

Exploring disposable diaper usage and disposal practices in rural areas

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EXECUTIVE SUMMARY

The following quote summarises the results of the study:

“Disposable diapers made from plastic components are a godsend for parents but a nightmare for the planet.” (Vidal, 2019:1)

Globally, single-use disposable diapers are one of the biggest contributors to plastic waste and one of the biggest threats to human health, animals and the environment. Developing countries are faced with the additional threat of high birth rates, urbanisation and insufficient or no solid waste management in rural areas. In many African countries, irregular and inefficient access to solid waste disposal is an additional problem. This forces communities to find alternative methods of disposal, including dumping on land and in water courses, burial and open burning. This is particularly prevalent in rural communities, who also often have limited access to clean water and sanitation. Very little scientific literature is available regarding the impact of dumped diapers on humans, animals and the environment, as well as on sustainable solutions relevant and appropriate for South African and African rural communities.

The research aimed to explore diaper usage and disposal practices in unserved rural areas and was conducted in the Kruger to Canyons (K2C) Biosphere Region. The area is a biodiversity hotspot that contains many different ecosystems supporting a significant number/multitude of rare and endemic, but threatened, species. Additionally, the biosphere includes two of South Africa’s key tourism sites (the Kruger National Park and the Blyde River Canyon), as well as a leading international floral hotspot, the Wolkberg Region.

An explanatory sequential mixed-methods approach was followed using quantitative and qualitative data collection methods. Firstly, 1576 quantitative diaper baseline questionnaires were completed. Secondly, a participatory mapping or drawing of the dumping areas was completed by the communities as part of the focus-group discussions in each of the villages. GIS mapping of dumped diapers over a period of six months was completed by the environmental monitors working for K2C in the villages. After the analysis of the data, feedback or member-checking sessions were held with the communities to verify the results. Lastly, a life cycle assessment was completed based on the results.

Results:

The completed questionnaires provided the biographical data, as well as diaper usage and management, while the focus-group results provided the reasons for using disposable diapers and the challenges experienced in managing their disposal. Then mapping of the dumped diapers provided insight into

1. The questionnaire was completed by 97% female and 3% male caregivers of diaper-wearing babies.
2. The unemployment rate of the caregivers was 71%.
3. The household size in the K2C region was 6,2 persons on average, which is close to double the average of the general South African household.
4. There were either one or two babies in diapers in each of the households interviewed.
5. Grant dependent caregivers made up 97% of all caregivers interviewed and received a combination of between two and eight grants per household.

6. Accessing water was found to be one of the major problems households experienced. Water was accessed from boreholes, taps or rivers, or was bought. The reason for the difficulties experienced with accessing water was given as mainly a collapsed water infrastructure not maintained by the local governments involved.
7. The households in the K2C region did not receive any form of waste management. One community had access to skips.
8. Regarding diaper usage, most of the participants bought packs of the well-known brands Huggies and Pampers at Shoprite and then, if needed, purchased single diapers at the Spaza shops in their areas.
9. On average, four to five diapers were used per day per child. The older the child, the fewer diapers would be used; if smaller or sick, it might use more diapers.
10. The main reasons for using diapers were their convenience for the caregiver and being perceived as providing comfort for the baby and it is fashionable and modern.
11. Reusable (or cloth) nappies would not be considered as the communities had no access to water in order to wash the nappies. They were also seen as being old-fashioned and would not provide the necessary comfort for a baby.
12. The management of used diapers entailed dumping in the open veld and rivers, as well as burning them or dropping them into pit latrines.
13. Great concern was expressed regarding the effect of diapers on the environment and the health of the people in the communities.
14. Traditional leaders were expected to take the lead in projects and programmes to manage diapers better - with the support of K2C and the municipality, councillors and other stakeholders.
15. From a life cycle assessment perspective, local electricity was a major contributor to locally manufactured diapers. However, it is important to consider other impacts as well, such as those from dumping diapers in rivers or the veld, which can affect the health of humans.

In summary: Although disposable diapers are convenient, the usage and disposal practices of diapers in the study area are creating social and environmental problems, affecting humans and animals, and are posing a threat to the biodiversity. The complexity of the problem should be systemically addressed through continuous interdisciplinary and transdisciplinary research, relevant policies and regulations, as well as projects. Platforms should be created on which information can be shared, and solutions generated, to improve the health and well-being of the communities and their environment. The achievement of 12 out of the 17 Sustainable Development Goals (SDGs) is under serious threat if waste management in general and in particular the management of disposable diapers is not under control.

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1 INTRODUCTION

According to the National Waste Management Strategy (2020), it was estimated that, in 2017, 55.6 million tonnes of general waste was generated in South Africa. The total domestic waste generated by households in South Africa is estimated at 12.7 million tonnes per annum of which approximately 3.67 million tonnes are not collected and treated through formal waste collection systems. The result is that large amounts of waste are being buried, dumped or burned (Rodseth et al., 2020; Polasi et al., 2020).

The South African Department of Forestry, Fisheries and Environment (DFFE, 2020; SACNU, n.d.) estimated that approximately 700 000 tonnes of diapers and other similar AHP waste are generated and disposed daily into landfills in South Africa. According to 2021 statistics, the major challenge was that only 60.3% of all households in South Africa had weekly refuse removal services (StatsSA, 2022). More than one-third (35.1%) of households had to rely on communal or household refuse dumps, while 1.6% of households had no facilities at all. Globally, single use disposable diapers are one of the biggest contributors to plastic waste and one of the biggest threats to human health, animals and the environment. Developing countries are faced with the additional threat of high birth rates, urbanisation and insufficient or no solid waste management in rural areas. In many African countries, irregular and inefficient access to solid waste disposal is an additional problem. This forces communities to find alternative methods of disposal, including dumping on land and in water courses, burial and open burning. This is particularly prevalent in rural communities, which also often have limited access to clean water and sanitation. Very little scientific literature is available on the impact of dumped diapers on humans, animals and the environment and on sustainable solutions relevant and appropriate for South African and African rural communities.

Between 2018 and 2021, the Chair in Waste and Society (the author and her team) conducted research funded by the Waste RDI Roadmap (Clean Cities and Towns Project). An in-depth household waste characterisation study, as well as an illegal-dumping mapping exercise, was conducted in a rural village, Matshelapata, in the Limpopo Province, an area which receives no waste collection. Due to the lack of collection services, the research results showed that households either bury, burn or dump their waste. One problematic waste fraction identified during the project was that of disposable diapers. It became apparent that residents were not able to manage this waste fraction as it cannot be buried in their yards due to a lack of space, as well as health and culturally linked concerns, and it cannot be burned due to its composition. As a result, it was dumped, mostly in streams or rivers surrounding the village. Disposable diapers are a relatively new and complicated waste fraction. Although solutions exist to collect, dispose of or beneficiate diapers responsibly, such solutions are not available to all rural areas.

Previous research has found that the environmental fate and long-term health effects of disposable diaper accumulation is not well studied (Kordecki, 2021). The water quality, insect prevalence, biodiversity of soil microbiota and the impact of chronic human faeces exposure to wildlife have not been attended to. Improved access to water, sanitation, hygiene and waste management services at the community level is regarded as a step towards a more sustainable future, in tandem with improved access to education, healthcare and an economy to support a growing society (Kordecki, 2021).

Life cycle assessments (LCAs) have been conducted comparing the environmental impacts associated with disposable versus reusable diapers. However, these studies are rarely conducted in rural areas in

developing countries, and thus there are limited insights into scenarios in which there is limited access to water, sanitation and waste management infrastructure. This is of particular importance as, during a meta-analysis of LCAs on diapers, geographical context was identified as one of the critical factors influencing the environmental impacts of diapers (UNEP, 2021).

Disposable diapers are increasingly popular in rural areas. However, the disposal of these diapers in areas without access to solid waste management infrastructure has become a scourge upon, in particular low-income communities, presenting a multitude of health and environmental risks. Kordecki et al. (2022) emphasise the urgency of enhanced understanding of purchasing and disposal practices, including economic, socio-behavioural and cultural factors, to guide interventions that seek to curb the use of disposable diapers or promote more sustainable practices regarding these diapers.

This study aimed to address what Kordecki et al (2022) called for.

1.1 Research Aim

The research aimed to explore diaper usage and disposal practices in unserved rural areas.

1.2 Research objectives

The objectives of the study were to:

1. explore the current disposable diaper usage practices in unserved rural areas,
2. investigate the current disposal practices of diapers in unserved rural areas,
3. observe how and where diapers are disposed of,
4. identify and map the hotspots of dumped diapers in the communities,
5. explore possible alternative options for diaper waste management practices, and
6. determine the environmental impacts of disposable diapers in the rural context through a life cycle assessment.

1.3 Research questions

1. What are the current diaper usage and disposal practices in the rural area of the Kruger-to-Canyons Biosphere Region (including Matshelapata, Limpopo)?
2. What are the environmental impacts associated with disposable diapers?

1.4 Study area

The research was conducted in the Kruger-to-Canyons (K2C) Biosphere Region.



Figure 1: Map of the K2C Biosphere (Source: <https://kruger2canyons.org/>)

The Kruger to Canyons Biosphere Region (K2C) is situated in the north-east of South Africa, straddling the Limpopo and Mpumalanga Provinces. The boundaries of the biosphere extend from the Letaba Catchment in the north to the Sabie Catchment in the south, and from the Drakensberg Escarpment in the west to the Kruger National Park and the Mozambique border in the east. This comprises a total of 2 474 700 ha with just under 1 500 000 residents. It is an extensive geographical area and, together with its large number of residents, forms a very active and diverse landscape.

The biosphere covers several important catchments located along the Drakensberg Escarpment and the adjacent Lowveld. The upper sections of these catchments constitute the majority of two major Strategic Water Source Areas (SWSAs) for both surface and groundwater, i.e., the Mpumalanga Drakensberg and Wolkberg SWSAs. The area is also a biodiversity hotspot that contains many different ecosystems supporting high levels of threatened, rare and endemic species. Additionally, the biosphere includes two of South Africa's key tourism sites – the Kruger National Park and the Blyde River Canyon – as well as a leading international floral hotspot, the Wolkberg Region.

The K2C's natural capital - and therefore the ecosystem services it provides, which underpin human well-being - is threatened by several impacts. On the foothills of these escarpment mountains are local communities located in previous Bantustans. Typically, these communities are underserved by local government, with limited water provision and waste removal. In addition, there is poor and incompatible land-use planning, pollution of land and water systems, mismanaged waste, human-wildlife conflict, climate change and encroaching developments to take into consideration.

2 LITERATURE REVIEW

Absorbent hygiene products (AHPs), including disposable child diapers and incontinence and menstrual sanitary products, constitute a sizeable portion of global landfill waste (Magadza, 2016; UNEP, 2021). AHPs have been estimated to amount to approximately 4% of solid waste and 2% of waste sent to landfill globally (Gerina-Ancane & Eiduka, 2016). Diaper use per child amounts to approximately 4.6 diapers per day, or 33 diapers per week (Gerina-Ancane & Eiduka, 2016). The weight of a used infant diaper is on average 230 g, which approximates a generated disposable diaper waste of 6 kg per child per week (Gerina-Ancane & Eiduka, 2016). The magnitude of the diaper waste

challenge is further illustrated by the projected income of the diaper industry, which is estimated at more than US\$71 billion per year globally (Perez et al., 2021; UNEP, 2021). In South Africa, it is estimated that more than 4 billion disposable diapers are sold annually (Vidal, 2019; Nyamayedenga & Tsvere, 2020). The percentage of South African households with babies using disposable diapers stands at 80% (Kakonke et al., 2019). A recent feasibility study under the auspices of the Department of Fisheries, Forestry and the Environment (DFFE) estimates theoretical AHP waste volumes to be between 67 000 and 160 000 tonnes per annum (tpa) per large metro, with recovery of between 22 000 and 52 800 tpa (DFFE, 2021).

AHPs have detrimental effects on health and the environment over the entire product lifecycle and require an extensive decomposition period in landfills (up to 300 years) (Nyamayedenga & Tsvere, 2020; DFFE, 2021; UNEP, 2021). Adverse effects are associated with resources, such as water and energy consumption, emissions and discharges related to the manufacturing of AHPs (DFFE, 2021). Furthermore, AHPs contribute to the decreased capacity of landfills and to methane emissions (DFFE, 2021). In developing countries, diapers not only contribute to general waste in municipal landfills but are also subject to undesirable waste disposal practices, such as burning, burial or disposal on open dumps or near (or in) watercourses (Owen & Strupat, 2017; Nyamayedenga & Tsvere, 2020).

Despite the extent of this problem, statistics on AHP waste are scarce, and there is a paucity of research on sanitary waste and its impacts, as well as appropriate solutions (Magadza, 2016; Muthu et al., 2013; Reese et al., 2015; Perez et al., 2021). In view of the proliferation of AHP waste, this lack of research is concerning. Specific research gaps related to diaper use and pointed out in literature include policy analysis, quantifying the number of diapers disposed of as municipal waste, municipal diaper waste management in developing countries, pathogenicity of disposed diapers and the identification of social practices that increase solid waste exposure risk (Reese et al., 2015). Significant challenges relevant to the research scope of this study include a lack of separation at source, disposable diaper collection and waste management (particularly in rural and informal areas), diaper cleansing and disposal site selection (DFFE, 2021).

Both a report by the United Nations Environmental Programme (UNEP) and a feasibility study conducted under the auspices of the DFFE make recommendations to address the challenge of diaper waste, and proposed solutions underline the importance of the human dimension in the management of AHPs. The UNEP study concentrated on a meta-analysis of seven LCA studies and concluded that the design of lighter products could significantly alleviate environmental impacts of diapers (UNEP, 2021). Furthermore, reusable diapers laundered with minimal water use (involving a full load of washing in a modern washing machine operated in an energy-efficient way) have a less harmful impact on the environment compared to single-use nappies (UNEP, 2021). The recommendations based on the meta-analysis of the seven LCA studies do not, however, take into account the limitations faced by AHP users in developing countries; for example, the lack of infrastructure and basic municipal services, such as electricity and water, as well as spatial constraints and risks (i.e., leaving reusable nappies out for line-drying in a non-secure environment). The DFFE feasibility study focused on waste management and recommended collection from source, improved waste management in rural and informal areas, the use of suitable receptacles and sealable bags, better communication via mobile applications, piggybacking on recycling collection and Extended Producer Responsibility (EPR) regulations (DFFE, 2021).

Accordingly, further research should address the geographic and socio-economic realities of rural areas in developing countries, as well as the behavioural dimension of socio-cultural practices regarding diaper disposal.

3 METHODOLOGY

An explanatory sequential mixed-methods approach was followed using quantitative and qualitative data collection methods (Creswell & Plano Clarke, 2011; Creswell, 2013; Romm & Hamann, 2021). We started with a quantitative questionnaire, followed by the community's mapping of the dumping areas, focus group discussions, mapping of dumped diapers over a period of six months, and feedback or member-checking sessions with the communities.

3.1 Sampling

Eight villages within the K2C Biosphere formed part of the study as per Table 1 below:

Table 1: Participating villages

Name of Village	Local Municipality	District Municipality	Province
Enable	Maruleng	Mopani	Limpopo
Balloon	Maruleng	Mopani	Limpopo
Metz	Maruleng	Mopani	Limpopo
Moremela	Bushbuckridge	Ehlanzeni	Mpumalanga
Boelang	Bushbuckridge	Ehlanzeni	Mpumalanga
Brooklyn	Bushbuckridge	Ehlanzeni	Mpumalanga
Ga-Inama	Bushbuckridge	Ehlanzeni	Mpumalanga
Matshelapata	Polokwane	Capricorn	Limpopo

3.2 Data Collection

Four sets of data collection were utilised to gather primary data:

1. Completing a diaper baseline questionnaire
2. Mapping of illegal diaper dumpsites using citizen science
3. Conducting focus group discussions
4. Interviewing a local diaper manufacturer

Secondary data required for the Life Cycle Assessment were gathered from literature and the Ecoinvent v3.9 database.

3.2.1 A diaper baseline questionnaire

The diaper baseline questionnaire was developed in collaboration with the One Health Approach to Diaper Waste Management Forum ("the Forum"). The Forum was established in 2021 and is a collaboration of industry professionals who aim to address the diaper waste crisis in South Africa through sound science and critical analysis to inform effective solutions.

With the help of the Forum, research tools and procedures were formulated and resulted in the development of a diaper baseline questionnaire. This questionnaire was implemented in communities across South Africa, including the study area identified for this research project. As a result, there is a

comprehensive database on diaper waste. The questionnaire was translated into Sepedi as this is the predominant language spoken by the residents in the study area (see Annexure 1).

The environmental monitors (EMs) employed by K2C were trained as fieldworkers/data collectors to conduct the survey in Sepedi. Fieldworkers captured data on hardcopy in English, and the data were then digitised by making use of the mobile application Survey123.



Figure 2: K2C Environmental Monitors. (Source: Researchers)

The assistance of the EMs during the research process, completing the questionnaires and monitoring the dumpsites, is seen as part of the K2C “Citizen Science” focus (Goldin et al., 2023). Details of the baseline questionnaires completed for this study are presented in Table 2 below.

Table 2: Baseline questionnaire fieldwork details

Location	Interview dates	Number of baseline questionnaires completed
Enable	14 April – 29 June 2022	191
Balloon	14 April – 29 June 2022	154
Metz	14 April – 29 June 2022	353
Moremela	19 April – 30 June 2022	211
Boelang	13 April – 22 June 2022	107
Brooklyn/Moloro	20 April – 04 July 2022	211
Ga-Inama	14 April – 30 June 2022	201
Matshelapata	20 June – 04 July 2022	148
TOTAL:		1576

A total of 1576 questionnaires were completed over the data collection period (mid-April to end June 2022).

3.2.2 Illegal dumpsite mapping

Citizen Science was also used for the mapping of the illegal dumping. The Oxford English Dictionary (2014) describes *citizen science* as “scientific work undertaken by members of the general public often in collaboration with or under the direction of professional scientists and scientific institutions”. The mapping of diaper dumps was done by collecting global positioning system (GPS) coordinates of diaper dumps from April to November 2022 in all villages except Matshelapata. The illegal dumpsites in

Matshelapata were mapped in 2021. During the data collection in Matshelapata the dumpsites were revisited and were found to be at the same spots as previously noted.

During the monitoring period in K2C villages, the GPS coordinates of dumped diapers were recorded by EMs who sent a geo-location pin to a designated chat group via the mobile application WhatsApp. The size of the diaper dump was also noted by the EMs with any of the following classifications: (a) diapers can fit into a single, standard, 8-litre plastic bag, (b) diapers can fit into a 20-litre bucket, (c) diapers can fit into a wheelbarrow. If the diaper dump was larger than would have fitted into a wheelbarrow, the number of wheelbarrows required to remove all the dumped diapers was noted. Mapping of the dumping spots also took place during the focus group discussions through thematic drawing.

3.2.3 Focus group discussions

A focus group discussion is a qualitative method typically used by social scientists when there is a need to discuss a topic in a way which resembles a natural conversation (George, 2021). Prior to conducting any focus group discussions, a Tribal Authority meeting was attended for each village to ensure that the Traditional Council was aware of and in favour of the research being undertaken. In total, eighteen (18) focus group discussions were held during the fieldwork period, as per Table 3 below.

Table 3: Tribal Authority meeting and focus group discussion details

Location	Meeting	Date
Enable	Focus group discussion 1	4 July 2022
	Focus group discussion 2	4 July 2022
	Tribal Authority meeting	1 July 2022
Balloon	Focus group discussion 1	21 July 2022
	Focus group discussion 2	21 July 2022
	Tribal Authority meeting	11 July 2022
Metz	Focus group discussion 1	18 July 2022
	Focus group discussion 2	18 July 2022
	Tribal Authority meeting	7 July 2022
Moremela	Focus group discussion 1	11 July 2022
	Focus group discussion 2	11 July 2022
	Tribal Authority meeting	8 July 2022
Boelang	Focus group discussion 1	13 July 2022
	Focus group discussion 2	13 July 2022
	Tribal Authority meeting	5 July 2022
Brooklyn/Moloro	Focus group discussion 1	5 July 2022
	Focus group discussion 2	12 July 2022
	Tribal Authority meeting	5 July 2022
Ga-Inama	Focus group discussion 1	14 July 2022
	Focus group discussion 2	14 July 2022
	Tribal Authority meeting	5 July 2022
Matshelapata	Focus group discussion 1	06 July 2022
	Focus group discussion 2	06 July 2022
	Tribal Authority meeting	06 July 2022

3.2.4 Member-checking sessions

During January 2023, after the collected data had been analysed, member-checking meetings were held with members of the selected communities. Member-checking, according to Birt et al. (2016), is also known as participant or respondent validation. Results are shared with the participants or respondents to check for accuracy and resonance with their experiences.



Figure 3: Member-checking sessions with community members, January 2023. (Source: Researchers)

3.2.5 Life cycle assessment (LCA)

A lifecycle assessment was completed. The methodology and results are discussed in 5.4

3.3 Analysis software used

The diaper baseline questionnaire was analysed with the use of Microsoft Excel. Where ranges were given (e.g. estimated number of diapers used per day), the average of the range was taken. The focus groups were analysed using thematic analysis (Brown & Clark, 2019).

4 RESEARCH ETHICS

Ethical clearance for the research was obtained from the Human and Social Science Research Committee (HSSREC) of the University of the Western Cape HS22/1/2 (see Annexure 3).

5 RESULTS

5.1 Results from the diaper baseline survey

The following section will discuss the answers to each of the survey questions.

5.1.1 Respondents per community (n=1576)

A total of 1576 questionnaires were completed throughout the eight villages surveyed. One environmental monitor was appointed per village to complete the surveys, except in Metz where two EMs conducted the surveys due to the size of the village. The number of respondents from Metz is also then the biggest.

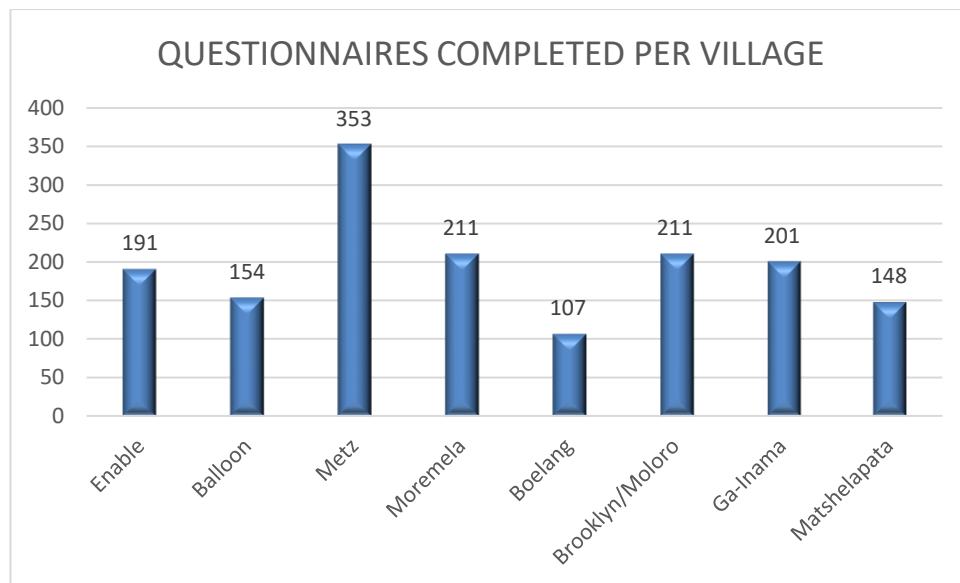


Figure 4: Questionnaires completed per village. (Source: Research data)

To be able to understand the diaper use, and the disposal management of the diapers, it is important to view it in the socio-economic context of the respondents, as will be described in the next section.

Biographical results of the respondents

5.1.2 Respondents' gender (n=1458)

Of the 1458 respondents, 1408 (97%) identified themselves as female, and 50 (3%) as male. This indicates that women are primarily responsible for infant care in the study area.

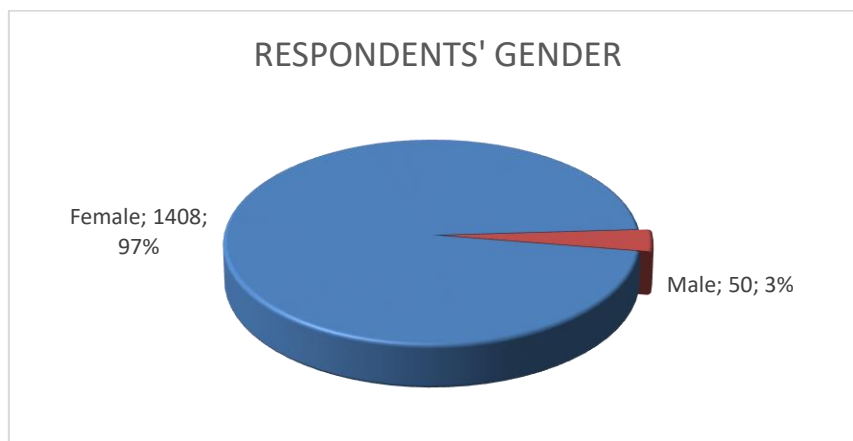


Figure 5: Gender of all respondents. (Source: Research data)

5.1.3 Respondents' age (n=1458)

The majority of respondents (79,7%) were between 20 and 39 years of age.

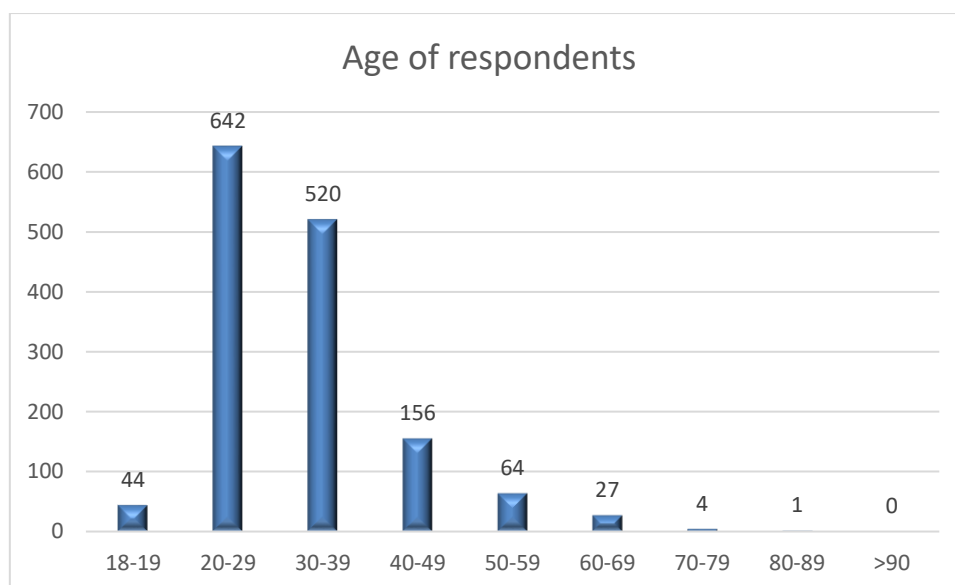


Figure 6: Respondents' age. (Source: Research data)

5.1.4 Total number of individuals per household (n=1462)

The average household size was 6.2 persons. As per the graph below, 72% of households house between 4 and 7 persons.

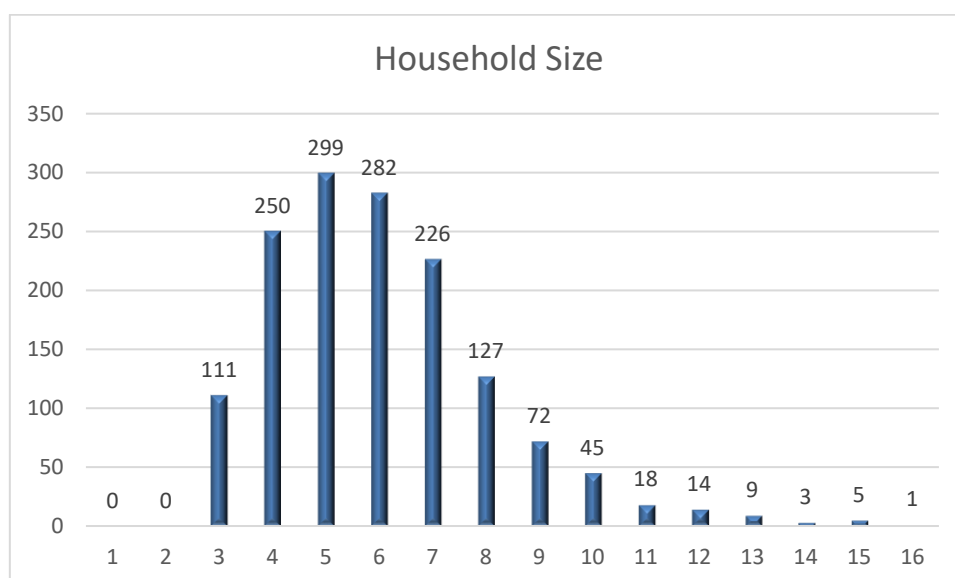


Figure 7: Household size. (Source: Research data)

The average household size in the selected villages is nearly double the average household size in South Africa which stands at 3.34 persons (StatsSA, 2022). It is probably due to more than one generation living in one household. This was also reflected by the amount of money, in terms of grants, which the households received.

Employment status of the households

5.1.5 Employment status of respondents (n=1465)

Most respondents (71%) indicated that they were unemployed and 21% that they were appointed on contract and part-time basis from time to time. The unemployment rate was much higher than the general unemployment rate of South Africa which stands at 32,9% (StatsSA, 2022).

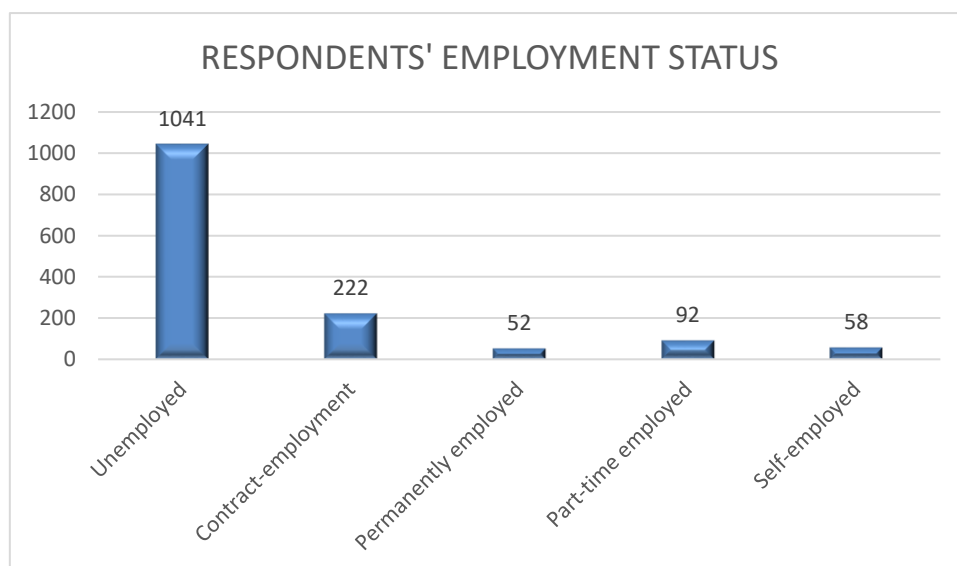


Figure 8: Respondents' employment status. (Source: Research data)

5.1.6 Occupation of respondents (n=605)

We also wanted to understand what type of work was available to those working full-time or part-time. Seventy-seven unique occupations were listed by respondents. Interestingly enough, being a 'pensioner' was listed as an occupation and was the main 'occupation' held by respondents (n=198). Being employed by the Expanded Public Works Programme (EPWP) and the Community Works Programme (CWP) was also not permanent employment. The main occupation categories are shown below.

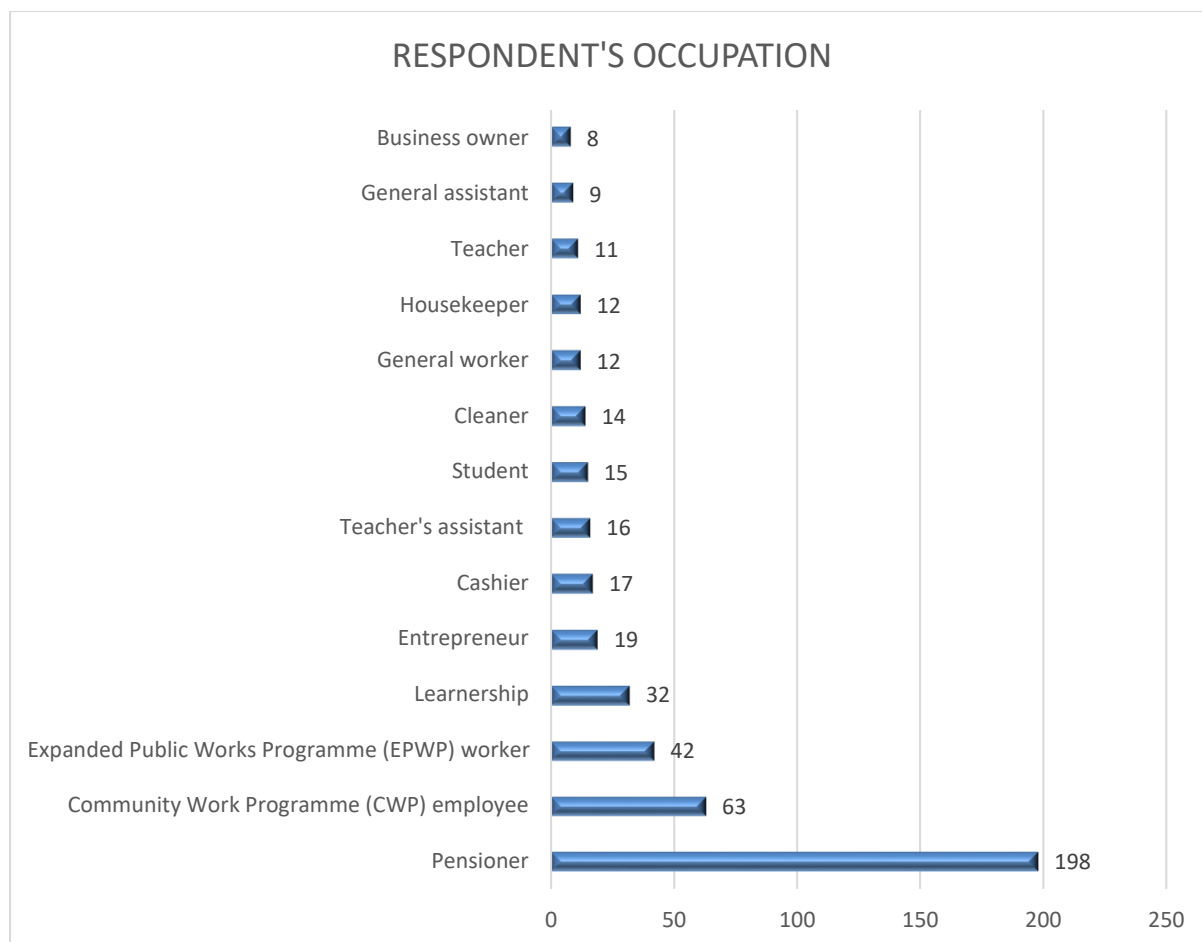


Figure 9: Respondents' occupation. (Source: Research data)

Most participants who saw themselves as employed were, in essence, temporary informally employed workers, such as cleaners, general workers, assistants and housekeepers, which exacerbates the employment situation, as will be seen in the discussion of grant dependency (see Section 5.1.12).

5.1.7 Employment status of heads of households (n=1464)

The majority of respondents – who themselves were not necessarily the head of their household - indicated that the head of their household was unemployed (n=864 or 59%).

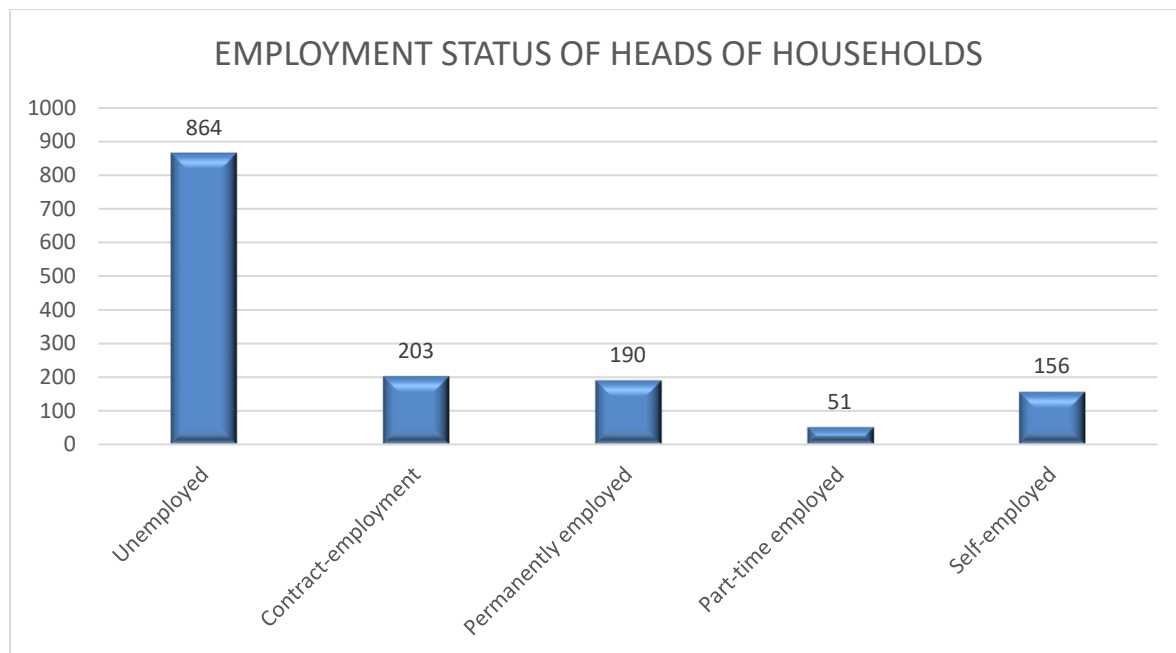


Figure 10: Employment status - heads of households. (Source: Research data)

5.1.8 Occupation of heads of households (n=1013)

The occupation rate of the heads of households seemed slightly better than the mothers/caregivers but, on closer scrutiny, unemployment was still exceptionally high. One hundred and forty-eight (148) unique occupations were listed by respondents. Again, being a pensioner was also listed as an occupation and was the main 'occupation' held by household heads (n=417). The main categories are shown below.

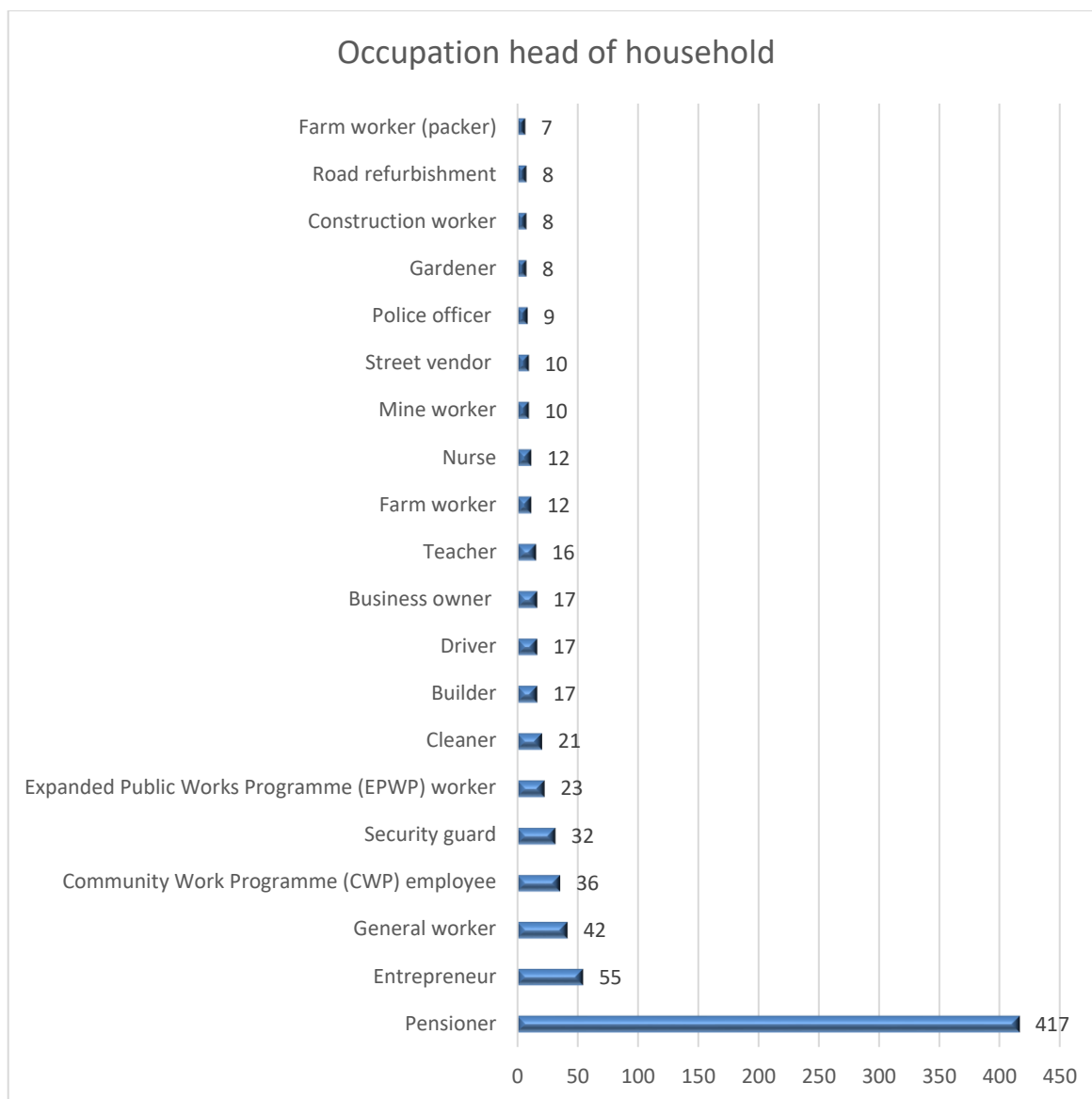


Figure 11: Occupation - heads of households. (Source: Research data)

Very few of the occupations mentioned were held by permanent workers and were referred to as informal employment, such as farmworkers (which may also have been seasonal), general workers, builders, street vendors and cleaners – or as temporary employment, such as EPWP and CWP workers.

5.1.9 Number of household members employed (n=1463)

The results showed that 453 (or 31%) of households had no employed household member, while 69% of households had at least one (or more) persons working full-time, part-time or receiving a pension.

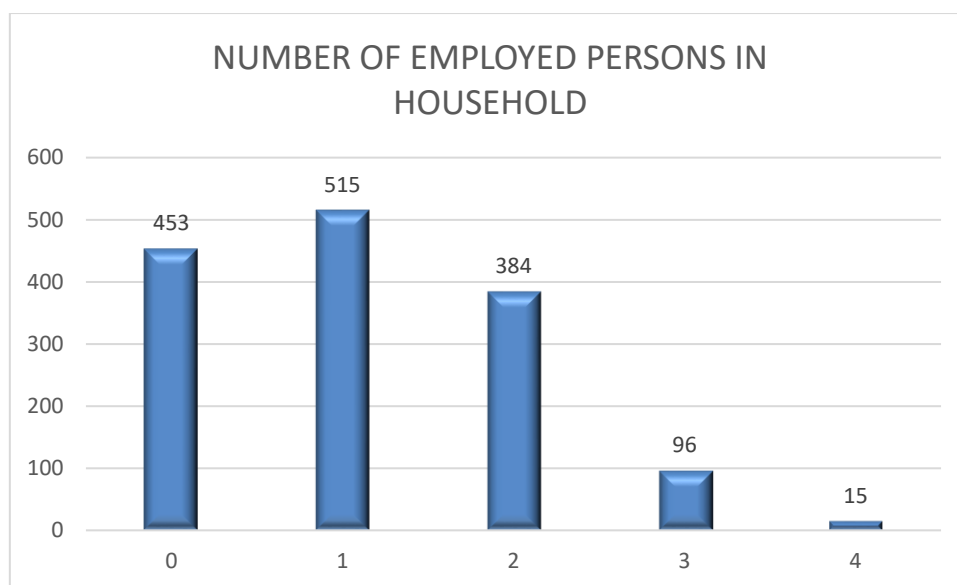


Figure 12: Number of employed persons in household. (Source: Research data)

5.1.10 Number of household members employed 'locally' (n=882)

Of all employed household members questioned, 87% said that they were employed 'locally'. For the purpose of this study 'locally' was defined as a household member who returned to the home daily after work and slept at home.

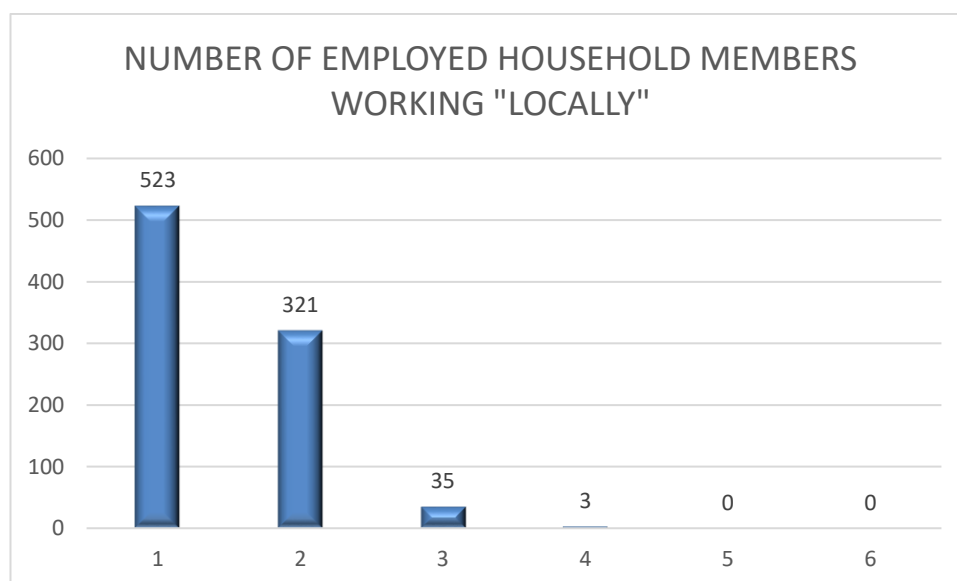


Figure 13: Number of employed household members working 'locally' (Source: Research data).

5.1.11 Number of household members working away from home (n=332)

264 households had one member working away from home meaning that the member returned home only for weekends or after longer periods.

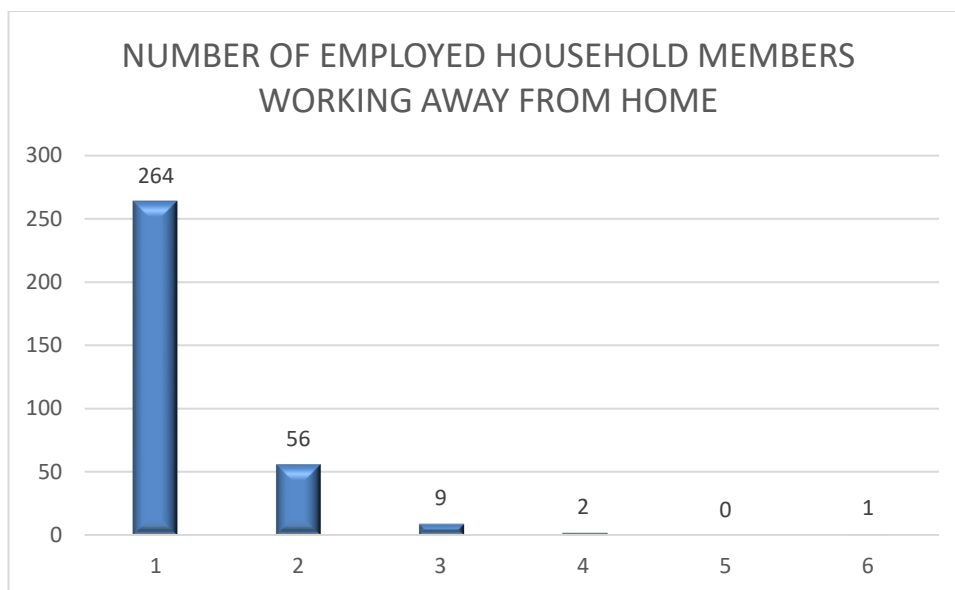


Figure 14: Number of employed household members working away from home (Source: Research data).

Grant reception of the households

5.1.12 Grant recipients in household (n=1464)

Given the high unemployment, 97% of the respondents indicated that they were dependent on a state grant.

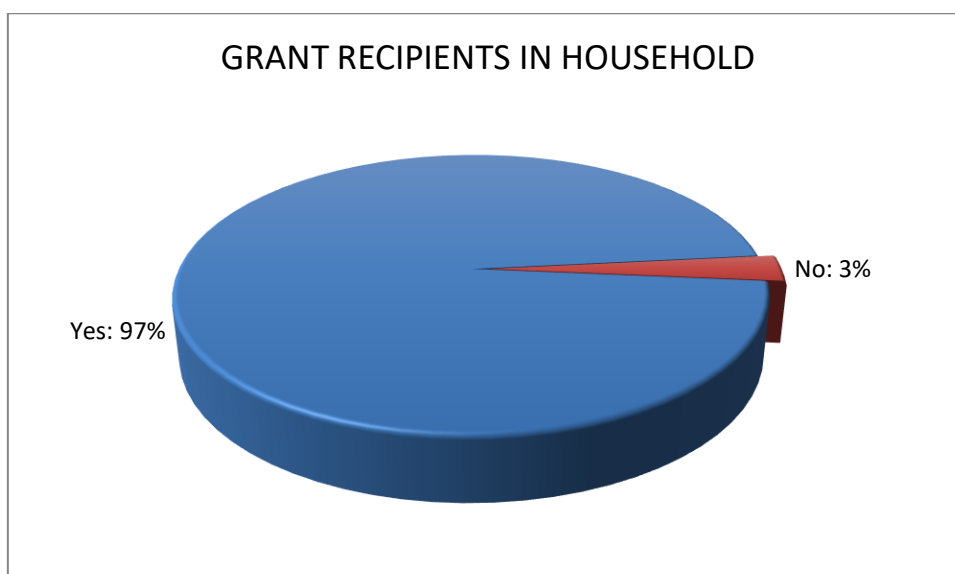


Figure 15: Grant recipients in household (Source: Research data).

Madisa and Amashabala (2023) report that 18 million of the 60 million people in South Africa receive state funding from the South African Social Security System. Another 11 million also receive the Covid -19 social relief fund which brings the number to close to 50% of the population who are dependent on grants.

5.1.13 Number of grants received by the household (n=1464)

It was further explored how many grants each household received.

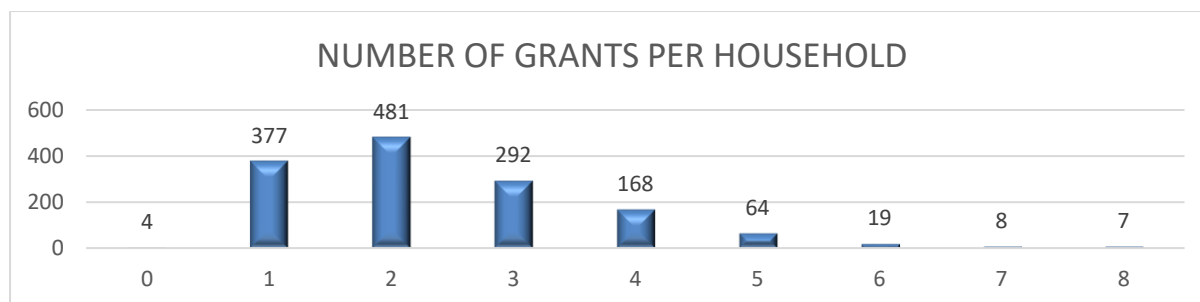


Figure 16: Number of grants per household. (Source: Research data)

Most of the 1464 respondents who answered this question received two or more grants; up to eight grants (n=7) per household were recorded. The type of grants received were not explored.

Infrastructural context

The decision regarding what type of diaper to use and how to manage the disposable diapers can be influenced by the infrastructural context of the users. The residents, the municipalities and K2C all confirmed that no waste management existed in these villages. During our visits to the villages we noticed one skip/container in the Enable village. The EM residing in the area confirmed that he and the councillor had requested the municipality to provide a skip for nappies. It is also cleaned quite often. At the time of the visit the skip had just been emptied. Thus, only one village has access to some form of waste management. It was an oversight of the questionnaire not to ask whether the respondents had access to waste management.



Figure 17: Skip available in Enable Village. (Source: Researchers)

5.1.14 Access to water (n=1465 primary; n=710 secondary; n=199 tertiary)

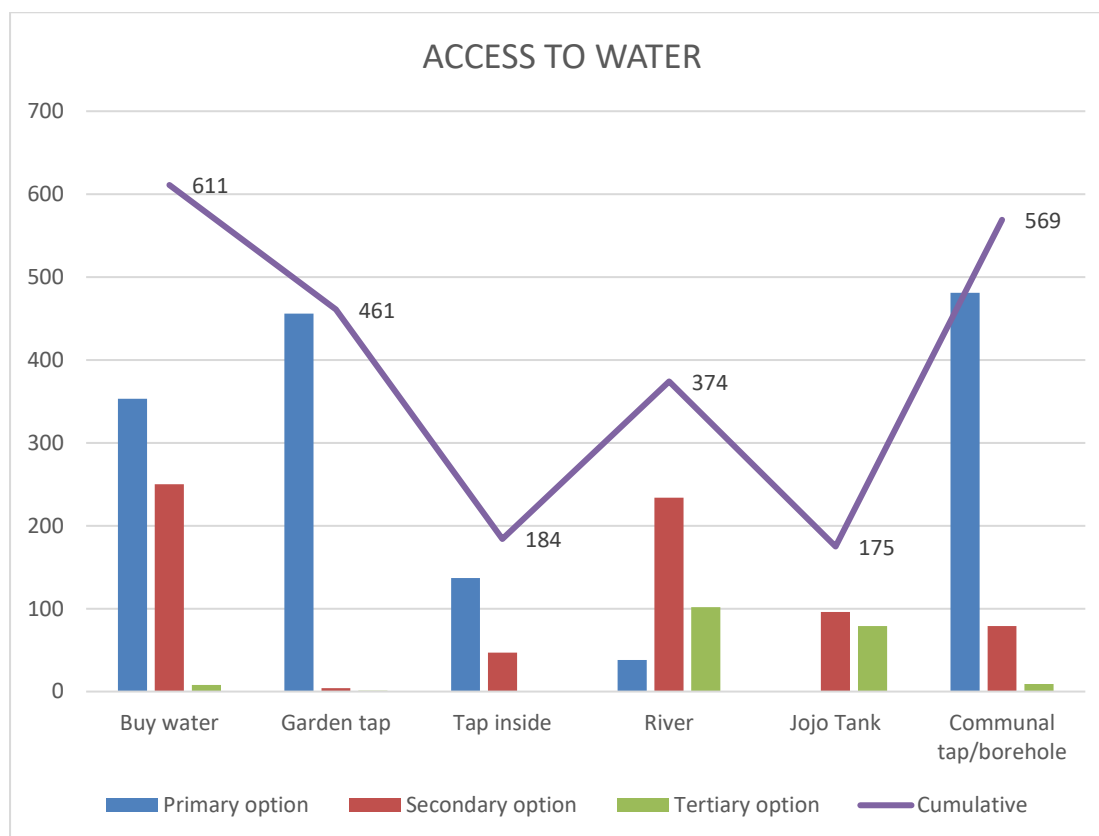


Figure 18: Access to water. (Source: Research data)

Access to water is a major problem in the K2C area as illustrated by Figure 18. Only 184 households indicated that they had a tap inside the house. The residents had to rely on communal boreholes, garden taps, had to buy water or collect water from the river. Limited access to water minimises the possibility of using cloth nappies. A considerable number of respondents (611) explained that one option of accessing water was to buy water. Two scenarios were described: They either bought bottled water from the shop, or bought water from those who had boreholes. They might pay in the region of R2 per litre for the borehole water. On further exploration, it seemed that the communities had had piped water previously but the infrastructure had not been maintained and had completely collapsed. This was again confirmed during the member-checking session.

During discussions with members of the municipality they confirmed the collapse of the water infrastructure and maintained that the municipality delivered water by truck to the communities weekly. This was not confirmed by the respondents in the communities (See Figure 20). On questioning why the infrastructure was not being maintained, it seemed that the district municipality was regarded as being responsible for the provision of water. This is an aspect to be further explored.

The answers to the next question further illustrate the dire water situation.



Figure 19: Resident collecting water. (Source: Researchers)

5.1.15 Daily access to water (n=1463)

A question was asked to determine whether the respondents had daily access to water.

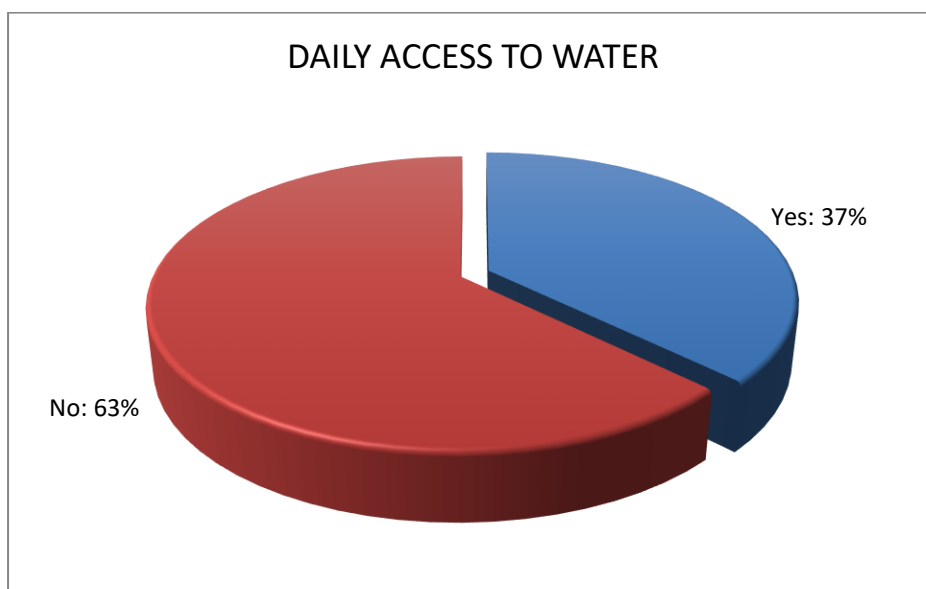


Figure 20: Daily access to water (Source: Research data)

Only 37% of the respondents had daily access to water. Water had to be sourced and kept in drums (see Figure 19 above). The next question was posed to determine the reasons for not having daily access to water.

5.1.16 Reasons for not having daily access to water (n=919)

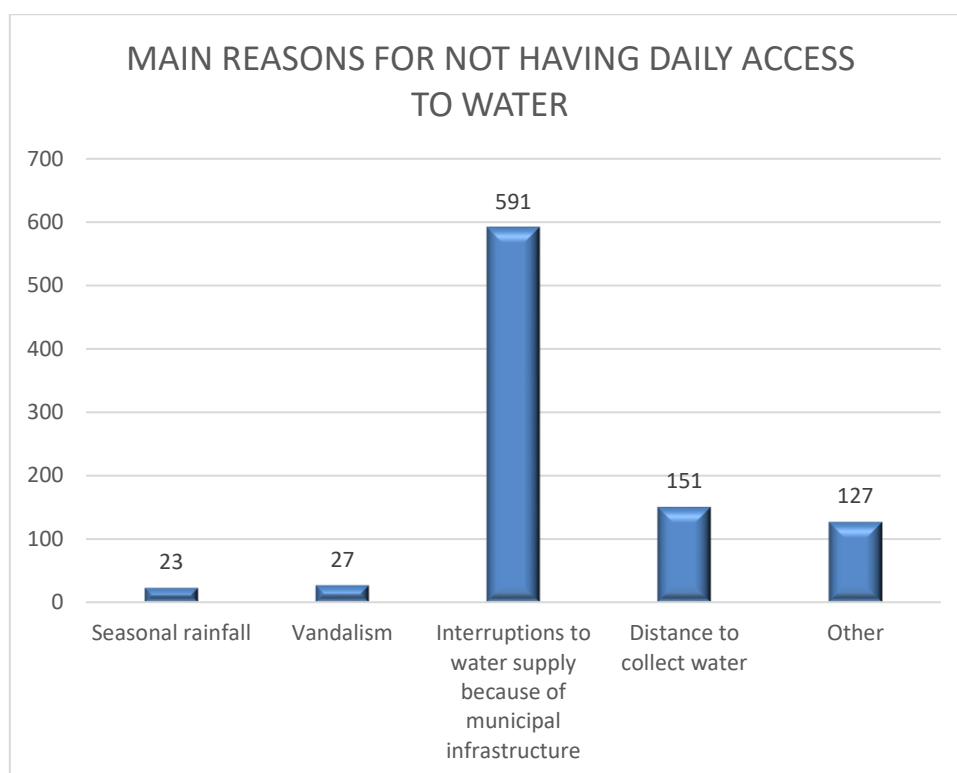


Figure 21: Main reasons for not having daily access to water. (Source: Research data)

The answers to the question clearly indicated that the residents perceived the reason for their lack of access to water as the collapsed water infrastructure. Vandalism was also a concern which added to the collapse of the infrastructure. At the time of the interviews it was winter, and the area had had very little rain during the summer season. Water in the rivers was scarce and polluted.

To make provision for more answers than the choices given in the questionnaire “Other” answers provide more reasons for not having access to running water. Some of the answers in this section referred to water being delivered by the truck from the municipality.

Table 4: Reasons for not having water daily. (Source: Research data)

Theme	Reason
1. Lack of funds to buy water	“We don’t have money to buy water.”
2. Infrastructural challenges	“In one of the communities solar energy was installed to enhance the water supply.” “We rely on solar energy for water supply & now there’s water shortages due (to) winter season.” “no water sometimes available in pipeline” “The pressure pump doesn’t work as it [is] meant to be.”
3. Water shortage	“Sometimes there’s shortage of water.” “There’s shortage of water.”
4. Politics	“political issues”
5. Historical backlog	“We never had water supply.”
6. Water load shedding	“get water by section per week” “Water come(s) on scheduled time.” “tanker to deliver”

5.1.17 Sanitation: Type of toilets available to the respondents (n=1407)

Linked to the water problem, the sanitation infrastructure was explored.

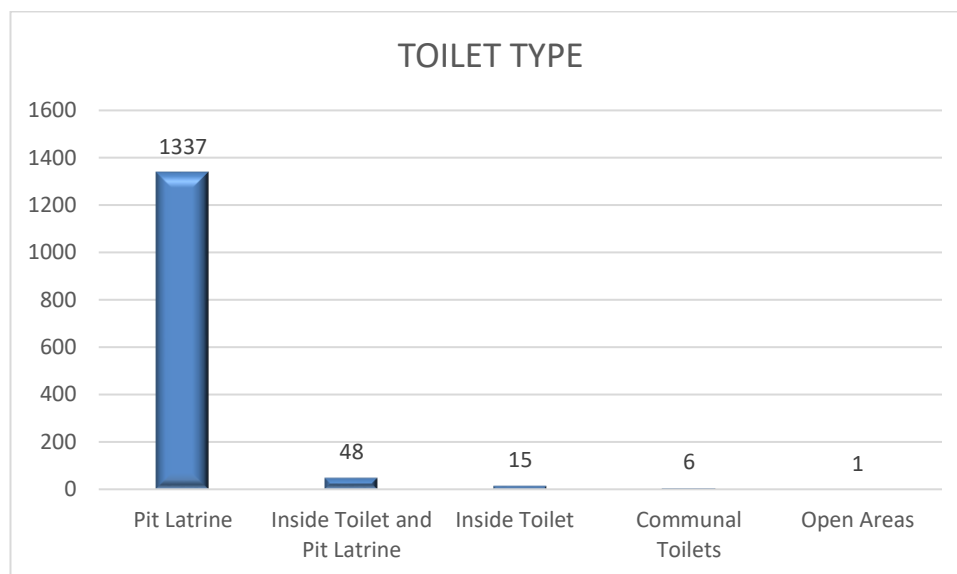


Figure 22: Toilet type. (Source: Research data)

The majority of the households had pit latrines, and only 63 households had inside toilets. This implies that the 48 and 15 participants answering that they had inside toilets, may have had some water in their homes. The water source was not clear.

Diaper use and management

In this section the diaper use and management are discussed.

5.1.18 Adults using adult diapers (n=1454)

None of the 1454 respondents answering the question whether there were adults using diapers, mentioned that any adult in the community was dependent on diapers. Later, however, when a question was posed to determine the ages of adults on diapers, four of the respondents mentioned such persons, their ages being 47, 82, 87 and 90. One started at a relatively young age (47) which might indicate a disability or health condition. During member-checking the answer to this question was confirmed: Both groups confirmed that there were adults on diapers but this would not easily be shared with outsiders.

5.1.19 Number of children in household using diapers (n=1450)

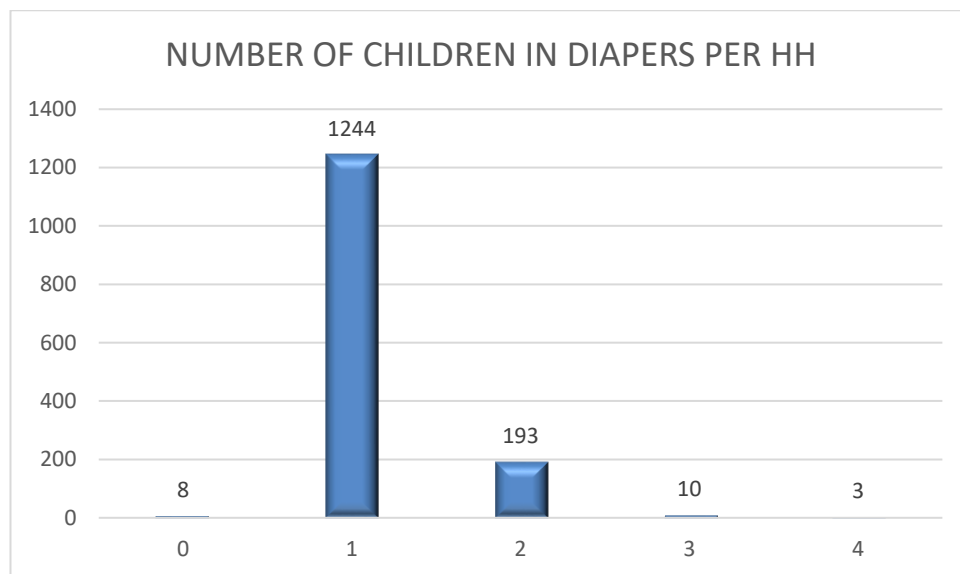


Figure 23: Number of children in diapers per household. (Source: Research data)

Most households had one child in diapers. Eight household mentioned that they had no children in diapers. These households should have been excluded from the study as the criterion for the study was ‘children in diapers’.

5.1.20 Person in the household responsible for changing the diapers (n=1448)

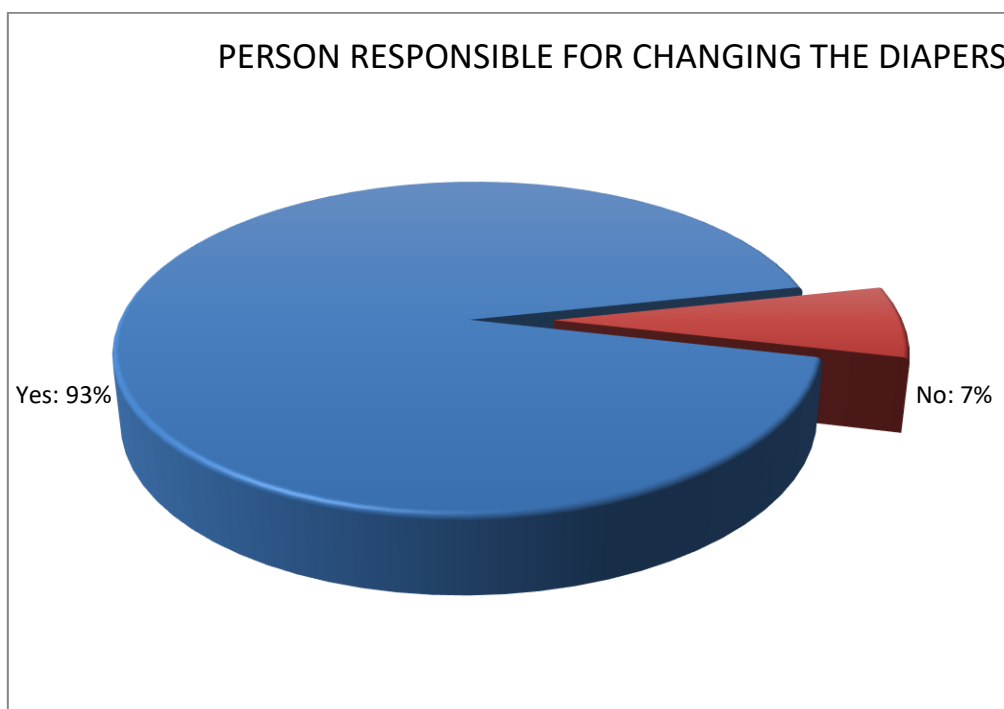


Figure 24: Person in household responsible for changing the diapers (Source: Research data)

The respondents who answered the question confirmed that they were responsible for changing the nappies.

5.1.21 Number of years children use diapers during the day and night (n=800)

It is estimated that children can be in diapers from 18 months to 3 years (DFFE, 2021; SACNU, n.d.). On average, the respondents in this study reported that children were out of diapers at 18 months or 1.69 years.

5.1.22 Number of years children use diapers at night only (n=800)

Following on the previous question, it was reported that, on average, children wore diapers during the night for only another year (1.03 years). Thus, in total and on average, children were in diapers for just over two and a half years (2.72 years)

5.1.23 Type of diapers used for the child/children (n=1463)

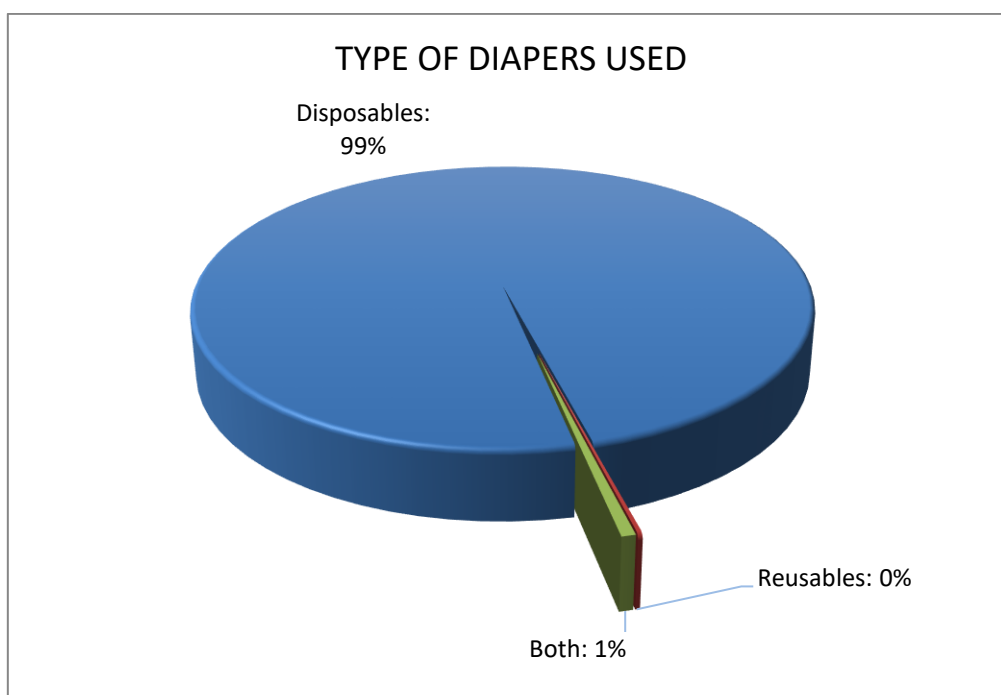


Figure 25: Type of diapers used. (Source: Research data)

All respondents were using disposable diapers and 1% indicated that they used both disposable and cloth nappies. Taking into consideration the context of water scarcity and the lack of a supportive infrastructure, this was expected.

5.1.24 Estimate how many disposable diapers used per day PER CHILD (n=1450)

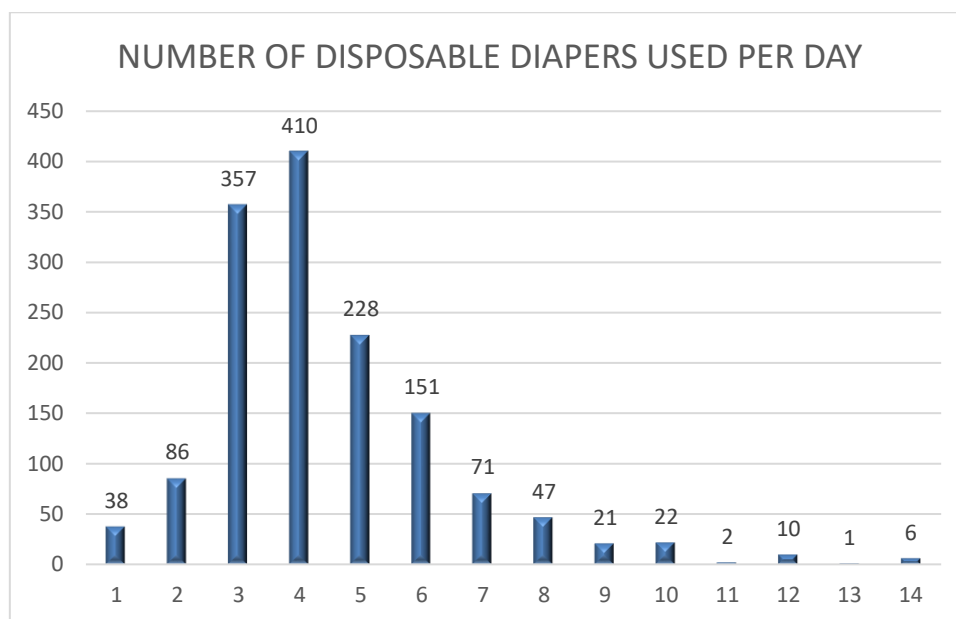


Figure 26: Number of disposable diapers used per day. (Source: Research data)

Some of the respondents provided ranges of diaper use. Where ranges were given the average of the range was taken. Some respondents also said that their child was basically potty-trained but, if they went to a clinic or to town, they used one or two diapers per day. Some respondents said that the number of diapers used depended on the age of the baby and the baby’s output, especially with upset stomachs – up to 14 per day. The older the baby the fewer diapers they used per day.

Taking all the above into account, in this study babies used an average of 4.47 diapers per day. According to SACNU (n.d.) an average of 4.6 diapers is estimated. During a study by Schenck et al. (under review) in the Samora Machel township, the respondents indicated an average of 3.58 diapers per day. Kordecki’s (2021) pilot study with 77 respondents reported that the estimated number of diapers used per child per day was 2.63.

5.1.25 Number of times reusable (cloth) diapers are changed per day (n=10)

According to Figure 25, only 1% of respondents mentioned that they used both disposable and cloth nappies. We also wanted to determine how many cloth nappies were used per day to compare this number with that of disposable nappies used per day. Judging by the 10 respondents’ answers to this question, an average of four (3.8) nappies were used per day, which is slightly less than the disposable diapers (see Figure 27).

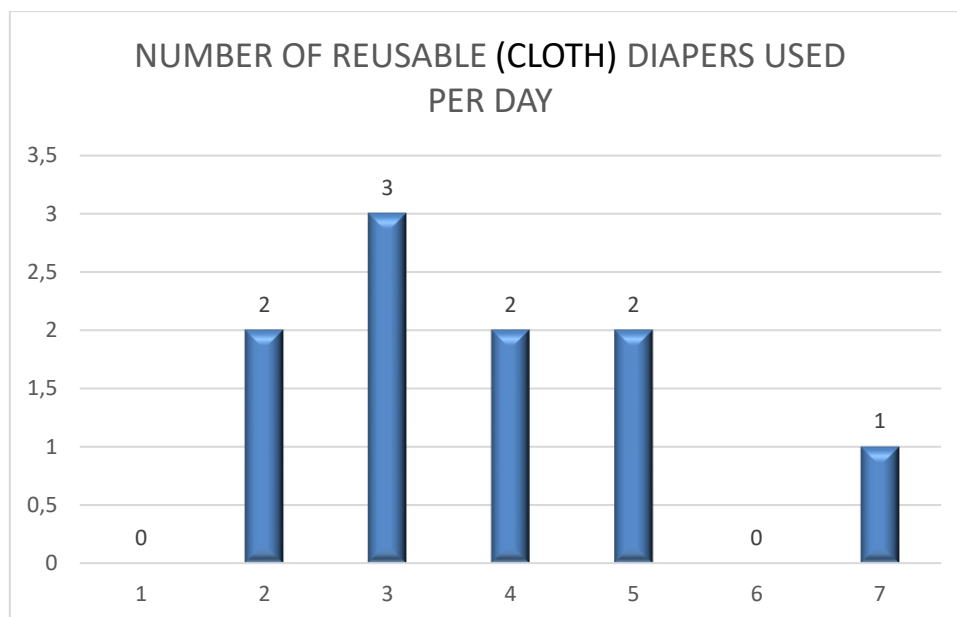


Figure 27: Number of reusable (cloth) diapers used per day. (Source: Research data)

5.1.26 Number of households which reuse disposable diapers (n=1461)

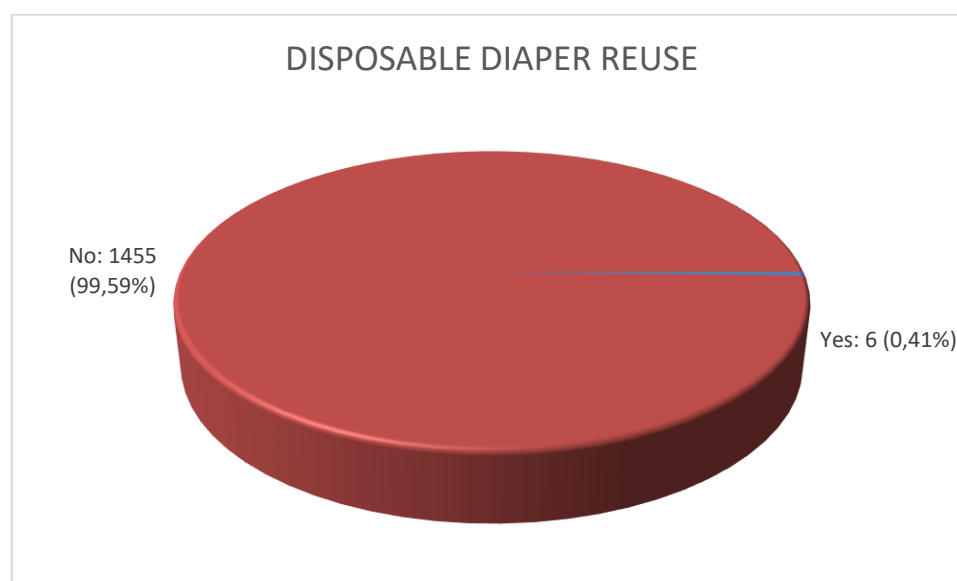


Figure 28: Disposable diaper reuse. (Source: Research data)

Only six (or 0.41%) respondents indicated that they reused disposable diapers. When checking the ages of these respondents, they ranged from 28 to 66 years (average 37). It was the more mature mothers, and not the younger mother in their 20s, who reused disposable diapers.

The six respondents were asked how many times they reused a disposable diaper. Five of the six who answered this question indicated that they reused disposable nappies one additional time, while one respondent reused such nappies twice.

5.1.27 Disposal of diapers (N=1428)

The question requested the respondents to rank the top three disposal methods with one being the most commonly used.

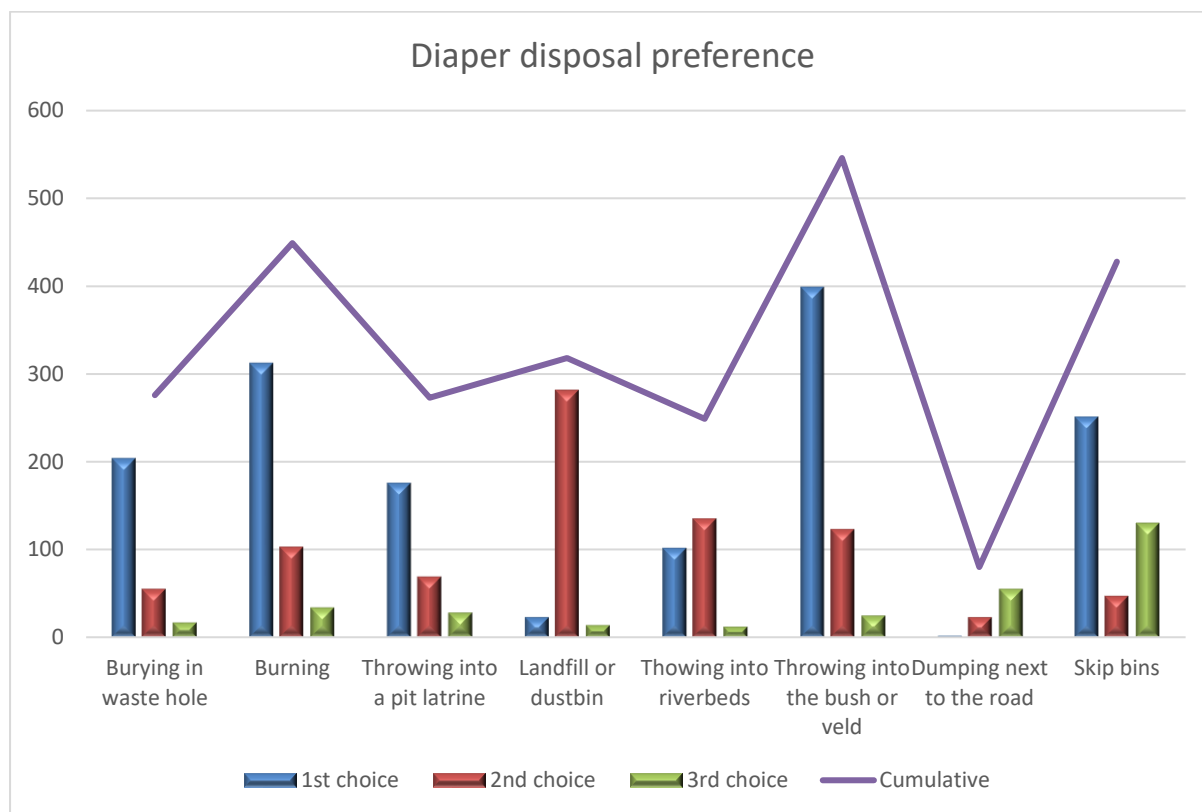


Figure 29: Diaper disposal preference. (Source: Research data)

Due to the fact that residents did not have access to waste management it is not surprising that most of them discarded their diapers in the bush/veld, in river beds and next to roads. Burying and burning diapers and throwing them into pit latrines was also practised. As stated previously, skip bins was available to one community and was used by some of the respondents. The disposal method which needs urgent attention is that of discarding such diapers in dustbins and landfills (done by 318 households). This number can probably be added to the number of households dumping diapers in the veld/bushes or riverbeds, as the household dustbins will also be emptied elsewhere. Equally, the diapers disposed of in the skip will also go to the landfill. The photo in Figure 30 is one of the many taken by the EMs showing the dumped diapers in the veld and next to rivers.

Dumping used diapers in the open veld and riverbeds is clearly illustrated in the maps (see Figure 39 and Figure 40).



Figure 30: Dumped diapers in the veld/riverbed. (Source: EM)

Over 200 respondents reported that they buried the diapers in a “waste hole” which would be dug and in which the diapers were buried. Figure 31 depicts such an example.



Figure 31: Diapers buried in a “waste hole” or pit. (Source: EM)

The following note was written by the EM:

“..... I visited a home where they have a pit for disposing nappies. They say this pit have been there for five years. When the child grow up they close it with steel door. Now there is a baby they use it again. The nappies are so many to fill a pallet bag.”

5.1.28 Person responsible for discarding the diapers

The respondents were requested to rank the top three persons with one being the person who does most of the disposal (n=1434)

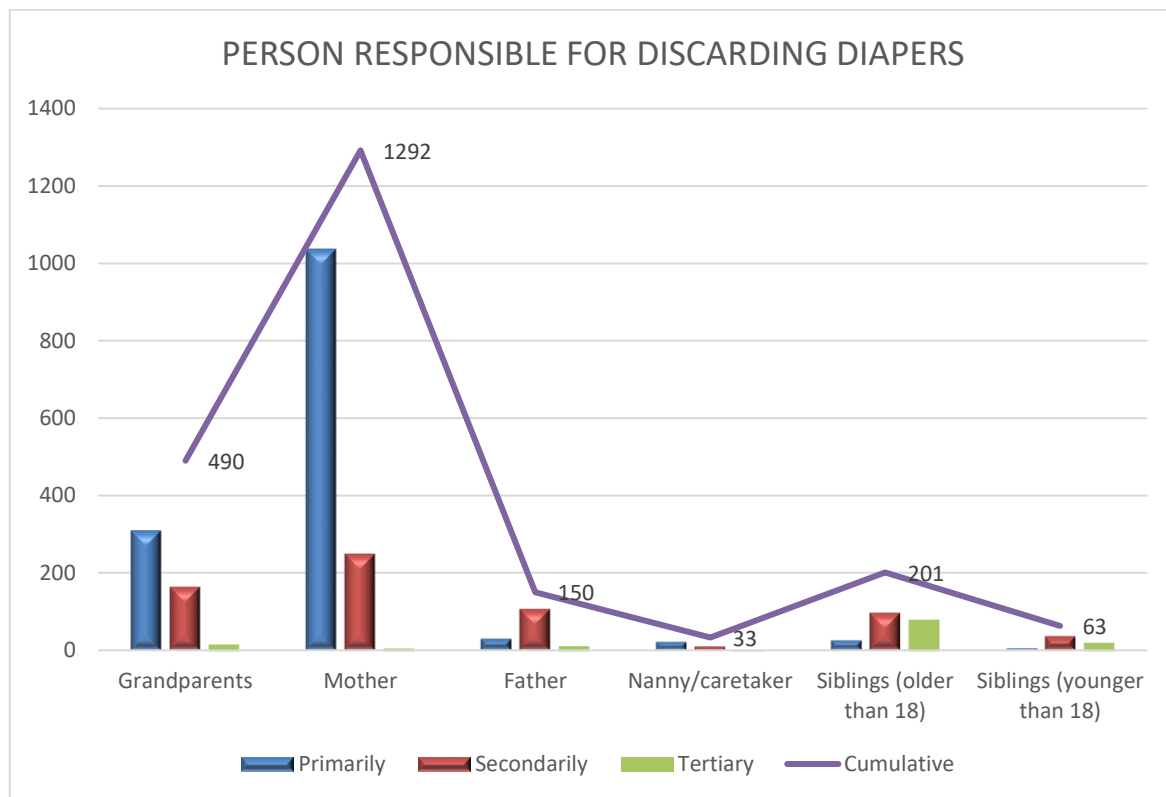


Figure 32: Person responsible for diaper disposal. (Source: Research data)

It is predominantly the mothers and grandparents who were responsible for the baby and who would discard the diapers. Some mothers mentioned to the EMs that they, at times, discarded the diapers during the night so that the community did not see where and how they discarded them.

5.1.29 Emptying of the stool before disposal (n=1464)

This important question was asked to determine whether the stool was removed before the diapers were thrown into the veld/river.

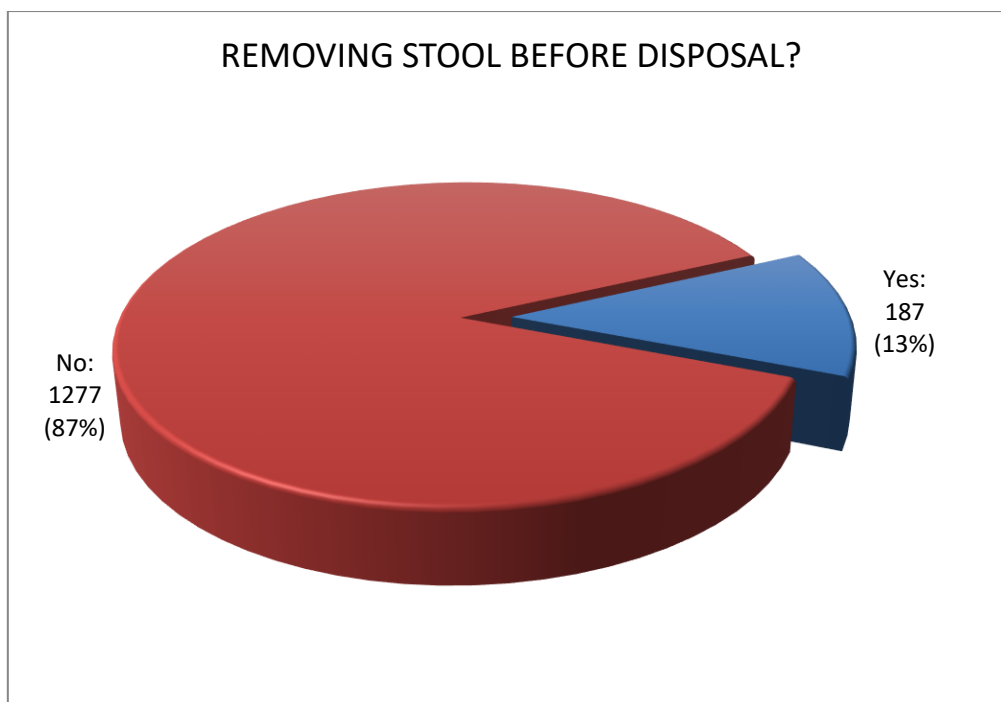


Figure 33: Removing stool before disposal. (Source: Research data)

A mere 13% of respondents removed the stool before discarding the diapers (see also LCA study).

The next question then probed why the respondents removed or did not remove the stool. Of the 398 respondents who provided an answer, the following themes were extracted:

Table 5: Reasons for not removing the stool before disposal. (Source: Research data)

Theme	Example of quote
New concept/have not done it before	"Never thought of doing that" "Traditional perception" "I have never tried it before." "I don't do that."
Unhygienic/"gross" to remove the stool	"It's disgusting." "They are unhygienic." "They are awful and I would never do that." "I can't deal with such a thing."
Time consuming/inconvenient	"It's a lot of work." "It is a waste of time." "I am old and I won't be able to do all the work." "It will increase my daily work load." "It is not easy to do that."
Unnecessary - still needs to be disposed	"Still need to be disposed" "Because they are disposable nappies" "Diapers will be thrown" "I just throw it away with the nappy." "I don't see a need to do that."

Table 6: Reasons for removing the stool before disposal. (Source: Research data)

Theme	Reason
Required as precursor to burning	<p>“Because the stool will not burn”</p> <p>“To let diapers dry”</p> <p>“They let it dry before burning.”</p> <p>“Because they will be burnt”</p>
To avoid creation of nuisance conditions	<p>“To avoid bad smell in my yard”</p> <p>“To avoid littering”</p> <p>“Avoid pollution”</p>
Only under certain conditions	<p>“We only empty the stool when using a cloth nappy.”</p>

In Figure 34 the participant illustrated to the fieldworkers how the stool was first removed, the nappies then dried before being burned as they cannot be burned with the stool.



Figure 34: Drying disposable diapers. (Source: EM)¹

The description accompanying the image above was made by the EMs.

5.1.30 Disposal of the stool (n=226)

We also probed where the removed stool was disposed of.

¹ The text underneath the photo was part of the WhatsApp message - italics cannot be added

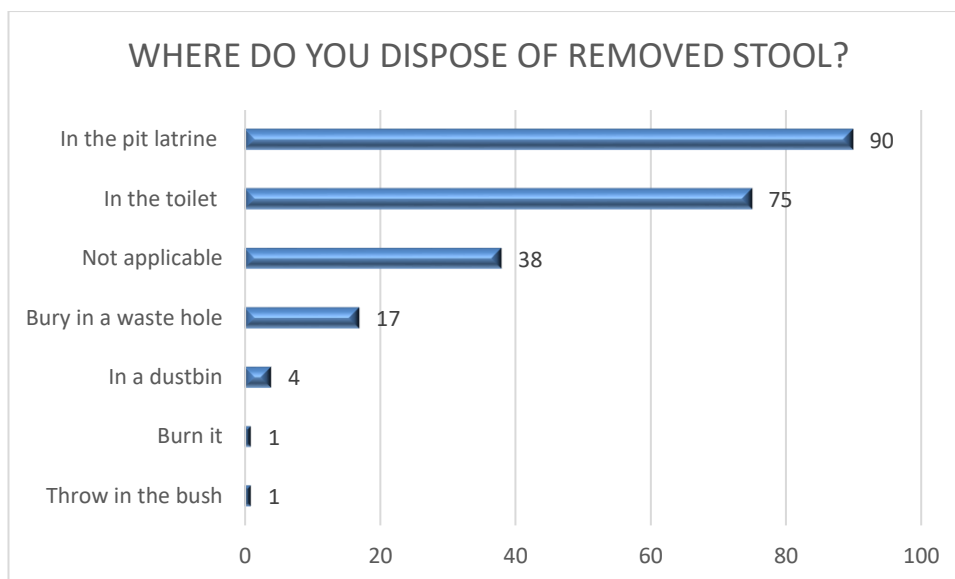


Figure 35: Disposal of removed stool. (Source: Research data)

Most discarded the stool in the pit latrines or toilets. Of concern is the disposal in a wastehole, dustbin or in the bushes.

5.1.31 Management of general waste disposal in the household

The respondents were requested to rank the top three persons responsible for the general waste management in the household with one being the person who does most of the disposal (n=1434)

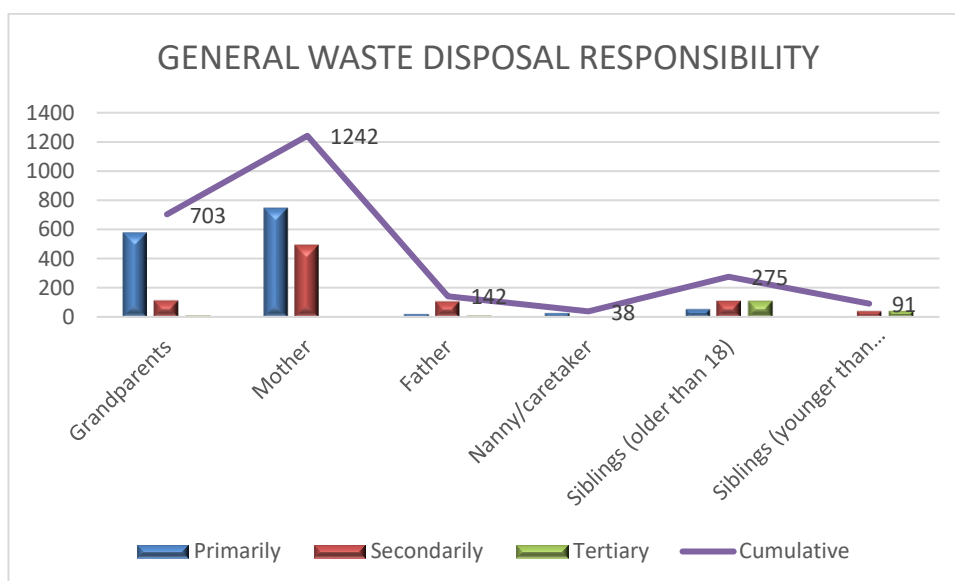


Figure 36: Person responsible for general waste disposal. (Source: Research data)

Mothers and grandparents were ranked as the persons managing the household waste. The older siblings in the household also took responsibility for the general waste.

5.1.32 Separation of the diapers from general waste (n=1461)

With this question we wanted to determine whether the diapers and general waste were discarded separately or together.

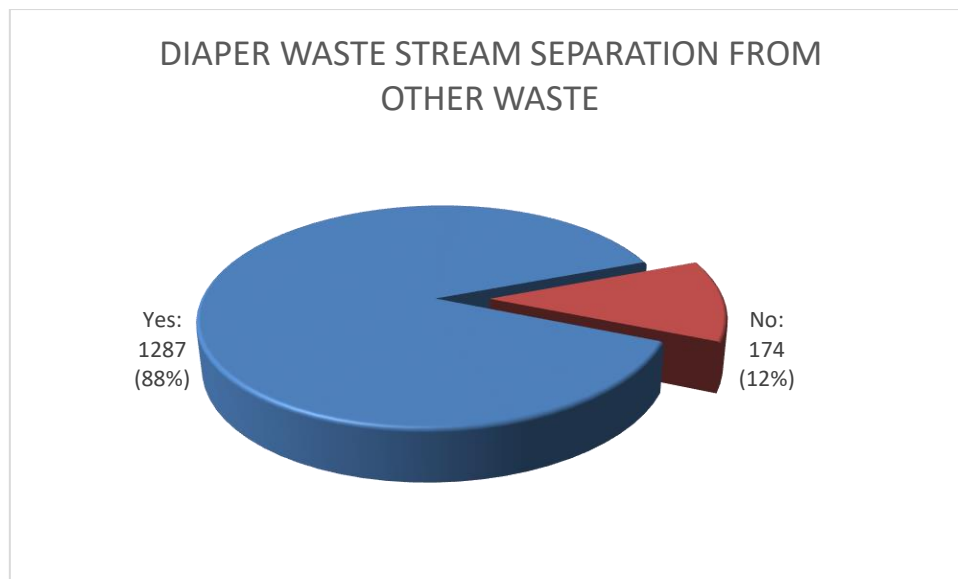


Figure 37: Diaper separation at source. (Source: Research data)

Only 12% responded that they separated the diapers from the general waste. The photos sent by the EMs confirmed that some community members separated the diapers from the general waste. There was also discarded mixed waste which means that more than just diapers was dumped in the riverbeds, next to the roads and in the open veld.



Figure 38: Separated diapers stored until discarded. (Source: EM)



Figure 39: Dumped separated diapers. (Source: EM)



Figure 40: Dumped general mixed waste. (Source: EM)

5.1.33 Distance walked to discard diapers (n=1464)

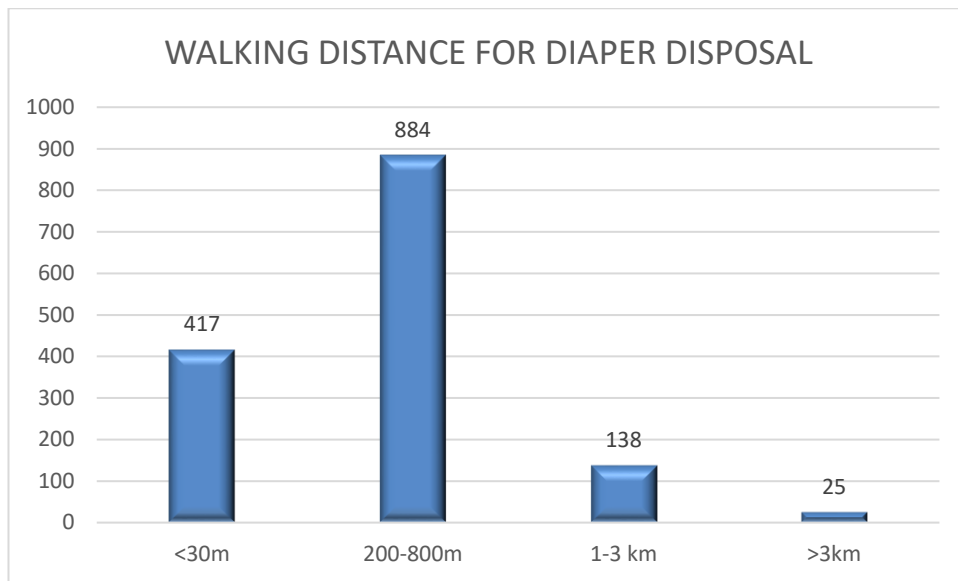


Figure 41: Distance walked to dispose of diapers. (Source: Research data)

Most of the respondents reported that they walked 200m-800m to discard their waste/diapers - some even more than 3km. The maps (Section 5.2) confirm 'discriminate' dumping of diapers in the open veld and riverbeds.

5.1.34 Diaper disposal preference of other members of the community (n=1435)

The respondents were also asked how other members of the community disposed of diapers. Similar answers were provided to choose from.

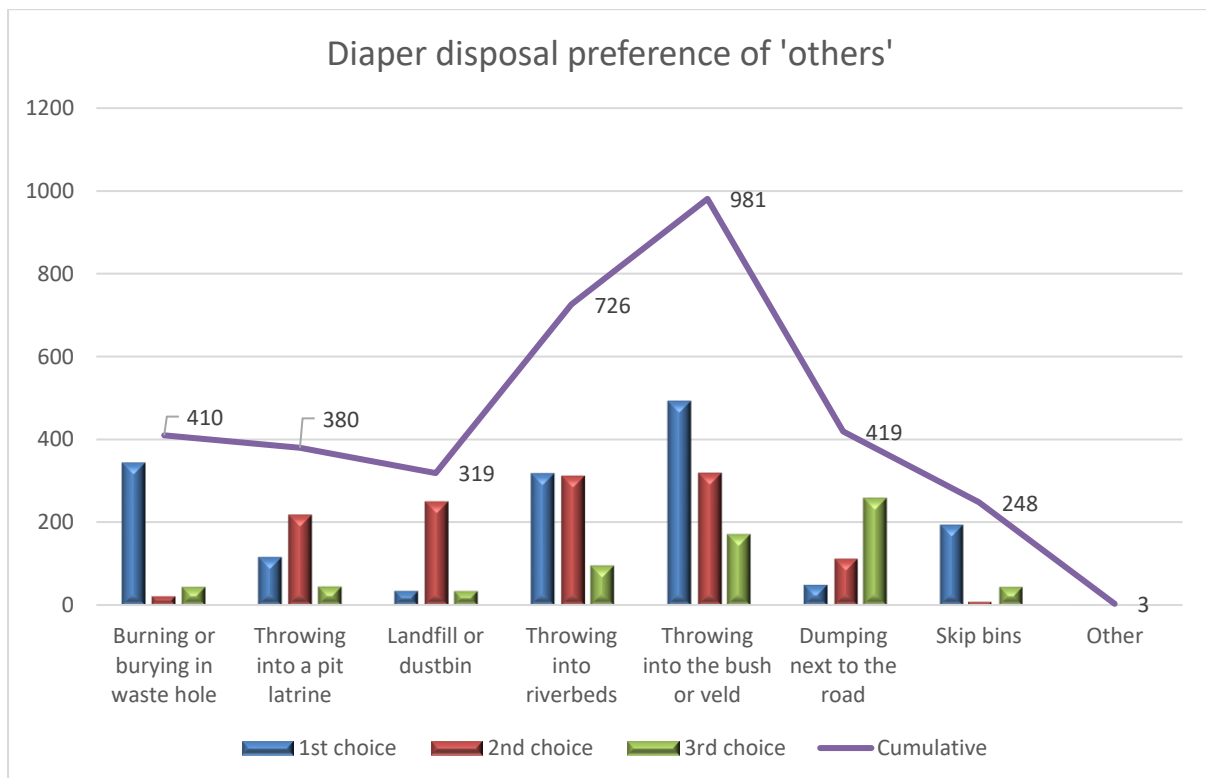


Figure 42: Diaper disposal preference of "others". (Source: Research data)

The cumulative answers show that the respondents believed that ‘other’ community members also disposed of diapers in the bush or veld, in riverbeds and next to roads, and a significant number of nappies were burnt. The maps (Section 5.2) confirm the location of the discarded diapers.

Furthermore, the maps confirm the answers of the respondents that most dumping of disposable diapers was taking place close to water courses and in the open veld. In Enable village skips were being used. The photo below (Fig. 43) indicates that the skip had been emptied but some diapers remained.



Figure 43: Skip with diapers sticking to its sides in Enable Village. (Source: Researchers)



Figure 44: Skip emptied but waste around the skip not cleaned. (Source: EM)

A comment by the EM was:

“I discovered skip bin. Inside of the skip bin I found out its small size polluted on there, outside at the bottom of skip bin I found out large size of disposable nappies and waste.”

5.1.35 Diaper preference and spending patterns

The diaper preference and spending patterns are described in the next section.

5.1.36 Types of nappies available for purchase (n=1467)

The types of diapers available to purchase in the local shops were explored, as well as the respondents' awareness of the availability of the types of diapers.

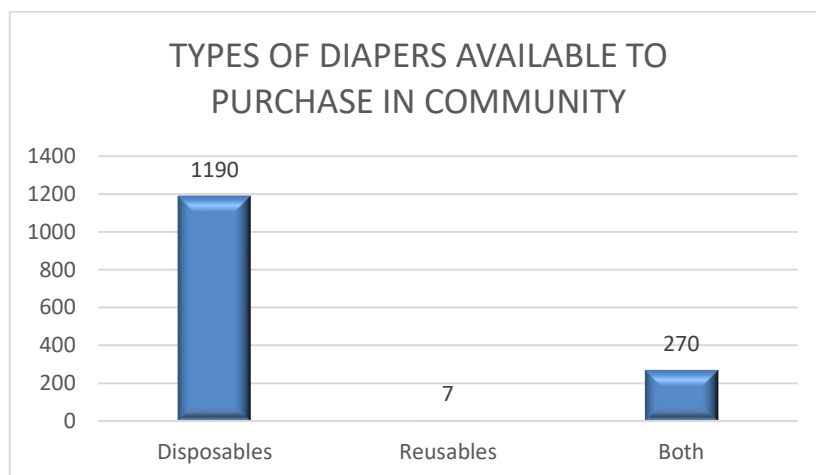


Figure 44: Types of diapers available for purchase. (Source: Research data)

Only 277 of the respondents were aware of the availability of reusable cloth nappies in the local shops. The majority (1190) mentioned only the availability of disposable diapers.

5.1.37 Preferred diaper retailers (n=1435)

The respondents were asked to rank the top three retailers where disposable diapers were bought.

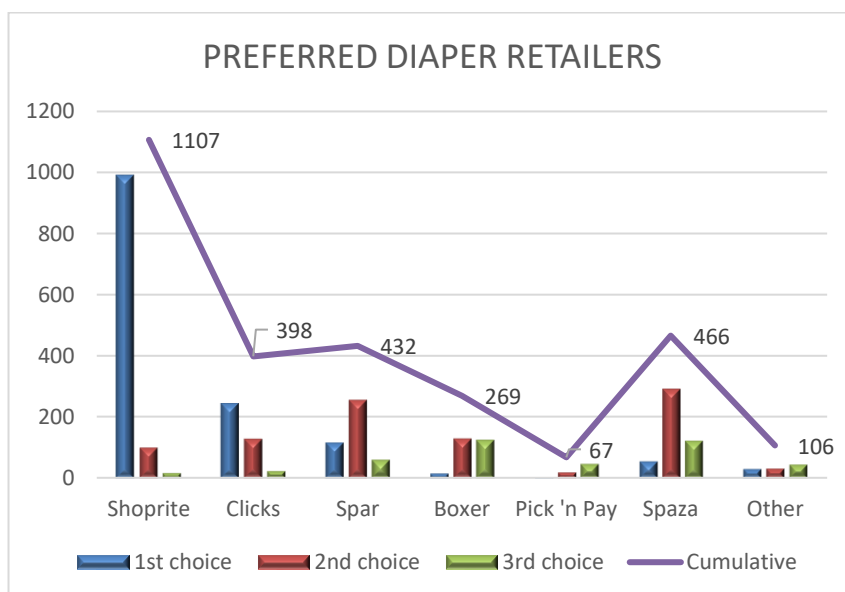


Figure 45: Preferred diaper retailers. (Source: Research data)

The villages had access to two shopping malls (approximately 3 to 5 km away from the villages) in which Shoprite² was the main available retailer. During the focus groups and the member-checking

² According to Shoprite's media overview, "it caters to the mass middle-income market by providing its lowest prices on basic goods. As the Group's original and flagship brand, Shoprite owns the most stores in South Africa, and is the main spearhead for growth into Africa".

https://www.shopriteholdings.co.za/content/dam/MediaPortal/LatestIntegrateReport/English/3_5740_Shoprite_IR_2016E_The_Group.pdf.

sessions, it was explained that, at the beginning of the month when the grants were paid, the diapers would be bought from Shoprite or other main outlets. Diapers would be bought from the Spaza³ shop in the village when they needed additional diapers later in the month. A list of retailers had been given in the questionnaire, but the respondents were also given the opportunity to mention the names of local stores which sold diapers. A fair number of respondents (102) mentioned the following list of shops (see Figure 46).

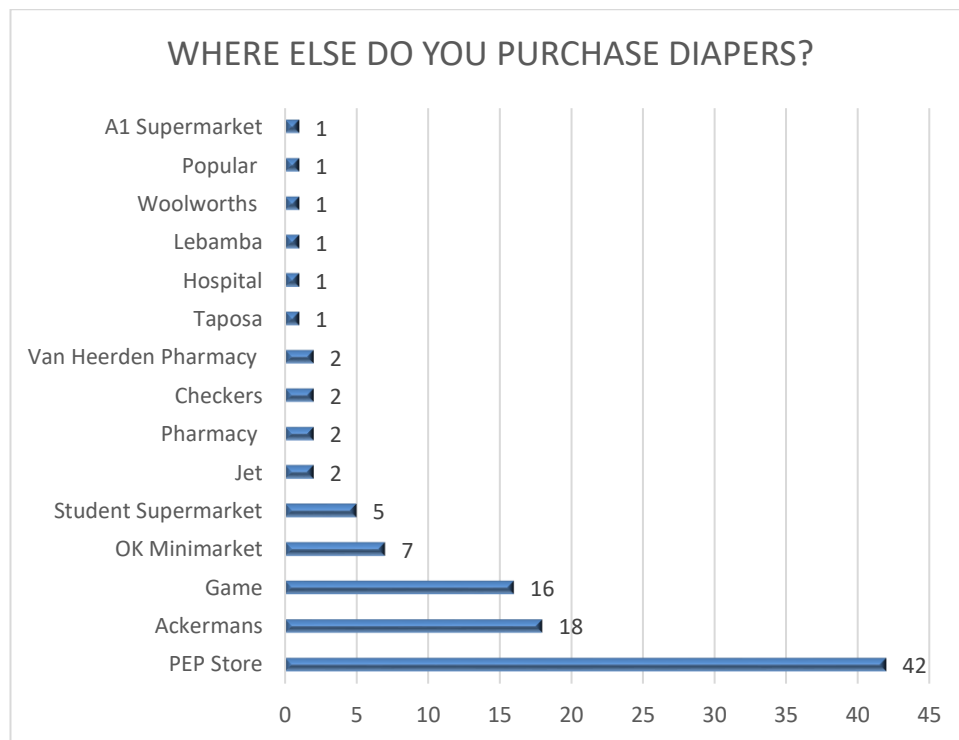


Figure 46: Where else do you purchase diapers? (Source: Research data)

5.1.38 Financial contributors to diaper purchasing (n=1437)

With the high unemployment rate and high grant dependency in the area the main financial contributor to buying diapers was explored.

³South African slang for a small shop in a township.
<https://www.collinsdictionary.com/dictionary/english/spaza-shop>

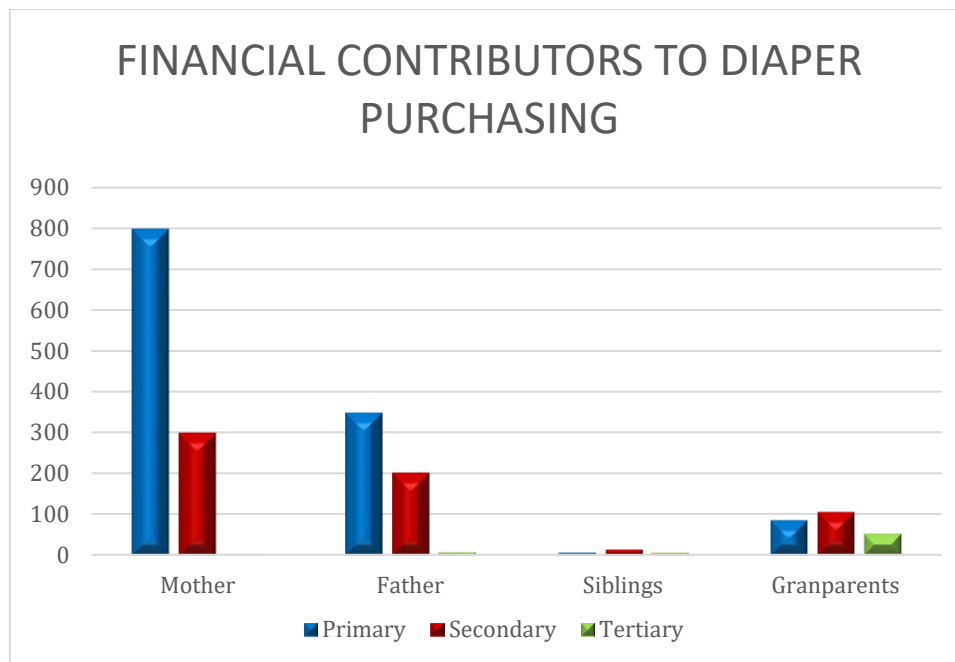


Figure 47: Financial contributors to diaper purchasing. (Source: Research data)

Mothers receiving state child support grants of R480 per month per child (at the time of the study) were identified as the main financial contributors to diaper purchasing, followed by the fathers.

A follow-up question was posed to determine whether there were any other buyers not listed. Interestingly enough, ‘the grant’ was identified as a ‘person’ who buys the diapers.

(n=42)

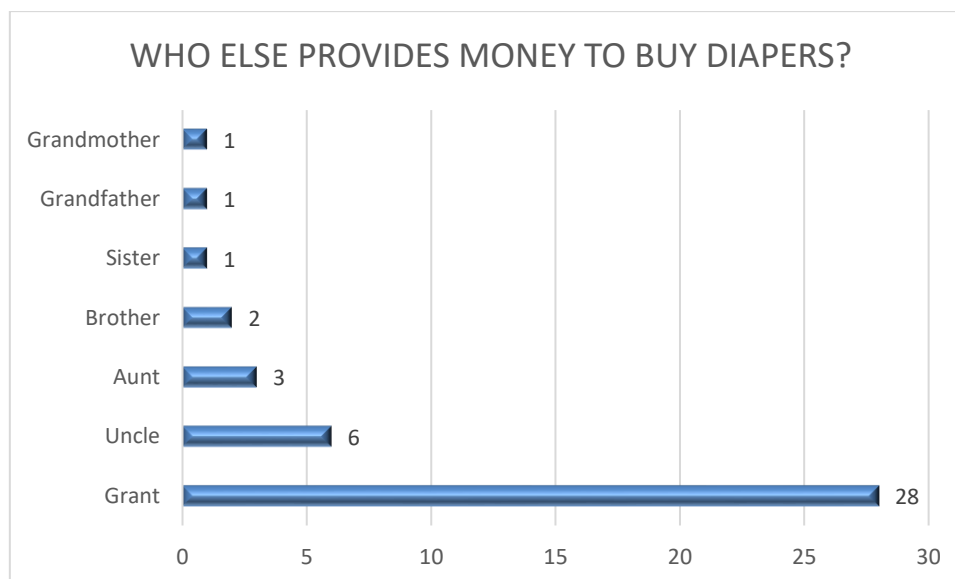


Figure 48: Who else provides money to buy diapers? (Source: Research data)

5.1.39 Diaper purchaser (n=1436)

Similar to Fig.48 the mothers were identified as the main purchaser of diapers

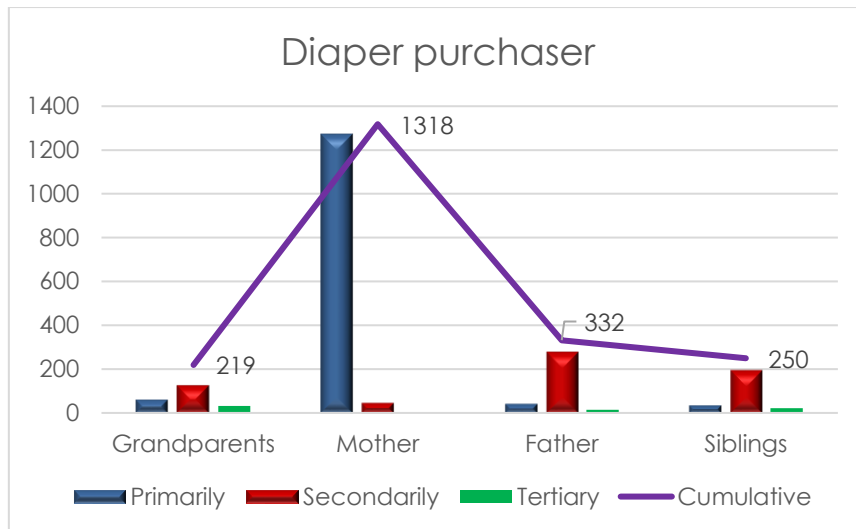


Figure 49: Diaper purchaser. (Source: Research data)

5.1.40 Diaper brand preference (n = 1435)

The respondents were requested to rank the top three brands which they preferred to buy.

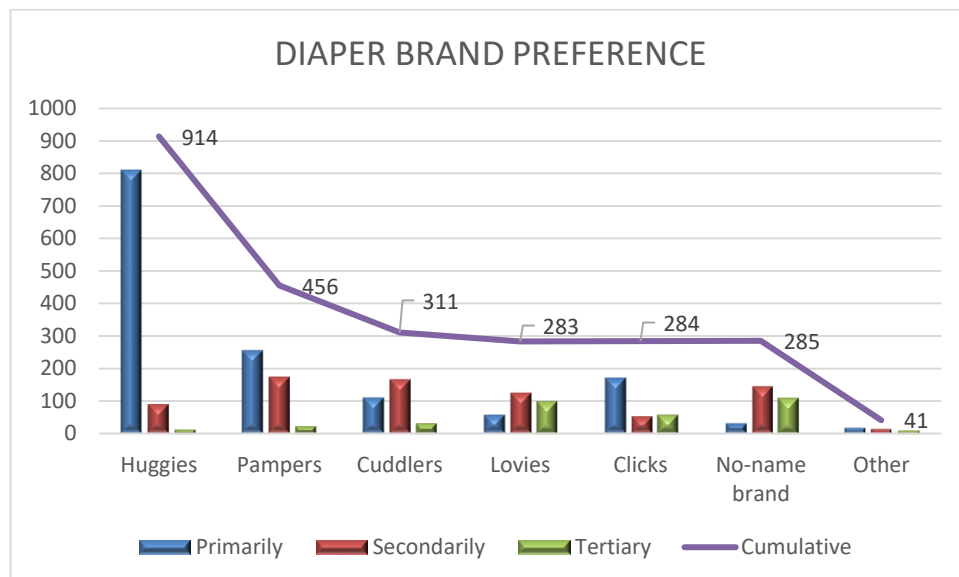


Figure 50: Diaper brand preference. (Source: Research data)

Despite the fact that disposable diapers are colloquially referred to as “pampers”, Huggies were by far the most popular brand, followed by Pampers. During the focus groups and member-checking discussions, the belief was expressed that Huggies was a quality brand and it was also seen as a status symbol to be able to afford Huggies. The results were confirmed by Kordecki’s (2021) pilot study in the same area. In her study, 100% of the respondents preferred Huggies.

As the more well-known brands had been given in the questionnaire, we also explored other less known brands available to them as 41 respondents referred to ‘other’. The following ‘other’ brands were identified:

5.1.41 Alternative diaper brands bought (n=40)

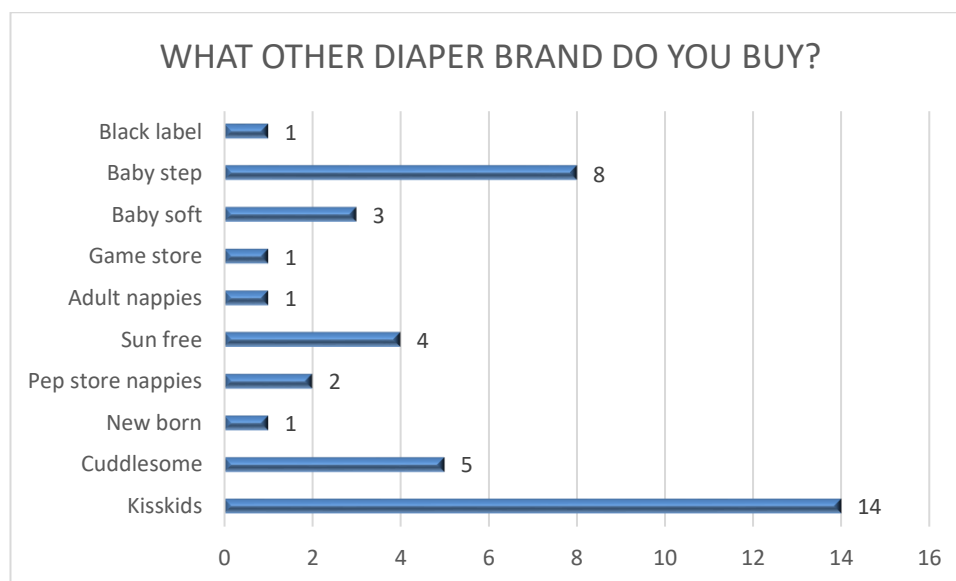


Figure 51: Alternative diaper brand preferences. (Source: Research data)

5.1.42 Estimated amount spent on diapers FOR ONE CHILD per month? (n=1465)

On average, R384.46 was spent on disposable diapers **per child** per month. During the member-checking session this amount was confirmed by the community members (of whom some were also respondents to the questionnaire). They explained that they bought two packets of diapers at the beginning of the month when the grants were paid, which amounted to the total mentioned above - depending on the brand.

Referring to Figure 52 below, the maximum of R1600 per child, and the minimum amount of R21.00 were outliers. The minimum of R21.00 per child appears to be a data capturing error because the respondents stated that they did three disposable diaper changes per day (which would have meant approximately R0.23 per diaper). Thereafter the closest minimum was R36 per month with two disposable diaper changes per day - which also seemed unrealistic at a supposed R0.60 per diaper. The first likely minimum was R80 spent per month per child with three changes per day (thus R1.13 per diaper). The household spending R1600 per month indicated that there were two children using disposable diapers in the household with approximately nine diapers being used per day. If the cost was for only one child then the diapers cost approximately R5.90 each, which is possible. However, the respondent likely gave the answer as the total spent per household per month - at R2.96 per diaper.

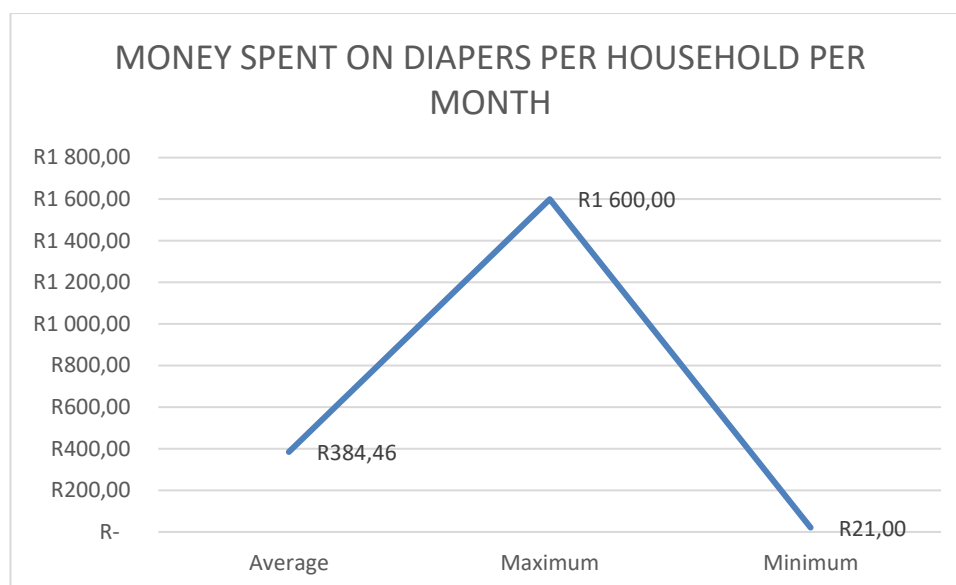


Figure 52: Money spent on diapers per household per month. (Source: Research data)

5.1.43 Reasons given for preference of disposable diapers (n=1460)

In an open-ended qualitative question the respondents were asked why they preferred to use disposable diapers. The identified themes are captured in Table 7.

Table 7: Reasons for preferring disposable diapers. (Source: Research data)

Theme	Reasons
1. Convenience factor	<p>“Because they are convenient”</p> <p>“They are easy to change.”</p> <p>“Because I don’t have to wash them”</p> <p>“I am a lazy person.”</p> <p>“Even grandparents can change the child.”</p> <p>“They are convenient when going out.”</p> <p>“They are available everywhere.”</p>
2. It saves time	<p>“Washing takes a lot of time and it is a problem when the weather is bad.”</p> <p>“I am always at work so no one will wash.”</p> <p>“They save me time.”</p> <p>“They are quick to use.”</p>
3. Due to limited access to water	<p>“Lack of water”</p> <p>“I can save water.”</p> <p>“They don’t require water.”</p>
4. Child-comfort	<p>“For the comfort of the child”</p> <p>“(It) is comfortable for kids.”</p> <p>“They are more comfortable than cloth nappies.”</p> <p>“It holds and comforts our kids perfectly.”</p> <p>“Doesn’t cause rash”</p> <p>“They are good for the baby.”</p>
5. Perception of efficiency	<p>“They are reliable.”</p> <p>“They are more absorbent than cloth diapers.”</p>

Theme	Reasons
	<i>"Does not leak"</i>
6. Affordability: Price-point	<i>"They are affordable."</i> <i>"Save money"</i>
7. Social acceptability	<i>"It is the modern fashion."</i> <i>"It is on fashion."</i>

The convenience factor was at the top of their preferences. Time saving can also be seen as part of the convenience factor. During the discussion of the infrastructure context of the K2C villages, the difficulties of accessing water was described. Disposable diapers do not require water or washing and, therefore, were preferred. In addition, the respondents believed that a disposable diaper provided more comfort and care for the baby and prevented rashes.

The affordability of diapers came as a surprise. The fact that "the grant" paid for them was possibly a reason for making them seem affordable. The social acceptability or fashionability of the diapers was explained as an important factor for using disposable diapers. Similar themes were identified in the study by Schenck et al. (under review), Matsabane (2021), Sepadi (2021) and Kordecki et al. (2022). These will be important aspects to take into consideration when planning interventions.

5.1.44 Reasons for preferring reusable (cloth) diapers (n=16)

Sixteen respondents who indicated that they preferred reusable (or cloth) diapers provided the following reasons.

Table 8: Reasons for preferring cloth diapers over disposable ones. (Source: Research data)

Theme	Reason
1. Price savings related: The respondents regarded cloth diapers as a cheaper option in contrast to the majority of the respondents	<i>"Save money"</i> <i>"They are cheaper."</i> <i>"The disposable nappies are expensive these days."</i> <i>"They are affordable."</i> <i>"When I have no money to buy nappies"</i> <i>"They save money."</i>
2. Reusability and waste reduction	<i>"They can be re-used."</i> <i>"To reduce nappy waste"</i>
3. Comfort/health related: Again, in contrast to the belief of the majority that disposable diapers did not cause skin rashes the three who answered this question were of the opinion that cloth diapers did not cause skin rashes and provided comfort to the babies.	<i>"They don't cause skin rash on babies."</i> <i>"It is comfortable for kids and easy to use."</i> <i>"Would use it when baby has a nappy rash"</i> <i>"Only for nappy rash"</i>

5.1.45 Considering using (cloth) reusable diapers? (n=1457)

The respondents were asked whether they had ever considered using cloth diapers. Only 18% mentioned that they had considered it.

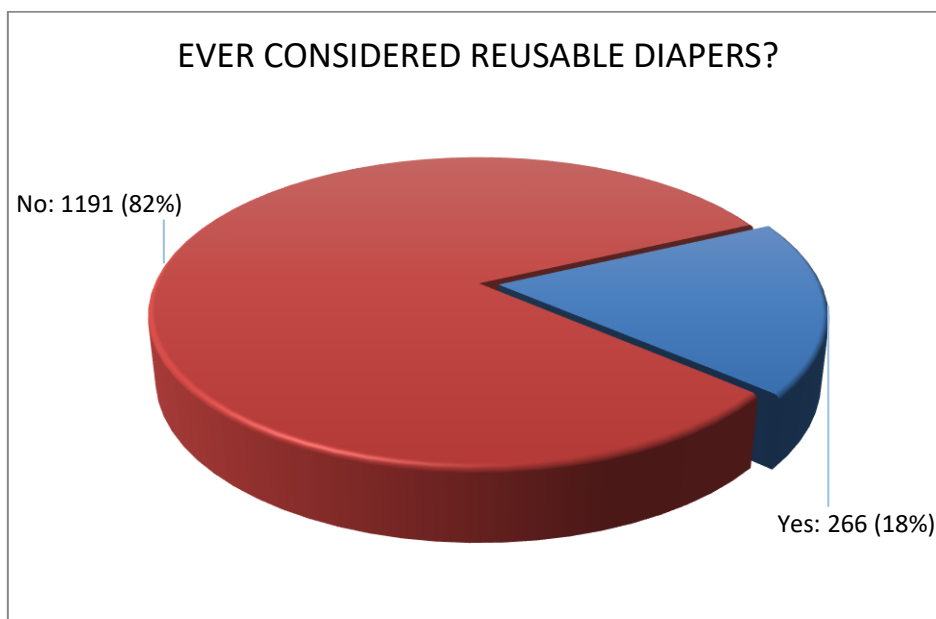


Figure 53: Consideration of reusable diaper usage. (Source: Research data)

5.1.46 Reasons for not using cloth diapers

This question was posed to determine why the purchase of cloth diapers was not considered. The majority (82%) indicated that they would not consider it. Similar themes to those for using disposable diapers were identified (Table 9).

Table 9: Reasons for not using cloth diapers. (Source: Research data)

Theme	Reason
1. Old fashioned	<i>"Adapted to new way of life"</i>
	<i>"Adapted to modern life"</i>
	<i>"It is (the) olden days style and it needs more time."</i>
	<i>"It's old fashioned."</i>
2. Water shortages	<i>"Lack of water in our community"</i>
	<i>"They require water."</i>
	<i>"Water scarcity"</i>
	<i>"There is no water in my community."</i>
3. Inconvenience of cloth diapers	<i>"We don't have access to water."</i>
	<i>"Require soap and water"</i>
	<i>"It needs more attention."</i>
	<i>"It increases laundry."</i>
	<i>"They are hard work and difficult to clean."</i>
4. Time constraints	<i>(Whiteness)</i>
	<i>"They give me too much work."</i>
	<i>"They are time consuming."</i>

Theme	Reason
5. "New" concept	"Wastes time"
6. Baby-comfort	"Never heard of reusable nappies"
7. Additional expenses	"They are less absorbent than disposable nappies."
8. Availability	"Washing powder is expensive."
	"Some of the materials are not available in the shops."
	"They are not available in shops."

The reasons for why the respondents would not use cloth nappies were the same as those for using disposable diapers - the lack of access to water being the major reason due to the crippled water infrastructure in the villages. Furthermore, some believed cloth nappies were not available in the shops, and one respondent mentioned that she was not even aware of the existence of cloth nappies. Similar to the study by Schenck et al. (under review) there was a perception that cloth diapers were more expensive as one had to buy washing powder and electricity which are expensive. One respondent explained that washing cloth diapers was time consuming and stressful as she needed to keep them white to avoid being criticised that the diapers were not white enough. According to the participant, the criticism was coming, in particular, from the older generation who used cloth nappies. Using disposable diapers prevented such criticism.

5.1.47 Better ways to dispose of used diapers (n=1463)

The aim of the question was to determine whether the respondents had possible ideas of how diapers could be better managed than with the current practices. Only 52,6% provided suggestions.

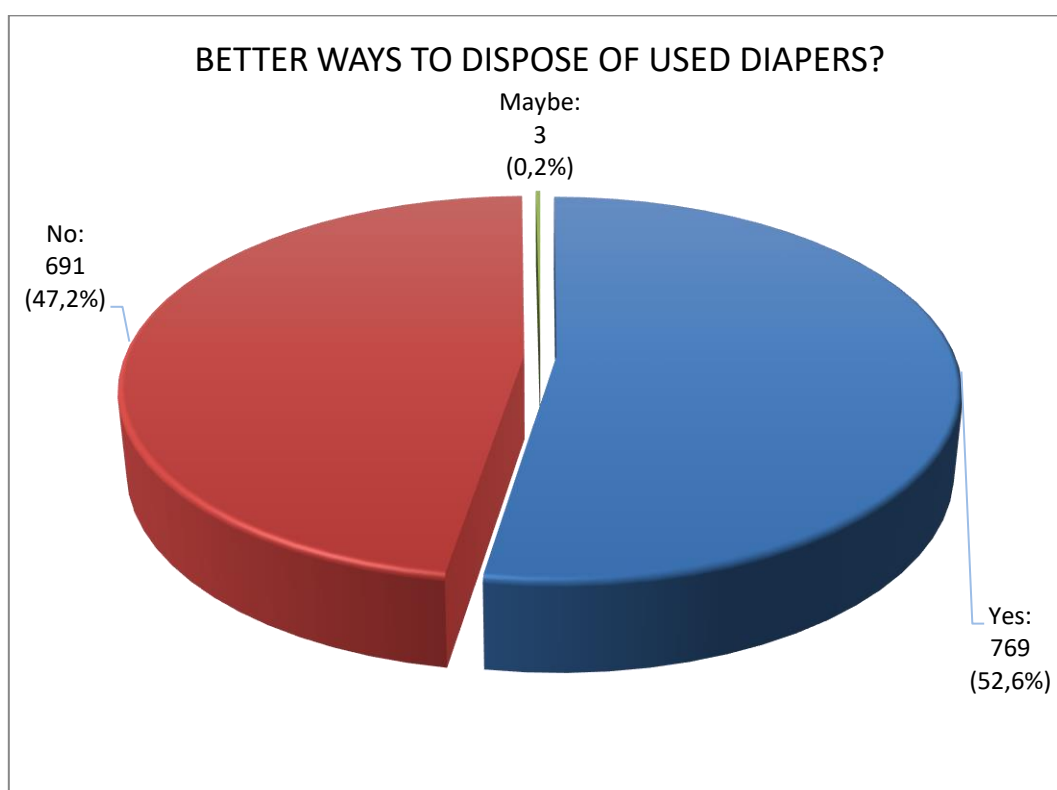


Figure 54: Better ways to dispose of used diapers? (Source: Research data)

Possible alternative diaper management options were then suggested:

Table 10: Suggestions for alternative management of used diapers. (Source: Research data)

Theme	Management options suggested
1. Central facility and/or central skips and bins	<p><i>"If there was a place and all people use it, it will be better to save our villages."</i></p> <p><i>"If a municipality can provide us with skip bin or a place that will [be] used as a dumping area"</i></p> <p><i>"Throwing them in skip bins"</i></p> <p><i>"Having skip bins near where we stay"</i></p> <p><i>"Bring dustbins closer"</i></p>
2. Incineration/Burning	<p><i>"Burning them"</i></p> <p><i>"Dry them first then burn after"</i></p> <p><i>"Dig a hole and burn it."</i></p>
3. Burn and then bury	<p><i>"Burn it and then bury it in your yard."</i></p> <p><i>"Burn them."</i></p>
4. Bury	<p><i>"Dig a hole and bury it."</i></p>
5. (Illegal) Dumping	<p><i>"To throw them in the bush"</i></p> <p><i>"Throwing them in the bush"</i></p> <p><i>"in the rivers"</i></p> <p><i>"in the bush"</i></p>
6. Landfilling/dumping	<p><i>"If municipality can provide us with piece of land that we can use as dumping area"</i></p>
7. Pit latrine	<p><i>"Use of pit latrine."</i></p>
8. (Door-to-door) collection	<p><i>"Weekly collection"</i></p> <p><i>"Weekly collection from municipality"</i></p>

The suggestions made by the respondents reflect the waste management practices known to them and those they already practise - including the dumping in the veld.

5.1.48 Use of a central place to dispose of used diapers (n=1466)

This question was then raised to determine whether a central place/s of collection would be used or considered.

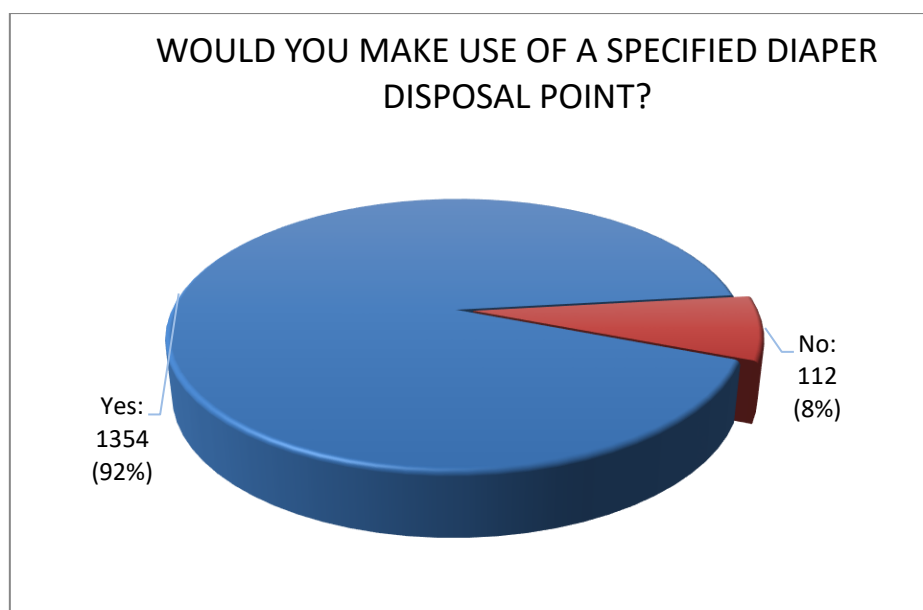


Figure 55: Specified diaper disposal point usage. (Source: Research data)

The majority indicated their willingness to take the diapers to central collection points. However, as can be seen from the map of the Enable village (Figure 64 and Figure 65), despite the presence of the skip there were still dumping sites as the skip was possibly too far away for all the residents to walk to. Enable village, though, had far fewer dumping areas than the other villages. The reasons for using central collection points are presented in the next section.

5.1.49 Reason(s) for using central collection point(s)

Table 11: Reason(s) for using central collection point(s). (Source: Research data)

Theme	Reason
1. Clean environment	<i>"To help reduce pollution"</i>
	<i>"To help keep my village clean"</i>
	<i>"To help keep my community clean"</i>
	<i>"Because we will keep our environment clean"</i>
	<i>"To avoid pollution"</i>
	<i>"It will be saving the environment."</i>
2. Convenience (if close by)	<i>"To avoid littering"</i>
	<i>"Because it won't be far"</i>
	<i>"Because it will be close"</i>
	<i>"Then I won't have to walk far to dispose the nappies."</i>
	<i>"It would save me time than to burn them."</i>
3. Health benefits	<i>"Yes, because unhealthy water makes people sick."</i>
	<i>"It will improve our lives."</i>
4. More control	<i>"They (the nappies) will then be controlled."</i>
5. Space saving	<i>"It will save space at home."</i>
	<i>"Our toilets will no longer be filled."</i>

Some respondents also gave reasons why they would not use central points - or what the conditions would have to be for using central collection points.

5.1.50 Reason(s) for NOT using the central points.

Table 12: Reason(s) for not being willing to use the central collection points for diapers. (Source: Research data)

Theme	Reason
Status quo to remain	<i>"I prefer burning them."</i>
Conditional requirements	<i>"Only if it is nearer"</i>

Although only 8% of the residents were not willing to use central drop-off points, it is important to listen to the conditions which were mentioned by those willing or unwilling to do so. Distance to the drop-off would be critical as most residents did not have access to transport other than wheelbarrows.

Effect of used diapers on people and the environment

This section aimed to explore the respondents' perceptions regarding the effect which dumped diapers had on people and the environment.

5.1.51 Effect of diapers on people

Table 13: Perceptions of the effect of dumped diapers on people. (Source: Research data)

Theme	Perception of the effect on people
1. Health related	<i>"They cause sicknesses."</i> <i>"Can cause diseases"</i> <i>"They can cause bacterias."</i> <i>"They cause TB."</i> <i>"It can cause mosquitos." (malaria)⁴</i>
2. Water pollution related	<i>"Most of the people will get affected and die from diseases caused by nappies."</i> <i>"People get sick from river water as they end up in rivers."</i> <i>"They are harmful to people drinking river water downstream."</i> <i>"Health issues because they are mostly flushed into rivers"</i> <i>"Drink unhealthy water"</i>
3. Air pollution related	<i>"They inhale unhealthy air."</i> <i>"The air we breathe is always dirty."</i> <i>"It brings diseases as they breathe dirty air from the nappies."</i> <i>"People will get sick because of the smell."</i> <i>"Bad smell"</i>

Most of the comments referred to the effect which dumped diapers have on the health of the community either via the water or air - or contributing directly to illnesses. The general perception was that the effect of the used diapers on the environment would then have an effect on the people.

⁴ K2C is situated in a malaria region. It is important to prevent the creation of ideal breeding conditions for mosquitos.

However, some respondents were of the opinion that the dumped diapers had no effect on the community: *“There is no effect.”*

5.1.52 Effect of the dumped diapers on the environment

Table 14: Perceived effect of the dumped diapers on the environment. (Source: Research data)

Theme	Perceived effect on the environment
1. Pollution	<p><i>“They pollute the environment.”</i></p> <p><i>“The environment will be dirty and our water in rivers will be dirty.”</i></p> <p><i>“Destroy environmental quality”</i></p> <p><i>“It increases pollution.”</i></p> <p><i>“Land pollution”</i></p>
2. Cleanliness and enjoyment of nature	<p><i>“Our land does not look good.”</i></p> <p><i>“Our natural resources are not enjoyable.”</i></p> <p><i>“It just creates a bad atmosphere.”</i></p> <p><i>“Our area does not look nice and is damaged.”</i></p> <p><i>“They destroy the beauty of nature.”</i></p> <p><i>“Our beautiful area is damaged.”</i></p>
3. Plant impact	<p><i>“They kill our plants.”</i></p> <p><i>“It pollutes the area and plants can’t survive.”</i></p>
4. Livestock/animal impact	<p><i>“Livestock may eat and die”</i></p> <p><i>“Animals will eat the nappies and they will die so the ecosystem will not be balanced.”</i></p> <p><i>“Animals will die as they will be eating the nappies, including birds.”</i></p> <p><i>“It causes hazard on cattle.”</i></p> <p><i>“Dogs tear them.”</i></p> <p><i>“Livestock might eat them.”</i></p> <p><i>“Our rivers are polluted, livestock drinks polluted water.”</i></p> <p><i>“Livestock graze around them.”</i></p> <p><i>“It pollutes the river which kills fishes.”</i></p> <p><i>“Health hazard on aquatic animals”</i></p> <p><i>“Animals will choke and die.”</i></p>
5. Water quality	<p><i>“They will affect water quality.”</i></p> <p><i>“Affects water quality negatively”</i></p>

Most of the participants expressed concern regarding the negative impact which the dumped diapers had on the environment. During the member-checking session, the men in particular emphasised the negative impact on their animals and water resources.

One positive comment was made by a respondent referring to the fact that the dumped diapers provided nutrient enrichment: *“It gives nutrients to the soil.”*

5.1.53 Proposed leadership to lead change regarding disposable diaper management in the community (n=1496)

A question was posed to obtain an indication of who the persons might be who should take the lead to change the disposable diaper management.

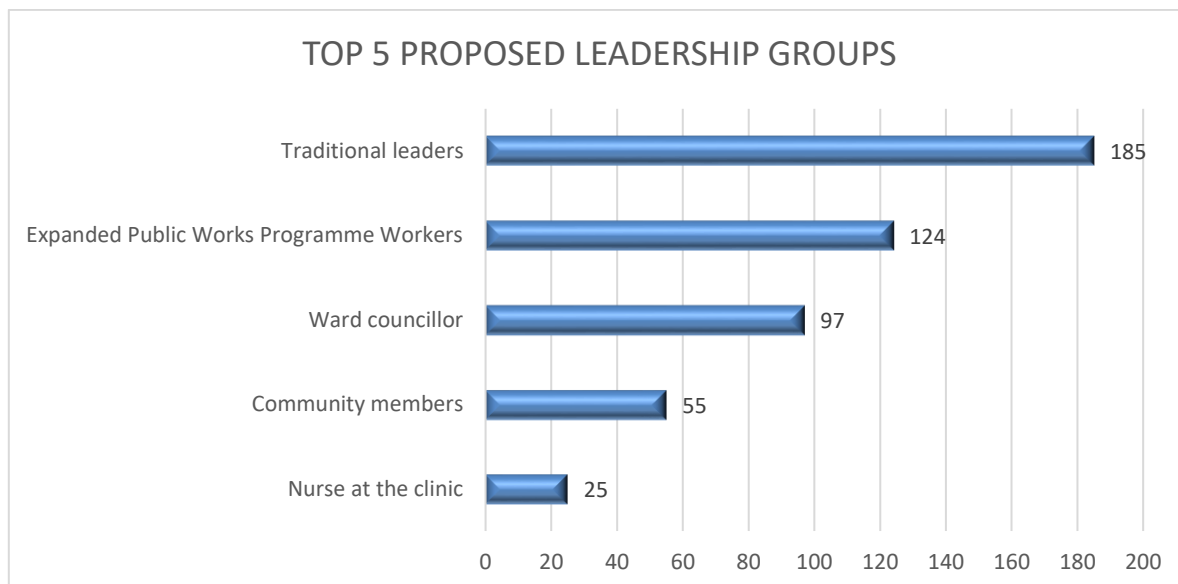


Figure 56: Proposed leadership groups. (Source: Research data)

The current leadership structures were identified as having to take the lead. It was interesting to see how many possible groups and organisations existed within the villages that could assist with the implementation of possible changes in disposal practices.

5.2 Results from the illegal dumping mapping

This section presents the maps generated by the Department of Geography at the University of Stellenbosch and based on the dumpsites identified by the EMs.

A total of 433 diaper dumpsites were reported during the monitoring period (April to November 2022): 27 in Balloon, 85 in Boelang, 20 in Brooklyn, 1 in Enable, 86 in Ga-Inama, 116 in Metz, and 98 in Moremela. The maps clearly show the dumping in rivers and open spaces.

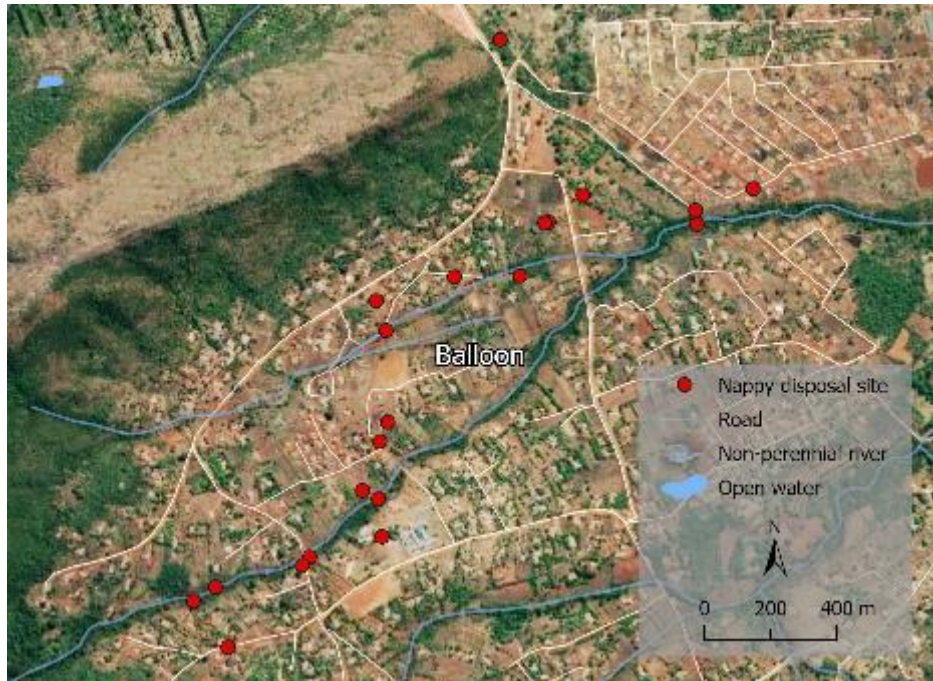


Figure 57: Balloon village nappy disposal sites. (Source: Research data)

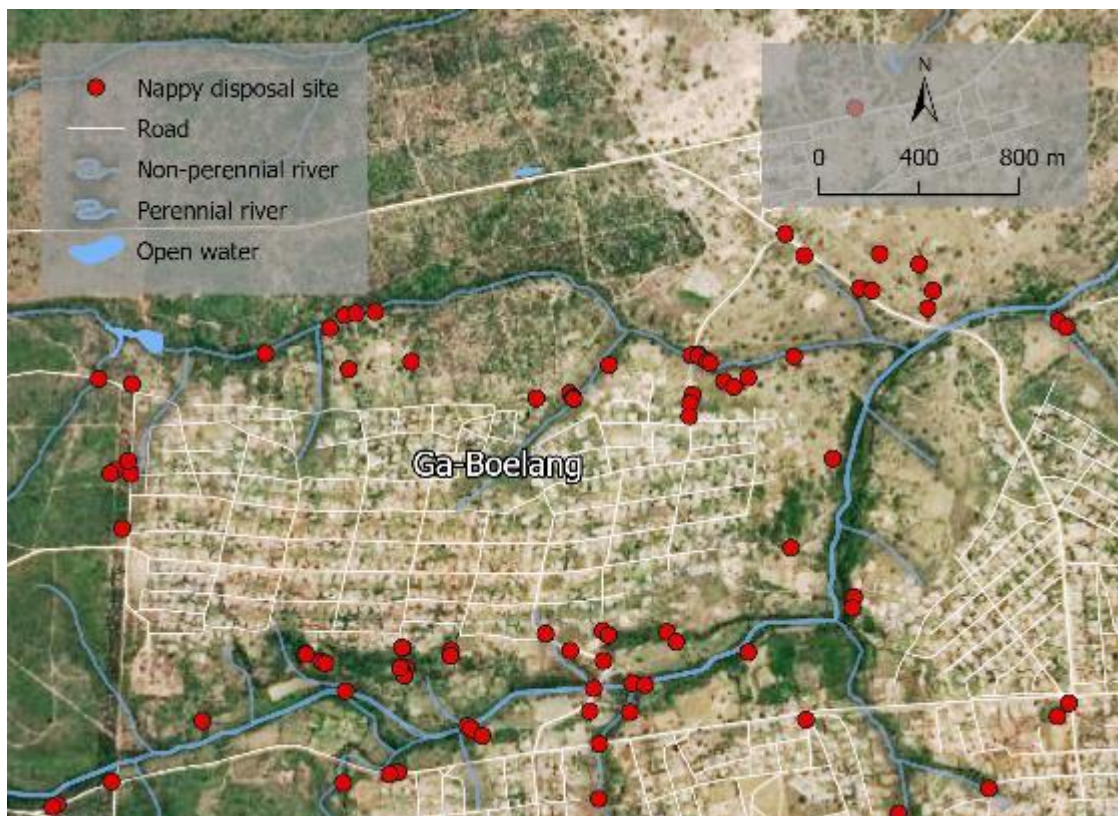


Figure 58: Ga-Boelang village nappy disposal sites. (Source: Research data)

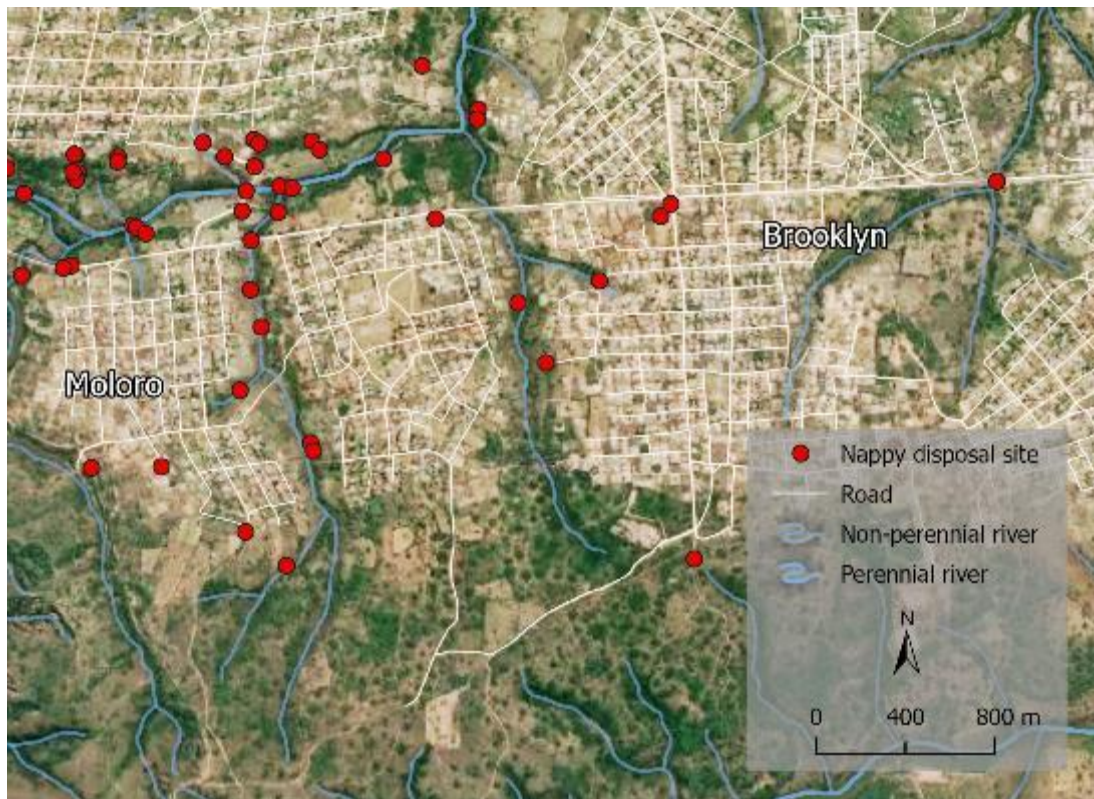


Figure 59: Brooklyn village nappy disposal sites. (Source: Research data)

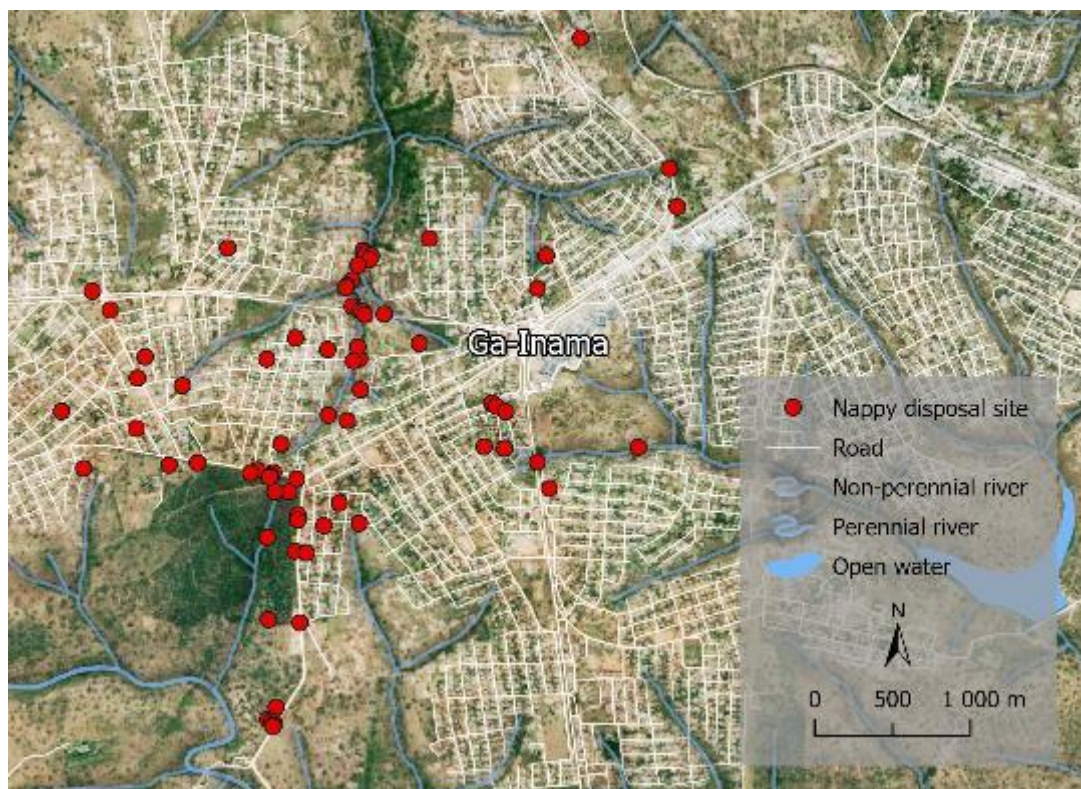


Figure 60: Ga-Inama village nappy disposal sites. (Source: Research data)

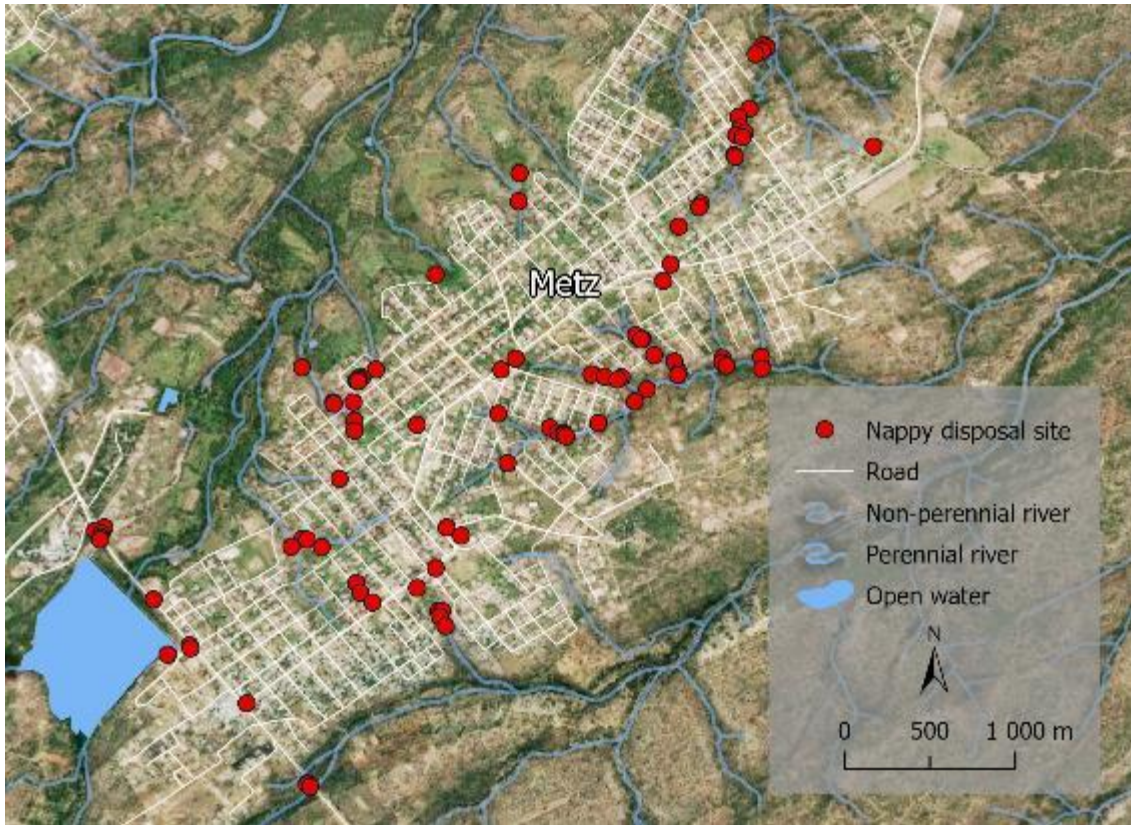


Figure 61: Metz village nappy disposal sites. (Source: Research data)

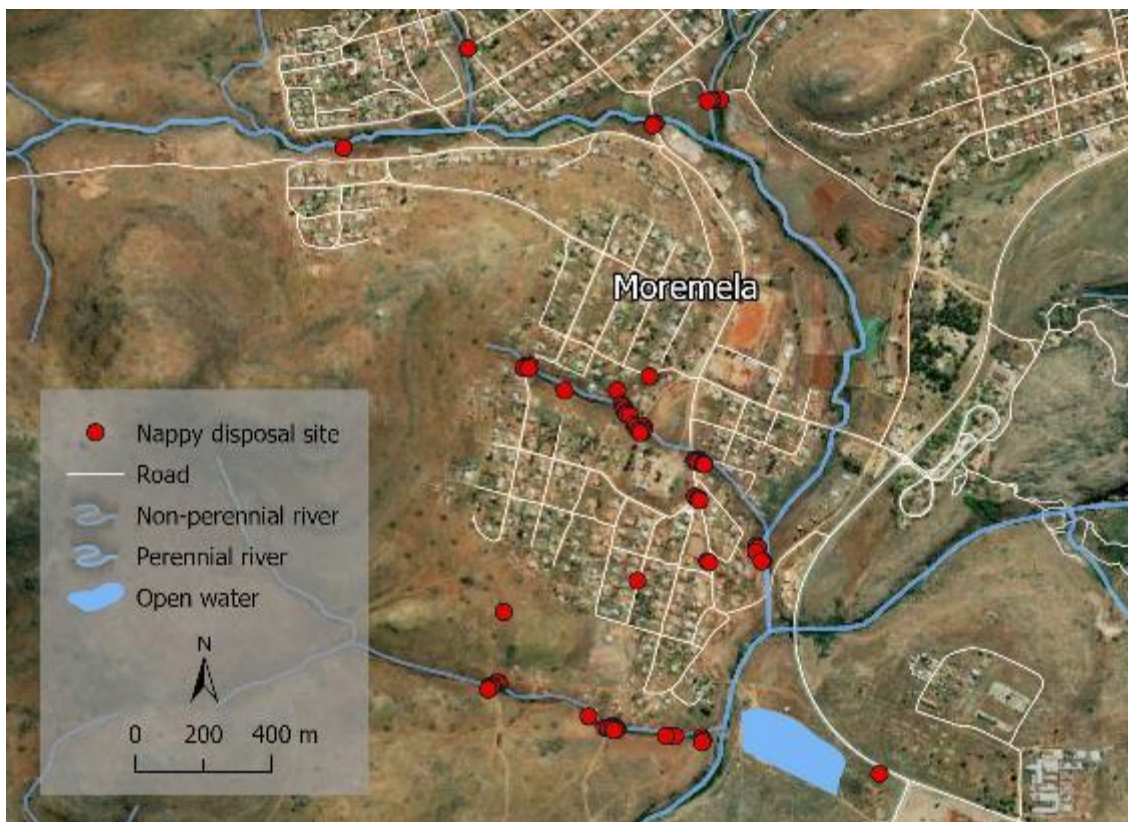


Figure 62: Moremela village nappy disposal sites. (Source: Research data)

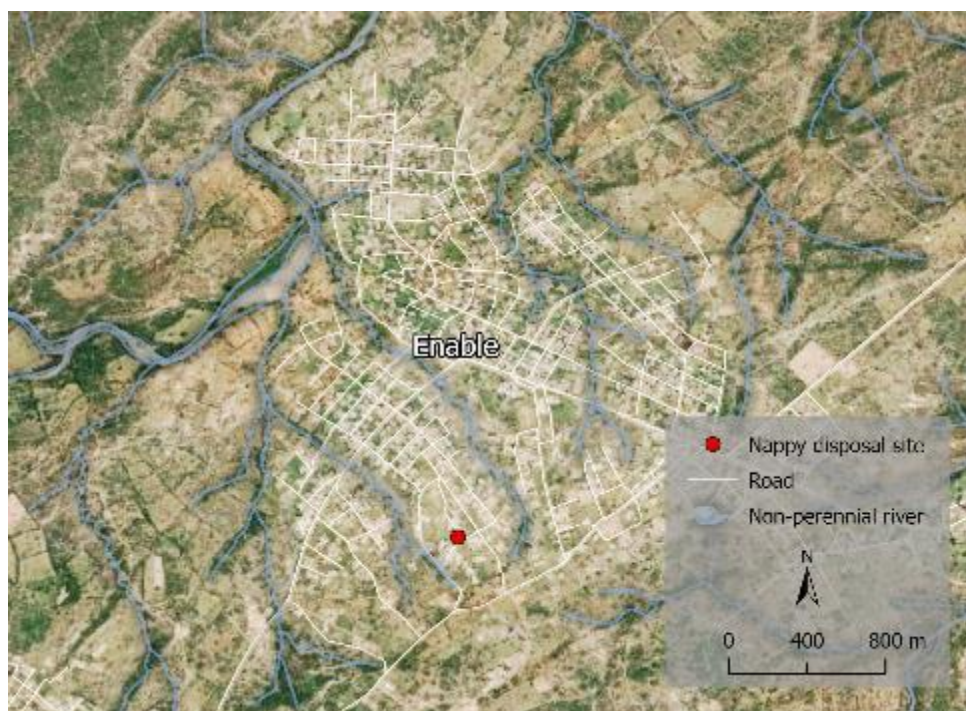


Figure 63: Diapers dumped in the available skip bin in the Enable village. (Source: Research data)

In Enable village, skip bins had already been placed, specifically for the disposal of diaper waste, prior to the start of the monitoring period. It seemed that the system was working well as only one case of dumped diaper waste was recorded in the eight-month monitoring period. The EM reported:

“During today's village patrol activity at Enable, I came across an area consisting of several nappies that have been improperly disposed of and scattered around with other waste materials. This new activity comes after successful focus group discussions I held with some community members. Fortunately, I was able to locate the person responsible for the disposable nappies and I advised her to collect them and dispose them properly in a local waste bin. The disposable nappies were 10 in total.”

The availability and regularly servicing of skip bins in Enable seemed to be enough reason for residents not to dump diaper waste in the surrounding environment. However, during the focus group discussions in the villages, maps were also drawn by the participants, and, in contrast to the data derived from the Enable map (Figure 64: Mapping dumped diapers in Enable Village. (Source: Research data)), the two maps drawn by the participants from Enable village provided different information regarding diaper dumping.

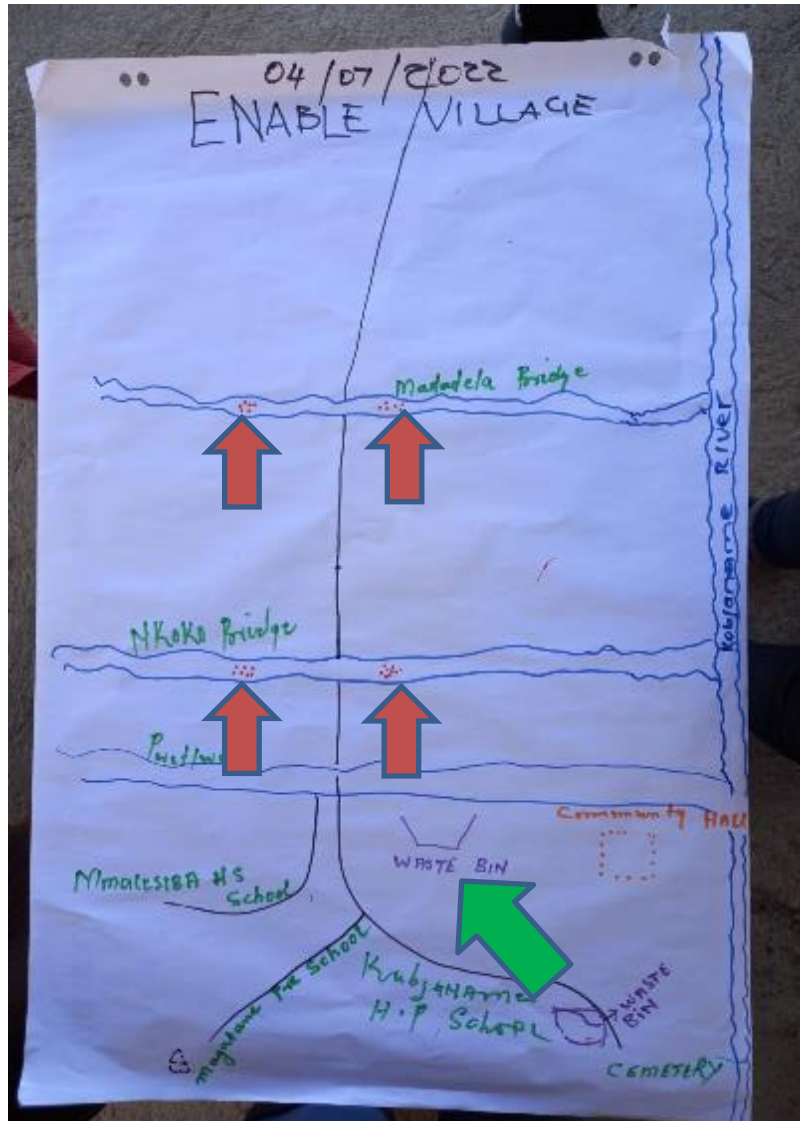


Figure 64: Mapping dumped diapers in Enable Village. (Source: Research data)



Figure 65: Enable village nappy disposal sites. (Source: Research data)

The orange arrows show the red spots where diapers in the Enable village were dumped and the green arrows show where the skips were placed. It seems that the skips was too far to walk to for some of the participants. In general the walking distance was given as a reason for using – or not using – the skips.

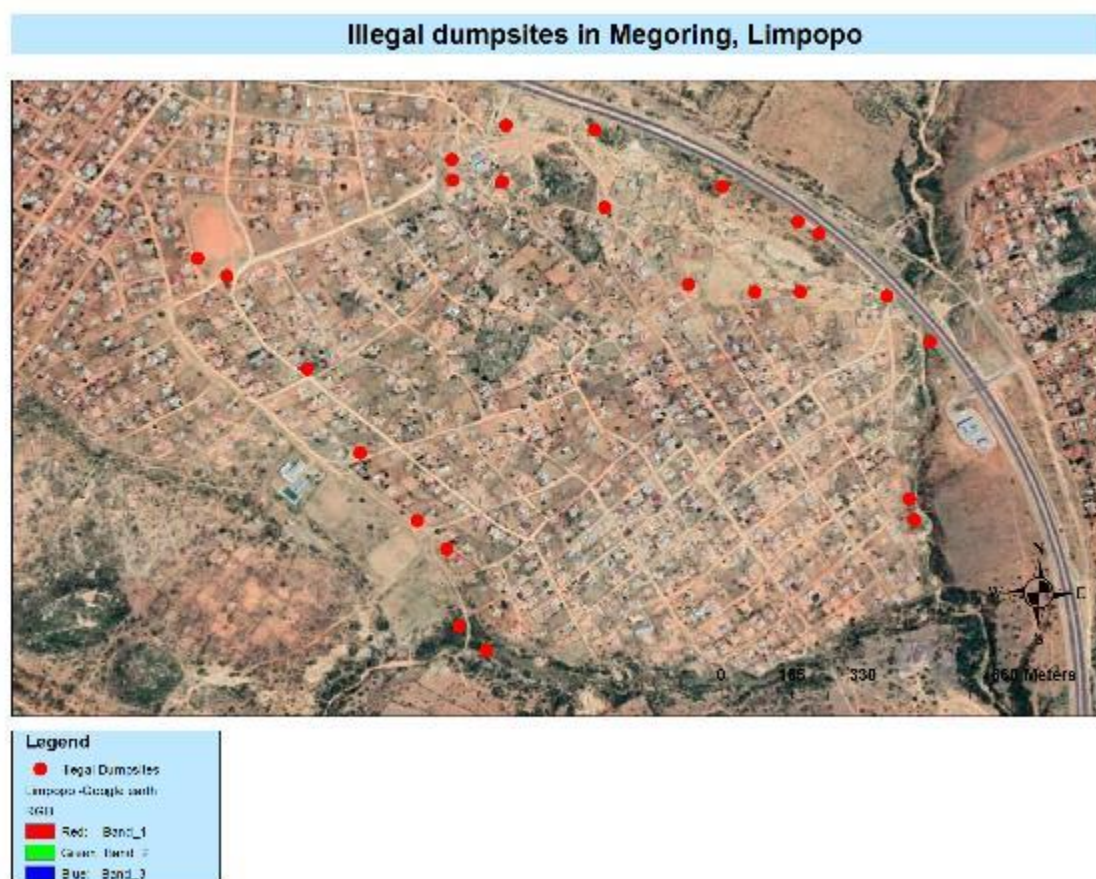


Figure 66: Matshelapata (Megoring) village nappy disposal sites. (Source: Research data)

In all villages, with the exception of Enable, multiple counts of dumping diaper waste were reported. As shown above, a database was developed which contains information on each identified dumping spot, including GPS coordinates and a short description. Observations and descriptions noted by the EMs were analysed and the following themes emerged:

Theme 1: Residents from other villages were the ones who dumped there

Multiple cases were reported by EMs in which the dumping that took place in the village they monitored was not primarily done by local residents, but by neighbouring residents who did not dump in their own areas, but transported waste by car or truck to an adjacent area and dumped there.

“This is another illegal dumping site mostly used by Morekeng residents. This is escalating daily approximately with a scale of more than ten trucks. Most of the garbage dropped here is diapers.”

“This bridge is used as one of the illegal dumping side (site) and people using cars coming far from this area dump diapers.”

Theme 2: Large quantities of diapers

Waste quantities from as little as a couple of diapers disposed of in a plastic grocery bag, to 80kg maize meal bags filled with used disposable diapers were identified (see image below for scale). The EMs

used the size of a wheelbarrow, or the sizes of the bags known to them to indicate the number of diapers dumped.



Figure 67: Different sizes of maize meal bags used for diaper containment

Maize meal bags (ranging from 12.5 kg to 80 kg capacity) were the preferred containment method for dumped diapers.

“Nappies disposal at Boelang village... this is a dumping spot, bad smelling of diapers full of plastic and 50kg and 12.5kg maize meal full of diapers. This is where animals like dogs visiting for searching what they can eat..”

“...I discovered more than three 50kg maize meal (bags) full of diapers...”

“...nappies disposal that can fill up 5+ wheelbarrows inside plastic bags.”

Theme 3: Transport methods of diapers for disposal

Wheelbarrows and cars were most often noted as the main transport methods to move the diapers from point of generation to disposal point.

“I interviewed one mother who told me she used to dump diapers in the stream. They used a wheelbarrow to drop them this site...”

“This bridge is used as one of the illegal dumping side (site) and people using cars coming far from this area dump diapers”

“It shows that they throw standing on the edge of the bridge which could be people coming driving cars.”

“I believe this is done by people who pass by the bridge (who use the road on daily basis), especially those with cars because near the road plastic bags full of disposable nappies are scattered.”

Theme 4: Disposal into or close to water courses

During the monitoring period, environmental monitors specifically mentioned diapers being disposed of in, or very close to, a river in 122 instances, in a gully in 61 instances, and in, or very close to, a stream in 144 cases. Collectively, these make up 327 cases out of 433 reported sightings, which translates to 76% of all disposal sites identified as being in proximity to surface water drainage systems.

“I identified the diapers in a shallow channel of water during raining season to meet the stream, which is flowing water to Klaserie River, livestock drinking water, and also people catching fish from the stream. This is more than 2 loads of wheelbarrow of nappies disposal. (It is approximately) 7m to reach the stream, meaning during raining season these diapers would (be) flushed away to the stream.”

“The stream flows through-out the year, and most of the rubbish is flushed away by water...”

Theme 5: Disposal close to homes

Disposal of diaper waste close to dwellings was also noted as a concern.

“I spotted a dumping site near 2 households where plastic bags of used diapers were dumped.”

Theme 6: Co-disposal of diaper waste with other domestic waste, but source-separation of diaper waste

The contents of some diaper dumpsites consisted of solely disposable diaper waste, but more often than not, diaper waste was found co-disposed of with other domestic waste. It should be noted, however, that despite both diaper waste and other domestic waste being observed in the same dumpsite, it was clear that in almost all cases diaper waste was source-separated and contained separately from other waste prior to disposal. This is also clearly visible in photos taken of the dumpsites.

This is an important observation, especially when starting to consider alternative diaper collection or beneficiation options. Households would likely not need to be trained on separating diaper waste from other waste as this is already being done. Accessing pre-sorted diaper waste would, therefore, be a relatively simple exercise when considering something like door-to-door diaper collection. This observation aligns with the answers in the survey which explored whether they separated diapers from the general household waste? Of the 1461 respondents, 88% indicated that they did, and only 12% indicated that they did not.

“I identified an illegal dumping spot with nappies disposal including unwanted households items that can fill 5 wheelbarrows next to households.”

“This area is used as an illegal dumping side and is in the middle of the village. People dump diapers and unwanted households items. The waste quantity is approximately one truck load and is escalating daily.”

5.3 Results from the focus group discussions

A Tribal Authority meeting was attended at each village prior to conducting any focus group discussions (FGD) to ensure that the Traditional Council was aware of and in favour of the research being undertaken. In total, eighteen focus group discussions were held during the fieldwork period.

5.3.1 Participatory thematic mapping

As an introduction to the FGD, participants were asked to draw a map on an A1-sized sheet of paper with coloured permanent markers. The following instructions were given to the environmental monitors who acted as the FGD facilitators:

- Draw a feature of the area on a piece of paper. Then ask the group to fill in houses, schools, the clinic, roads or other features using coloured pens. At first, you may need to encourage them by asking questions, e.g. Can you show me where the clinic is? But then let them do it – the idea being for the group to discuss and rearrange and generate ideas. The less input from the facilitator the better.
- Then ask them to point out areas where nappies tend to be dumped more frequently. Once agreement is reached on the different sites, use paper or pens to mark permanently. If there are few nappies in a particular area where they are usually disposed of (e.g. washed away by rain), prompt them to show where they are normally disposed of if they have not yet identified the area.
- If the question is not immediately understood, ask questions such as: Where do you collect water? If nappies are burnt, how does it affect the air we breathe? Are all the parts of the nappies burnt or are some left behind? Are animals ever affected by people dumping nappies in 'natural areas' or by their being burnt? What about children?

In all cases, participants were able to draw coherent and realistic maps of their village. Some groups did require a little more motivation than others to engage with the task, but this exercise worked particularly well as an ice-breaker and kindled a lively conversation for the rest of the FGD. In addition, it created the feeling that every attendant's opinion mattered as consensus needed to be reached on the location of features on the maps before being drawn. This drew all attendants into the conversation and made them take ownership of the meeting.

Some observations:

- It was interesting to observe that multiple groups started drawing the maps by first marking out where the rivers or streams run through the village.
- Most participants were able to reach consensus very quickly on where dumping of nappies took place, and to indicate this on the map.

5.3.2 Discussion questions

After the thematic drawing had been completed, participants were asked to discuss nine questions (see Annexure 2). The ensuing discussions led to the identification of the following themes across all focus groups:

Theme 1: Concerns about the effect which used disposable diapers have on humans, animals and the environment

During the completion of the questionnaires, the effect of incorrectly managing used disposable diapers on people, animals and the environment were noted. This was again raised during the focus group and member-checking discussions.

“The way we dispose nappies is not safe for both humans and livestock.”

“Vegetable gardens get affected by water collected from polluted rivers.”

“Our community becomes dirty, smell disturbs breathing as the air is dirty.”

One EM who facilitated one of the group sessions noted down the following comments:

“Parents said biggest concern is that nappies disposal in streams and rivers causes several diseases to any living organisms because of everyone rely on water.”

“Nappy waste affect animals especially dogs and cattle because they eat them and die”.

“People pollute rivers due to a lack of waste bins.”

“Our river systems are no longer safe for human consumption.”

“The smell of diaper waste could cause hazardous illnesses to humans.”

Theme 2: Lack of waste infrastructure and regulations

The respondents confirmed yet again that, without the support from the municipalities, the communities struggled to manage their waste.

“Their disposal (diapers) is all over the village and not having enough waste skip or a place to dump them.”

“Diapers is the main problem in our village and there are no laws that binds people not to dump illegally, everywhere a person sees is suitable for him or her they just dump especially in the dongas, rivers and in the bridges.”

“The community does not have respect for by-laws anymore.”

“NO place to dump waste; hence people dump in streams.”

Theme 3: Dumping by outsiders

In some of the focus groups references were made regarding outsiders who brought their waste in cars and dump it in the rivers in their areas:

“The main problem is people who drives from far away and come and drop in their village.”

“Most of the people in our communities are not from here so the landlord should be responsible to have places in place for tenants to dump their waste.”

“If there's no municipality as community said nothing they can do to manage nappies disposal because of people who do this disposable nappies are from far not from their area.”

Allegations were also made that members of the communities used each other's facilities to dump.

“Some people dump in other people's toilets at night.”

Theme 4: Attempts to manage disposable diapers

The difficulty of managing used diapers was discussed. They described some attempts they had made but none were sustainable or successful.

“We tried burning them but it was in vain.”

“There was a team that used to clean up before. They used to collect the diapers and put them in black refuse bags and place them by the road for the municipal truck to collect them. It worked as there was no pollution. Their contract ended.”

“The community used to dig holes in their homes to dispose.”

“Traditional council was involved to check if we have disposal waste in place.”

“CWP once gave us refuse bags to use for collecting waste but it did not last because the communication was breached.”

“Managing waste only lasted for three months, but then they went back to their old ways of polluting the area.”

One of the EMs made the following remark:

“Parents said there's nothing they did previously to manage nappies disposal except [for] environmental monitors and EPWPs group did a role play by engaging with local municipality to collecting nappies disposal in the bush, streams and Klaserie river. Municipal[ity] was bring truck to collect the nappies was collected by this group EM and EPWP group before COVID-19. After COVID-19 everything stopped no one was working at municipality.”

It was also highlighted by an older person that “[t]he current generation is lazy to dig a pit to dispose nappies. There was no attempts to manage the waste; that is why pollution is getting worse.”

Theme 5: Experiences of inequality and distrust of the municipality

In the study by Schenck et al. (2022) a major theme of distrust, inequality and exclusion emerged. In the present study similar comments in this regard were made:

“Government people are eating the people's money for service delivery.”

“The municipality is very stingy in providing services to community members. We want refuse bags and moveable bins.”

"The municipality does not recognise us."

"Municipality should recognise us and provide skips."

"Rural areas should be treated the same as those in urban areas where municipal trucks pick [up] waste weekly."

Theme 6: No payment for services

Due to the fact that poverty and unemployment were high, payment for services became a major discussion point. There were those who could not pay due to their financial constraints.

"Unemployment rate is high; so we won't afford pay revenues."

"We are unemployed; so we can't afford to pay for removal."

"We can't afford to pay municipal bills because we are poor, but we can collect or burn diapers in our own yard."

"None - because of unemployment, therefore no money to pay that business."

"Due to a lack of employment, not all people will be able to pay."

"Community members are failing to pay those young boys fixing potholes on the roads, so how can they be able to pay a volunteer to collect nappy waste from their households?"

Comments were also made indicating that paying for waste services should be considered.

"If budget is a problem towards the waste management from municipality, then paying municipal rate should be an option."

"Yes, R50 per household per month will be fine."

"Yes, R100 – R120 (per household per month)"

"Yes, about R100 (per household per month)"

"Per household can pay R50-R100 (per month)"

"Willing to pay R50 for waste management (per month), but the amount to be paid depends on the kilograms."

"Business wise, they can pay but some it will be a problem money-wise."

Theme 7: Suggestions made for waste management

Again, as with the questionnaire, suggestions were sought regarding how to deal with used disposable diapers. The following suggestions were made.

Table 15: Suggestions with regard to better used diaper disposal. (Source: Research data)

Theme	Suggestion
<p>1. Job creation/ Business opportunities</p>	<p><i>“Community members don’t mind collecting disposable nappies, but only if they get paid.”</i></p> <p><i>“Yes, there can be a business opportunity where community members will collect those nappies from households at a certain price.”</i></p> <p><i>“There should be drop-offs where community members put nappy waste for waste pickers to collect.”</i></p> <p><i>“Yes. If I can use my own car to collect nappies in household whereby I am paid, [the] problem [is that] we lack capital to start the business.”</i></p> <p><i>“The creche principal came with a proposal (business) whereby Ramoka people should use her bins for nappy disposal and pay R10.00 but the ward councillor should assist with transport.”</i></p> <p><i>“Job creation - we do not mind to pick them up if we are paid.”</i></p>
<p>2. Provision of accessible skips and the management of the skips</p> <p>Two requirements were expressed regarding the use of skips. They should be accessible to all people and should be managed well.</p>	<p><i>“The municipality should provide more waste skip which should be at an accessible place.”</i></p> <p><i>“More waste skips to be provided and placed at a place where people will access them.”</i></p> <p><i>“We should be provided with moveable bins.” (to be accessible)</i></p> <p><i>“If municipal give them a skip bin it should be monitored not over follows [flow].”</i></p> <p><i>“An orientation or awareness and monitoring of the skip bins should be done if they are provided.”</i></p>
<p>3. Municipal waste collection</p>	<p><i>“A schedule of dates whereby the municipal truck will collect the black refuse bags on the road”</i></p> <p><i>“Municipal truck to assist just like other villages”</i></p> <p><i>“Municipality should be involved to curb this disposal problems.”</i></p>
<p>4. Burying and burning</p>	<p><i>“We must dig holes to bury them/burn the nappies if we don't have enough space in our homes.”</i></p> <p><i>“Dry out the nappies and burn them.”</i></p>

Theme	Suggestion
	<p><i>“Dig holes at home, fill the pit latrine.”</i></p> <p><i>“Burn them, but they don't easily burn.”</i></p> <p><i>“Communities should dig holes in their homes for waste disposal.”</i></p>
5. The development of a landfill site	<i>“Develop a dumping site.”</i>
6. Collaboration between mothers	<p><i>“All baby mother around our village must know each other and register them self in order to control illegal dumping.”</i></p> <p><i>“Mothers should work together to manage waste and the headman should enforce the law.”</i></p>
<p>7. Education and awareness</p> <p>Discussions on waste management, and the management of diapers in particular, were proposed.</p>	<p><i>“First they should be educated and made aware of the consequences that these nappies have in our health.”</i></p> <p><i>“There must be an awareness made on recyclables and non-recyclables.”</i></p>
<p>8. Commitment from community members</p> <p>Comments were also made referring to the participation of and commitment from the community to take responsibility.</p>	<p><i>“People must agree to volunteer in cleaning campaigns”</i></p> <p><i>“Community ask for partnership with K2C”</i></p>

Theme 8: Conditions for using cloth nappies.

A further question was posed to determine under what conditions cloth nappies would be considered.

An EM noted the following:

“They (the community) want or wish to use cloth nappies but due to a lack of water they cannot.”

“When the price of disposable nappies goes up its when we will start to use the reusable nappies.”

“If we could have access to water once or twice a week, it would help in curbing the pollution of nappies and also we would go back to reusable nappies.”

“We might use them if they change the colours.” (not white)

“if there are working taps in the house or on the streets”

Theme 9: No willingness to use reusable cloth diapers

In the previous themes conditions were set for using cloth nappies, but there were those who would not consider using cloth nappies under any circumstances.

“Using cloth nappies is a no because we have evolved so we can't go back and it takes time to wash.”

“These days cloth nappies are outdated.”

“NO water for washing”

“Our pride does not allow anymore.”

“This new generation – honestly - they don't want to use cloth nappies because of they don't have time to do washing, but some they using cloth nappies because of poverty.”

“Reconsidering the use of cloth nappies is not a viable option, with the current water scarcity.”

Theme 10: How cloth nappies were managed before disposable diapers

The groups were requested to share how cloth nappies were washed before disposable diapers came into use.

“They washed their cloth nappies using water from streams, community taps and rain water.”

“There was water in the community furrow available and we didn't have water challenge like we are experiencing now.”

“We had access to water, there were also furrows and streams that had water. We didn't have shortage of water like we do now.”

“Soaking them overnight”

“We used to soak them overnight and wash them in the rivers.”

Theme 11: Regulations, laws or by-laws should be in place to manage nappies (Who should enforce them?)

One of the questions attempted to determine who should take the lead in enforcing the management of used disposable diapers.

“The tribal councillors should be responsible and enforce the law. If anyone breaks the law, a fine must be paid.”

“Ward councillors should also be involved in ensuring that nappy pollution is reduced.”

“Fines (penalty) to everyone who dumps nappies. Tribal councillors should enforce the laws after engaging with the community.”

“The traditional council should have this regulation made and enforce it but engage with all the relevant stakeholders before enforcing the law.”

“The chief of Moremela should enforce the bylaws.”

“Councils should call a meeting to enforce this laws.”

“After a week the council should go house to house to check for compliance.”

“The council should enforce the laws that prohibits people from disposing in rivers and impose fines.”

“Engage with the induna (tribal leader) to set by-laws and fines.”

“Community will set by-laws with the tribal leader to reduce illegal dumping.”

“By-laws of managing nappies disposal in our environment, leader of the community and us as parents should co-operate together for protecting our environment because of if we let it like this our environment would be harmful to any living organisms especially animals and humans, so then the solution is to get skip bin any village but if someone else still dumping in veld should be a fine to pay for jumping the rules.”

“The council welcomes suggestions from communities and with their support they can enforce by-laws.”

“The issue with the current generation is we have lost respect for tribal due to politics, which rips the honour off of them and they end up being disregarded of the position and authority, hence the society is collapsing.”

“Community members do not participate when it comes to waste management.”

5.4 Lifecycle assessment

5.4.1 Introduction

For a number of years now the environmental impact associated with diapers has been a matter of interest to the community involved in lifecycle assessments (LCA). Such assessments are often conducted from a comparative perspective, i.e. reusable vs disposable diapers (Aumónier, Collins & Garrett, 2008; Ng et al., 2013; Notten, Gower & Lewis, 2021). With the evolution of technology and development of new materials, studies have been conducted to evaluate potential future environmental impacts of different types of diapers (Mirabella, Castellani & Sala, 2013; Cordella et al., 2015; Mendoza et al., 2019). However, the majority of studies have been conducted in developed countries (Notten, Gower & Lewis, 2021). Thus, it is necessary to investigate the local context. This study contributes to the limited body of research done in developing countries. Furthermore, it investigates the rural context in particular. This is of particular importance as geographical context was identified as one of the critical factors influencing the environmental impacts of diapers (Notten et al., 2021).

This study is carried out to provide a more holistic perspective to the impacts of diaper waste mismanagement in rural areas. It places particular emphasis on the end-of-life of diapers which differentiates the study from previous research.

Structure of a diaper

Diapers are constructed from a large variety of components. However, the raw materials used are similar - with differences in their construction and the additives employed. Table 16, shows the major materials used. The absorbent core, comprised of pulp and super-absorbent material (sodium polyacrylate), accounts for the bulk of the mass of a diaper at 65.2 %. This is to be expected as its primary function is the absorption and retention of excreta.

Table 16: Primary raw materials used in diaper manufacturing. (Source: local diaper manufacturer)

Material type	Percentage mass contribution
Pulp	33.9%
Sodium polyacrylate (SAP)	31.2%
Polypropylene (PP)	20.8%
Polyethylene (PE)	9.8%
Elastics	1.0%
Adhesive	3.2%

Lifecycle assessment

Lifecycle assessment (LCA) is a method used to assess the environmental impacts of a product or process from raw material extraction to disposal. It can be split into four stages (Figure 68):

- Goal and scope definition
- Lifecycle inventory analysis
- Lifecycle impact assessment
- Interpretation

The goal establishes the aims of the study whilst the scope determines the system boundaries. During this step, a functional unit is also defined which aims to determine the amount of product to be assessed, based on the function it provides. During the lifecycle inventory analysis, the inputs and outputs of the process are quantified. The lifecycle impact assessment (LCIA) stage aims to characterise the inventory flows into specific impact categories. Normalisation is an optional step in LCIA which aims to assess the significance of the results relative to the average societal impact per capita. During the interpretation phase, the results are evaluated against the goal of the study from which conclusions can be drawn.

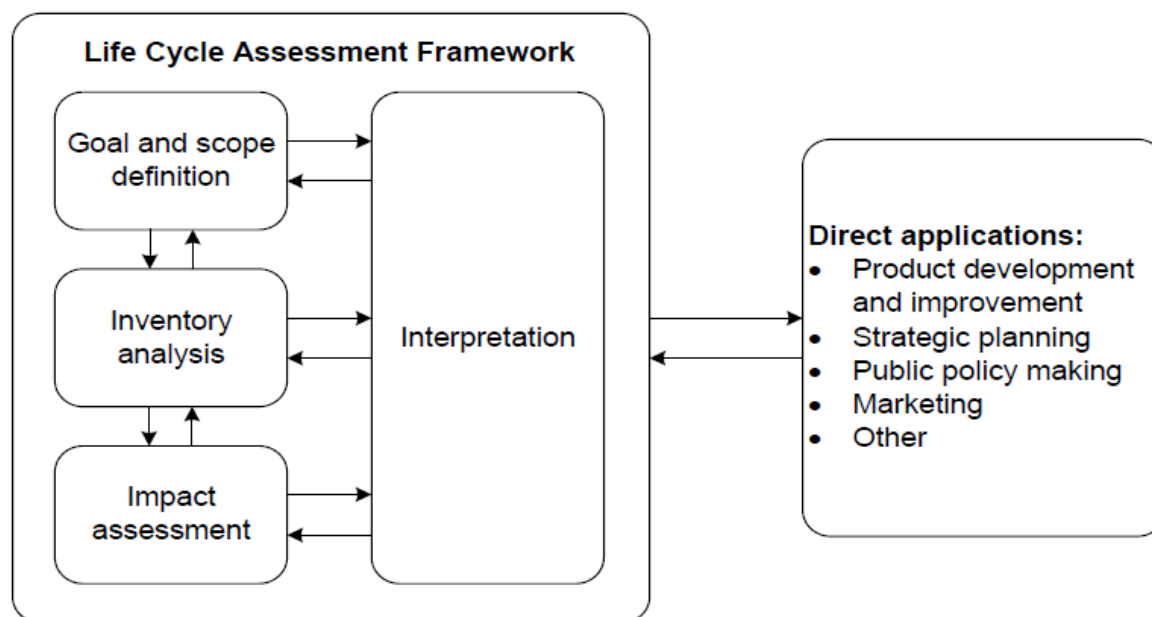


Figure 68: The general LCA methodological framework according to ISO 14040.

5.4.2 Goal and scope

The goal of this study is to evaluate the potential environmental impacts of disposable diaper usage in rural areas. It places a particular focus on the end-of-life of diapers, aspects of which have yet to be investigated in previous research.

Data sources and modelling approach

The diaper modelled was based on primary and secondary information. Specifically, the foreground data were informed by primary data provided by a major local diaper manufacturer. This was supplemented by secondary data sourced from literature. Background data were based on the Ecoinvent v3.9 database. The cut-off system was selected to ensure all associated impacts are allocated to the product manufactured. Information regarding the use phase and waste scenario was based on the interviews conducted in this research. The LCA was modelled on SimaPro LCA Software v9.4.0.1.

In this study, no details are disclosed regarding the actual components needed to manufacture a diaper. This is to maintain the anonymity of the manufacturer. Instead, they are referred to according to their primary raw materials, as shown in Table 16 (p. 67).

Functional unit and reference flow

Previous studies have used a number of functional units. For example, a number of studies have utilised the average number of children's diapers used over 2.5 years (Aumónier, Collins & Garrett, 2008; Brien et al., 2009; Hoffmann, de Simone Morais & Teodoro, 2020). In some cases the functional unit seems arbitrarily chosen, such as the 1000 units used by Mendoza et al. (2019). As mentioned in Section 5.1.24 of this research report, the average number of diapers used per day was 4.47. This is similar to studies by Hoffmann, de Simone Morais and Teodoro (2020), as well as Aumónier, Collins and Garrett (2008), in which they estimated 5 and 4.16 diapers per day respectively. Thus, this study will utilise the number of diapers required in one day which equates to 4.47 diapers.

System boundaries

A cradle-to-grave LCA was conducted - from raw material extraction to disposal. Both informal and formal disposal methods were taken into consideration. Transport and distribution were partly included and use phases were excluded (further discussed in the following sections). The system under consideration is depicted in Figure 69.

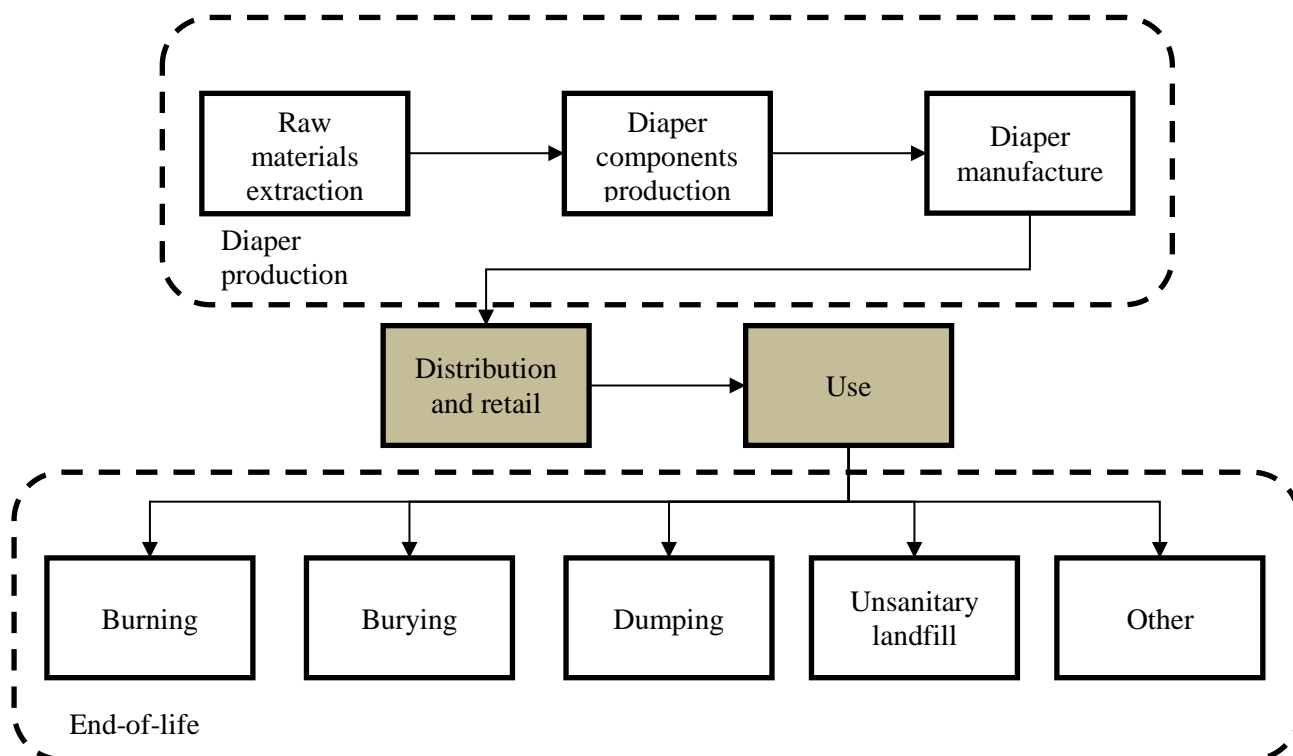


Figure 69: Diaper lifecycle stages. (Source: author's own)

The packaging for the diapers was not included in the model. This is supported by the results of the LCA conducted by Cordella et al. (2015) wherein they found the impacts of packaging across the lifecycle to be negligible.

5.4.3 Lifecycle modelling

Diaper components

There were limited data regarding the production of diaper components. The manufacturer provided the types of components, their weights and their primary materials, as well as the country of origin, as some of the components are imported. However, no information was provided on the component manufacturing or the processes employed. Therefore, the modelling of these components was based on datasets available in Ecoinvent and were modified as far as possible to reflect the conditions in the country of origin, for example, changing the electricity to reflect the country dataset.

Many of the diaper components are composed of composite materials. However, in this study only the primary materials were modelled per component, similar to Cordella et al. (2015) and Mendoza et al. (2019).

Diaper manufacture

Data regarding diaper manufacture were provided by a major diaper manufacturer in South Africa. This includes amounts of diaper components used, electricity consumption, waste generation and disposal.

Use phase

The use phase was not modelled due to different transport distances and the methods (public transport, private transport or walking) that would be used by consumers to reach a wide variety of available retailers located at varying distances.

Transport

Transportation of the imported diaper components was included in the model. These components are shipped from the originating country to South Africa. The distances were approximated using a major port in the country of origin as the source and Durban Harbour as the destination. As mentioned in previously, details of the origins of the components have not been disclosed due to confidentiality reasons. The components are then transported by road to the factory. An average distance of 1 880 km – obtained via google maps - was used for transport from the factory to distributors and retailers in Hoedspruit. However, further details could not be modelled as the diapers could pass through several hands before they are retailed to consumers, e.g. distributors to wholesalers to spaza shops.

End-of-life

Waste residues from the diaper production process reportedly account for only 3 % of materials. This is higher than the study by Mendoza et al. (2019) which utilised a figure of 1% for waste residue. These residues are reportedly sent for further beneficiation by other value chain members. However, we were not privy to the nature of these beneficiation methods; therefore, it was not possible to model the waste scenario in this case.

Based on the interviews, respondents used a variety of methods for the disposal of nappies as shown in Figure 29 (p. 26). They did not necessarily adhere to one method only but might use different options based on convenience. Only skip bins were collected by the municipality and taken to an unsanitary landfill, whereas the respondents used bins as temporary waste retainers till they could dump the waste. Dumping included multiple environments: riverbeds, bush/veld and next to roads. The most popular method was dumping in the bush/veld followed by burning. Other practices entailed dumping in pit latrines or methods not mentioned in the questionnaire.

Four waste scenarios (Table 17) were modelled using the models developed by Doka (2021): open burning, open dumps and unsanitary landfills, as well as ‘Other’. Using the available information, the underlying data were modified to reflect the region. Burying was modelled as an unsanitary landfill; however, it is acknowledged that this does not fully represent the method. Disposal in pit latrines and other methods (reflected as “Other” in Table 17) were modelled using a dummy waste treatment; thus, the impacts are not reflected in the LCIA. The consequences of this modelling choice were investigated by modelling additional waste scenarios wherein pit latrines were modelled as open dumping (waste scenario 2) and unsanitary landfill (waste scenario 3) respectively (Section 5.4.5) The potential impacts will also be discussed in Section 5.4.6.

Table 17: Waste scenario 1. (Source: Research data)

Disposal method	Percentage waste
------------------------	-------------------------

Open dump	43.8%
Unsanitary landfill	26.1%
Burning	18.6%
Other	11.5%

The impacts of the disposal of urine and faeces was not modelled. Instead, the potential impacts are discussed in Section 5.4.6. This includes impacts that cannot be accounted for in LCA, such as, ingestion by animals and dumping in rivers.

5.4.4 Lifecycle impact assessment

Previous studies have used the CML 2001 or ReCiPe methods for calculating such impacts (Notten, Gower & Lewis, 2021). In this study, a long-term approach was taken regarding the environmental impacts. Thus, the impact assessment was conducted employing the ReCiPe Midpoint (H) method which uses global models to evaluate environmental impacts. The method also provides a comprehensive set of indicators. The results of the characterisation phase are presented in Table 18. A contribution analysis was performed on each indicator so as to highlight the major contributors. The impacts were then normalised, using default ReCiPe values, to enable a determination of the relative significance of the different impact categories.

Table 18: LCIA characterisation results (Source: Research data)

Impact category	Unit	Total	Diaper production	Transport to distributors	Waste scenario
Global warming	kg CO ₂ eq	6.10E-01	5.59E-01	2.44E-02	2.61E-02
Stratospheric ozone depletion	kg CFC11 eq	3.19E-07	2.81E-07	1.04E-08	2.78E-08
Ionizing radiation	kBq Co-60 eq	1.52E-02	1.47E-02	5.07E-04	0.00E+00
Ozone formation, Human health	kg NO _x eq	2.35E-03	2.10E-03	2.20E-04	3.41E-05
Fine particulate matter formation	kg PM _{2.5} eq	1.27E-03	1.11E-03	5.33E-05	1.06E-04
Ozone formation, Terrestrial ecosystems	kg NO _x eq	2.39E-03	2.13E-03	2.24E-04	3.83E-05
Terrestrial acidification	kg SO ₂ eq	3.38E-03	3.25E-03	1.27E-04	1.15E-05
Freshwater eutrophication	kg P eq	5.50E-04	3.60E-04	8.25E-06	1.82E-04
Marine eutrophication	kg N eq	3.07E-05	2.18E-05	4.06E-07	8.48E-06
Terrestrial ecotoxicity	kg 1,4-DCB	1.74E+00	1.29E+00	4.51E-01	2.87E-03
Freshwater ecotoxicity	kg 1,4-DCB	2.34E-01	1.80E-02	6.89E-04	2.15E-01
Marine ecotoxicity	kg 1,4-DCB	3.49E-01	2.45E-02	1.16E-03	3.23E-01
Human carcinogenic toxicity	kg 1,4-DCB	1.85E+01	3.72E-02	1.52E-03	1.84E+01
Human non-carcinogenic toxicity	kg 1,4-DCB	8.16E-01	6.02E-01	2.40E-02	1.91E-01
Land use	m ² a crop eq	9.17E-02	8.91E-02	2.60E-03	5.20E-05
Mineral resource scarcity	kg Cu eq	1.49E-03	1.41E-03	7.59E-05	0.00E+00
Fossil resource scarcity	kg oil eq	2.19E-01	2.11E-01	8.30E-03	0.00E+00
Water consumption	m ³	5.23E-03	5.14E-03	8.70E-05	0.00E+00

Figure 70 illustrates that diaper production, from cradle-to-gate, accounted for the majority of impacts on average (> 65 %) except in the case of freshwater ecotoxicity, marine ecotoxicity and human carcinogenic toxicity. In these cases, the disposal of diapers was the highest contributor, accounting

for 96 % or more. During diaper production, the absorbent core was a notable contributor across all impact categories. In particular, it accounted for 92 % of land-use impacts; this can be attributed to the land needed to grow the trees from which pulp fluff is made. Another notable contributor across all impact categories was a locally manufactured PP-based component. Whilst there are a variety of PP components, the one contributing the most to negative environmental impacts was the heaviest. As mentioned earlier, no names of components are being used. Thus, the rest of the study will refer to this component as 'PP component A'.

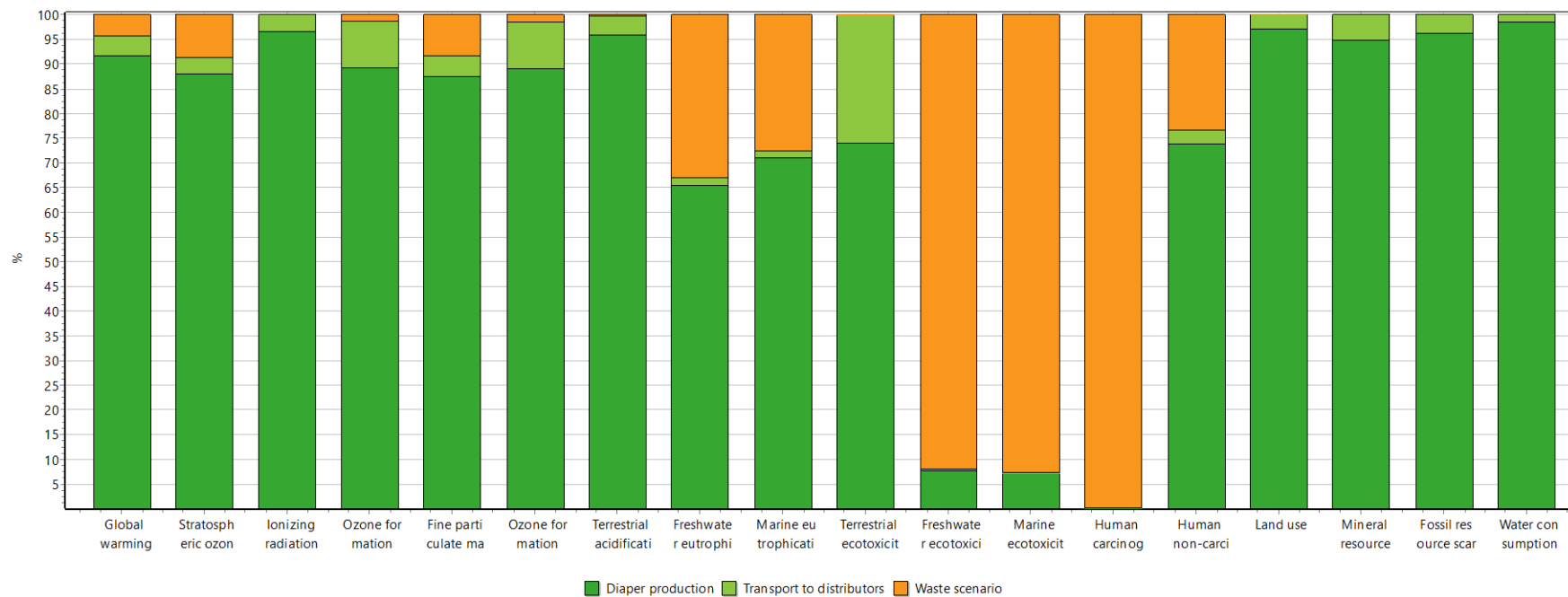


Figure 70: Relative contribution of lifecycle stages to different environmental impacts. (Source: Research data)

Global warming potential (GWP)

The total global warming potential was 0.610 CO₂ eq with diaper production accounting for 0.559 kg CO₂ eq. The major contributors were diaper manufacturing (DM) electricity (0.148 kg CO₂ eq), the super absorbent material (0.112 kg CO₂ eq) and the locally produced PP component A (0.0935 kg CO₂ eq). The electricity contribution is not surprising as South Africa's electricity is mostly coal-based. Furthermore, locally, the precursor for PP (propylene) is produced from coal via the Fischer-Tropsch process. In addition, it is processed using coal-based electricity as an energy source. Transportation to distributors and the waste scenario make minor contributions of 4.0 % and 4.3 % respectively.

Stratospheric ozone depletion

Electricity consumption during diaper manufacturing was a top individual contributor with 34.8 %. This can be traced back to the use of coal as an energy source. Open burning of diapers contributed a relatively small amount in comparison to diaper production (8.7 %).

Ionizing radiation

As shown in Figure 70, diaper production contributed 96.7% to ionizing radiation with transportation making up the balance. DM electricity consumption was once again a top contributor accounting for 33.9 %. The electricity contribution can be attributed to the presence of nuclear energy in the national energy mix.

Ozone formation, Human health

Again, DM electricity consumption was a top contributor to ozone formation, accounting for 27.7 %. This is due to the use of coal to generate electricity; the combustion of coal leads to the release of many pollutants including nitrogen oxides. The absorbent core of diapers contributed almost the same percentage (27.0 %) to ozone formation. This can be attributed to the use of heavy fuel oil and marine diesel oil to provide energy to freight ships for shipping.

Fine particulate matter formation

Diaper production contributed 87.4 % to particulate matter formation. Local electricity produces particulate matter when the coal is combusted to generate steam for the electricity. Thus, it contributed 33.5 % to the total emissions. The absorbent core was a notable contributor as well accounting for 22.9 %. Open burning also releases particulate matter which accounted for 8.4 %.

Ozone formation, Terrestrial

The results for terrestrial ozone formation (0.000239 kg NO_x eq) were similar to those for ozone formation, and Human health (0.00235 kg NO_x eq). So, unsurprisingly, the top contributors were the same: DM electricity (27.3 %) and absorbent core (27.0 %). Transport contributed 9.4 %.

Terrestrial acidification

Diaper production accounted for 95.9 % of terrestrial acidification impacts. Electricity contributed 41.7 %; this can be traced back to the use of coal for energy production. SAP and PP component A were also notable contributors with 12.9 % and 15.1 % respectively.

Freshwater eutrophication

Diaper end-of-life was a notable contributor to freshwater eutrophication, accounting for 33.1 % of impacts. This was due to leachate produced in open dumps and unsanitary landfills. The treatment of spoil from coal mining was also a contributor to emissions (49.6 %).

Marine eutrophication

Similar to freshwater eutrophication, diaper dumping and unsanitary landfills contributed to marine eutrophication (27.6 %). Treatment of coal spoil in the electricity production process was a major contributor with 54.3 %.

Terrestrial ecotoxicity

The waste scenario was a miniscule contributor to terrestrial ecotoxicity (1.74 kg 1,4-DCB) with 0.17 %. Diaper production and transport to distributors contributed 73.9 % and 25.9 % respectively. Emissions were from a variety of sources including SAP production, SAP and pulp transportation from the Durban Harbour to the factory, DM electricity consumption and locally made PP.

Freshwater ecotoxicity

Unsanitary landfilling of diaper waste accounted for the majority (92.0 %) of freshwater ecotoxicity impacts (0.234 kg ,4-DCB). Diaper production and transport accounted for 7.69 % and 0.29 % respectively.

Marine ecotoxicity

Once again, unsanitary landfilling contributed the most to marine ecotoxicity with 92.7 %. This may be attributed to the uncontrolled release of leachate that is formed in the landfill.

Human carcinogenic toxicity

Unsanitary landfilling of diapers was virtually the only contributor to human carcinogenic toxicity contributing 99.8 %. This may be attributed to the emission of carcinogenic gases from the landfill.

Human non-carcinogenic toxicity

Diaper production contributed 73.7 % to human non-carcinogenic toxicity whilst the waste scenario contributed 23.4 % to the total emissions. A variety of contributors arising from the diaper production stage, including DM electricity, PP components and SAP, were identified.

Land use

Pulp was the major contributor (97.1 %) to land use. This is to be expected as the production of pulp is dependent on the growing and harvesting of softwood trees.

Mineral resource scarcity

Diaper production was the only contributor to mineral resource scarcity. PP components manufactured in South Africa were significant contributors accounting for 55.6 %. The waste scenario was not a contributor. This can be attributed to the fact that the diaper disposal methods do not require any mineral resources to be executed.

Fossil resource scarcity

The total fossil resource scarcity emissions were 0.211 kg oil_{eq}. A variety of DM production materials and processes contributed to this impact category including plastic polymer production, DM electricity and SAP. Transport to distributors was a minor contributor.

Water consumption

As was to be expected, the top contributor was pulp (33.9 %) due to the water consumption during farming and pulp production. This was followed by SAP which contributed 18.9 %.

Normalisation

The results of the normalisation can be seen in Figure 71 below. The most significant impact was human carcinogenic toxicity of which the major contributor was the waste scenario. Thus, whilst the waste disposal was not a major contributor across all the impact categories, it had the largest impact when translated into 'real world' terms. The waste scenario was also a major contributor to marine and terrestrial ecotoxicity which also had relatively significant impacts upon exclusion of human carcinogenic toxicity. However, this does not mean that the other categories should be entirely ignored; instead the normalisation highlights hotspots for improvement.

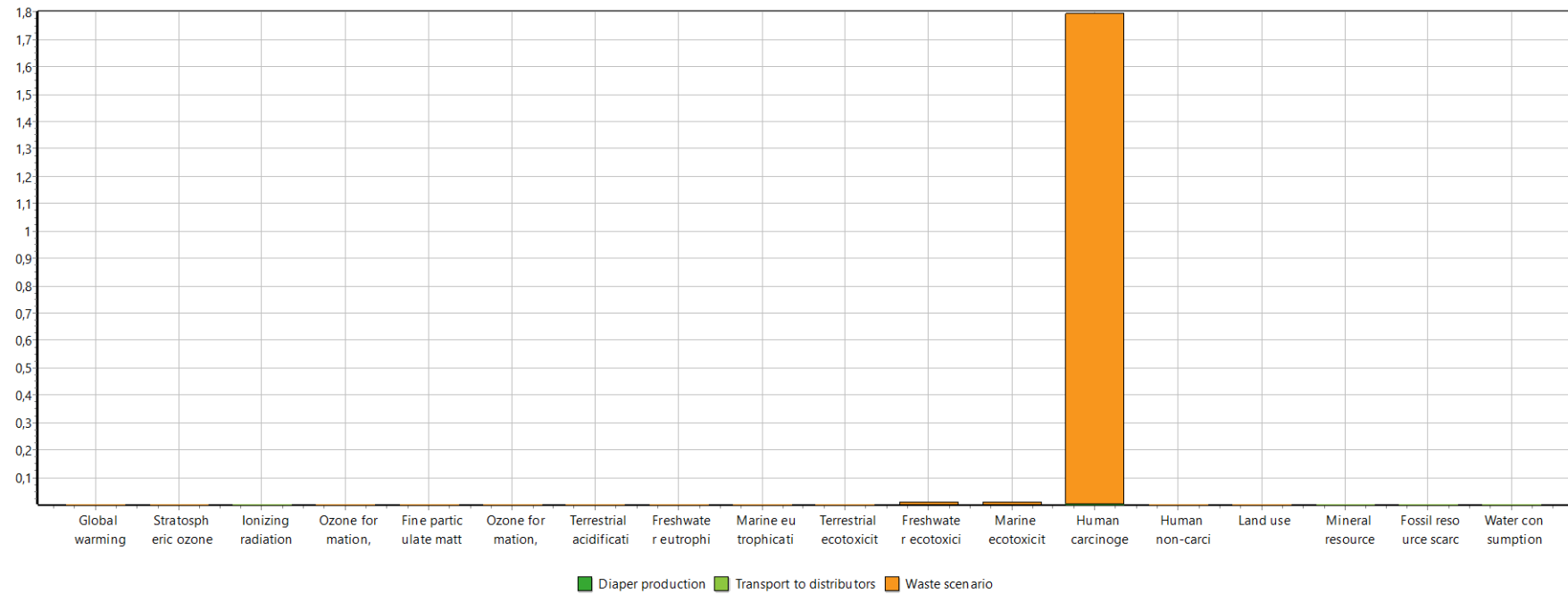


Figure 71: LCIA normalisation results. (Source: Research data)

5.4.5 Pit latrine modelling

In the base case waste scenario (Table 17), disposal in pit latrines was modelled as a dummy treatment. The consequences of these choices were investigated by modelling pit latrines as ‘open dumping’ and ‘unsanitary landfill’ - as waste scenarios 2 and 3 respectively.

As can be seen in Figure 72, no changes in impacts are observed for some of the impact categories including ozone formation, fine particulate matter formation and ionizing radiation. In the cases where changes were observed waste scenario 3 had the highest impacts. Waste scenario 3 was particularly significant for human toxicity and ecotoxicity.

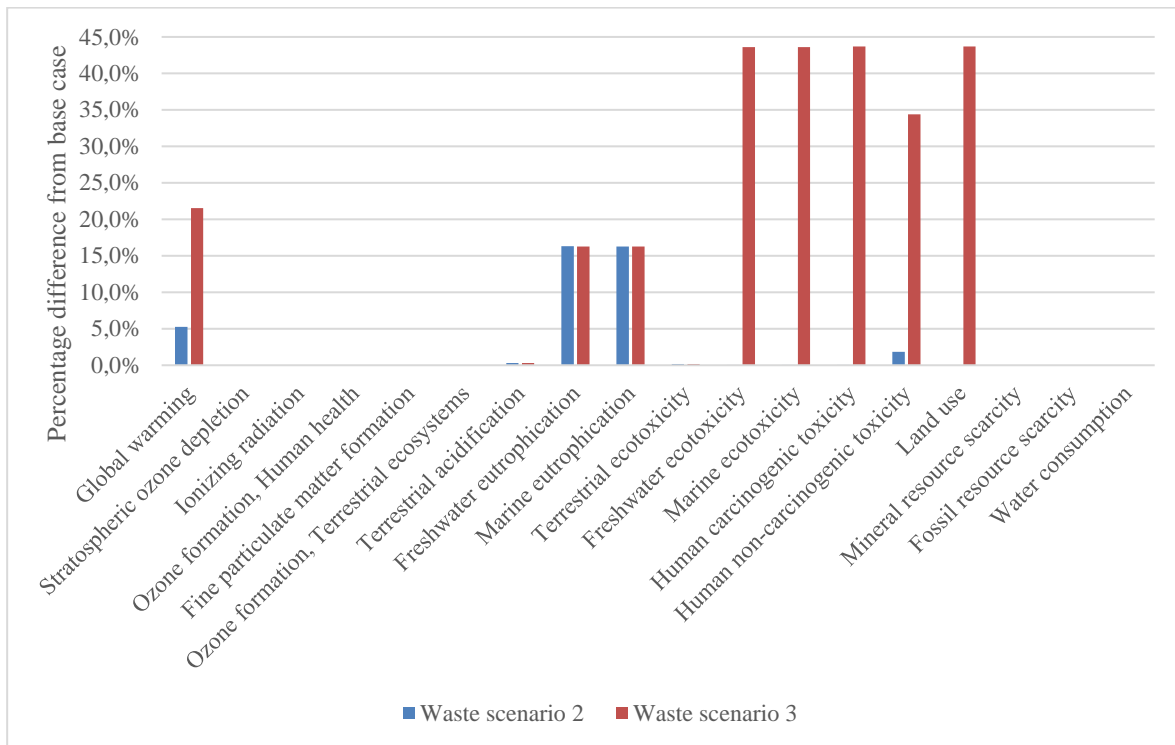


Figure 72: Comparing modelling choices for pit latrines

5.4.6 Further Results – Diaper disposal

It was not possible to portray accurately the end-of-life impacts within LCA. In particular, the impacts of improper disposal of excreta in the environment were not addressed. In K2C, only 12.8 % of the respondents reported emptying the stool before diaper disposal, meaning that the bulk of diapers were disposed with stool in them. This is a danger to the environment, as well as human and animal health. Used diapers carry viruses and diseases, and their proper disposal is essential to limit human exposure to these (Meseldzija, Poznanovic & Frank, 2013; Ntekpe et al., 2020; Kordecki et al., 2022). Excreta have been associated with many diseases including cholera, typhoid and hepatitis.

Burning diapers releases a variety of pollutants including carcinogens, such as dioxins and greenhouse gasses (Meseldzija, Poznanovic & Frank, 2013). It is a difficult process due to the wetness of the excreta. This may result in a residue that may be ingested by dogs or other animals, such as goats. Furthermore, the ash created can leach pathogens into surface and groundwater sources when it rains (Ntekpe et al., 2020).

Burying, whilst it puts the waste out of sight and makes it less available to humans and animals, has the potential to contaminate groundwater sources with pathogens (Ntekpe et al., 2020; Kordecki et al., 2022). This is similar to unsanitary landfilling and open dumping where there is no leachate control; so it is free to be absorbed into the soil and potentially contaminate groundwater. Furthermore, gases that permeate through the landfill and are released into the air may contain harmful pollutants.

Open dumping leaves diapers out in the open which may attract dogs and small children. This results in exposure to disease as described earlier and, additionally, creates the risk of ingestion by animals. Another route for potential risk to health is the dumping of diapers next to rivers or onto dry riverbeds. This has the potential of directly contaminating the river's water when it starts to flow again. This is a significant risk to community members who rely on the river as a water source. Dumping in rivers also has the potential of damaging infrastructure, such as bridges, as reported by municipal officials. This was attributed to flash floods which occur when the waste dams a river and the water eventually breaks through.

Pit latrines are essentially a pit that is dug for the purpose of human defecation. A shelter is often built around the hole which may include an air vent. Once the pit is almost full the waste is buried and another pit is dug. A pit latrine has the potential to leach into underground water sources, thus contaminating them.

5.4.7 Interpretation

As established by Aumónier, Collins and Garrett's research (2008), across the lifecycle of disposable diapers, the production phase was the major contributor to environmental impacts, with the exception of freshwater ecotoxicity, marine ecotoxicity and human carcinogenic toxicity, which were the impacts with the most significant relative importance. During the production phase, manufacturing electricity was consistently a top contributor across the majority of impact categories. This increased the contribution made by the diaper manufacturing phase, as opposed to the findings of Mendoza et al.'s (2019) study. The electricity impacts can be attributed to the South African energy source, as the bulk of energy is sourced from local coal deposits. Thus, it stands to reason that electricity, as a top contributor, is a situation unique to the South African context.

The absorbent core was also found to be a top contributor. In the case of SAP, which is not locally produced, its production could be traced as the primary contributor to impacts. This is similar to results obtained by Mendoza et al. (2019). The pulp also played a notable role in impacts associated with the ecosystem. Cordella et al. (2015) found pulp to be the top contributor across the majority of impact categories - with SAP being the second most significant. The contributions made by SAP and pulp can be influenced by their ratios in the absorbent core. In this case, the pulp:SAP ratio is 1:0.92, whereas Mendoza et al. (2019) reported a ratio of 20:80. Some studies have been conducted on the efficacy of changing the ratio of pulp:SAP in diapers, finding that a reduction in materials leads to a reduction in environmental impacts (Cordella et al., 2015; Mendoza et al., 2019).

The emergence of these processes highlights potential hotspots for improvement. In terms of electricity consumption, the diaper manufacturing factory should consider using renewable energy sources and reduce reliance on the national grid which is already strained (Trenner, 2023).

Whilst there is a national push for the use of locally produced materials, it is important to note the potential impacts associated with such a shift. This was demonstrated by the featuring of locally

produced PP components, e.g. PP component A, as a notable contributor in many indicators. This can be attributed to the fact that the precursor for PP is a by-product of coal processing via the Fischer-Tropsche process. Chitaka, Russo and von Blottnitz (2020) found that polypropylene produced in South Africa had higher GWP than the production of the same material in the United States and Europe.

Diaper disposal was dominant in only three impact categories: freshwater ecotoxicity, marine ecotoxicity and human carcinogenic toxicity. However, the importance of these categories was shown to be significant after normalisation. It is important to note that diapers can take up to 500 years to decompose, thus they are largely inert in landfills and dumps (Płotka-Wasyłka et al., 2022). Furthermore, the impact assessment methodology chosen has only a 100-year timeframe. In addition, diaper disposal presents a greater scope of impacts than can be assessed by current LCA models, and further research is required to address this limitation. Thus, when developing interventions to reduce the environmental impacts of disposable diapers, emphasis should be placed on waste disposal.

5.4.8 LCA Conclusions

The most significant impacts from disposable nappies are those contributing to human and ecological toxicity, the major contributor of which was improper disposal of used diapers. Thus, interventions to address the impacts of diapers should focus on the proper disposal of used diapers.

Local electricity used in the manufacture of diapers is a top contributor to the majority of impact categories. This indicates the need for increased energy efficiency and a shift towards renewable sources of energy.

It is important to address the human carcinogenic toxicity impacts. In order to do this, there needs to be proper waste management of diaper waste, which requires an improvement in waste management service delivery to such areas and improved landfill conditions.

The absorbent core is another aspect that can be earmarked for improvement. This may be in the form of material reduction or substitution of materials.

In rural areas, the impacts of disposable diapers extend beyond what can be captured by LCA. Thus, it is important to consider the wider consequences of the use and disposal of diapers in such contexts.

6 Summary and Recommendations

The research study contributes valuable insight into diaper use and disposal behaviours across eight villages in the K2C biosphere region. Data were collected by means of 1576 interviews in a baseline study, 18 focus group discussions, participatory mapping with all eight communities, and the mapping of dumped diapers through a participatory 'citizen science' process, with the assistance of community environmental monitors. In addition, an LCA study was completed in order to assess the impacts which the disposable diapers had on human health and the environment within the region.

Respondents were predominantly female caregivers between the ages of 20-39 years, unemployed and grant dependent, with most households receiving more than one grant. Moreover, in addition to their lower socio-economic status, respondents lived with little to no waste management services, poor access to running water and decaying infrastructure.

Results from the survey show that 99% of respondents used disposable diapers. This is both surprising and unsurprising. It is surprising because diapers are a relatively large expense per household, consuming a significant portion of grant income on disposable items. However, the context of poor service delivery, as well as lack of water and electricity, makes the adoption of reusable alternatives, such as cloth diapers, all but impossible. Moreover, without reliable waste management services, respondents are forced to depend on a product which they struggle to dispose of sanitarily. As a result, the study reveals the lengths to which individuals within the study area must go in order to manage this highly complex and problematised product by burying, burning or dumping it in the veld and watercourses, which, as the LCA suggests, has a multitude of detrimental effects on the health of the residents, their livestock, wildlife, water and the environment in general.

None of the eight villages receive waste management services from their respective municipalities and, therefore, form part of the South Africans who have to deal with their waste themselves. One of the major reasons provided by the respective municipalities for why they do not deliver services is that the communities cannot pay for service delivery. This means that lower-income communities, deprived of waste service delivery, resort to burying, burning and dumping waste as they have no means to manage waste in an environmentally appropriate manner.

These results speak directly to the manner in which compounding service delivery failures, including solid waste management, complicate the lives of lower-income communities, and those in underserved communities more generally. Moreover, it aligns with other studies, such as Kalina 2020 and 2021, Schenck et al. (2022) and Schenck et al. (under review), which directly link service delivery, inequality and human rights in South African communities. This body of work speaks to the ways in which inappropriate or insufficient waste management delivered to lower-income areas, compounded by poor state support and low socio-economic conditions, leaves communities with few pathways to enhance their well-being – or, as Sen (1999) would express it, “to live a valued life”.

Thus we need to emphasise the consequences of denying essential public services, such as waste management, to low-income communities, and we believe it is time for the South African government to acknowledge that it neglects the majority of predominantly poor communities to whom they are supposed to render vital services. Few residents in such communities are in a position to pay for services, and thus the majority have to manage their waste themselves. Not rendering appropriate services to low-income areas exacerbates their already taxing living conditions, intensifies inequalities and contributes to environmental degradation - including in ecologically sensitive spaces, such as K2C. The challenge should be placed at the door of governments of developing countries, such as South Africa, to develop innovative service delivery and fiscal models (with their constituents) such that the well-being of all communities and their environment can be supported adequately.

We want to concur with Kirsten and Fourie (2021) that the complex developmental problems that South Africa faces cannot be solved with local municipalities operating in isolation. Public-private partnerships can assist to improve knowledge, skills, management, maintenance and implementation of service delivery. Close partnerships with Non-Governmental Organisations, such as K2C, are strongly encouraged as such NGOs operate closely with communities.

The results further highlight how successfully disposable diapers are designed and produced. Amongst several reasons given by the respondents for using disposable diapers were their convenience for the caregiver/mother, being perceived as providing comfort for the baby, and being fashionable and modern. Mothers or caregivers indicated that they would **not**, even under more favourable circumstances, easily turn back to using reusable or cloth diapers. The Department of Fisheries, Forestry and the Environment should urgently develop Extended Producer Responsibility (EPR)⁵ regulations for disposable diapers so that the producers, importers and brand owners also take responsibility for the complex products designed. Producers themselves should make a contribution towards improved waste management, development of alternative management and preferable recycling options. More importantly, according to Ntekpe et al. (2020), producers should be held accountable for the entire lifecycle of their products.

Previous research has found that the environmental fate and long-term health effects of disposable diaper accumulation has not been well researched (Kordecki, 2021). The deteriorating water quality, insect prevalence, biodiversity of soil microbiota and the impact of chronic human faeces exposure to humans, livestock and wildlife have not been attended to.

In summary: Although disposable diapers are convenient, the usage and disposal practices of these diapers in the study area are creating serious social and environmental problems, affecting humans and animals, and are posing a serious threat to the biodiversity. The complexity of the problem should be systemically addressed through continuous interdisciplinary and transdisciplinary research and relevant policies and regulations. Platforms should be created on which information can be shared, and solutions generated, to improve the health and well-being of the communities and their environment. In addition, improved access to water, sanitation, hygiene and waste management services at the community level is regarded as a step towards a more sustainable future - and this should be undertaken in tandem with improved access to education, healthcare and an economy that would support a growing society (Rodic & Wilson, 2017; Kordecki, 2021).

⁵ The EPR regulations for paper and packaging, as well as electronic and electrical waste, came into effect on 5 May 2021. This new legislation makes EPR mandatory for all producers and importers of packaging. It changes how producers, brand owners, retailers and importers design, make, sell and keep their products in the recycling loop as far as is practicably possible.

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ANNEXURE 1

DIAPER BASELINE QUESTIONNAIRE - K2C Biosphere

Name of the fieldworker:	
Introduction	
<p>Littering of disposable nappies is a public health concern in communities. There are several environmental and public health related concerns associated with this problem. Some of these include exposure of human waste to water drainage areas and subsequently to humans who drink the water, animals that may consume or scavenge on the soiled nappies, and the aesthetic impact on the environment.</p> <p>Go phatlalatsa ga maleiri ago lahlwa ke hloba boroko go maphelo ka kakaretso mo setshabeng. Go nale di pelayelo tse etsego tsa tokologo le tsa bophelo ka kakaretso tse di amanago le bothata bjo. Tse dingwe tsa gona di akaretso go phatlalatsa ga ditshela mo go galelang meetse, gape lemo batho ba nwago meetse ao, diphoofolo tseo dika jago le go tsoma mo mobomg wago aparela ke maleiri a ditshela , le khautso ya bottle bja tokologo/naga.</p>	
<p>The aim of this study is to better understand why people in three rural communities use these disposable nappies, what happens with the nappies after they are used, and what options may be available to manage the problem.</p> <p>Maikemisetso a morero wa thuto e ke go kwisisa bo kawone gore lebaka ekaba eng batho ba somisa maleiri ago lahlwa mo ditshabeng tse tharo, gore go diregang ka maleiri ao a somilego le go tseba gore ekeba dikgetho dife tseo di kabago gona go laela bothata bjo.</p>	
<p>Environmental monitors will be delivering surveys verbally and recording responses electronically and all personal details will remain anonymous.</p> <p>Ba hlahlobi/hlokamedi ba tokologo/naga ba tlabo ba dira boithuto bjo ka molomo, ba tlaega di Karabo ka elecktroniki le gore ka moka dinthla tsa botho etlaba khupa marama.</p>	
Questions-Dipotseso	Possible answers
Do you understand the aims of the study? Le kwisisa Maikemisetso wa morero wa thuto ye?	Yes - Ee No - Awoa
Do you understand that your personal details will be anonymous? Na le a kwisisa gore dinthla tsa lena tsa botho etlaba khupa marama?	Yes - Ee No - Awoa
Do you agree to participate in this study? Lea dumela go tsea karolo go morero wa thuto ye?	Yes - Ee No - Awoa
Date and time of interview Letsatsi le nako ya thlahlobo	Date: _____ Time: _____
Which organisation is collecting the data? Ke mokgahlo ofe o okgobokanyago tshedimoso?	University of Western Cape
Demographics	
1.1 Name of Community Leina la setshaba	_____
1.1.1 Location of interview – Lefilo la thlahlobo	GPS COORDINATES
1.2 Gender Sebopego	Female/Monna Male/Mosadi
1.3 Age: (inclusion criteria 18+) Mengwaga:	_____
1.4 Total Number of people in the household Le ba ba kae kamo Lapeng?	_____
1.5 Employment status of interviewee	<input type="radio"/> Unemployed: Go hloka mmereko

<p>Seemo sa mohlalobja sa Mmereko</p> <p><u>CHOOSE ONLY ONE</u></p>	<ul style="list-style-type: none"> ○ Part-time employment- Go thwalelwa sa nakwana ○ Contract employment- Go thwalelwa ka konteraka ○ Permanent employment- Go thwalelwa sa ruri ○ Self-employed- Moipereki/Baipereki
<p>1.5.1 Occupation of the interviewee</p> <p>Sekgoba sa mohlalobja Mosomong</p>	<hr/>
<p>1.6 Employment status of head of household</p> <p>Seemo sa tsa mosomo sa hlogo ya lapa?</p> <p><u>CHOOSE ONLY ONE</u></p>	<ul style="list-style-type: none"> ○ Unemployed: Go hloka mmereko ○ Part-time employment- Go thwalelwa sa nakwana ○ Contract employment- Go thwalelwa ka konteraka ○ Permanent employment- Go thwalelwa sa ruri ○ Self-employed- Moipereki/Baipereki
<p>1.6.1 Occupation of the head of household</p> <p>Ba Beraka Mereko Ofe ?</p>	<hr/>
<p>1.7 How many people in the household are employed?</p> <p>Go Bereka batho Ba Bakae Ka Lapeng ?</p>	<hr/>
<p>1.7.1 Number of household members employed locally?</p> <p>EKaba Ke Ba Bakae Ka Lapeng Bao Ba Berekago Kgauswi Le Gae ?</p>	<hr/>
<p>1.7.2 Number of household members working away from home?</p> <p>Ke ba Bakae Ka Lapeng Bao Berekago Kgole le Gae ?</p>	<hr/>
<p>1.8 Do you or any members in your household receive any state grants?</p> <p>Ekaba Go Nale O Mongwe Wa Lena Kamo Lapeng a Hwetsago Mphiwa-fela Go tswa Go Mmuso ?</p>	<p>Yes - Ee</p> <p>No - Awoa</p>
<p>1.8.1 If yes, how many grants?</p> <p>Ke Ba Bakae Ba Hwetsago Mphiwa-fela?</p>	<hr/>
<p>1.9 How do you access water?</p> <p>Ekaba Le Hwetsa Meetse Kae?</p> <p>YOU CAN CHOOSE MORE THAN ONE</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Garden tap- Pompo ya serapeng <input type="checkbox"/> Tap inside- Pompi ka gae <input type="checkbox"/> Communal tap/borehole- Pompi yago kopanelo <input type="checkbox"/> Buy water- Go reka meetse <input type="checkbox"/> River- Nokeng <input type="checkbox"/> Jojo tank- Gotswa tankeng
<p>1.9.1. Do you have access to water daily?</p> <p>Le hwetsa meetse ka mehla?</p>	<p>Yes - Ee</p> <p>No - Awoa</p>
<p>1.9.1.1 If not, what is the main reason why not?</p> <p>Lebaka ekaba eng le sa hwetse meetse ka mehla?</p>	<ul style="list-style-type: none"> ○ Interruptions to water supply because of

	<p>municipal infrastructure- Tshitiso ya go hwetsa meets ka baka la masepala</p> <ul style="list-style-type: none"> ○ Seasonal rainfall-Pula ya gona ka dilemo ○ Vandalism-Tshinyagalo ○ Distance to collect water-Leeto go hwetsa meetse ○ Health limitations to collect water-Tsa bophelo tseo di tekanyetsago go hwetsa meetse ○ Other- Engwe
<p>1.9.1.2 If other, what is the reason? A mangwe, Mabaka ekaba afe ?</p>	
<p>1.10 What kind of toilets do you mainly use? Le Berekisa/Somisa Dintlwana bo swela mare tsa mohuta mang? YOU CAN CHOOSE MORE THAN ONE</p>	<p><input type="checkbox"/> Inside toilet-Dintlwana tsa ka ntlong</p> <p><input type="checkbox"/> Pit latrine-Dintlwana tsa molete</p> <p><input type="checkbox"/> Communal toilets-Dintlwana tsa kopanelo</p> <p><input type="checkbox"/> Open areas- Se bakaa bakeng</p>
<p>1.11 How many adults use adult diapers in the household? Go Nale Batho Ba Bagolo Bao Ba Berekisago Maleiri ?</p>	
<p>1.12 Number of children using nappies? ke bana ba ba kae bao ba berekisago maleiri?</p>	
Nappy Use / Perekiso ya maleiri	
<p>2.1 Are you the person in your household responsible for changing the nappies on the children? Ekaba ke lena le tseyang maikarebo a o apola lego apesa Bana maleiri?</p>	<p>Yes - Ee No - Awoa</p>
<p>2.2 Number of years children use the nappy in the day and night- Ke mengwaga e mekae bana ba berekisa maleiri mosegare le boshego?</p>	
<p>2.2.1 Number of years children use the nappy only at night (after they start using the toilet) Ke mengwaga e mekae bana ba berekisa maleiri boshego fela? Ge ba thoma go ya ntlwaneng.</p>	
<p>2.3 Of the adults wearing adult diapers in your household, from what age did they start wearing diapers? Go Batho Ba Bagolo Bao Berekisago Maleiri, Ekaba ba thomile ba nale mengwaga e mekae ?</p>	

<p>2.4 Which type of nappies do you use for your child/children? Bana Ba Lena Ba Aparara Maleiri a Mohuta Mang?</p> <p>CHOOSE ONLY ONE</p>	<ul style="list-style-type: none"> <input type="radio"/> Disposable (e.g., Pampers)- Maleiri ago lahlwa <input type="radio"/> Reusable/cloth nappies- Maleiri a leshela <input type="radio"/> Both disposable and reusable/cloth nappies- Ka moka maleiri ago lahlwa le a leshela
<p>2.5.1 Estimate how many disposable nappies you use per day? Ekeba le somisa maleire a go lahlwa a ma kae ka letsatsi?</p>	<p>_____</p>
<p>2.5.2 How many times a day do you change reusable nappies? Le Berekisa Maleire a Leshela a makae ka letsatsi?</p>	<p>_____</p>
<p>2.6 Do you reuse disposable nappies? Ekaba le boeletsa maleiri a go lahlwa?</p>	<p>Yes - Ee No - Awoa</p>
<p>2.6.1 If yes, how many times? Le somiswa ga kae pele leka lahlwa?</p>	<p>_____</p>
<p>2.7 When you dispose of used nappies, do you empty the stool before disposing? Ge le lahla Maleire a o a berekileng ekaba lentsha di ka gare naa?</p>	<p>Yes - Ee No - Awoa</p>
<p>2.7.1 Why, or why not? Lebaka keng ?</p>	<p>_____</p>
<p>2.8 Where do you dispose of the stool? Di ka gare di lahlwa kae ?</p>	<p>_____</p>
<p>Nappy and waste disposal- Go Lahliwa ga maleire le ditshila</p>	
<p>2.11 How do you dispose of the used disposable nappies? <u>Please rank the top 3 disposal methods with 1 being most commonly used.</u></p> <p>Ekaba le dira bjang ka Maleire a o a somilego?</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Burying in waste hole - go boloka moleteng wa ditshela <input type="checkbox"/> Burning- Go fisa <input type="checkbox"/> Throwing in a pit latrine- Dintlwana tsa molete <input type="checkbox"/> Landfill or dustbins- Go lahla ga gare ga tlwana goba se tshela ditshela <input type="checkbox"/> Throwing in riverbeds- Go lahla di nokeng <input type="checkbox"/> Throwing in the bush or veld-Go lahla le fokeng <input type="checkbox"/> Dumping next to the road- Go lahla kgaufe le ditsela <input type="checkbox"/> Skip bins-Se tshela ditshela <input type="checkbox"/> Other-Engwe
<p>2.11.1 If other was among your top 3 methods, what is the other method of disposal? Ekaba go nale mehuta yengwe ya go lahla maleire?</p>	<p>_____</p>

<p>2.12 Who typically discards the used nappies? <u>Please rank the top 3 people with 1 being the person that does most of the disposal</u></p> <p>Ekaba Kebo mang ka gae Bao ba lahlang maleire ao a somilego?</p>	<input type="checkbox"/> Grandparents- Bo Nkgono <input type="checkbox"/> Mother- Mme <input type="checkbox"/> Father- Tate <input type="checkbox"/> Nanny/ caretaker- Mo hlokamedi <input type="checkbox"/> Siblings (older than 18)- Barathu ba mengwaga ya godimo ga 18 <input type="checkbox"/> Siblings (younger than 18)- Barathu ba mengwaga ya tlase ga
<p>2.13 Who deals with general waste disposal in the household? <u>Please rank the top 3 people with 1 being the person that does most of the disposal</u></p> <p>Kebo mang bao ba lahlago ditshila kamo gae?</p>	<input type="checkbox"/> Grandparents- Bo Nkgono <input type="checkbox"/> Mother- Mme <input type="checkbox"/> Father- Tate <input type="checkbox"/> Nanny/ caretaker- Mo hlokamedi <input type="checkbox"/> Siblings (older than 18)- Barathu ba mengwaga ya godimo ga 18 <input type="checkbox"/> Siblings (younger than 18)- Barathu ba mengwaga ya tlase ga
<p>2.14 Do you separate nappies from general waste? EKaba le Arogantsha ditshila tse dingwe le maleire naa?</p>	<p>Yes - Ee No - Awoa</p>
<p>2.15 What distance do you walk to discard nappies? Ekaba le sepela Dikilometera goba dimetera tse kae go yo lahla maleire?</p>	<p><input type="radio"/> <30m <input type="radio"/> 200-800m <input type="radio"/> 1-3 km <input type="radio"/> >3 km</p>
<p>Nappy Purchase</p>	
<p>3.1 What kind of nappies are available to purchase in your community? Ekaba le Reka Maleire a mohuta mang mabenkeleng mo mosechabeng sa lena?</p> <p>CHOOSE ONLY ONE</p>	<p><input type="radio"/> Disposable (e.g., Pampers)- Maleiri ago lahlwa <input type="radio"/> Reusable/cloth nappies- Maleiri a leshela <input type="radio"/> Both disposable and reusable/cloth nappies- Ka moka maleiri ago lahlwa le a leshela</p>
<p>3.2 Where do you purchase nappies? <u>Please rank the top 3.</u></p> <p>Le reka Kae Maleire?</p> <p>YOU CAN CHOOSE MORE THAN ONE</p>	<input type="checkbox"/> Shoprite <input type="checkbox"/> Clicks <input type="checkbox"/> Spar <input type="checkbox"/> Boxer <input type="checkbox"/> Pick 'n Pay <input type="checkbox"/> Spaza shop <input type="checkbox"/> Other
<p>3.2.1 If other, then where?</p>	

Go gongwe ke kae ?	
3.3 Who gives the money to buy the nappies? <u>Please rank the top 3.</u> Kebo Mang Bao ba ntshego tshetele yago reka maleire?	<input type="checkbox"/> Mother- Mme <input type="checkbox"/> Father- Tate <input type="checkbox"/> Siblings- Barathu <input type="checkbox"/> Grandparents- Bo Nkgono <input type="checkbox"/> Other- O Mongwe
3.3.1 If other, then who? Entle le Bao Ekaba Bo Mang ?	
3.4 Who goes out to the shop to buy the nappies? <u>Please rank the top 3.</u> Ke Mang Ka gae a yago mabekelang go rekago Maleire?	<input type="checkbox"/> Mother- Mme <input type="checkbox"/> Father- Tate <input type="checkbox"/> Siblings- Barathu <input type="checkbox"/> Grandparents- Bo Nkgono <input type="checkbox"/> Other- O Mongwe
3.4.1 If other, then who? Kebo Mang Bao ba rekego maleire?	
3.5 What nappy brands do you usually use? <u>Please rank the top 3 brands, with 1 being the brand most commonly used?</u> Ke Maleire mafe ago lahlwa le a somisago ? YOU CAN CHOOSE MORE THAN ONE	<input type="checkbox"/> Huggies <input type="checkbox"/> Pampers <input type="checkbox"/> Cuddlers <input type="checkbox"/> Lovies <input type="checkbox"/> Clicks <input type="checkbox"/> No-name Brand <input type="checkbox"/> Other
3.5.1 If other, then which nappy brand? A Mangwe ekaba afe ?	
3.6 Can you estimate how much is spent in your household on nappies <u>FOR ONE CHILD</u> each month? Ekaba le somisa bokae go reka maleire ka kgwedi ya ngwana o mo tee ?	R_____
Preferences	
4.1 Why do you prefer to use disposable nappies? Lebaka ke eng le somisa maleire ago lahlwa ?	
4.2 Why do you prefer to use reusable nappies? Lebaka ekaba eng le somisa maleire a Leshela ?	
4.3 Who or what mainly influences you to buy nappies? Ekaba ke mang goba Ke eng seo sele hloletsago go reka maleire? YOU CAN CHOOSE MORE THAN ONE	<input type="checkbox"/> Price- Theko <input type="checkbox"/> Specials- Tse kgethegilego <input type="checkbox"/> Adverts- Di papatso <input type="checkbox"/> Social media <input type="checkbox"/> Friends- Ba gwera <input type="checkbox"/> Family- Ba leloko <input type="checkbox"/> Doctors- Ngaka <input type="checkbox"/> Other- E Mangwe
4.3.1 If other, then who or what? Ekaba go nale se sengwe, ke eng goba ke mang?	

<p>4.4 Do you know how other people in the community dispose of used nappies? Please rank the top 3.</p> <p>Ekaba la tseba gore ba bangwe mosechabeng sa lena ba lahla Bjang Maleire?</p>	<p><input type="checkbox"/> Burning or burying in waste hole- Go fisa goba go boloka moleteng wa ditshela</p> <p><input type="checkbox"/> Throwing in a pit latrine- Dintlwana tsa molete</p> <p><input type="checkbox"/> Landfill or dustbins- Go lahla ga gare ga tlwana goba se tshela ditshela</p> <p><input type="checkbox"/> Throwing in riverbeds- Go lahla di nokeng</p> <p><input type="checkbox"/> Throwing in the bush or veld- Go lahla le fokeng</p> <p><input type="checkbox"/> Dumping next to the road- Go lahla kgaufe le ditsela</p> <p><input type="checkbox"/> Skip bins- Se tshela ditshela</p> <p><input type="checkbox"/> Other- Tse dingwe</p>
<p>4.4.1 If other, then how? Go Nale tsela yengwe ?</p>	<p>_____</p>
<p>4.5 Have you ever considered using cloth/reusable nappies? Le ile la nagana goba go naganisa go somisa/berekisa maleire a Leshela naa?</p>	<p>Yes - Ee No - Awoa</p>
<p>4.5.1 Why would or would you not use cloth or reusable nappies? Lebaka ekaba eng gore le somise goba leseka somisa maleire a mashela ?</p>	<p>_____</p>
<p>4.6 Can you think of a better way to throw your nappies away? Le ka nagana ditsele tse dingwe tsa maleba tsa go lahla maleire ao a somilego?</p>	<p>Yes – Ee No - Awoa</p>
<p>4.6.1 What would be a better way to throw your nappies away? Ekaba efe tsela ya maleba yago lahla maleire yao ma somilego?</p>	<p>_____</p>
<p>4.7 If there was a central/specific place to dispose of nappies, would you use it? Ge nkabe go nale le lefelo leo le kgethilego go lahla maleiri ao a somilego, le ka le somisa?</p>	<p>Yes - Ee No - Awoa</p>
<p>4.7.1 If yes/no, why? Lebaka ke eng?</p>	<p>_____</p>
<p>4.8 What effect do you think nappy waste has on people? O Nagana gore ke khuwetso yefe yeo e thlolago ke ditshila tsa maleire bathong?</p>	<p>_____</p>
<p>4.9 What effect do you think nappy waste has on the environment? O Nagana gore ke khuwetso yefe yeo e hloago ke ditshila tsa maleire nageng?</p>	<p>_____</p>
<p>4.10 Are there any community groups that may be able to lead and organize more environmentally friendly nappy disposal options? (Participants can name a group, some options may include: creche, hospital, church, women's group, tribal leaders) Ekaba go nale di thlopha hlophana mo setshabeng tseo dika etelago pele le go kopanya ditsela tsa maleba tsago lahla maleire a ditsheia?</p>	<p>_____</p>

<p>4.11 Would you be interested in participating in a focus group to discuss possible solutions for nappy disposal? Leka thabela go tseya karolo mo sehlophaneng se seitsego go ahla-ahla tharollo ya go lahla maleire a ditshila naa?</p>	<p>Yes - Ee No - Awoa</p>
<p>4.12 Name for participation in contact group (interviewees name): Leina la motsea karolo mo sehlopheng</p>	<p>_____</p>
<p>4.13 Phone number for participation in contact group (interviewees number): Di nomoro tsa mogala wa motsea karolo mo sehlopheng</p>	<p>_____</p>

Interviewer: Thank the respondent for his/her participation.

For more information contact:

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ANNEXURE 2

FOCUS GROUP DISCUSSION QUESTIONS - K2C Biosphere

FOCUS GROUP DISCUSSION QUESTIONS - K2C Biosphere

1. What are your biggest concerns regarding disposable nappies?
2. Were there previous attempts to manage disposable nappies in your village? If yes, how did it work? What worked and what did not?
3. What suggestions do you have to manage nappies in your village?
4. If there is no municipality, what can or should be done then?
5. Are there possible business opportunities to manage nappies in your village? If yes, what are they?
6. If there is a business that manages nappy waste, would you be willing to pay towards this service? If yes, how much per month?
7. Under what conditions would you be willing to use cloth nappies?
8. Before disposable nappies were available, how did you wash cloth nappies?
9. What regulations, laws or by-laws should be in place to manage nappies? Who should enforce it?

ANNEXURE 3
ETHICAL CLEARANCE CERTIFICATE



UNIVERSITY of the
WESTERN CAPE



14 March 2022

Prof C Schenck
Social Work
Faculty of Community Health Sciences

HSSREC Reference Number: HS22/1/2

Project Title: Investigating disposable diaper usage and waste management in rural communities

Approval Period: 13 March 2022 – 13 March 2025

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology, and amendments to the ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report by 30 November each year for the duration of the project.

For permission to conduct research using student and/or staff data or to distribute research surveys/questionnaires please apply via:

<https://sites.google.com/uwc.ac.za/permissionresearch/home>

The permission letter must then be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse events and/or termination of the study.

A handwritten signature in black ink, appearing to read 'Josias'.

*Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape*

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NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Council for Scientific and Industrial Research

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