnaire for mothers that brought babies to the clinic

SECTION A: DEMOGRAPHIC PROFILE OF RESPONDENTS

1. Gender

Female	
Male	

2. Under which age group do you fall? Please tick the appropriate answer.

Age	Tick

27-37

38-48

49-59

3. Which of the following is your educational status? Please tick the appropriate answer.

No formal education	
Primary	
Secondary	
College/University	

4. Which village do you reside at? Please tick the appropriate answer.

Village	
Ga-Lamola	
Ga-Sebotse	
Pinkie	
Leokaneng	
Ga- Manhlodi/	

CoopersPark	
-------------	--

5. Do you have children who still go for post-natal services? Please tick the appropriate answer.

Yes	
No	

If your answer is No, please proceed to **SECTION D**.

If **YES** above

6. How many are they?

7. How old is the child you brought to the clinic today

SECTION B: USE OF DIAPERS

1. Which of the following type of nappies does your child use? Please tick the appropriate answer.

Cloth diapers	
Disposable nappies	
Modern Cloth nappies	

2. How much do you spend buying nappies per month?

SECTION C: DISPOSAL OF SOILED/DIRTY NAPIES

1. Which of the following methods do you use to dispose of the dirty or used nappies? (Tick the ones you use)

Throwing in the pit at home	
Burning the nappies	
Throwing them in the open area	
All of the above	

2. Are you willing to take your waste to skip bins if they were

provided? Yes

No	

SECTION D: RESPONDENTS' OPINIONS REGARDING THE MANAGEMENT OF SOILED NAPIES

1. Please circle your extent of agreement on the following statements:

5-Strongly Agree

4- Agree

3-Unsure

2-Disagree

1-Strongly Disagree

- **The used nappies that are buried as a method of disposal can pollute underground water.**

5 4 3 2 1

- **The used nappies that are burnt as a method of disposal have an effect on the atmosphere.**

5 4 3 2 1

- **The used nappies that are burnt as a method of disposal causes respiratory problems such as asthma.**

5 4 3 2 1

- **It is not wrong to throw used nappies in the open fields or surroundings.**

5 4 3 2 1

- **The management of used diapers is the responsibility of the municipality.**

5 4 3 2 1

- **There has to be a municipality programme for the management of used nappies.**

5 4 3 2 1

Soiled nappies do cause plastic pollution

Nappies that are thrown in the open are likely to cause aesthetic nuisance

THANK YOU FOR COMPLETING THIS SURVEY

Appendix 3: Survey questionnaire follow-up questions

QUESTIONNAIRE FOLLOW-UP INTERVIEW QUESTIONS FOR SELECTED RESPONDENTS

- 1) What is the reason of using the type of diaper that you have selected in the questionnaire?
- 2) What is the reason for your method of disposal?
- 3) How often do you dispose of the soiled diaper?
- 4) Are instructions provided by the manufacturer of disposable diapers about how to dispose the used diapers?
- 5) Is your waste collected by the municipality or any private firm?
- 6) If skip bins were provided, would you take your waste there?

- 7) Are willing or interested to be involved in waste management with your local municipality? Please provide reason(s) for your answer.

- 8) What bothers you the most about the soiled disposable diapers that are dumped near roads, water stream and in the bushes?

Thank you for your time

Appendix 4: Fieldwork observation checklist

Field observation checklist

Points of observation	Notes
1.How many dumpsites has the researcher noticed	
2.Where are the dumpsites commonly found	
3.How are the soiled diapers disposed at those dumpsites	

Appendix 5: Interview questions for the waste management official in BLM

INTERVIEW QUESTIONS FOR THE MUNICIPAL OFFICIAL IN CHARGE OF WASTE MANAGEMENT IN BLOUBERG MUNICIPALITY

a. Which areas does the municipality offer waste refusal collection services to, is it provided to both urban and rural areas?

b. I observed that in many villages people scatter used diapers in the open, are you aware of that?

If yes, what are you doing about the situation?

If no, what are you going to do about the situation as waste managers?

c. Does the municipality have solid waste management system? If

yes, how does it cater for the disposal of soiled diapers?

d. What is the current policy saying regarding the disposal of soiled diapers as part of the household solid waste?

e. Does the municipality have an awareness programme of community involvement in solid waste management, but in this case the parents whose children are still using diapers on how to handle or dispose the soiled diapers in an environmentally friendly manner?

f. What is the municipal plan regarding solid waste management in areas/villages that are excluded in waste collection service by the municipality?

g. What method(s) should people use to dispose of their soiled diapers in rural areas that do not receive waste collection service?

Thank you for your consideration

Appendix 6: Interview questions for Ga-Lamola village's traditional leader

INTERVIEW QUESTIONS FOR THE TRIBAL LEADER OF GA-LAMOLA VILLAGE

- a) Are you aware that there are people who discard their used disposable diapers in the open fields?
- b) What is your comment or views regarding this matter?
- c) Is this trend a problem in this village?
- d) What is your envisioned solution(s) to this matter?

Thank you for your participation in this survey

Appendix 7: Ethical clearance



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TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 14 October 2021

PROJECT NUMBER: TREC/218/2021: PG

PROJECT:

Title: Used Diaper Disposal Practices by People Served by Rosenkrantz Clinic in Ga-Matlala, Limpopo Province
Researcher: RS Lamola
Supervisor: Dr MR Ramudzuli
Co-Supervisor/s: Mr MD Belelie
School: Agricultural and Environmental Sciences
Degree: Master of Science in Geography

PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

- i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
- ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
- iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.