

AN INVESTIGATION OF PRACTICES AND EFFECTS OF DISPOSABLE INFANT
DIAPERS ON THE ENVIRONMENT: A CASE STUDY OF MASHASHANE VILLAGE

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SEOPA SEDIMA HLOLOGELO MATSOBANE

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SUPERVISOR: Dr J.M. LETSOALO

CO-SUPERVISOR: Dr M.J. MASHABA

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DECLARATION

I Sedima Hlologelo Matsobane Seopa, student number: 201201903 declare that: **“AN INVESTIGATION OF PRACTICES AND EFFECTS OF DISPOSAL OF DISPOSABLE INFANT DIAPERS ON THE ENVIRONMENT: A CASE STUDY OF MASHASHANE VILLAGE”** is my own work and that all sources that I used or quoted have been indicated and acknowledged by means of a complete list of references.



SIGNATURE

(SEOPA S.H.M)

██████████

07/10/2021

DATE

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Abstract

Disposal of disposable infant diapers has emerged as one of the major challenges in solid waste management. The use of disposable infant diapers is an unmanageable challenge in many rural areas due to a lack of disposal equipment and proper disposal methods. Incorrect disposal of used disposable infant diapers causes immediate and long-term negative health, environmental, social and economic impacts on communities. Consequently, this study sought to establish the practices and effects of used diaper disposal in the community of Mashashane Village, Limpopo. Using snowball sampling, households with infants determined participants for this study. The data collection methods were observations and questionnaires. The results showed that most mothers used disposable infant diapers. All respondents indicated that they did not have proper places for disposal and as a result, they disposed of used disposable infant diapers at any convenient place such as near streams, in wetlands and open places. The study, therefore, concluded that disposal of used disposable infant diapers was not appropriately practised in Mashashane Village and that led to environmental, social and economic challenges that require immediate intervention by the municipality. The study recommended that the municipality should encourage proper disposal of used disposable infant diapers through provision of skip bins and waste collection trucks.

Key words: Waste, Waste Management, Disposable Infant Diapers, Disposal, Environment.

ACRONYMS

DEAT	Department of Environmental Affairs and Tourism
EA	Environmental Agency
EE	Environmental Education
EEA	European Economic Area
ELARD	Earth Link and Advanced Resources Development
EPA	Environmental Protection Agency
IEP	Integrated Environmental Plan
IDP	International Development Programme
IPCC	Intergovernmental Panel on Climate Change
IRG	Integrated Resource Group
ISWM	International Solid Waste Management
IWMP	Integrated Waste Management Plan
MSW	Municipal Solid Waste
MSWG	Municipal Solid Waste Generation
NDWCS	The National Domestic Waste Collection Standards
NEMA	National Environmental Management Act
NEMWA	National Environmental Management Waste Act
NGO	Non-Governmental Organization
PPE	Personal Protective Equipment
SAM	Super Absorbent Material

SAP	Superabsorbent Polymers
STH	Soil Transmitted Helminthes
SWM	Solid Waste Management
TBT	TriBuTyltin
TREC	Turfloop Research Ethics Committee
UNEP	United Nations Environmental Protection
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WEN	Women's Environmental Networks
WHO	World Health Organization

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DEFINITIONS OF TERMS

Disposable Diapers

Disposable diapers are garments produced for personal hygiene, designed to absorb and retain urine as well as faeces (EDANA, 2007).

Municipal Solid Waste

Municipal Solid Waste is a term given to all waste handled by municipalities or local authorities generated from sources such as households, streets, public places, retail shops, hospitals and commercial offices (Chung et al., 2010).

Waste

According to Porteous (2008), waste is any substance that constitutes a scrap material or an effluent or other unwanted surplus substance arising from the application of any process.

Waste Management

Waste management entails the separation, collection, transportation, processing, disposal and monitoring of waste materials, to prevent or reduce their negative effect on health, environment or aesthetics (Otchere *et al.*, 2014).

Waste Minimisation

Waste minimisation is the reduction of waste at the source through reuse and recycling, with the intention to eliminate the generation of harmful and persistent wastes in order to promote a more sustainable society (USEPA, 2012).

Waste Management Hierarchy

Waste management hierarchy is an internationally accepted guide for prioritising waste management practices with the objective being to achieve optimal benefits from products prior to disposal as well as reducing the detrimental environmental impacts (Zero Waste Strategy, 2010).

CHAPTER 1: INTRODUCTION

1.1 Background

Municipal Solid Waste (MSW) disposal has become a challenge to many developing countries of the world including South Africa. MSW is complicated by the switch from cloth nappies to disposable ones. The indiscriminate disposal of used disposable infant nappies is an increasing challenge to solid waste management (Hodge *et al.*, 2016). Scattered bundles of plastics containing used disposable infant diapers are often found incorrectly disposed of. The major concern is that opportune diseases can take hold due to such disposal practices (Lopez *et al.*, 2016). The challenge is that disposable diapers are regarded indispensable in modern society. Disposal of used disposable diapers is a major global environmental problem as they constitute a large percentage of the MSW (Majeed *et al.*, 2018).

According to Hoornweg & Tata (2012), about 1.3 billion tons of municipal waste is generated per annum globally. This amounts to 3.6 million tons per day, with the average daily rate per capita generation of 1.2 kg worldwide. Developing countries tend to produce MSW ranging between 0.45-0.95 kg per capita per day while developed ones generate about 2.2 kg per capita per day on average. These statistics are expected to double from 1.3 billion tons in 2010 to 2.2 billion tons in 2025 (Ayuba, 2013). Developing countries are the greatest contributors to these increases because of rapid urbanisation, anticipated economic growth as well as unrestrained consumption of goods and services (Hoornweg & Tata, 2012).

Although MSW generation in developed countries is high, such countries are well equipped financially and in terms of human skills to deal with the issue. In addition, such countries also manage MSW better because of effective waste legislation, policies and strategies, as well as the availability of resources and means to execute waste management properly. The resources include the provision of waste bins to enable households to separate waste at the source. In countries such as the United States of America and Denmark, high taxes are imposed on households for the disposal of high

volumes of mixed waste to landfill facilities (EEA, 2009). In the rural areas of developing countries MSW management is a challenging problem, due to insufficient funds, lack of managerial skills, poor environmental awareness and lack of landfill sites. According to Ayuba (2013), most developing countries have waste management standards, legislation and policies that are out-dated and of poor quality. Lack of proper planning by waste management officials also hinders the implementation of adequate waste management services. Disposal of solid waste is also a problem as one-third of MSW generated remains uncollected at source and the rest may not always be disposed of in appropriate landfill facilities (Sankoh & Yan, 2013). Consequently, this has led to illegal dumping which pollutes the ambient air, freshwater resources as well as undermines human health (Matsuto *et al.*, 2004). As a result, waste usually ends up on the streets, open spaces, rivers, wetlands amongst others.

1.1.1 Solid Waste management

Any garbage, refuse or sludge or any other discharge material from mining, agricultural operations and community activities that is no longer wanted is regarded as waste (Naidoo, 2009). Solid Waste can be defined as unwanted and useless items that result from human and animal activities, which are therefore discarded (NEMWA, 2009). Waste is very complex and is classified into categories of general and hazardous based on origin, composition and physical form (Yay, 2015). Solid waste also consists of harmful substances, such as batteries, paints, etc., which may be hazardous to human and environmental health (Frantz, 2006 & Post, 2007). Waste management involves processes of generation, separation, storage, collection, transportation, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites (European Council, 1991). A good waste management process should prevent, minimize, recover and dispose of waste safely. Municipal waste, household waste, industrial waste etc., are some of the waste types that pose a challenge to the management of waste. ELARD (2009) maintain that solid waste disposal has always been a problem in rural areas causing serious environmental problems. Burning and illegal dumping of solid household waste are the most common disposal methods practised in rural areas, resulting in unmanageable land, water and air pollution (Polokwane Local

Municipality IDP, 2011). Rural communities also dump waste along roadsides and on any available open space, regardless of the impact on the environment (Kaundal & Sharma, 2007).

1.1.2 Disposable Infant Diapers

Disposable infant diapers are garments for personal hygiene designed to absorb and retain urine and faeces (EDANA, 2007). Since the introduction of disposable infant diapers, many innovations, including the use of Superabsorbent Polymers (SAP), resalable tapes, and elasticised waistbands were added to the product. Disposable infant diapers are now thinner and more absorbent. In recent times, the product extends into children's toilet training phase with the introduction of training pants and pant diapers, which are now used as undergarments (Counts *et al*, 2014). The following are some of the reasons why disposable infant diapers are preferred:

- They are convenient to use, especially when travelling.
- They do not cause baby rash.
- They are used once and then thrown away.
- They help keep the baby dry.
- They do not require water, soap and energy to clean.

It is for these reasons that, despite the negative impact, disposable infant diapers continue to be favoured as they are easier to use than cloth diapers.

1.1.3 South African Waste Management Legislations

South Africa has policies and laws that include environmental waste management planning, based on the Constitution of South Africa, which states that, all people have the right to an environment that is not detrimental to human health. It also imposes a duty on the State to propagate legislation and to implement policies to ensure that this right is upheld (DEAT, 2007). The following are some of the legislations passed to ensure proper management of waste: The National Waste Management Strategy of 2010; National Environmental Management; Waste Act 2008 (Act No. 59 of 2008); Local Government

Transition Act 1993 (Act No. 209 of 1993); Municipal Structures Act 1998 (Act No. 117 of 1998) and Municipal Systems Act 2000 (Act No. 32 of 2000). It is unfortunate to observe that although the South African government has the legislation on solid waste management, the management of used disposable diapers as solid waste is not correctly embraced.

1.2 Problem statement

Dealing with used disposable infant diapers has become an unmanageable challenge to the health of the environment. In the village of Mashashane, Limpopo, used disposable infant diapers are informally and illegally dumped in almost every open space in the village. In order to gather more information about why disposable infant diapers have become a challenge in the village of Mashashane, structured questionnaires and observation were used. Unfortunately, disposable infant diapers were introduced to societies without consideration of how they may negatively affect the physical, socio-economic and cultural environment. Waste such as used disposable infant diapers is a threat to the health of society and environment, because it is non-degradable and hazardous (NEMA, 2011). Incorrect disposal of disposable infant diapers may have immediate and long-term negative impacts on health, the environment as well as society and economy of communities.

1.3 Rationale

Many developing countries face challenges in the management of solid waste. According to Tunesi *et al.*, (2016), waste management structures in developing countries are inadequate and in some cases, cause environmental problems as waste tends to be unseparated and disposed of in open informal sites. Incineration, illegal dumping and informal landfilling are the dominant approaches of dealing with waste in many African countries, including South Africa (Harijani *et al.*, 2017). The collection process of waste is poor and that is associated with insufficient funds. As a result, safe disposal of waste in well-equipped and engineered landfills of developing countries appear to be a dream that many countries are yet to realise. Many rural areas in South Africa are without waste

collection infrastructure which makes it difficult to transport waste to the nearest landfills or dumping sites. In municipalities where high levels of separate waste collection occurs, disposable infant diapers constitute a large portion of the refuse and that challenges and

1.3 Aim and objectives of the study

1.3.1 Aim of the study

To investigate the practices and effects of the disposal of disposable infant diapers on the environment of Mashashane Village.

1.3.2 Objectives of the study

The objectives of the study were to:

- i. determine the degree to which Mashashane mothers use disposable infant diapers.
- ii. ascertain where and how the households of Mashashane Village dispose of used disposable infant diapers.
- iii. establish why households of Mashashane Village dispose of the used disposable infant diapers in the manner they do.
- iv. determine the level of awareness and perceptions of the Mashashane community towards the consequences of incorrect disposal of used disposable infant diapers on the environment.

1.4 Scientific Contribution

The study will contribute to the pool of knowledge on environmental health with special reference to disposal of used disposable infant diapers in South Africa's rural areas. A wider understanding of disposable infant diapers as a health hazard will be highlighted by the study. It is possible that the study will inform the local municipality in terms of solid waste management and the regulations that promote the health of the environment as contained in the South African Constitution.

1.5 Organisation of the study

This study consists of five chapters. Chapter 1 introduces the study and outlines the background, research problem, aim and objectives, rationale as well as scientific consideration of the study. Chapter 2 reviews literature on disposal of used disposable infant diapers and the management thereof in the waste stream, with attention paid to rural areas of developing countries. Chapter 3 describes methods for data collection, analysis and presentation. Chapter 4 presents results and discussions thereof. Chapter 5 provides a summary of findings, conclusions, recommendations as well as suggestions for future research.

1.6 Conclusion

This chapter introduced the study by explaining the background, the rationale, problem statement, aim and objectives of the research study. The chapter also outlined the significance of the study, its contribution to knowledge on waste and portrayed the definition of concepts used in the dissertation. The chapter that follows deals with the literature review of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The production of solid waste has become a serious challenge worldwide. It is so because everything at some point becomes waste. The rate of solid waste generation is increasing with the high population numbers and industrialisation. As a result, solid waste management has become a major challenge within developing countries such as South Africa and parts of the world at large, this includes disposable infant diapers. According to Vaccari *et al.*, (2018), the need for disposable infant diapers came into being during World War 2, because of shortage in cloth used in traditional diapers. Infants were often wrapped in blankets that kept them warm and acted as basic diapers in colder regions. Disposable diapers were for the first time introduced in the year 1949 and were preferred for their multiple layers. They came on the market in the 1980s, and nearly every mother switched to them. In the year, 1984 a super absorbent material from polymers known as sodium polyacrylate, which was an improvement of what originally developed in 1949 was introduced (Linzner & Salhofer, 2014). This chapter examines different literature contributions on disposal of used disposable infant diapers as solid waste and gives an overview of the concerns around generation, impact and management thereof. Case studies to show the different physical and socio-economic impacts of disposal of used disposable infant diapers as waste are highlighted.

2.2 Disposable infant diapers

The need for diapers existed since the beginning of history. The word diaper originally referred to the type of cloth rather than its use. "Diaper" was the term for a pattern of repeated diamond shapes, and later came to describe a white cotton or linen fabric with a pattern. A century ago, diapers were made primarily of woven textile fabrics such as cotton or wool, soaked in wax to prevent leakage and control containment. The fabrics were often triangular and needed to be folded and wrapped around the diaper zone (Modak *et al.*, 2015). Subsequently, inner liners were developed to provide a higher capacity. In the middle of the last century, diapers were made of cotton fixed with pins

and waterproof rubber pants used as outerwear. Early disposable infant diapers contained a poly-back sheet film, a fluff pulp core, and a separate removable top sheet that could be discarded with the feces. A change in the environment, population growth, urbanisation as well as a rise in the living standards of communities have resulted in a large increase of MSW generation in developing countries (Minghua *et al.*, 2009). Used disposable diapers represent about 4% of solid waste and are the third largest single consumer item in landfills which are discarded after a single use (Tembo & Chazireni., 2017).

2.2.1 Composition of disposable infant diapers

A disposable infant diaper is composed of a liquid-permeable membrane lining the inside surface which is made of non-woven polymer and watertight membrane on the outer surface and from polymers, starch, woven cloth or rubber. An absorbent core called pulp fluff made up of a fibrous material of cellulose and hemp or synthetic materials is enclosed in water-resistant paper. The absorbent part also contains a super-absorbent polymer (SAP) material, which has a high capacity to bond with water, making it possible to retain urine within the absorbent part (Krafchik, 2016).

A disposable infant diaper (Figure 2.1) consists of the top sheet with non-woven surface, which is the high absorption area that locks urine immediately and keeps baby's skin dry and comfortable. The Absorbing Diaper Layer (ADL) made of Super Absorbent Material (SAM) is also for urine absorption and keeps the diaper surface dry, while the standing non-woven leak guard are there to help trap side leakage effectively. The frontal tape on the disposable infant diaper helps to make easy replacements. The printed back sheet helps to prevent leakage and keeps the baby more comfortable, while the magic tape keeps the disposable infant diaper taped around the child. The elastic waistband is adjustable to enable the disposable infant diaper to fit the infant.



Figure 2.1: A disposable Infant Diaper (Sepadi, 2021)

According to Gupta (2007), disposable infant diapers are an absorbent pad inserted between two sheets of non-woven fabric and contains chemical crystals that can absorb up to 800 times of their weight in liquid and hold it in a gel form. That helps keep liquids away from the baby's skin. It is for this reason that disposable infant diapers are more convenient and popular among mothers. Hence, the usage of disposable infant diapers has grown with the growing population. World Health Organization (WHO) (2016), reiterated that a disposable diaper, by design, consists of an absorbent pad between two sheets of non-woven fabric, one of which is permeable and one which is impermeable. The pad is comprised of a hydrophilic polymer and a fibrous material, leading to maximum absorption capacity.

The polymer is a good water absorber, which can retain 200 to 300 times its weight and hold it in a gooey gel. The major part of the polymeric material is based on petroleum, which is a non-replaceable resource, hence, the need to preserve it (Yego *et al.*, 2013). Consumers switched from cloth diapers to disposable diapers for many reasons, which included the inherent advantages of the product. Unfortunately, the polymeric material, which takes, almost a lifetime to biodegrade, have ended up in landfills. Thus, environmentalists encourage a switch back to cloth diapers (Deloitte, 2011). A lot of mothers like the idea of using disposable infant diapers compared to the cloth diapers because disposable infant diapers have a lot of advantages such as the fact that they are

quick and easy to use, absorb liquid better and they have different ranges to accommodate all baby ages (Maluni, 2020). Though they have disadvantages, these do not immediately and directly affect the mothers. Many caregivers do not only like using disposable infant diapers but can also afford to buy them since there are different types of diaper products which come at affordable prices.

Leak guard are polymers with high molecular weight presenting the ability to absorb and retain high quantities of liquid as compared to their own weight (Reese *et al.*, 2015). An unused disposable infant diaper is composed of a liquid-permeable membrane lining the inside surface, made of non-woven polymer; a watertight membrane on the outer surface made from polymers, starch, woven cloth or rubber and an absorbent core (pulp fluff) made up of a fibrous material (cellulose, hemp or synthetic materials), enclosed in water-resistant paper. ADL also contains a leak guard material of sodium polyacrylates, which has a high capacity for bonding with water, making it possible to retain urine within the absorbent part, with an average weight of 41 grams (EDANA, 2008). The production of leak guard requires high quantities of water, fuel and natural gas (Aumônier & Collins, 2005). In contact with urine, leak guard takes the form of a gelatinous mixture known as hydrogel. Although urine is an organic substance, in terms of the visual impact during the composting process, it is considered an impurity since the high adherence of hydrated leak guard to organic materials makes it very difficult to separate it in composting plants. According to Reese *et al.*, (2016), the composting process degrades the polymer cross-linkages responsible for the gel formation, when urine is released, the polymer can degrade normally.

On the contrary, eight percent of leak guard molecules degrade during 100 days of composting period, although residual polymers continue to degrade at a rate of 0.007 percent per day, which suggests that they will eventually degrade completely. However, given the long degradation time estimated for leak guard, it must be pointed out that some harmful effects can appear for human and other environments, as previously reported, although new materials used for leak guard fabrication are claimed not to be toxic (Scorgie *et al.*, 2016). Nevertheless, regarding the composting process, only non-biodegradable molecules are considered as impurities. Once released, urine initially retained in leak

guard is composted with the organic matter present in the mixture (Kosemund *et al.*, 2009).

Many disposable infant diapers contain a chemical called TriBuTyltin (TBT). According to Kim & Kim (2015), this toxic pollutant is extremely harmful to aquatic life and causes endocrine disruptions in aquatic organisms. In addition, TBT is a chemical that remains in the food chain in the environment. Disposable infant diapers frequently contain chemicals called Volatile Organic Compounds (VOCs), which include chemicals such as ethyl benzene, toluene, xylene and dipentene (Kim & Kim 2015). Other chemicals, used in disposable infant diapers, include fragrances, petrolatum, adhesive chemicals used in the sticky tabs that close the infant diapers and dyes used to colour and make the patterns and labels that mark diapers. Perfumes and fragrances used in some disposable infant diapers help to mask odours (Kim & Kim 2015).

In the 1970s and 1980s, the rectangular diaper shape changed to some die-cut shapes with leg cuffs. Most importantly is that the leak guard was introduced and mixed with the fluff-pulp to make diaper cores. Elastic barrier leg cuffs were developed to further contain/stop leakage. According to Kasgoz *et al.*, (2008), modern fastening technologies evolved from plain adhesive tapes to the addition of hook and loop fasteners that allow opening and closing even when the caregiver's hands are contaminated with lotion or creams (EDANA, 2007). Recently, very dynamic innovations in the area of SAP allow a more efficient use of raw materials and the development of increasingly thinner, underwear-like diapers. Today, specific disposable infant diapers are available for infants at different developmental stages (GOA, 2009). These new products are characterised by increased speed of liquid acquisition and higher absorbent core capacity, resulting in increased skin surface dryness. The use of lotion on inner top sheets is an elegant approach to the care of infant skin by ensuring the ongoing application of a small amount of a petrolatum-based ointment (Kim & Kim 2015).

2.3 Used Disposable Diapers as Solid Waste

Disposable diapers on the environment are believed to be the third largest individual component of municipal solid waste just after newspapers and bottles (Ogundele *et al.*, 2018). According to Excelsior News (2017), the generation of solid and liquid excreta between the age of 0-30 months ranges from 0.448 to 0.601g in a day per child. For a soiled disposable diaper, the average weight is 212 g, in accordance with experimental data based on the average weight of 610 diapers collected in municipalities of Mancomunitat La Plana (Barcelona, Spain), between 18 and 24 February 2008. The organic part of diapers, considering only cellulose and solid excreta, accounts for 11.4 percent of diapers' weight (EDANA, 2007). According to Kaoje *et al.*, (2018), the number of disposable diapers discarded in 2013 alone was about 3.6 million tons, the equivalent of more than 20 billion diapers. From birth to the time they are potty-trained, a single child will use around 7,000 diapers. That figure translates to more than 2 tons of waste per child. In the United States of America (USA), disposable infant diapers are the third largest contributor to MSW, accounting for 1.5-4 percent of the total waste (Pham & Brown, 2009). Ogundele *et al.*, (2018) reiterated that used disposable infant diapers were believed to be the third largest individual component of municipal solid waste just after newspapers and bottles and accounted for 1.5% and 4% of the total.

The focus of this study is on MSW, with reference to disposal of used disposable diapers which is part of household waste. MSW includes everyday items or general waste, which encompasses product packaging, grass clippings, furniture, food scraps and hazardous waste such as appliances, batteries and solvents containing toxic chemicals and other consumer-related forms (Jaunich, 2016). Solid waste and its management always need special attention because it consists of substances, which are sometimes detrimental to the environment (Eurostat, 2018). For waste to be managed properly, it must follow the legislation and regulations put in place as alluded, just as the hierarchy is followed for good management. In order to have proper waste management systems in place, the hierarchy need to follow various stages: waste prevention, recovery and safe disposal (Kan, 2009). It is of utmost importance to have a good system of waste management in place, as it will help reduce waste volumes and redirect people's mindset regarding waste

management at generation level. Disposable infant diapers have major implications on municipal waste management.

The United States Agency International Development (USAID) has reported a waste management problem, that in most of the Sub-Saharan countries, waste generation exceeds the collection rate due to urbanisation and lack of waste management capacity (USAID, 2009). The majority of the poor urban population in developing countries find shelter in the informal settlements where residents suffer from a shortage of waste management services and infrastructure which aggravates poor health conditions (Maluni, 2020; Odhiambo & Wekesa, 2010). In Abidjan, for example, rural areas informal settlements were at high levels of environmental risk factors, due to poorly managed waste management services (Dongo *et al*, 2010).

2.3.1 Waste Separation and Storage

Household waste separation at source is among the best ways for appropriate waste management and thereby helps to avoid environmental and health hazards. Waste separation is a critical component of a successful integrated waste management system (Mohsin *et al.*, 2016). Separation of MSW at generation source would greatly improve the management of solid waste (Polokwane IDP, 2010). Waste separation increases the quality of produced compost, recyclables, and improves incineration. It also enables better financing of waste management activities and reduces the energy and labour inputs to any downstream processes (Mohsin *et al.*, 2016). Separating used disposable diapers from the rest of the waste is necessary in order to avoid contamination of other waste that could be recycled.

Waste separation is enhanced by the availability of storage containers. Waste storage helps to keep the environment clean as waste is collected in containers. Movable bins are flexible in terms of transportation but lack durability, while fixed bins are more durable, as their positions do not change once they are installed (NEMA, 2004). It is, however, improper to store used disposable diapers in containers for longer periods as this would cause odour and accumulation of pests.

2.3.2 Waste Collection and Transportation

MSW collection and transportation are the responsibilities of the local municipality. Waste collection simply refers to gathering of waste for transportation to the final disposal site (Fernandez-Nava *et al.*, 2014). Many developing countries especially in Africa have a serious problem of servicing their waste collection trucks and have no modern and efficient technology for waste management, which at the end, affect waste collection badly (Babayemi & Dauda, 2009). A review of the IDPs in 2012 indicated that 15.6 percent of households did not have refuse removal at all (IDP, 2012). The collection efficiency of MSW varies from 0 percent in the rural communities to 90 percent in high-income areas.

In many developing countries, a large fraction of MSW generated remains on streets uncollected. Many studies on urban environment have revealed that MSW collection efficiency is a function of two major factors: of labour availability and transport capacity (NEMA, 2004). Many countries are unable to provide waste collection services to all parts of the country, especially the rural areas. Generally, overcrowded low-income settlements do not have MSW collection and disposal services (Malviya *et al.*, 2002). The reason is that these settlements are often illegal, and the inhabitants are unwilling or unable to pay for services. Hence, waste is thrown near or around houses at any time, and that makes collection and transportation of waste in such areas very difficult (NEMA, 2004)

Waste collection services differ greatly in developed countries. For example, in Chinese cities such as Beijing, waste collection services in sections where standards of living are high, is very efficient and reliable. In poorer suburban areas which are considerably more undeveloped, collection is inefficient and unreliable (Karathodorou *et al.*, 2010). Without transportation of waste from collection points to final disposal sites collection would remain a futile exercise. Transportation is the most expensive part of waste management process as compared to other operations and management procedures. That is so because it needs special vehicles, experienced people to manage activities, more manpower, hand tools, more funds for fuel, salary, maintenance, gathering or picking up of solid waste from various sources as well as taking collected wastes to the points where it is offloaded and emptied (Karathodorou *et al.*, 2010).

2.3.3 Waste treatment

Waste treatment is a very important part of waste management, because it helps to avoid disposal of unnecessary waste in landfill sites. Disposal and treatment methods involve a variety of techniques used to transform waste into forms that are more manageable (IRG, 2005). Waste treatment intends to reduce the toxicity of waste and to make the waste easier to dispose of (Wilson *et al.*, 2017). Although NEMWA adopted waste management hierarchy as a national approach to waste management, some municipalities still have increasing volumes of waste that reach the landfill sites untreated and therefore, need to be treated in one way or the other (Arena *et al.*, 2016). The waste disposal methods used today such as incineration, which subjects the waste to extremely high temperatures, or disposal, are taken as the last resorts in SWM and should therefore be accounted for when applied (IDP, 2010). Used disposable diapers are not easy to treat as it is made from materials that can be toxic when exposed to treatment methods.

2.3.3.1 Composting

Composting is a disposal practice that involves bio-degradation of solid waste through bacterial action that converts the solid material into humus-like material (Martin, 2011). This practice appears to be a desirable solution to environmentalists, as it results in making waste a usable product of soil conditioners and fertilisers (Wu *et al.*, 2010). The nutrient content of compost is quite different from manure and other feedstock waste (Martin, 2011). As water evaporates during the process, the carbon breaks down into carbon dioxide and phosphorous, while most of the other nutrients become more concentrated. Some nitrogen is lost during composting and converted from readily available forms (nitrates and ammonia) into more stable organic forms. The nutrient value of compost can be highly variable depending on the materials composted and the composting system applied.

Table 2.1. Advantages and disadvantages of composting (Martin, 2011).

Advantages	Disadvantages
<ul style="list-style-type: none"> • Reduces and eliminates pathogens. • Reduces volume and moisture content. • Stabilises organic components and nutrients. • Reduces odour. • Reduces viable weed seeds. • Reduces insect larvae (fly problems). 	<ul style="list-style-type: none"> • Poorly run processes that achieve very little results. • Pathogen control requires high temperatures and good aeration. • Land required for composting and storage areas. • Often requires additional bulk material. • May require large investment. • Long processing time.

The above show that there is a possibility of used disposable diapers being composted as part of the product is bio-degradable while the other part is mostly plastic which takes longer to decompose.

2.3.3.2 Incineration - open burning

MSW treatment can use heat, in a process called thermal treatment. According to Ionescu, & Rada (2012), incineration is controlled combustion process for reducing solid, liquid or gaseous waste primarily of carbon dioxide and other gases to non-combustible residue or ash. It leads to energy recovery and destruction of toxic wastes, such as, waste from hospitals. The gases are released into the atmosphere through a chimney, whereas, the residue is disposed of in sanitary landfills. Incineration is a very efficient SWM method and the most widely used of all thermal processes at present (Oseghale & Aja, 2011). The temperature in the incinerators can vary from as high as 980 to 2000 degrees Celsius. One of the most attractive features of the incineration process is that it reduces the original volume of flammable solid waste by 80–90 percent. In some newer incinerators designed to operate at temperatures high enough to produce a molten material, it may be possible to reduce the volume of waste by about 5 percent or even less (Gupta *et al.*, 2003). Burning of used disposable infant diapers is not done under controlled conditions but as open informal burning of used disposable diapers in countries such as Kenya and Zimbabwe. The moisture in used disposable diapers makes them very difficult to burn (Muia, 2018).

Informal waste burning can generate an unpleasant smell and unaesthetic views. Yelda & Kansal (2003) further state that, such cases usually lead to a problem of air pollution that can, in the end cause respiratory tract infections of individuals when exposed to such pollution. Still, incineration is suggested to be used as a viable interim solution by the World Health Organisation (WHO), more especially in developing countries where options for waste treatment such as autoclaves, shredders or microwaves are limited (WHO, 2010).

2.3.4 Waste Minimisation

Waste minimisation is a process used to reduce waste production at the source in order to reduce the demands for large-scale treatment, disposal facilities and re-use processes (Cordell *et al.*, 2010). Manufacturing products with less packaging can reduce waste by encouraging customers to bring their own re-usable bags for packaging; promote backyard composting; share and donate any unwanted items rather than discard them and encourage the public to choose re-usable products, such as cloth napkins (Jia *et al.*, 2018). Furthermore, waste minimisation uses less material to produce a product, so that when it is thrown away, there is less waste created. Minimisation can be through creation of durable products, where the function of the product does not change. Avoidance of waste generation results in waste minimisation. There are two ways to avoid waste generation. One method is to change the production process, so that less production waste occurs (Kim *et al.*, 2018). The other way is to try to utilise the created waste so that there is no longer waste.

2.3.5 Disposal of used disposable diapers

Waste disposal is the final stage of solid waste management where disposal is safe in relation to associated risks. Disposal is done at landfill sites, by composting, incineration or recycling (Gregory & Andrady, 2003). Some disposal methods are not environmentally friendly, for example, open dumping leads to land degradation. In many countries, open uncontrolled and poorly managed dumping are generally practised, giving rise to serious environmental degradation (Mohammed & Eyasu, 2017). Such dumping has in many coastal towns led to heavy metals rapidly leached into coastal waters (Siddiqui *et al.*,

2006). Uncontrolled waste disposal by households in cities of developing countries not only harms the environment but also inflicts health damage and creates bad smells and a polluted landscape (Swift & Wiles, 2004). Some ways to curb this problem promote concerns for the environment, control of wastes at source such as waste separation and appropriate disposal methods.

2.3.5.1 Open Dumping

An open dump is land on which solid waste is dumped in a way that does not safeguard or shield the territory or domain (Al-Khatib & Sato, 2009). Open pit dumping is the most common method for clinical waste disposal in developing countries. This is probably so because open dumping is less expensive as there is no other reasonable alternative method. Open dumping causes serious risk and damage to the environment. Some rural communities in Nigeria hold the belief that infant excreta, if disposed in the bush, is a blessing to their farms and so they dump soiled disposable diapers on vacant plots (Wambiu *et al.*, 2015). Uncontrolled and scattered deposit of waste leads to acute pollution problems, fires, high risk of disease transmission, and attracts scavengers and animals. Some components of solid waste such as street sweepings, ashes and non-combustible rubbish are suitable for open dumping (Mutha *et al.*, 2006). Generally, solid waste provides sources of food and shelter for flies, rats and other vermin. It causes intolerable odours and smoke, nuisance and hazards. Carefully selected rubbish must be disposed of in order to prevent fire accidents that might occur. Furthermore, the location of an open dumpsite needs a carefully chosen area so that there are minimum chances of complaints from nearby residents (Coker, 2009).

Table 2.2 Advantages and disadvantages of open dumping (Noya *et al.*, 2018)

Advantages	Disadvantages
<ul style="list-style-type: none"> • It can take care of most types of solid wastes. • It causes less health problems if properly selected. • It needs less labour and supervision. 	<ul style="list-style-type: none"> • It attracts flies, mosquitoes and other insects as well as stray dogs, rats, and other animals. • It creates breeding sites for rodents, arthropods and other vermin. • It creates smoke, bad odour and nuisance.

	<ul style="list-style-type: none"> • It renders the land and other surrounding areas useless. • It attracts scavengers of both humans and animals.
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2.3.5.2 Sanitary Landfilling

In general, landfilling is an easy and low-cost waste disposal method. However, an improperly managed landfill causes human health risk and environmental pollution concerns (Aleisa & Al-Jarallah, 2018). Proper landfilling is often lacking, especially in developing countries. Landfilling usually progresses from open dumping, controlled dumping, controlled landfilling, to sanitary landfilling (Kansal, 2002). However, landfilling is considered an complicated disposal method, which requires careful separation of waste so that it does not pose significant health hazards on public health and the environment (Inglezakis & Moustakas, 2015).

The reasons landfills are unacceptable to most communities is because they are often not properly sited, not well-managed and not efficiently operated. Considering siting, management and operation, landfills could be the best solution for urban waste disposal. The serious environmental impact linked with landfills is the potential to pollute nearby surface streams or underlying aquifers with leachates (Bjelic *et al.*, 2017). Landfill sites are common dumping areas for most developing countries if not all, because of lack of infrastructure for other disposal methods. This has resulted in having all types of waste including used disposable infant diapers being disposed of at landfills. Since used disposable infant diapers need to be exposed to oxygen and sunlight to decompose, they do not degrade well in a landfill (Real Diaper Association, 2011). Diapers made up 3.4 million tons of waste or 2.1 percent of garbage in landfills in 1998 in the USA. It is a major challenge because used disposable infant diapers fill up the landfills before their lifespan. Despite their high volume and excellent water absorption, used infant diapers have been mostly landfilled (Arena *et al.*, 2016). The greatest challenge with regard to landfilling in South Africa is poor waste management of the landfill sites (IDP, 2010). The problem is that permit conditions are not adhered to due to lack of manpower and machinery, which takes long to be repaired resulting in backlog on covering and compacting, etc. (IDP,

2010). Sanitary landfill has the following advantages and disadvantages according to IDP (2010).

Table 2.3: Advantages and disadvantages of sanitary landfill

Advantages	Disadvantages
<ul style="list-style-type: none"> • Sanitary landfilling is a relatively economical and acceptable method for waste disposal. • Initial investment is low as compared to other proven methods. • The system is flexible. • It can accommodate increases in population. • May result in low collection cost as it permits continued collection of refuse. • All types of refuse may be disposed of. • The site may be located close to or in populated areas, thus reducing the hauling cost of collection. • Sanitary landfill enables the reclaiming of depression and sub-marginal lands for use and benefits of the community. • Completed landfill areas are used for agricultural whereby other purposes, such as; unsightliness, health hazards and the nuisance of open dumping can be eliminated. • It may be quickly established and can be used with several disposal sites simultaneously 	<ul style="list-style-type: none"> • Sometimes suitable land within economical hauling distance may not be available. • Relatively large areas of land are required due to slow decomposition of refuse. • Adequate supply of good earth cover may not be readily accessible. • If sanitary landfill is not properly located, seepage into streams may increase the chance for stream pollution. • Sanitary landfill needs careful and continuous supervision by skilled personnel. • SWM if not properly done can deteriorate into open dumping where special equipment is required.

2.3.5.3 Illegal Dumping

Illegal dumps are unauthorised areas of dumping waste, which are classified for the dumping of waste larger than a litter in public and private areas such as roadsides, illegal landfills or water sources, without the approval of the Environmental Protection Agency's (EPA) (UNEP, 2015). One common method that city households in developing countries

use to get rid of their waste is dumping in unauthorised areas (Jaunich, 2016). The large waste items found on illegal dumping sites include general household rubbish, which range from supermarket bags, larger domestic items such as mattresses, green waste, construction materials, hazardous waste, abandoned vehicles and tyres (Coker, 2009). Tembo & Chazireni (2017), stated that about 50% of caregivers in Mberengwa district, Zimbabwe, dispose of soiled diapers in open places especially in bushes and on roadsides.

Illegal dumping has very significant environmental impacts as dumped rubbish can degrade available bush-land, reduce its biodiversity, degrade plant and animal habitats, and hamper vegetation growth (UNEP, 2015). Dumping of green waste spreads seeds and increases nutrients in the soil, promotes the spread of weeds, and invasive plant species. The long-term effects thereof can be detrimental to the ecosystem and can lead to the following impacts as indicated by Aleisa & Al-Jarallah (2018):

- Breeding ground for vermin, which in turn poses a health risk,
- Run-off from dumping sites may contain toxic materials, which contaminate soil and water sources such as lakes, creeks and drinking water supplies,
- Create fire hazards and flooding,
- Lead to loss of natural resources, as some items could have been recycled,
- Discourage people from visiting areas that have become illegal dumping hot spots and
- Can intensify the problem of environmental pollution.

A study conducted in Australia proved how much of a financial burden illegal dumping could be. In 2006/2007, it was reported that councils in South Australia were estimated to have spent \$1.5 million (R21, million) on cleaning up illegal dumps which included used disposable infant diapers. For larger councils, this could be as much as \$350 000 (R4.9, million) a year. The cleanup costs in New South Wales were generally comprised of 51 percent of local council's total expenditure while enforcement took up to 39 percent. This is in comparison to educating the community on good dumping methods that would comprise of 6 percent of the total expenditure (Coker, 2009).

2.4 The Impact of used Disposable Infant Diapers on the Environment

Used disposable infant diapers affect the environment in many ways and the impact can be associated with the material used to manufacture them. The impact relates to physical, social and economic environments.

2.4.1 Physical impact of used disposable infant diapers

The most obvious impact of used disposable infant diapers on the environment is that, in many developing countries, they are dumped in open areas and along roadsides (Pham & Brown, 2009). Dumping of soiled diapers in illegal open dumpsites is reported to expose communities to diarrheal diseases and obnoxious odours. Air pollution from the manufacturer of disposable infant diapers is far more toxic than the air pollution from production and use of cloth diapers. In addition, chemicals such as chlorine, dioxins and sodium polyacrylate are released into the air (Šmajgl & Obhođaš, 2015). Disposable infant diapers have a huge impact on the environment. According to the Environmental Agency (EA), (2005), a disposable infant diaper is responsible for 630 kg of greenhouse gases, which is equivalent to an average car driven over 2 896 kilometres. The infant faeces can leach and contaminate underground water as well as spread communicable diseases when disposed of in landfills. Many disposable infant diapers can decompose within five months, as they are wood or cotton products, while the superabsorbent gel and the plastic need at least 500 years to decompose.

Apart from the solid waste problems, chemicals released by decomposing solid wastes can leak from dumping sites and landfills to ground water. In that way, they can lead to contamination of groundwater, soil and nearby water streams, resulting in waterborne diseases such as cholera (Šmajgl & Obhođaš, 2015; Jaunich, 2016). Million tons of untreated waste are added to landfills each year through disposable infant diapers . The main environmental impacts of disposable infant diapers occur also during transportation, treatment of waste in landfills and in incinerators. Impacts that occur during commercialisation and use are considered less harmful (Aumonier & Collins, 2005). During commercialisation process and use, environmental impact associated with

disposable infant diapers is limited to energy consumption and gas emissions related to transportation and infrastructure maintenance.

Thirty-five percent (35%) of cellulose pulp in baby diapers is mainly obtained from coniferous woods. Therefore, diapers are associated with deforestation or loss of soil quality and biodiversity in cases where cellulose is from plantations (Šmajgl & Obhodaš, 2015). According to Kharaka *et al.*, (2006) renewable energy sources for manufacturing of pulp involves the extensive use of chlorine and alkalis, which often end up in an effluent and result in the synthesis of other potentially harmful substances like dioxins and furans.

In the case of landfilling, the main impacts are the pollution of land, methane emissions and possible leachate to groundwater due to the presence of organic wastes. Disposal of organic waste without pre-treatment may also entail a risk for human health (Women's Environmental Networks (WEN), 2003). The main impacts of waste incineration are emissions of pollutants to the atmosphere, generation of contaminated wastewater and generation of contaminated ashes (Real diaper Association, 2011). The main gases produced due to incineration of diapers are greenhouse gases considering their composition which includes several polymers and organic compounds whose incineration may generate other pollutant substances, such as Chlorine (CL) and Carbon dioxide (CO²) (Riber, 2007).

2.4.2 Social Impact of used disposable infant diapers.

Viruses excreted in human faeces can pose health problems. Most disposable infant diapers are dumped together with household garbage in compost pits while others litter the streets posing a great danger of infection to those who encounter them. Disposable infant diapers contain harmful substances such as dioxins which are stubborn environmental pollutants that can accumulate in human bodies, and when released into the environment they can cause a range of health problems that include developmental delays, compromised immune system, hormone interference, skin diseases and certain types of cancer (WHO, 2014). Furthermore, Wambiu *et al.*, (2015) indicated that the inner absorbent layer of a diaper is treated with chemicals, which can trigger allergic reactions in babies.

Used disposable infant diapers carry faeces and urine, which generally contain pathogens and microorganisms such as viruses and bacteria. These pathogens can lead to numerous infectious diseases in humans. WHO (2014) further indicated that human excreta has been implicated with the transmission of many infectious diseases including cholera, hepatitis, polio, typhoid, cryptosporidiosis, schistosomiasis and ascariasis. Disposable infant diapers generally trap heat and the amount of heat trapped in the diapers may lead to fertility problems in males. In addition, the scrotal skin temperatures of baby boys rise significantly when they are wearing the diapers. Research confirmed that prolonged use of disposable diapers in infants is an important factor contributing to the decline of sperm production among adult males (Maluni, 2020).

Toileting practices can also have dramatic effects on motor development. In parts of Northern China where water is scarce, caregivers lay infants on their backs inside bags filled with fine sand for most of the day. The sandbags were intended to absorb waste effectively and keep infants clean, but unfortunately, they restricted infants' movements severely leading to substantial delays in sitting and walking compared to children who were not sandbagged (Adalat *et al.*, 2007). Extended time between changings of diapers prolongs infants' contact with urine and faeces, which can cause urinary tract infections as well as diaper rash and other dermatological problems on the infant (Sugimura *et al.*, 2009). Diaper rash usually worsens with moist skin. Whether or not a baby's skin is damp depends more on the diapering habits than on the type of diaper. Cloth diapers have the advantage of feeling wet, so that infants and parents know it is time to change.

Skin care in the diaper area needs to be considered in a broad sense, addressing containment and hygienic cleaning aspects as well as cosmetic skin care and aesthetic issues (Hopkins & Westra, 1990). To address the above-mentioned concerns, diaper changes can use a wide variety of cleansing techniques such as immersion bathing, application of lotions, creams, ointments and powders. The habits and practices of caregivers with regards to disposal of disposable infant diapers show significant variability and depend on culture, social status, beliefs, and often, emotional aspects (Maluni, 2020).

According to Modak *et al.*, (2015), diaper rash or irritant diaper dermatitis is a nonspecific medical term that describes a spectrum of symptoms in the diaper area caused by

inflammatory skin reactions. It is still a general agreement among the dermatologist community that diaper rash occurs regularly, although overall incidences and severities have declined. Published clinical and laboratory model studies demonstrated the etiologic factors for diaper rash, which include skin wetness, biochemical irritants, and an increased pH because of skin exposure to excreta. The resulting coenocyte proteins and interstitial lipid lamellae of the stratum cornea result in an impaired barrier function (Wilson *et al.*, 2017).

Mothers are often embarrassed, frustrated, distressed and feel guilty when infants exhibit frequent or severe diaper dermatitis (Heimall *et al.*, 2006). If diaper dermatitis is severe and prolonged, allegations of child abuse and neglect may occur (Scheinfeld, 2005). Stress and concern related to disposable diaper need might have a negative impact on parent-infant relation. This is especially important because women with mental health issues report a higher diaper need than women without mental health concerns, creating potentially greater risk for negative social and emotional effects (Smith *et al.*, 2013). In some instances, mothers may adopt inappropriate toilet training in order to reduce diaper costs.

Hydrated skin is also more prone to mechanical damage and roughness of showing increased coefficient of friction with irritants that may penetrate the stratum cornea more easily. These observations contributed to the understanding that good control of skin wetness and pH are critical for maintaining skin health in the diaper area (Atherton, 2004). The use of ointments provide an efficient skin barrier without occluding the skin. On the other hand, the cosmetic barrier treatment also facilitates easier cleaning of the skin, leaving less residual faecal material and thus fewer potential irritants on skin resulting in the more preference for disposable infant diapers (Kim & Kim 2015).

2.4.3 Economic impact of used disposable infant diapers

Disposable infant diapers are expensive necessities that help parents keep and observe their infant's health. New infants require frequent change of disposable diapers, as regularly as every hour while older infants do change on every three to four hours. Pediatric nurses advised parents to expect six to eight wet diapers per day as an

indication that their infants are sufficiently fed by taking in adequate volumes of breast milk or formula (Shin, 2005). The expected wet diaper guideline extrapolates to 2, 55 million diapers per year at a total annual cost of approximately \$945.00 (R12 000) for disposable infant diapers, using an average per-unit cost as found on an internet-based retail diaper distributor (Karp, 2011). Based on the average 6.3 diapers used per day for American infants, diaper manufacturers estimate the cost higher at \$1,500 (R20000) annually (Browne, 2011). The cost of diapers may even be higher for families with low income because of limited or no access to internet for purchasing and transport costs to supermarkets, discount stores, and warehouses that have the lowest diaper prices. As a result they have to rely on local convenient stores to purchase disposable infant diapers (Neff, 2011). Cloth diapers are seen by some as cost-saving because they may be reused. However, low income families may not have sufficient resources required for the purchase of required amounts and facilities for daily laundering. Furthermore, many childcare centers require infants to wear disposable diapers while almost all mothers consider disposable infant diapers a necessity (Raver *et al.*, 2010).

About forty eight percent (48%) of infants and toddlers under three years of age live in low-income families in the United States. Therefore, disposable infant diapers may be difficult to afford (Addy & Wright, 2010). Families need approximately twice as much income as the country's poverty line estimate of economic resources. Since diaper changes are a routine of infant caregiving, the inability to meet an infant or toddler's need for sufficient diaper changes may negatively affect maternal feeling, such as a mother's feelings of being an incapable parent (Raver *et al.*, 2010).

2.5 Case Studies

Rahat *et al.*, (2014) researched used diaper disposal and its environmental impacts on the populated urban area of Dhaka city, Bangladesh. The article was an attempt to identify locations where diaper pollution was most prevalent. Other goals of the study incorporated data collection concerning the lack of awareness to the issue of disposal of disposable infant diapers and finding possible crosslinks between pollution effects associated with improper diaper disposal. The article contained a preliminary feasibility

analysis and a design suggestion for cost effective, replaceable, environmentally friendly disposable infant diaper changing stations in locations requiring it the most.

Majorin (2017) conducted a study on practices of disposal of child faeces as practices, determinants and health effects in Eastern India. The research had two overall aims, the first of which was to summarise existing knowledge on health impact of safe disposal of child faeces. The second was to advance the understanding of the scope and possible impacts for unsafe disposal of child faeces among the population. The systematic review summarised the evidence on the effectiveness of interventions to improve child faeces disposal for preventing diarrhea and Soil Transmitted Helminthes (STH) infections from 46 studies. The evidence suggested that safe child faeces disposal might reduce diarrhea.

Tembo & Chazireni (2017) investigated the negative environmental impact of disposable infant diapers in Mberengwa District, Zimbabwe. The study's aim was to investigate the challenges caused by diapers on the environment. Disposable diapers were found to pose serious health hazards in several communities in Mberengwa District. Through questionnaires and laboratory analysis, the researchers managed to gather information about the negative impacts of diapers on the environment and communities. A number of problems emanated from the use and mismanagement of disposable diapers. The study thus recommended for the need to consider environmentally sustainable methods of disposing disposable diapers.

2.6. Conclusion

This chapter discussed the status of MSW from generation to disposal and its effects on the environment. It highlighted different MSW disposal methods from a global scale down to South Africa and Limpopo province. It established that lack of proper waste disposal facilities are the main reasons people dispose of waste everywhere on the environment. The chapter also outlined different strategies of waste management, with an emphasis on disposal of disposable infant diapers as components of MSW. Legislations highlighting management of waste composition, more especially of disposable infant diapers were discussed. Local, regional and global case studies were used to show the extent to which

disposal and poor management of waste and specifically used disposable infant diapers are challenges in different countries.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents methodology used in this research study. The chapter commences by providing an overview of the study area, research design and explains in detail the primary and secondary data collection methods, as well as the data analysis techniques.

3.2 Study area

Mashashane Village is in the Polokwane Local Municipality, Capricorn District of the Limpopo Province. Mashashane Village occupies an area of 8.67km² with a total population of 5 395 and 1 424 households (Stats SA, 2011). Ndebele and Sepedi speaking people predominate. Five percent of the population practice subsistence farming while 25% are unemployed (Polokwane Local Municipality IDP, 2018/19).

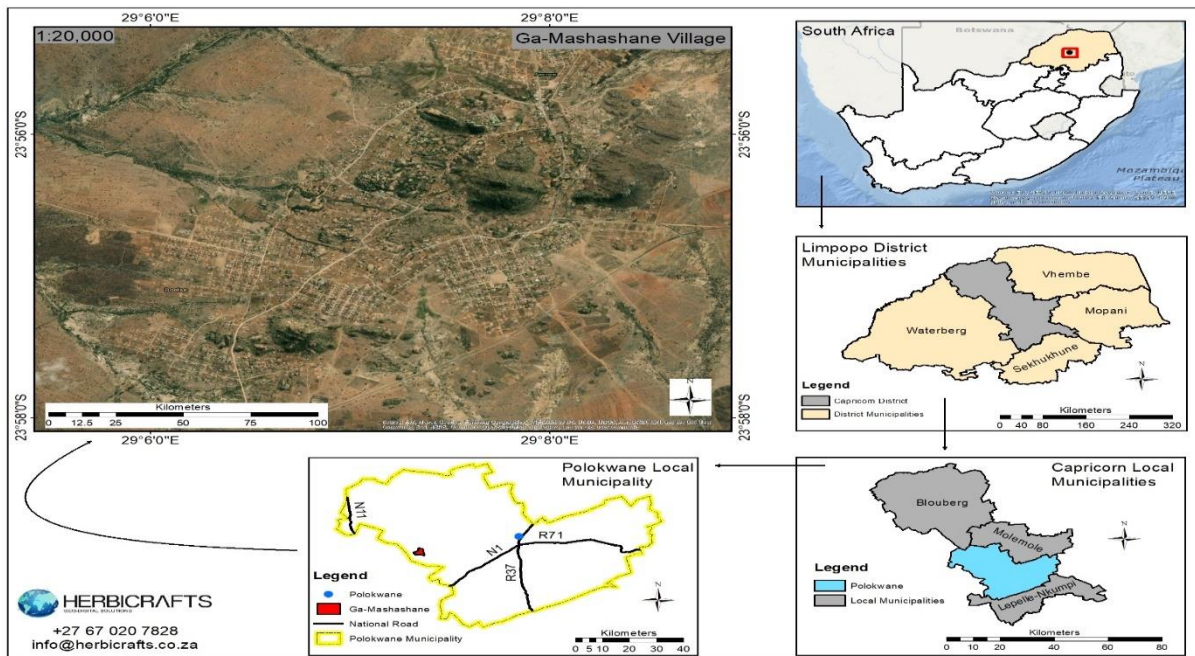


Figure 1: Study area map (Herbicrafts, 2021)

3.3 Research design

Case study research method can be defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, for example when the researcher seeks to establish the causes of a community problem such as illegal waste disposal (Malhotra & Birks, 2006), the study on the disposal of used disposable infant diapers in Mashashane Village, is a case study as it complies with the definition as indicated above.

3.4 Sampling

Bryman & Bell (2011) defined sampling as the process of selecting units such as people, objects, etc. from a population of interest, so that by studying the sample the researcher may fairly generalise results to the population. The sampling frame for this study was all 1 424 households of Mashashane Village. This study used purposive sampling, which is a sampling technique whereby the researcher uses his or her own judgment to choose members from a population to participate (Charmaz, 2006). The sample size for this study was therefore, determined by the presence of households with infants 0-24 months who use disposable infant diapers. People in the streets of Mashashane Village were arbitrarily asked to help identify the first household with infants using disposable infant diapers. From this first household the researcher applied snowballing technique to find the next relevant household. A total of 90 households were found to have infants who were using disposable diapers.

3.5 Data collection methods

Data collection methods refer to ways of gathering information to address critical evaluation questions that the researcher has identified (Ayres, 2006). Data collection is an important aspect of any type of research study. In this study, primary data sources were field observation and questionnaire surveys. Questionnaires are some of the primary sources of data that consist of a series of questions asked to a respondent in a written form, who also responds in writing (Malhotra & Birks, 2006). Ninety (90) questionnaires were distributed among mothers of infants using disposable infant diapers. Field observation is a method for obtaining information that involves inspection of variables or assembling data necessary for measuring the variable under investigation

(Douglas, 2015). The researcher visited the area of study and observed how conditions were with regards to disposal of disposable infant diapers and took notes as well as photos of the places where disposable infant diapers were disposed of.

Table 3.1: Summary of data collection methods.

Objective	Tool(s)	Type of information
Degree to which Mashashane community/mothers use disposable infant diapers.	Observations and questionnaire surveys	The extent in which community/mothers use disposable infant diapers.
How and where used disposable infant diapers were disposed of.	Observation and questionnaire surveys	Manner and place of disposal of used disposable infant diapers.
Reasons for disposing of used disposable infant diapers where they did.	Questionnaire surveys	Separation, storage, collection, treatment, recovery and disposal of used disposable infant diapers.
Awareness and perception of respondents.	Questionnaires surveys	Perceptions regarding effects of used disposal of disposable infant diapers on the environment.

3.6 Data analysis and presentation

Quantitative data was analysed using Statistical Package for the Social Sciences (SPSS) software 2013 and the results were presented in the form of table, bar graphs and pie charts. Descriptive statistics were run to give frequencies. Qualitative data was analysed using themes and photographs. Multiple response questions were analysed into frequencies and percentages. Notes taken during site observation were summarised and linked to the photos taken. Logical conclusions on how the disposal of used disposable infant diapers affect the environment were made.

Table 3.2: Summary of data analysis and presentation.

Objective	Analytical Method	Presentation
Degree to which Mashashane community/mothers use disposable infant diapers.	Spatial and Thematic Analysis	Photos and Narrative Description
Where used disposable infant diapers were disposed of.	Spatial Analysis	Photos and maps
Reasons for disposing used disposable infant diapers.	Descriptive Statistics	Tables and Graphs
Awareness and perception.	Thematic Analysis	Narrative Description

3.7 Ethical Considerations

The researcher obtained ethical clearance from the University of Limpopo's Turfloop Research Ethics Committee (TREC) and other relevant authorities before data collection. Other important ethical considerations of the study included seeking informed consent from respondents and assuring respondents of anonymity and confidentiality of the information supplied.

3.8 Limitations of the study

The general intention of this study was to understand the challenges of disposable infant diapers, in rural areas with reference to Mashashane Village. During the collection of data, the following challenges emerged and solutions thereof were sought.

- It was a challenge to find the first household with an infant between 0 to 24 months. As a result, the researcher entered many houses asking for referrals of households with infants that use disposable diapers until one was found. Thereafter, the researcher started to receive correct referrals for similar households.
- Most interviewees were uncomfortable in terms of disclosing where they dispose of used disposable infant diapers, fearing that they may be reported and penalised. The

respondents were therefore reassured that the questions asked were for educational purpose and that their identities will remain confidential.

- Although interviews were conducted during the week, some respondents were unavailable so some houses were visited over the weekend.
- There was a problem of transport to the village because many taxis went as far as the main road. As a result, the researcher had to hire a van to visit the village. In addition, the hired van only went up to a certain distance because the gravel road was not in good condition so the researcher had to walk the remaining distance. This impacted on time spent collecting data.
- Dogs were a deterrent to visiting homes, so visits were delayed at times.

3.9 Conclusion

This chapter explained in detail methodology for this research study, taking into consideration aspects such as research design, sampling which included sampling frame, sampling size and sampling techniques, data collection methods, data analysis and presentation, as well as ethical Clearance and Limitations of the Study. The findings and discussions of the results of the study are discussed in detail in the next chapter.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussion of the research project. The research study exposed ways in which used disposable infant diapers are disposed of and how the Mashashane community is affected by the disposal of used disposable infant diapers. The study also established reasons behind the manner of disposal adopted by the residents of Mashashane. Graphs, photos and tables are used to present the findings of the study.

SECTION A: RESULTS

4.2 Demographic characteristics of the community of Mashashane Village

4.2.1 Age of respondents in years

Age in this context refers to the interval of time between the day, month and year of birth and the day and year of occurrence of the interview or administering questionnaires (Krafchik, 2016).

Table 4.1 Age of respondents and the percentages

Age	Percentage
20 and younger	10
21-30	50
31-40	25
41 and Above	15

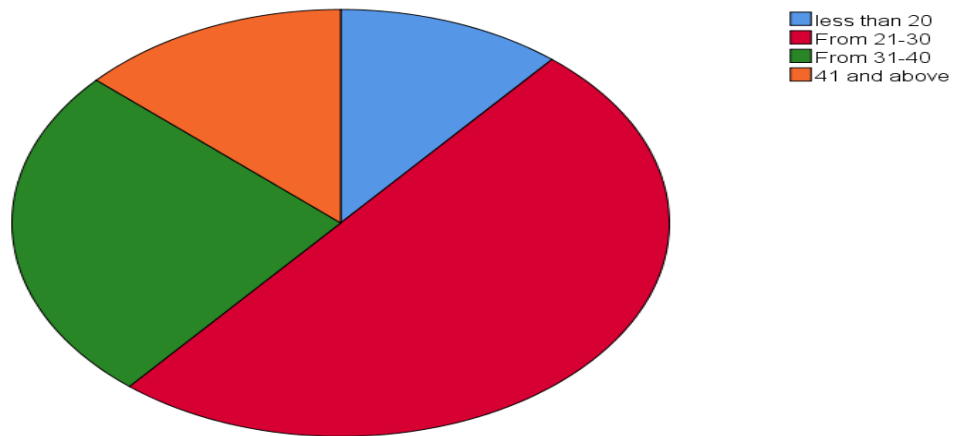


Figure 4.1 Age of respondents in years.

The relationship between ages of respondents is in this regard important to the responses of the respondents. Respondents who were under 20 years of age constituted 10%, those aged 21-30 years constituted 50%, while the age category of 31-40 years totalled 25% and those aged 41 years and above were at 15% as seen in Table 4.1 and Figure 4.1.

4.2.2 Gender of respondents in Mashashane Village

In the context of this study, gender refers to characteristics, behaviour and roles deemed appropriate as expected of men and women including boys and girls of a given society (Rolleri, 2012). In this study, male respondents totalled 4% and female respondents were at 96%.

4.2.3 Marital status of the respondents in Mashashane Village

Marital status refers to the state of being married or unmarried, used on official forms to indicate whether a person is married, single, divorced, or widowed (Arber, 2004).

Table 4.2: Marital Status of the respondents in Mashashane village

Marital status	Percentage
Single	77
Married	19
Widowed	3
Divorced	1

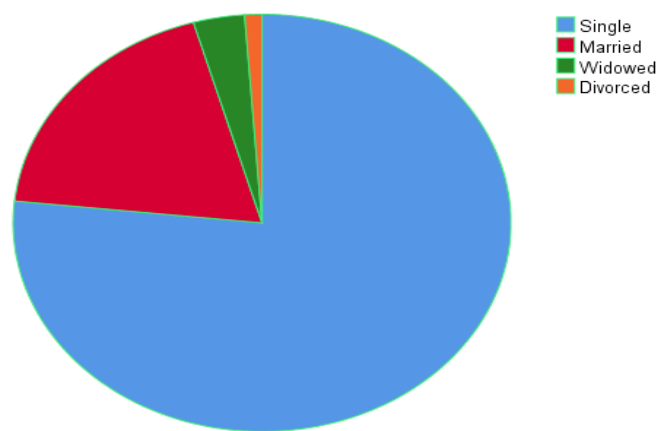


Figure 4.2 Marital status of the respondents in Mashashane Village.

In this study, seventy-seven percent (77%) of the respondents were single, 19% married, 3% widowed and only 1% was divorced.

4.2.4 Number of infants in each household

An infant is a child in the early stages of life (Van Voorhees *et al.*, 2014).

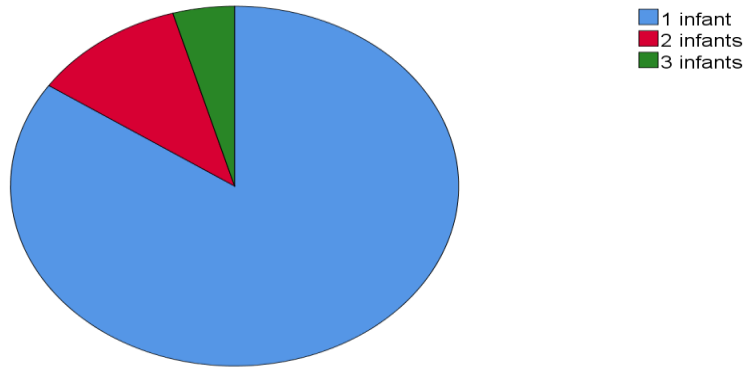


Figure 4.3 Number of infants per household in Mashashane Village.

Eighty-four percent (84%) of the respondents had one infant, 11% had two infants and 5% had three infants. All infants wore disposable diapers.

4.2.5 Age of infants in months

Age of infants refers to the number of months from the day the baby is born until a stage of being a child (Mason *et al.*, 2004).

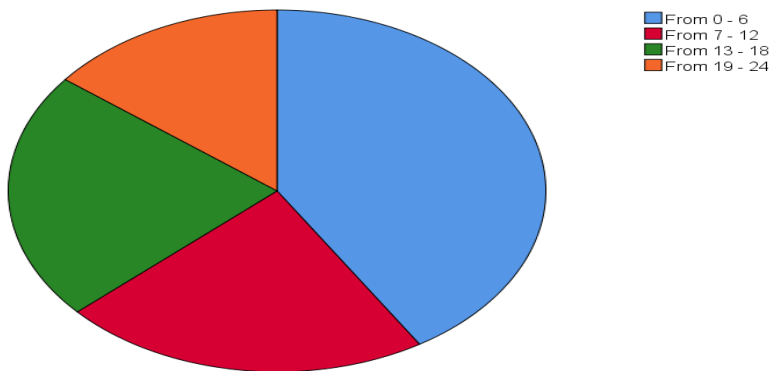


Figure 4.4 Age of infants in months in Mashashane Village.

The responses in Figure 4.4 indicates that infants aged 0-6 months were at 41%, infants from 7-12 months totalled 22%. Infants from 13-18 months were at 22% and those from 19-24 months old constituted 15%.

4.3.1 Educational level of respondents in Mashashane Village

Educational level refers to the highest stage of learning that a person has achieved. At primary and secondary school levels, educational attainment refers to the highest grade completed or whether one has or has not obtained a secondary school education, diploma or an equivalent certificate (Ardila *et al.*, 2000).

Table 4.3: Educational level of respondents in Mashashane Village

Educational Level	Percentage
None	3
Primary	3
Secondary	66
Tertiary	28

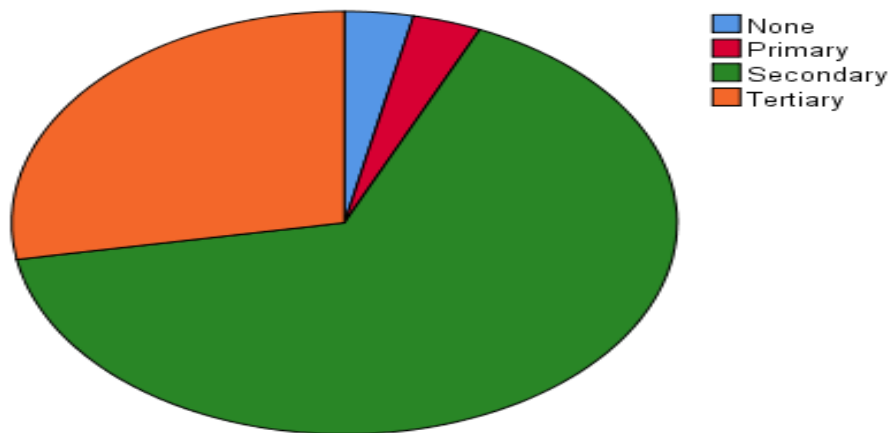


Figure 4.5 Educational level of respondents in Mashashane Village.

Three percent (3%) of the respondents had no schooling experience, another 3% had primary education, while 66% of the respondents indicated that they had secondary education and 28% had tertiary education.

4.3.2 Employment status of respondents in Mashashane Village

Employment status refers to the position of a worker in a company or institution, but in this context, employment status refers to whether a person is working or not (Bodibe, 2006).

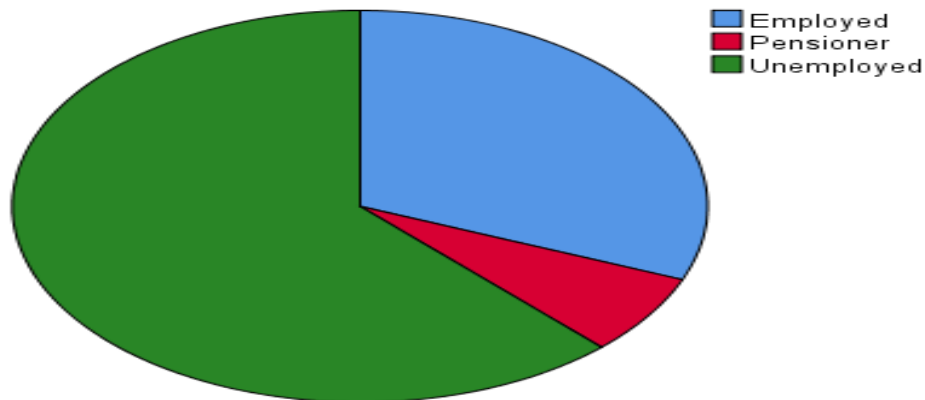


Figure 4.6 Employment status of respondents in Mashashane Village.

Figure 4.6 is a presentation of responses from all sampled respondents about the status of employment. About 62% of the respondents were unemployed, while 30% indicated that they were employed and 8% were pensioners.

4.3.3 Monthly income of respondents in Mashashane Village

Monthly income refers to gross monthly wages or salaries for employees before deductions of Central Provident Funds (CPF) contributions and personal income tax. It comprises of basic wages, overtime pay, commissions, tips, other allowances and one-twelfth annual bonuses (Dyran *et al.*, 2012).

Table 4.4: Income Level of respondents in Mashashane Village

Income Level	Percentage
Less than R5 000	79
From R5 001 - R10 000	12
From R10 001 – R15 000	3
Greater than R15 000	6

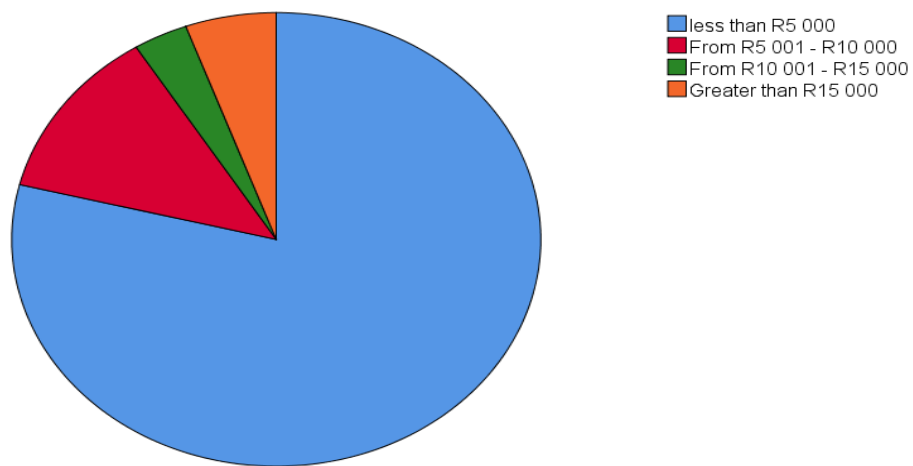


Figure 4.7 Income level of respondents in Mashashane Village.

Figure 4.7 presents responses to the questions about monthly income of respondents. It was found that 79% of the respondents received monthly income of less than R5 000. Income of R5 001-R10 000 was received by 12% of the respondents while R10 001-R15 000 was received by 3% of the respondents and more than R15 000 was earned by only 6% of the respondents.

SECTION B: DISCUSSION

4.4 Demographic characteristics of the respondents of Mashashane Village

In this study, the relationship between age of a mother and the use of disposable infant diapers plays an important role. Young mothers (21-30 years) prefer to use disposable infant diapers than cloth infant nappies. The reasons given for the high usage of disposable infant diapers by mothers in this age category was that disposable infant diapers are convenient as mothers do not have time to wash the cloth infant nappies and that disposable infant diapers do not cause nappy rash. The relationship was determined by means of a Pearson Chi-Square test.

$$X^2 = \sum(\text{Obs} - \text{Exp})^2 / \text{Exp}.$$

Where,

Obs = Observed frequency

Exp = Expected frequency

\sum = Summation

X^2 = Chi Square value

H_0 means that there is a relationship between age of respondents and the use of disposable infant diapers.

H_a means that there is no relationship between age of respondents and use of disposable infant diapers.

Table 4.5: Relationship between age of respondents and use of disposable infant diapers.

Age of respondents (years)	Less than 20	21-30	31- 40	41+	Total
Disposable infant diapers use (observed)	10	45	23	12	
Expected	22.5	22.5	22.5	22.5	90
(Obs-Exp)	-12.5	22.5	0.5	-10.5	
(Obs-Exp) ²	156.25	506.25	0.25	110.25	
(Obs-Exp) ² / Exp.	6.94	22.5	0.1	4.9	

$$\sum(\text{Obs} - \text{Exp})^2 / \text{Exp} = 6.94 + 22.5 + 0.1 + 4.9 = 34.44$$

$$X^2 = 34.44$$

$$\alpha = 0.05$$

$$DF = (R-1) (C-1) = (2-1) (4-1) = 3$$

$$\text{Critical Value} = 7.81$$

Rejected H_0 ; $P < 0.05$, because the significance value (0.05) is below critical value (7.81) at a degree of freedom of 03.

The results indicate no relationship between age and the use of disposable infant diapers. Disposable infant diapers are therefore, used by all mothers who can afford them or prefer to use them.

Traditionally, women play a major role in terms of sanitation, through household chores such as preparation of food, collection of water, changing of children's nappies, cleaning, etc. Men are traditionally providers for the family and play no role in baby care. It is therefore, evident from the research findings that this study had more female respondents than males. Furthermore, gender plays an important role when it comes to waste

management, because women are more affected than men. According to Akanle *et al.*, (2017), in Africa men are regarded traditionally as superiors. As a result, they do not perform household chores. Instead, they participate less in family matters and expect to be served by their wives and children thereby driving common gender stereotypes of women as housekeepers.

A study conducted in Nigeria by Akanle *et al.*, (2017) highlighted that culture and tradition do not generally support men to engage in domestic roles such as cooking, fetching water, doing the dishes and laundry. However, the study established that some men have favourable household chores. For example, one woman singled out her husband by saying that he enjoys cleaning the house more than she does.

According to the responses of the marital status, marriage is not a prerequisite to have a baby. Many mothers in Mashashane Village are single. This might be due to the need to access child grant. Other reasons might be peer pressure and absence of guidance from parents or guardians. A Pearson Chi-Square test was done to determine whether there is a relationship between marital status and the use of disposable infant diapers in Mashashane Village:

$$X^2 = \sum(\text{Obs} - \text{Exp})^2 / \text{Exp}.$$

Table 4.6: Relationship between marital status of respondents and use of disposable infant diapers.

Marital Status	Single	Married	Widowed	Divorced	Total
Disposable infant diapers' use (observed)	77	19	3	1	
Expected	22.5	22.5	22.5	22.5	90
(Obs-Exp)	54.5	-3.5	-19.5	-21.5	
(Obs-Exp) ²	2970.25	12.5	380.25	462.25	
(Obs-Exp) ² / Exp.	132.01	0.56	16.9	20.54	

$$\sum(\text{Obs} - \text{Exp})^2 / \text{Exp} = 132.01 + 0.56 + 16.9 + 20.54 = 170.01$$

$$X^2 = 170.01$$

$$\alpha = 0.05$$

$$\text{Critical Value} = 7.81$$

Rejected H_0 ; $P < 0.05$ because the critical value (7.81) is greater than the significant value (0.05) calculated at 3 degrees of freedom. Therefore, there is no relationship between marital status and the use of disposable infant diapers. This means that disposable infant diapers are used by anyone who affords to buy them.

4.5 Socio-economic characteristics of the respondents in Mashashane Village

It is observed that many people in rural areas like Mashashane Village do not continue with their education to higher institutions of learning while others do not even manage to go to high school or even school. As a result, most of the youth drop out of school earlier than expected, as they are to help support their families financially because of parents not working or not having enough money to provide the households' needs.

The high percentage of unemployment is a cause for concern, because that would mean that there are many respondents who depend on child grants for survival. This promotes a high rate of pregnancy, which in turn stimulates production of more disposable infant diapers. Adato *et al.*, (2007) used a case study of a mother of two in Kwa-Zulu Natal as an illustration of dependency on child grant as follows:

Mbali was a 22-year-old mother of two living in Zululand doing Grade 12. Mbali received Child Support Grants (CSGs) for each of her two children, a four-year old girl and a boy of one year. She stayed in a rural household with other 5 adults and 10 children. She had to leave school in 1999 because she fell pregnant and had to resume her studies the following year. In 2002, she fell pregnant and left school again. She started to receive two CSGs for her two children in September 2003 and began to attend school again in 2004. Mbali said that she was the only person to make decisions on how to spend her CSG money as the money made a huge difference in the family.

Respondents who were unemployed and depended on CSGs were in larger numbers in the community of Mashashane Village and they earned less than R5 000 a month. The other reason for the large percentage of residents earning less than R5 000 can be associated with the level of education. A Pearson Chi-Square test was done to determine the relationship between income level of respondents and use of disposable infant diapers:

$$X^2 = \sum(\text{Obs} - \text{Exp})^2 / \text{Exp}.$$

Table 4.7: Relationship between income level of respondents and use of disposable infant diapers.

Income level (R)	Less than R5000	R5001–R10 00	R10 001-R15 000	R15 000+	Total
Observed	71	11	3	5	
Expected	22.5	22.5	22.5	22.5	90
(Obs-Exp)	48.5	-11.5	-19.5	-17.5	
(Obs-Exp) ²	2352.25	132.25	380.25	306.25	
(Obs-Exp) ² / Exp.	104.54	5.87	16.9	13.61	

$$\sum(\text{Obs} - \text{Exp})^2 / \text{Exp} = 104.54 + 5.87 + 16.9 + 13.61 = 140.92$$

$$X^2 = 140.92$$

$$\alpha = 0.05$$

Critical Value = 7.81

Rejected H_0 ; $P < 0.05$, because level of significance value (0.05) is lower than critical value (7.81) with a degree of freedom of 03.

The test for relationship done showed that there is no relationship between the use of disposable infant diapers and monthly income of respondents. This is so because the P value (0.05) is less than the critical value (7.81) and this shows that anyone who afford to buy disposable infant diapers can use them.

Eighty-four-percent (84%) of the mothers who were in the early 20s, said they were not ready to have children, but due to circumstances beyond control such as lack of employment, not attending school, they ended up falling pregnant.

4.6 The degree of use of disposable infant diapers

Infants differ in the use of disposable infant diapers needed in a day from birth to the age at which they stop using disposable infant diapers. Younger infants use about six disposable infant diapers per day while older ones use about two disposable infant diapers a day. Babies need their diapers changed less frequently as they get older. A new-born baby may need 10 or more diaper changes per day, while a toddler may use more or less five disposable infant diapers per day. A study conducted by Aronson & Shope (2008) in Washington, United States of America, showed that more than 50% of mothers reported three or more changes per night and that nearly one-third reported four or more diaper changes per night. A follow-up study observed that a higher frequency of nocturnal diaper changes cause infants' sleep disruptions, as well as shorter sleep periods, in babies who wear disposable infant diapers at night than in those using cloth nappies.

4.6.1 The number of mothers using disposable infant diapers in Mashashane Village.

This refers to mothers and caregivers who use disposable infant diapers to care for infants. Ninety-nine percent (99%) of the respondents use disposable infant diapers to care for their infants while 1% uses cloth nappies.

4.6.2 Reasons for using disposable infant diapers

It is believed that the reason behind the large use of disposable infant diapers is attributed to their user-friendly character and the fact that disposable infant diapers do not cause

baby rash. It is estimated that 90-95% of diapers used in developed countries are disposable (Edana, 2008).

Studies have indicated that disposable infant diapers are associated with better hygiene. Research in the United States of America has shown hygiene benefits of disposable infant diapers versus cloth diapers in day care environments (Kamat & Malkani, 2003).

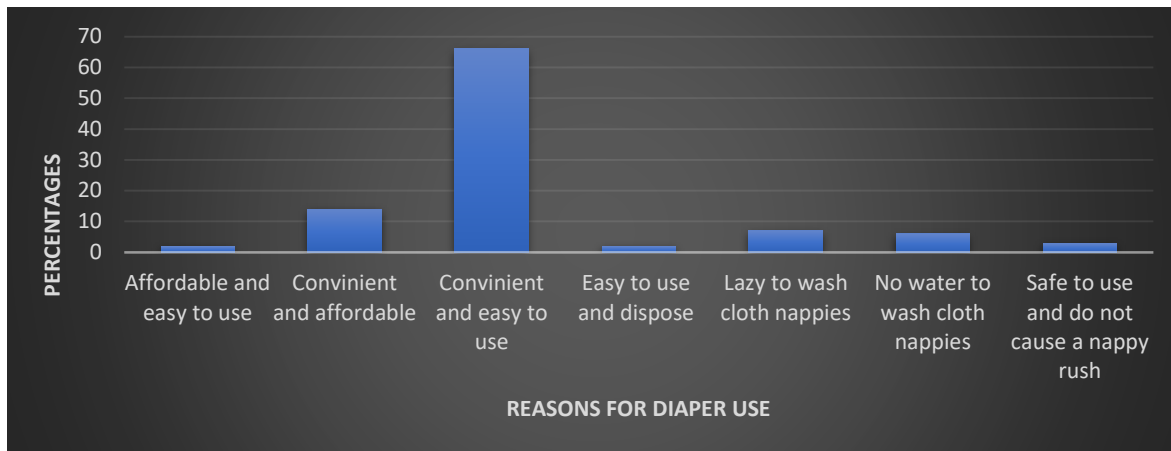


Figure 4.8 Reasons for using disposable infant diapers.

Those who used disposable infant diapers had various reasons for doing so. Out of respondents who used disposable infant diapers, 14% indicated that they found disposable infant diapers affordable and easy to use, whereas those who found disposable infant diapers convenient and affordable were 2% and those who found disposable infant diapers convenient and easy to use constituted 66% of the respondents. Respondents who mentioned that disposable infant diapers are easy to use and to dispose of, formed 2%. On the other hand, seven percent (7%) of the respondents said that, they used disposable infant diapers because of laziness to wash cloth diapers and 6% of the respondents indicated that they used disposable infant diapers because of lack of adequate water to wash cloth diapers constantly. The remaining 3% indicated that disposable infant diapers are safe to use and do not cause nappy rash. In comparison to cloth nappies, disposable infant diapers offer benefits that help reduce the possibility of potential infections (Edana, 2008).

4.6.3 Number of disposable infant diapers used per infant per day

Number of disposable infant diapers used in a day refers to the total number of disposable infant diapers used in each household per infant in a day, starting from morning until evening.

Table 4.8 Number of disposable infant diapers used per infant per day

Number of disposable infant diapers per infant per day	Number of households	Percentage (%) of infants using disposable diapers
1	4	4%
2	7	8%
3	17	19%
4	17	19%
5	16	18%
6	20	22%
7	3	3%
8	4	4%
9	3	3%

Table 4.7 is a presentation of the number of disposable infant diapers used daily. About 4% of the infants used one disposable infant diaper per day, 8% used two disposable infant diapers and 19% used three disposable infant diapers per day, while the other 19% used four disposable infant diapers daily. Eighteen percent (18%) used five disposable infant diapers per day, 22% used six disposable infant diapers per day and 3% of the infants used seven disposable infant diapers daily, while 4% used eight disposable infant diapers daily and 3% used nine disposable infant diapers per day.

4.7 Management practices of used disposable diapers in Mashashane Village

4.7.1 Storage of disposable infant diapers before disposal in Mashashane Village

Storage in this context refers to safekeeping of used disposable infant diapers before disposal. This means the materials are kept for collection and disposal after they are discarded (Ali et al., 2017).

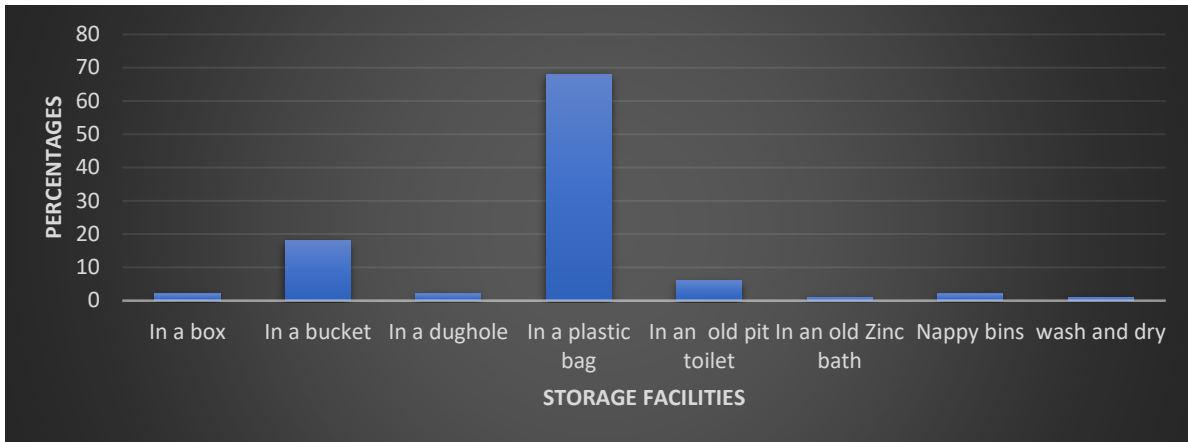


Figure 4.9 Storage of disposable infant diapers in Mashashane Village before disposal.

The researcher asked respondents about the availability of storage containers for disposable infant diapers before they are disposed of. The responses were that 68% of the respondents stored used disposable infant diapers in plastic bags before disposal, 18% used buckets as storage and 6% threw them into pit toilets. On the other hand, 2% used boxes, another 2% dug holes in the backyard and the other 2% used nappy bins as storage. A small percentage (1%) stored the used disposable infant diapers in an old zinc bath, while another 1% washed and dried the used disposable infant diapers before burning them.

4.7.2 Waste separation in Mashashane Village

Waste separation is a process whereby waste at the source, is sorted in order to make the process of disposal easy. Household waste separation at the source is an appropriate waste management approach through which environmental health hazards are controlled. According to McDougall *et al.* (2001), waste separation is a critical component of a successful Integrated Waste Management System (IWMS).

Ninety-seven percent (97%) of the respondents separated their waste. That might be because most respondents burn their waste and use wet waste to feed domestic animals such as pigs, goats, chicken, etc. Only 3% did not separate their waste. That means used disposable diapers are mixed with other waste in one container or plastic.



Plate :4.1 Unseparated dumped waste (Field Work: 2018)

Waste separation increases the quality of compost, recyclables and improves incineration. It also assists in better financing of waste management activities and reduces the energy and labour inputs for any downstream processes (Murray et al., 2015).

4.7.3 Respondents' reasons for or against waste separation

Source separation is widely accepted as a key means to reduce waste and enhance recycling and disposal efficiency (Owens *et al.*, 2000).

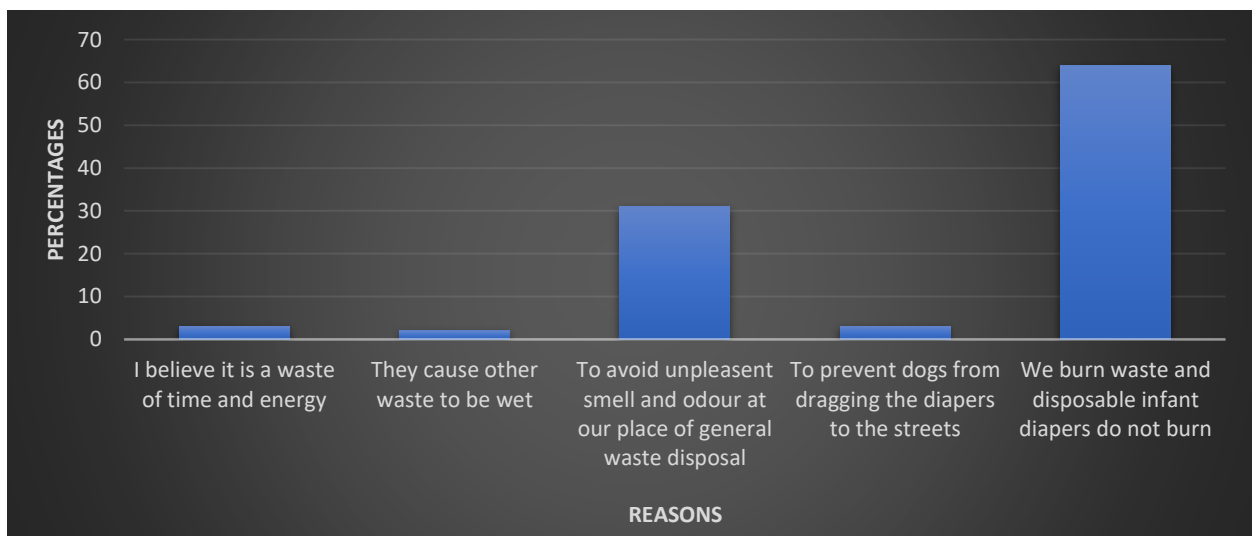


Figure 4.10 Reasons for waste separation or not for waste separation.

The respondents gave reasons (Fig 4.10) why they separated or did not separate waste. Three percent (3%) of the respondents did not separate waste. The reason being that they regarded separation as a waste of time and energy. Sixty-four percent (64%) of the respondents indicated that they separated waste because used disposable infant diapers do not burn easily. On the other hand, 31% of the respondents separated waste in order to avoid unpleasant smell at the places of generation, while 3% separated waste to prevent dogs from dragging away the used disposable infant diapers in the streets. The remaining 2% of the respondents separated waste because used disposable infant diapers wet other waste such as paper at the place of disposal. Waste separation poses a serious challenge to communities and therefore requires urgent attention. A case study of domestic waste disposal practices and perceptions of private sector waste management in urban Accra, Ghana conducted by Ramatta *et al.*, (2014) revealed that most of the respondents did not separate waste. Out of the 364 households, only 63 (17.3%) separated waste before storage, while the remaining 301 (82.7%) did not do any form of solid waste separation. This is a reflection of what happens in most African cities. Such conditions create a suitable environment for breeding of disease vectors, such as mosquitoes, cockroaches, and the production of rodents like rats and mice, which pose a threat to public health.

In many developing countries such as South Africa, especially in rural areas of these countries people practice waste separation without knowledge of why they do so. They just see themselves putting used disposable infant diapers to one side and the other waste on the other side so that they can burn the dry waste. As a result, many people do some waste management processes at home without knowledge of managing waste and how best to do it.

4.7.4 Collection of waste in Mashashane Village

Waste collection simply refers to gathering of waste for transportation to disposal site (Ali *et al.*, 2017). Since there was no waste collection, participants gave views about the importance of waste collection in the Village of Mashashane. Ninety-eight percent (98%)

of respondents agree that it is important to have a waste collection system and 2% responded that there is no need to have a waste collection system in Mashashane Village.

Figure 4.11 presents all the reasons given for the need of a waste collection system in the village of Mashashane. Of all respondents who said it is important to have a waste collection system, 86% indicated that collection of waste help reduce open dumping of used disposable infant diapers as well as other waste.

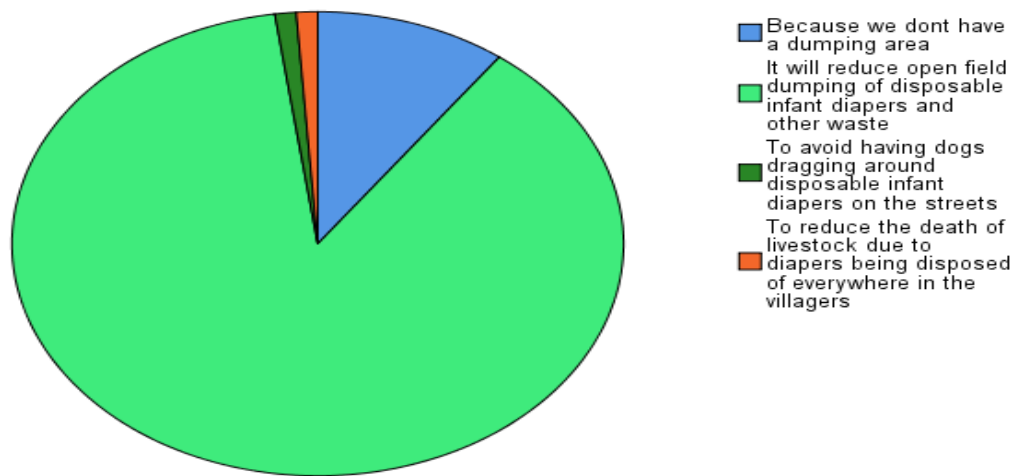


Figure 4.11 Reasons for waste collection in Mashashane Village.

Ten percent (10%) of the respondents agreed to have a waste collection system, because there is no legal dumping site in Mashashane Village, 1% believed that there is a need for waste collection in order to reduce the death of livestock caused by consumption of plastics that compose disposable infant diapers that are thrown everywhere in the village. The remaining respondents (1%) also agreed that having a waste collection system is important because it helps stop dogs from dragging disposable infant diapers in the streets. Two percent (2%) of the respondents who said no to collection mentioned that there was no need for waste collection, as they preferred to burn the waste than having them collected.

- The high percentage of disposable infant diaper storage in plastic bags might be the fact that Mashashane Village is in a remote area with no access to sanitary services. In anyway, the reason given was that plastic bags are accessible and make good

carriers as well as easy to dispose of. Storage for MSW at the source is substantially lacking in most of the rural areas of Limpopo province such as Mashashane Village. Hence, the place of generation or disposal is also a storage facility.

- Waste separation comes naturally more especially when it consists of general waste such as paper and wet waste (food waste and used disposable infant diapers) which cause bad odour to other waste types. If separation of MSW including used disposable infant diapers does not take place at the source, the waste finally finds its way to the disposal site (photo 4.1).

The responses show evidence that majority of respondents deem it a necessity to have a waste collection system in place in order to protect the community of Mashashane Village from unpleasant consequences such as bad odour, damaged scenery, diseases, etc. Collection efficiency is high in countries where private contractors and NGOs are engaged in the collection and disposal of MSW. Many countries are unable to provide waste collection services to all parts more especially the rural parts of countries.

In a study by Ogola *et al.*, (2011) it was observed that in the city of Polokwane, waste from households was not sorted. Instead, all waste collected from individual households was put into refuse bags. That makes recycling of wastes from homes impossible by reducing the quality of recyclable wastes such as paper and cardboard. The waste refuse bags from households were collected weekly on a specific day from each suburb. For example, for Ivy-Park, collection was on Thursdays, for Flora-Park on Wednesdays and for Ster-Park on Tuesdays. The amount of waste collected weekly from these residential areas and the city center amounted to 456 m³. The collection system is quite effective as no refuse bag is left by the roadside to litter the city. In fact, there are four cooperatives involved in litter picking in the city with a total number of 47 workers and a four-ton truck for collection of waste from litter picking groups. The municipality had 13 contractors that collect waste from residential areas in refuse bags and bins in the business area. Furthermore, there are 3 load ladders that collect solid waste from the skip bins at the

factories, 7 grabs that collect waste in transfer stations and illegal dumping areas, and 3 multi-lifts for waste bins at the factories.

The manner in which members of Mashashane community disposed of used disposable infant diapers is influenced by lack of knowledge on how used disposable infant diapers would in the end affect the quality of the physical, social and economic environments. Used disposable infant diapers affect the physical environment by degrading arable land, water bodies as well as polluting air in a manner that can cause those with breathing problems to stay indoors to avoid encountering polluted air. Consequently, the government or the private entity might suffer serious financial setbacks by trying to take care of the environment for the sake of those living in it. Absence of a waste collection facility also influences the manner of disposal of waste in Mashashane Village.

Open-air burning is practised mainly in rural and agricultural areas, where pollutants may settle on crops, in lakes and rivers and where animals graze or live. These pollutants can negatively affect microorganisms, plants, fish and mammals, or may settle on plants eaten by livestock. The pollutants are then absorbed into the animals' digestive system and stay in the food chain. In addition, smoke from open-air-burning results also in black carbon or "soot", which contributes to climate change. Bottom ash (heavier ash) may cause local soil contamination or be carried off-site with surface water runoff (Okecha, 2000).

According to Niklasson (2007), there is very little literature on disposable infant diapers practices and on how used diapers should be disposed of. The norm is that diapers need to be cleaned and the soils drained down the toilet. Untreated faeces and urine are removed when used diapers are disposed of (Rahat *et al.*, 2014). Manaf *et al.*, (2009) reported that in Canada, diapers are not collected separately but are instead disposed of as MSW with the majority ending in landfills, incinerators and composting or anaerobic digestion facilities. People in areas where waste collection is poor tend to improvise by using plastic bags for storing waste that includes used diapers. The plastic bags are often dumped in open spaces near homes where they become part of the MSW stream (Ramaswamy & Sharma, 2011).

4.8 Disposal of used disposable infant diapers in Mashashane Village.

4.8.1 Manner of disposal of used disposable infant diapers in Mashashane Village

Disposal is the fate of all solid waste in Solid Waste Management System (SWMS) (Vesilind *et al.*, 2002).

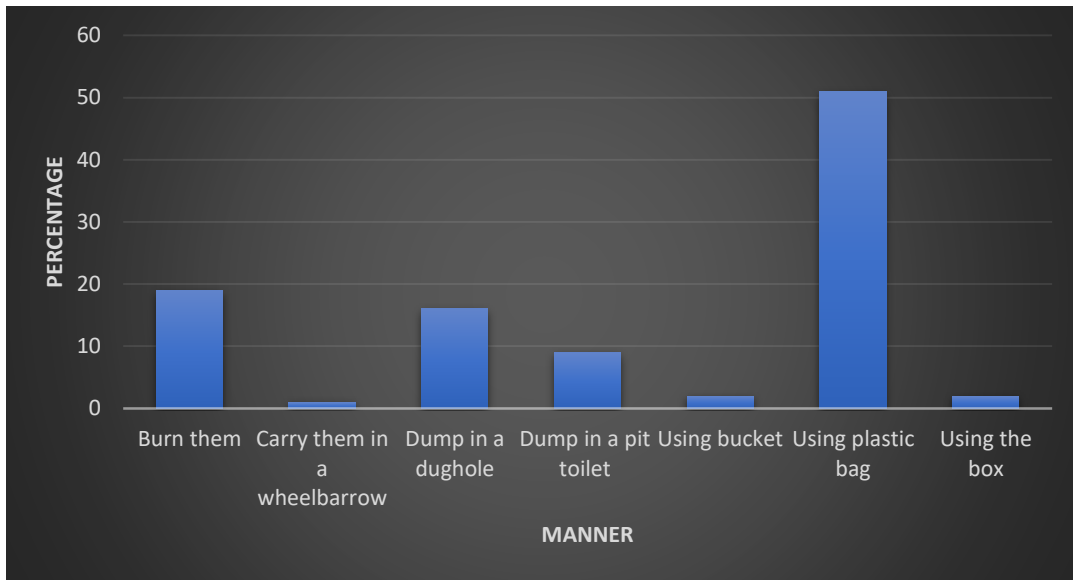


Figure 4.12 Manner of disposal of used disposable infant diapers in Mashashane Village.

Participants in Mashashane Village indicated how they dispose of used disposable infant diapers as shown in Figure 4.16. Nineteen percent (19%) of the respondents washed, dried and burnt the used disposable infant diapers in the homes, 1% carried the used disposable infant diapers in wheelbarrows to the place of disposal and 16% of the respondents disposed of the used disposable infant diapers in a hole dug in the backyard and buried them. Nine percent (9%) dumped used disposable infant diapers into pit toilets, 2% used buckets, 51% of the respondents used plastic bags to dispose of the used disposable infant diapers, and the remaining 2% used boxes.

4.8.2 Places of disposal for used disposable infant diapers in Mashashane Village

Place of disposal in this context refers to a site used for the accumulation of waste with the purpose of disposing or treating such waste, as is the case at a landfill site (Manaf *et al.*, 2009).

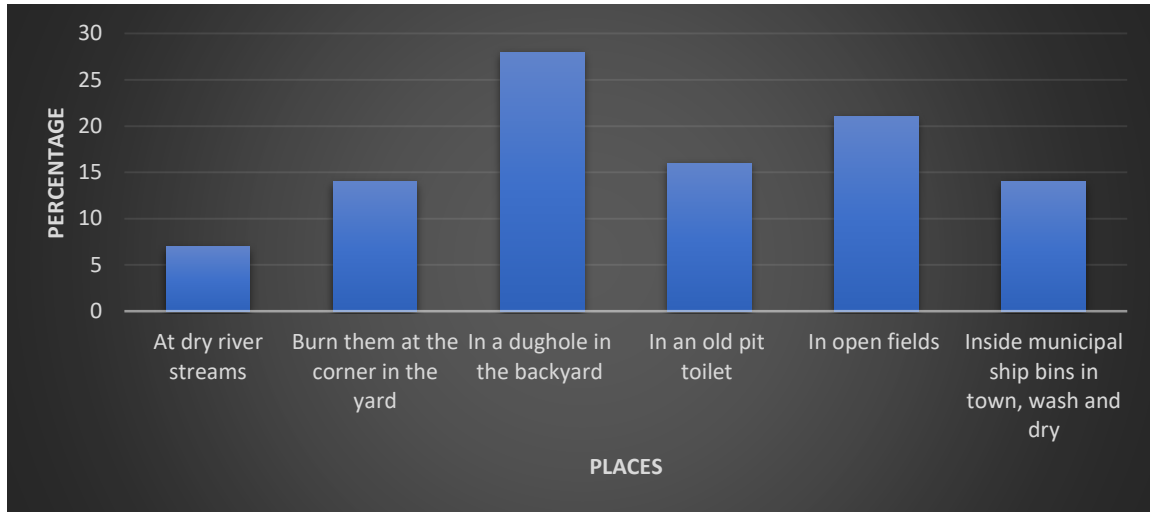


Figure 4.13 Places of disposal for used disposable infant diapers in Mashashane Village.

Figure 4.13 is a presentation of the responses about the place of disposal for the used disposable infant diapers. Twenty-eight percent (28%) of the respondents said that they dispose of used disposable infant diapers in a hole dug in the backyard (plate 4.2), twenty-one percent (21%) disposed of used disposable infant diapers in open fields (plate 4.4) and 16% disposed of the used disposable infant diapers in an old pit toilet in the yard. About 14% of participants disposed of the used disposable infant diapers into skip bins in town, while another 14% burnt them at a corner in the yard. The remaining 7% dumped the used disposable infant diapers in dry river streams.



Plate :4.2 A dry river stream wherein used disposable infant diapers are disposed of in Mashashane Village (Field Work: 2018)

It would be good to have a reliable and well-managed site for waste disposal, because it makes the process of waste management easy, more especially with the disposal of used disposable infant diapers. In as much as disposable infant diapers take more than 500 years to biodegrade on land and thereby reduce the lifespan of landfill sites, used disposable infant diapers require a controlled and supervised area for disposal.

Commonly, used disposable infant diapers are dumped or thrown together with household garbage into compost pits while others are left to litter the streets, posing a great danger of infection to those who come across them. About eighty percent (80%) of hospital visits in Kenya are due to preventable diseases. It is discovered that fifty percent (50%) of the illnesses are related to water, sanitation and hygiene because there are garbage heaps everywhere as evidence of poor management of solid waste. In South Africa, NEMA recommends that waste be sorted to facilitate disposal and recycling processes (NEMA, 2011).



Pate :4.3 Used disposable infant diapers disposed of in the open field (Limpopo Mirror, 2019).

4.8.3 Reasons for disposal of used disposable infant diapers at the place of own choice

In figure 4.14, the respondents provided reasons for disposing of the used disposable infant diapers where they did.

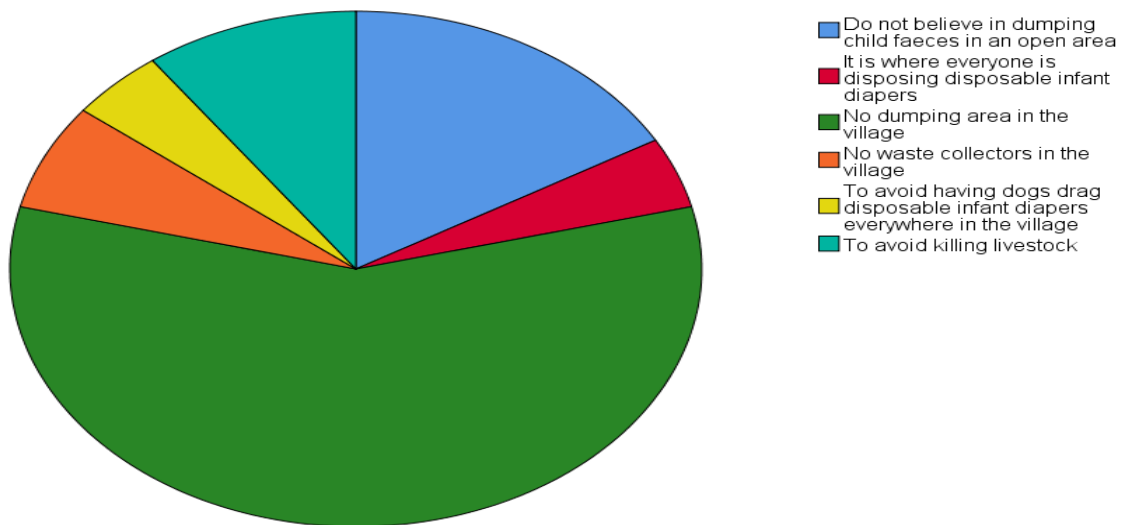


Figure 4.14 Reasons for disposal used disposable infant diapers at a place of own choice.

Sixty percent (60%) of the respondents said that they dispose of used disposable infant diapers in open fields because there is no dumping area in the village. Fifteen percent (15%) of the respondents who dug a hole in the backyard did so because culturally, they did not believe in leaving used diapers in an open area and the 10% who dumped in skip bins in town did so in order to prevent the death of livestock. Nine percent (9%) of the respondents who disposed of the used disposable infant diapers everywhere mentioned that it was because there was no waste collection in the village. The 3%, who disposed of into pit toilets, indicated that they did so to avoid dogs from dragging the used disposable infant diapers everywhere in the village. The other 3% who disposed of in the open fields, indicated that it is where everyone disposes of used disposable infant diapers.

4.8.4 Access to waste dumping sites outside the Village of Mashashane

Accessibility to dumping sites in this context refers to the ease at which to reach or use the dumping sites, which are places used to dispose of solid waste without environmental controls. A good example of such an area is a landfill site, which is a facility into which solid waste from municipality and/or an industry is disposed of. On the other hand, sanitary landfills are dumping sites where waste is spread daily, compacted, and covered with a layer of soil in accordance with environmental protection standards (Aboho *et al.*, 2016).

Respondents were asked whether they have or do not have access to any dumping site outside the village and the response was “No”. In many developing and developed countries, there are lack of waste facilities. Similarly, in Mashashane Village and neighbouring areas, there are no waste facilities and that results in waste dumped at every corner of the streets.

All respondents disposed of the disposable infant diapers at different places with reasons. It is therefore, believed that the vicious cycle of waste disposal will continue until the municipality intervenes. Majority of Romania's population live in rural areas and poor waste management facilities in that country led to waste dumping on riverbanks, former quarries and roadside, resulting in pollution of the environment and damage of the

landscape. Mihai *et al.*, (2012) observed that in 2008, eight Romanian provinces did not provide waste collection services to their rural areas. The share of rural population with access to these services was very low (<10%). Lack of sanitation services and poor waste management facilities increased the amount of waste disposed of in open dumps. Provinces of Northeast, Southeast and South of Romania have the lowest percentage of rural population served by sanitation services despite the demographic factors, the various geographical conditions of provinces such as location or relief, which influence the number and areas of rural dumpsites in the context of limited access to waste collection services.

All participants indicated that they do not know the length of time taken by disposable infant diapers to biodegrade. The “No” response was an indication that users of disposable infant diapers were only aware of benefits that come with the products and did not know the negative impact thereof. Used disposable infant diapers have major implications on municipal solid waste management. In the United States of America, disposable infant diapers are the third largest contributor to MSW, accounting for 1.5 - 4 percent of the total waste (Pham & Brown, 2009).

4.9 Perceptions and attitudes of respondents in Mashashane Village towards disposal of used disposable infant diapers

Perception is a mental image and physical sensation understood in the light of understanding a concept or awareness while, attitude can be defined as a psychological condition with regards to a statement or a situation (Teachman *et al.*, 2008).

4.9.1 Reasons for suitability or unsuitability of a place for disposal of used disposable infant diapers

Suitability of a disposal area refers to the degree to which the disposal area is appropriate for dumping waste. Suitability of an area for disposal of used disposable infant diapers depends on what the residents perceive or not perceive as a good place for dumping all kinds of waste (Collivignarelli *et al.*, 2004). The issue of lack of knowledge on what is a

suitable or unsuitable area for dumping waste, might be a contributing factor to the behaviour of residents of Mashashane Village towards waste disposal.

In responds to the question about whether places of disposal are suitable or unsuitable, 60% of the respondents indicated that their places of disposal are suitable for the disposal of used disposable infant diapers and 40% of the respondents indicated that their places of disposal are not suitable for disposal of used disposable infant diapers.

The respondents gave reasons as to why the places of disposal were suitable or unsuitable. The reasons were as follows: Fifty-two percent (52%) of the respondents felt that disposing in the yard is convenient and therefore suitable for disposal of used disposable infant diapers. Twenty-two percent (22%) indicated that their place of disposal is suitable because they dispose of in town at municipal skip bins, which are emptied at landfill sites, while 20% felt that disposing in open areas is good, because they believed that the dumping places are far for the bad smell to reach the village. Four percent (4%) said that their place of disposal is safe because the area is far away from homes (Plate 4.4) and the livestock that often consume the plastic component of the disposable infant diapers are safe. Two percent (2%) felt that burning the disposable infant diapers is good because burnt disposable infant diapers do not harm any living creature.

All in all, an appropriate place for disposal of solid waste is a landfill where waste is loaded off, spread into thin layers, compressed and covered with inert material. To meet the minimum standards for environmental protection and to allow proper operation of a landfill, it is necessary to carry out some unchanging operations such as waste reception, waste deposition, general site maintenance, environmental monitoring and leachate, gas and odour control. A landfill with simple daily operations can be an effective disposal destination as it allows sustainable waste disposal without serious environmental impacts caused by waste composition and climate conditions (Sabbas *et al.*, 2001).



Plate :4.4 A place far from homes regarded suitable for disposal of used disposable infant diapers (Field Work: 2018)

Furthermore, 30% of those who said that their places of disposal are not suitable stated that where they dispose of waste the disposable infant diapers suffocate livestock when consumed, dogs drag them near homes and pollute water streams. As a result, 22% of respondents find their disposal place unsuitable, because it is in an open field, where people's livestock graze and it is also near some residences. Eighteen percent (18%) felt that their place of disposal is not suitable, because disease-carrying flies from the dumping site get into homes spreading diseases. Twelve percent (12%) of the respondents stated that their place of disposal is not suitable for disposal of used disposable infant diapers because the disposable infant diapers reduce the anticipated lifespan of pit toilets. A further eight percent (8%) said that burning the diapers is not good because chemicals released into the atmosphere affect the air quality and that result in breathing problems when intoxicated air is inhaled. Six percent (6%) felt that their area of disposal is not safe as it is near a periodic river on which people depend, while 4% stated that disposing in a dug hole is unsuitable because dogs dig out the disposable infant diapers and drag them in the streets.

All the respondents who felt that their places of disposal were suitable, might have said that because their livelihoods and health were not affected, while those who found their places of disposal unsuitable, might have mentioned that because used disposable infant diapers caused harm to the residents and livestock.

4.9.2. Suggested measures to take in order to make unsuitable places for waste disposal in Mashashane Village suitable.

In this context, suggested corrective measures refer to actions to be taken in order to reduce severity of impact of used disposable infant diapers on unsuitable places of disposal (DEAT, 2007). Ninety-two percent (92%) of the respondents stated that the municipality should provide refuse bags as well as collection trucks. Eight percent (8%) of the respondents said that digging a large hole outside the Village for everyone to dispose of used disposable infant diapers could be one of the possible solutions.

4.9.3 Cultural beliefs of Mashashane community members towards leaving used infant diapers in public for collection.

In the context of this study, cultural beliefs refer to a medium of domination and subordination of ideas and values (Agbesola, 2013). Participants responded to a question in relation to cultural beliefs towards leaving used disposable infant diapers in public for collection. Ninety percent (90%) of the respondents said that they do not have any cultural belief that stops them from leaving the faeces and urine in used disposable infant diapers in the streets for collection. On the other hand, 10% stated that cultural beliefs do not allow them to leave used disposable infant diapers that have faeces and urine everywhere as they fear that, their children might be bewitched.

Cultural beliefs of Mashashane community members play a very huge and important role in the issue of disposal of used disposable infant diapers, because it involves the handling of child faeces and urine, which are regarded as sacred and need to be protected from those who intend to harm the family through the children.

4.9.4 Possession of information by Mashashane community members as a factor in decision-making about disposal of used disposable infant diapers.

Possession of information in this context refers to the quality or state of ownership or having knowledge about waste management practices of solid waste disposal, especially disposal of used disposable infant diapers in order to take a good decision for disposing waste (Hayes, 2002).

The respondents were asked whether possession of information contributes to the way people in Mashashane Village dispose of used disposable infant diapers. Ninety percent (90%) of the respondents indicated that to have no access to information about waste disposal is a major contributing factor to the manner of disposal of used disposable infant diapers. On the other hand, 10% of the respondents/residents of Mashashane Village agreed that the manner of disposal of used disposable infant diapers and other waste is a result of lack of information about appropriate disposal methods of waste.

Being knowledgeable about something in this case, disposal of disposable infant diapers and resulting impact is good because it helps with decision-making on how to use and dispose of the disposable infant diapers in a manner that is friendly to the social, economic and physical environments.

4.9.5 Mashashane community’s participation to help reduce the problem of disposal of used disposable infant diapers.

Community participation refers to involvement of people in community projects in order to solve community’s problems (Laurent *et al.*, 2014).

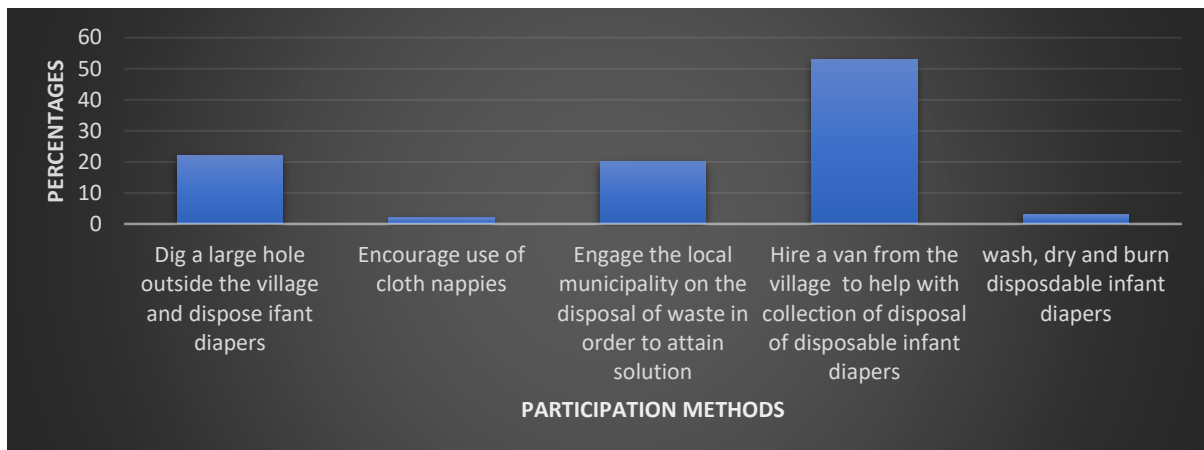


Figure 4.15 Mashashane community’s participation to reduce problems of disposal of used disposable infant diapers.

The responses to the question about what contribution the community can make to reduce the problems associated with the disposal of used disposable infant diapers are reflected in figure 4.16. Fifty-three percent (53%) of the respondents suggested the hiring

of a van of one of the residents to collect the waste (including disposable infant diapers) to a dumping site, while 22% stated that to dig a large hole outside the village wherein to dispose of waste would be better. On the other hand, 20% felt that to engage the local municipality in the issue of disposal of used disposable infant diapers could provide a good solution. Three percent (3%) of the respondents stated that to wash, dry and burn the used disposable infant diapers could solve the challenge posed by the disposal of used disposable infant diapers in Mashashane Village whereas 2% of the respondents believed that the residents could instead change and use cloth nappies.

4.9.6 Importance of education about disposal of used disposable infant diapers to Mashashane community

Education is a process of imparting or receiving knowledge (MacIntyre & Dunne, 2002). Environmental education is a process that allows individuals to explore and understand environmental issues and engage in problem-solving activities, to improve the quality of the environment (Wals, 2007). Educating the community about the disposal of used disposable infant diapers would be a good way to help impart the necessary knowledge required to manage waste in the village (MacIntyre & Dunne, 2002).

Ninety-seven percent (97%) of the respondents felt that education is key to attain knowledge and information about disposal of used disposable infant diapers. The respondents mentioned that awareness campaigns and workshops about the consequences of poor practices of disposal of used disposable infant diapers should go a long way for residents to change the ways in which they dispose of used disposable infant diapers. In that way, the community members can come up with temporary measures for disposal while waiting for municipal intervention. Such actions will at the same time help save livestock from consuming plastics of disposable infant diapers.

Three percent (3%) of the respondents did not regard education about the disposal of used disposable infant diapers as one of the key solutions to help eradicate the problem of waste disposal. These respondents felt that educating the community is a waste of time and government's resources. They stated that many community members, if not all, are aware of all the possible steps that should be followed to improve the manner of disposal

of used disposable infant diapers in the village, instead people prefer to ignore that and act as if they do not know.

4.9.7 Suggestions by Mashashane respondents on how Polokwane Local Municipality can contribute towards disposal of used disposable infant diapers.

Municipal contribution in this context refers to the part played by the municipality to help community members resolve and eradicate the challenges posed by the disposal of used disposable infant diapers. Municipal waste is waste collected by municipalities or other local authorities (Guendehou, 2004).

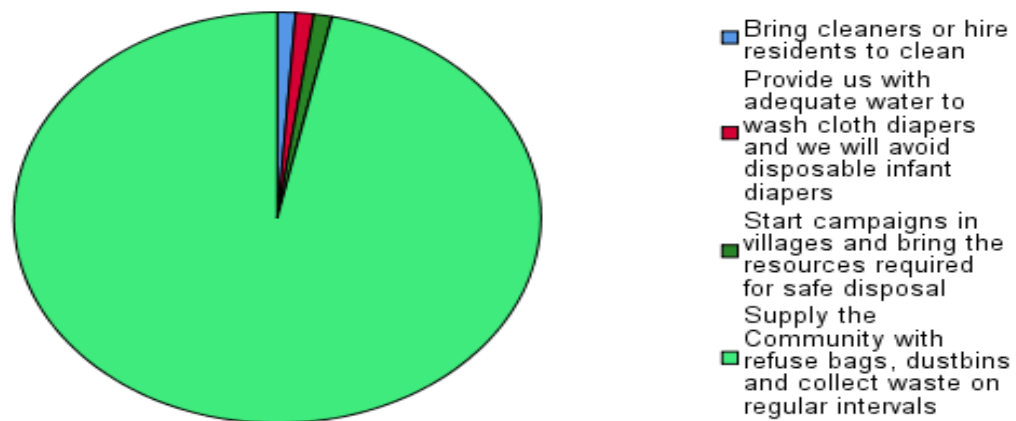


Figure 4.16 Suggestions by Mashashane respondents for Polokwane Local Municipality to contribute towards the challenges of disposal of used disposable infant diapers.

Ninety-seven percent (97%) of the respondents suggested that the municipality should supply the village with refuse bags and waste bins to collect waste at regular intervals. One percent (1%) of the respondents indicated that to engage residents or hire people to clean the village could be one of the solutions to the problem. Another 1% of the respondents thought of the municipality to provide adequate water to wash used cloth infant diapers, to enable a switch back of the use of cloth nappies. Another 1% indicated that it would be good if the municipality could continue with awareness campaigns and supply equipment for safe disposal of used disposable infant diapers to reduce the problem of waste disposal.

Corrective measures are necessary in Mashashane Village in order to avoid deterioration of the environment. The respondents suggested that while the municipality tries to provide waste services in the village there should be temporary measures such as providing at least one waste container for the village, to assist the community to keep the environment clean and healthy. According to Rahat *et al.*, (2014), users of disposable infant diapers should first sanitise them before they are disposed of and thereafter, pelletise the non-woven material of the diapers. The endeavour helps to reduce pollution of the environment and weaken the possibility of spreading pandemics and epidemics in the area. Such initiatives can be realised only if the municipality works together with other stakeholders such as the Department of Health (DoH), the Department of Environmental Affairs (DEA) and the residents of Mashashane Village to create public awareness of the environmental threat caused by indiscriminate dumping of used disposable infant diapers (Mohsin *et al.*, 2016).

The possible solutions on how to address the challenges of disposal of used disposable infant diapers in Mashashane Village are good steps, because some of the brainstormed ideas are what the community need to practise in order to get rid of the uncontrolled disposal of used disposable infant diapers. Public participation is a mechanism for entrenching democracy and promoting social cohesion between the government and the citizens particularly with the provision of quality and sustainable service. The Public Service Commission (2008) pointed out that the importance of public participation is in the enhancement of sustainable service delivery including waste management issues. If there were sufficient and continuous public participation from residents in Polokwane local municipality, there would be no visible excessive illegal dumping caused by communities. Pollution of the environment violates the constitutional right of citizens as enshrined in Section 24 of the 1996 South African Constitution.

It is of utmost importance to educate everyone about the disposal of disposable infant diapers in both urban and rural areas of developing and developed countries. Lack of information and knowledge regarding disposal of disposable infant diapers is harmful to humans, plants and animals, as it results in health-related diseases and negative environmental conditions such as those of global warming, environmental pollution, etc.

According to Kroukamp (2002), to engage and properly educate different communities through public participation enhances participation at grassroots level within the community about learning how to better care for the environment. People who are consumers of services at grass root level should acquire knowledge through education about the projects of waste management. Hence, participation need to take place at all stages of a project. The stages may include briefing sessions, ways to present plans, availability of assistance for citizens, implementation, and evaluation of whether the project is feasible or not. Therefore, the community should be able to take decisions in the management of its own affairs such as disposal of disposable infant diapers.

In the same way, Polokwane Local Municipality can contribute towards solving the problem faced by Mashashane Village by conducting awareness campaigns to the community through the provision of the necessary resources such as refuse bags, skip bins and collection trucks for proper management of disposable infant diapers, as per the South African Constitution (1996) and the Municipal System Act (2011). Solid waste management is the responsibility of local municipalities. According to Naidoo (2009), rural municipalities face challenges of lack of legal dumpsites and no collection of revenue results in lack of waste collection.

Local municipalities are therefore, to have an Integrated Waste Management Plan (IWMP) that will enable the community to deal with waste economically and safely as far as possible. The plan should ensure that any waste produced by the community is treated and disposed of correctly. However, if left uncontrolled, the waste can result in an aesthetic problem and pose serious health risks, which can be hazardous if material such as absorbent part of the disposable infant diapers are present in the waste. It is of utmost importance to collect waste from all sources, as efficiently as possible and dispose of it in controlled and licensed disposal facilities (Integrated Environmental Plan (IEP, 2010).

4.10 Conclusion

This chapter presented a detailed data analysis and discussion of findings of the study with regards to Mashashane Village. Demographic characteristics of the residents of Mashashane Village were outlined with regards to the use of disposable infant diapers.

The disposal of disposable infant diapers with their effect on the environment and perceptions and attitudes of the community of Mashashane towards disposal of used disposable infant diapers were explained. Summary, conclusions and recommendations of the study are presented in the next chapter.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter focuses on the summary, conclusions and recommendations as guided by the results of the study. The research study achieved its main aim of investigating in detail, practices and effects of disposal of used disposable infant diapers on the environment. The manner of disposal, places of disposal, effects of used disposable infant diapers on the community and natural resources such as water bodies are explained in detail. The study also examined the reasons behind the manner of disposal of the used disposable infant diapers by the community of Mashashane.

5.2 Summary

5.2.1 Demographic characteristics of Mashashane Community

The demographic characteristics of the community of Mashashane Village shows that majority of respondents are aged 21-30. This is a young and more active age group, which prefers to use disposable infant diapers than any other age group. Females are dominant because in most cases household chores that include care for infants are done by women. Therefore, it became easier for females to give appropriate answers to the questions asked. The results indicated that nearly all respondents, regardless of age, marital status, income, etc., use disposable infant diapers for their infants.

5.2.2 Socio-economic characteristics of the community of Mashashane

The socio-economic characteristics of the community of Mashashane Village shows that most households have at least one infant who uses disposable infant diapers, with few houses that have two or three infants who use disposable infant diapers. Infants aged 0-6 months use more disposable infant diapers daily compared to older infants. Most respondents are mainly single. The highest educational level of respondents consists of those who left school at secondary level while a small percentage of respondents have no schooling experience. Majority of respondents in Mashashane Village are unemployed

and depend on CSGs for survival as indicated by the results of the study. A very low percentage of respondents is employed in informal and formal sectors, while the rest are pensioners.

5.2.3 The degree to which disposable infant diapers are used.

Majority of mothers in Mashashane Village use disposable infant diapers for their infants with only a small percentage that use cloth nappies. Mothers using disposable infant diapers for their infants highlighted comfort, affordability, easy use and no nappy rash on infants as some of the main reasons for the use of disposable infant diapers. The number of disposable infant diapers used in a day per household depends on the age of the infant. For example, infants younger than 6 months need more disposable infant diapers and those older than 12 months use fewer disposable infant diapers. The highest average number of disposable infant diapers used is 6 per day per infant.

5.2.4 Management practices of disposable infant diapers in Mashashane

Each household has its own way of storing disposable infant diapers before disposal. Many prefer to use plastic bags as the affordable means of storage because of their easy to carry ability. Many respondents in Mashashane Village practise waste separation at household level, with only a few who do not separate. Separation of waste by many respondents is done because it helps facilitate the burning of general waste and disposal of used disposable infant diapers.

Waste collection is regarded as an essential service by majority of the respondents in Mashashane Village, with only a few who do not regard it as important. The respondents view waste collection system as a necessity because it helps reduce open field dumping of general waste as well as used disposable infant diapers.

5.2.5 Disposal of used disposable infant diapers in Mashashane Village.

The manner of disposal of used disposable infant diapers in Mashashane Village is influenced by lack of knowledge about the impact of used disposable infant diapers on the social, economic and physical environment. Places of waste disposal in Mashashane

Village such as open fields, streets, etc. are found not suitable for disposal of used disposable infant diapers. Reasons for disposing of used disposable infant diapers at the places of own choice are caused by lack of suitable areas for waste disposal and lack of waste collection equipment as well as insufficient waste disposal knowledge. Furthermore, community members of Mashashane Village have no access to dumping sites outside the village and that makes it difficult for the community members to dispose of used disposable infant diapers at dumping sites.

5.2.5 Perceptions and attitudes towards disposal of used disposable infant diapers.

The majority of the Mashashane community members perceive most places of disposal for used disposable infant diapers as suitable because livestock do not access such places. A few respondents believe that their places of disposal are not suitable because those places are within reach while others dispose of in open fields where livestock graze. The respondents believe that some control measures such as penalty to anyone found dumping illegally should be put in place to prevent illegal disposal of used disposable infant diapers.

Many respondents do not have cultural beliefs that stop them to leave infant faeces and urine in open places. Only a few respondents are reluctant to leave their infants' used diapers in public for collection. Majority of the respondents regard possession of information as an important factor that influences decision-making on disposal of used disposable infant diapers, as it helps to take informed decisions. The respondents view community participation as a very important aspect that can help to address the problem of disposal of used disposable infant diapers.

Majority of respondents also feel that educating the community about disposal of disposable infant diapers might be a solution to eradicate the problem of waste disposal faced by Mashashane community, while only a small percentage do not see education of the community as a solution. Most respondents believe that should the municipality supply resources such as refuse bags, collection trucks, bins, etc., challenges posed by disposal of used disposable infant diapers to the Mashashane community members could be addressed.

5.3 Conclusions

The study concludes that:

- Most mothers are young, unemployed and dependent on government CSGs.
- Infants in Mashashane Village are mostly in the age group of 0-6 months, hence a high usage of disposable infant diapers.
- Mothers in Mashashane Village prefer disposable infant diapers, because of convenience.
- Separation of waste is at household level and waste is stored in the yard until the day of disposal.
- The disposal methods used by Mashashane community are inappropriate for disposal of used disposable infant diapers, because they harm the environment.
- The manner of disposal of used disposable infant diapers in Mashashane Village is influenced by lack of knowledge about the impact of used disposable infant diapers have on the environment as well as lack of collection equipment.
- Many of the respondents acknowledge that their disposal methods for used disposable infant diapers are unsuitable as they are a threat to the ecosystem.
- Members of Mashashane community regard management of solid waste as the responsibility of the local municipality.

5.4 Recommendations

The study recommends that;

- The municipality provide skip bins, refuse bags to store waste at homes and waste collection trucks for collection in Mashashane Village.

- Capricorn District Municipality construct a disposal site to cater for all the villages in PLM.
- Mothers in Mashashane Village be educated on the importance of interchanging the use of disposable infant diapers with reusable nappies to care for infants to avoid damage to the environment and human health.
- Government authorities should take it upon themselves to come up with campaigns that encourage suitable waste disposal methods.
- Further research on how disposable infant diapers can be recycled and turned into useful products for use in other industries should be done.

The results show that mothers and caretakers of infants prefer to use disposable infant diapers as compared to cloth nappies. Furthermore, it is evident that even though there is a preference for disposable infant diapers, the product also poses a challenge to the community because of their long lifespan and inability to biodegrade. Consequently, this causes health problems to community members of Mashashane. In conclusion, if the municipality can implement the suggested recommendations and monitor the situation, there will be a relief from the challenge caused by disposal of used disposable infant diapers in Mashashane Village.

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Appendix A: Turfloop Research Ethics Committee (TREC)



University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 14 May 2019

PROJECT NUMBER: TREC/116/2019:PG

PROJECT:

Title: An investigation of practices and effects of the disposal of disposable infant diapers on the environment: a case study of Mashashane village, Limpopo province.

Researcher: SHM Seopa

Supervisor: Mrs JM Letsoalo

Co-Supervisor/s: Dr MJ Mashaba

School: Agriculture and Environmental Sciences

Degree: Master of Science in Geography


PRECIOUS 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.

Appendix B: Application for Permission to conduct survey in Mashashane Village



P.O Box 180

Polokwane

0700

13 May 2019

Mashashane Traditional Authority

P.O Box 27

Mashashane

0743

Subject: Permission to conduct research survey in Mashashane village

Dear Sir/Madam

I, Seopa Sedima Hlogelo Matsobane, a student conducting a research titled AN INVESTIGATION OF PRACTICES AND EFFECTS OF DISPOSAL OF DISPOSABLE INFANT DIAPERS ON THE ENVIRONMENT: A CASE STUDY OF MASHASHANE VILLAGE, am writing this letter to you as the head (chief) of Mashashane village to kindly grant me permission to conduct research survey in your village.

I am hoping to receive a positive reply from your side.

Yours Sincerely

Seopa S.H.M

A handwritten signature in black ink, appearing to read 'Seopa S.H.M', written over a light blue circular stamp.

Appendix C: Response Letter from Mashashane Traditional Authority



REF NO: CH 11/8/4-92
Enq: Robert Mashashane
Cell: 078 3603 555

Mashashane Traditional Authority
P. O Box 27
MASHASHANE
0743
13 May 2019

TO WHOM IT MAY CONCERN


Sir, Madam

PERMISSION TO CONDUCT MASTER'S RESEARCH

Permission is hereby granted to Mr SHM Seopa Student No:201201903 for the purpose of conducting his Master's Research on the impacts and effects of the disposal of disposable Infant Dippers on the Environment. Case Study of Mashashane Village, Capricorn District, Limpopo Province.

Hope you find the above in order.

Yours faithfully


SENIOR ADMIN OFFICER

13-05-2019
DATE



Scanned with CamScanner

Appendix D: Consent Form

TITLE OF RESEARCH PROJECT: AN INVESTIGATION OF PRACTICES AND EFFECTS OF DISPOSAL OF DISPOSABLE INFANT DIAPERS ON THE ENVIRONMENT: A CASE STUDY OF MASHASHANE VILLAGE

Dear Respondent

The aim of the study was to investigate the practices and effects of the disposal of disposable infant diapers on the environment of Mashashane Village.

Your participation is voluntary. You have the right to be part of the study, choose not to participate or to stop participating at any time without penalty. There are no right or wrong answers. The information provided will remain strictly confidential and anonymous and will only be used for research purposes.

You will not directly benefit by participating in the study; however this study will indirectly benefit you as a participant in the form of providing information that can be used to improve the state of the environment you live in.

CONSENT

I, have read the above information relating to the research and have also heard the verbal version, and declare that I understand it.

Signature of participant.....

Signed at.....**on**.....

WITNESSES

1.....

2.....

Appendix E: Research Questionnaire 1a

I am Sedima Hlologelo Matsobane Seopa, a registered student at the University of Limpopo studying towards an MSc in Geography in the department of Geography and Environmental Studies. I am conducting a research study entitled: An investigation of practices and effects of the disposal of disposable infant diapers on the environment: A Case Study of Mashashane Village, Limpopo Province.

A. DEMOGRAPHIC PROFILE

1. Age

2. Gender

Male	Female
------	--------

3. Marital Status

Single	Married	Widowed	Divorced
--------	---------	---------	----------

4. Educational Level

None	Primary	Secondary	Tertiary
------	---------	-----------	----------

5. Occupation

6. Monthly income level (Rands)

< 5 000	5 000 -10 000	10 001 – 15 000	>15 000
---------	---------------	-----------------	---------

7. How many infants are there in your household?

8. How old is / are the infant(s)?

0-6	7-12	13-18	19-24
-----	------	-------	-------

B. DISPOSAL OF DISPOSABLE INFANT DIAPERS

9. Do your children use disposable infant diapers?

Yes	No
-----	----

10. Why do you use disposable infant diapers?

11. In a day, how many disposable diapers does your infant(s) use?

12. How much is one packet of the disposable infant diapers?

13. Where do you buy them?

14. After use where do you your disposable infant diapers before disposal?

15. Do you separate waste before collection?

Yes	No
-----	----

Support your answer.

16. Is there a waste collection system in your Village?

Yes	No
-----	----

17. If yes, on which days of the week is waste collected?

Monday	Tuesday	Wednesday	Thursday	Friday
--------	---------	-----------	----------	--------

18. Do you think collection is necessary?

Yes	No
-----	----

Support your answer

19. Who collects waste in your Village?

Municipal Collectors	Private Collectors
----------------------	--------------------

20. How efficient is the waste collection system?

21. How do you dispose your infant's disposable diapers?

22. Where do you dispose of your child's disposable diapers?

23. Why do you dispose them where you do?

24. Do you know how long it takes for the disposable infant diapers to biodegrade?

Yes	No
-----	----

25. Do you have access to any dumping site near your Village?

Yes	No
-----	----

26. If yes, is it within a walking distance or do you use transportation to access it?

Walking distance	Transportation needed
------------------	-----------------------

C. PERCEPTION AND ATTITUDE TOWARDS DISPOSAL OF DISPOSABLE INFANT DIAPERS

27. In your view, is the place of disposal suitable?

Yes	No
-----	----

Support your answer

28. If the dumping place is not suitable, what do you think can be done?

29. Do you think that the packaging and leaving of waste outside the yard for collection is good?

Yes	No
-----	----

Support your answer

30. Culturally do you think it is against people's beliefs on packaging delicate waste such as faeces found in infant diapers and putting them in the public for collection?

Yes	No
-----	----

Support your answer

31. In your view, does lack of knowledge influence the manner in which waste is disposed of in your Village?

Yes	No
-----	----

32. Are you aware that waste can cause water pollution, which can result in outbreak of diseases such as cholera?

Yes	No
-----	----

33. Are you aware that it can also cause harm to livestock?

Yes	No
-----	----

34. In your opinion, what can the community do to improve the manner of disposal of disposable infant diapers?

35. Do you think that educating the community on waste can help increase the knowledge on waste management?

Yes	No
-----	----

Support your answer

36. What do you think the municipality should do to minimise the problem of the disposal of disposable infant diapers?

Appendix F: Translated Questionnaire 1b

I am Sedima Hlologelo Matsobane Seopa, a registered student at the University of Limpopo studying towards an MSc in Geography in the department of Geography and Environmental Studies. I am conducting a research study titled An investigation of practices and effects of the disposal of disposable infant diapers on the environment: A Case Study of Mashashane Village, Limpopo Province.

A. DEMOGRAPHIC PROFILE

1. Mengwaga

2. Bong

Monna	Mosadi
-------	--------

3. Maemo a lenyalo

Kgope/ Lefetwa	O nyetse/nyetswe	Mohlologadi/ Mohlolo	Le kgaogane
-------------------	---------------------	-------------------------	----------------

4. Maemo a thuto

Ga se a tsena sekolo	Sekolo sa tlasana	Sekolo sa godingwana	Unibesithi
----------------------------	----------------------	-------------------------	------------

5. Moshomo

6. Letseno la kgwedi (diranta)

< 5 000	5 000 -10 000	10 001 – 15 000	>15 000
---------	---------------	-----------------	---------

7. Go na le masea a ma kae ka lapeng la lena?

8. Mengwaga ya lesea/ masea ke ye me kae?

0-6	7-12	13-18	19-24
-----	------	-------	-------

B. GO LAHLWA GA MALEIRI A SEJWALEJWALE A MASEA

9. Na masea a lena a shomisha maleiri a sekwalejwale?

Ee	Aowa
----	------

10. Goreng le shomisha maleiri a sekwalejwale?

11. Ka lesatsi lesea/masea a lena a shomisha maleiri a ma kae?

12. Na phakete ya maleiri ao a sekwalejwale ke bokae (diranta)?

13. Le a reka kae?

14. Ka morago ga go shomisha maleiri ao lea bea kae pele aka lahlwa?

15. Na lentsha ditshila ka gare ga maleiri pele ba maspala b aka tsea dikantle?

Ee	Aowa
----	------

Thekga karabo ya gago.

16. Gee le gore ba gona, bat la ka labokae?

Moshupulogo	Labobedi	Laboraro	Labone	Labohlano
-------------	----------	----------	--------	-----------

17. O bona go rwalelwa dikantle gole bohlokwa?

Ee	Aowa
----	------

Thekga karabo ya gago

18. Le rwalela ke bo mang dikantle?

Maspala	Batho ba go ithaopa
---------	---------------------

19. Na maleiri ao a sekwalejwale a masea lea a phatlalatsa goba le a lahla jwang?

20. Na le lahla kae maleiri ao a sekwalejwale a masea?

21. Goreng lea lahla fao lea lahang gona?

22. Na lea tseba gore maleiri a sekwalejwale a tsea nako e ka kang go shilega?

Ee	Aowa
----	------

23. Mo motseng wa lena gona le tulo yeo e lego ya go lahlela dikantle fela?

Ee	Aowa
----	------

24. Gee le gore e gona, go hlokagala senamelwa goba lea fihla ka maoto?

Ba fihla ka maoto	Go hlokagala senwamelwa
-------------------	----------------------------

**C. MEGOPOLO LE DIKAKANYO TSEO DI AMAGO GO PHATLANTSHA
MANTLE AO A HWETSAGO MALEIRING A SEKWALEJWALE A MASEA**

25. Go ya ka menagano ya go, o bona tulo yeo le lahang go yona ele ya maleba?

Ee Aowa

Thekga karabo ya gago

26. Ge ele gore tulo yeo go lahlwago dikantle a seya maleba, le nagana gore go ka dirwa eng go e kaonafatsa?

27. Le bona o kare go phuthela dikantle la di bea ka ntle ga kgoro ele mogopolo o mobotse

Ee Aowa

Thekga karabo ya gago

28. Go ya ka setjo o nagna gore ditumelo tsa batho di kgahlanong le go phuthela dilo tsa go swana le mantle a masea ao a lego ka gare ga maleiri a sejwaleljwale a beiwa kantle go tlo rwala ke maspala?

Ee Aowa

Thekga karabo ya gago?

29. Go ya ka wena, go hloka tsebo go ka be go hlohleletsa ka mokgwa wo batho ba phatlalatsago dikantle ka gona mo motseng ya lena?

Ee Aowa

30. Na o na le maetemogelo a gore dikantle di ka shilafatsa meets ebile di ka hlola malwetsi a go swana le cholera?

Ee Aowa

31. Lena le maetemogelo a gore go lahlwa la dikantle go ka ama diruiwa gampe ?

Ee	Aowa
----	------

32. Go ya ka wena keng seo se ka dirago ke sechaba go kaonafatsa mokgwa wa go phatlalatsa maleiri a sekwalejwale a masea?

33. O nagana gore go ruta sechaba ka dikantle go ka thusa ka go oketsa mokgwa owe di phuthelwago ebile di phatlalantsago ka gona?

Ee	Aowa
----	------

Thekga karabo ya gago

34. O nagana gore maspala o ka dira eng go fokotsa mathata ao a amanago le go lahlwa goba go phatlalatsa ga maleiri a sekwalejwale a masea?
