reviewed paper

Community Perceptions of Municipal Stormwater Management in Durban, KwaZulu-Natal: Evaluating Progress and Challenges

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1 ABSTRACT

In Durban, KwaZulu-Natal, inadequate maintenance and limited capacity of municipal stormwater drainage systems have been repeatedly linked to urban flooding, causing significant property damage, health risks, and public dissatisfaction, particularly in the wake of extreme rainfall events such as the 2022 floods. This study investigates community perceptions and responses to municipal stormwater drainage management in urban and peri-urban areas of the eThekwini region, KwaZulu-Natal, South Africa. In 2024, 200 residents participated in structured surveys, with quantitative data analysed using descriptive and correlation statistics and qualitative responses examined through thematic analysis. Results indicate that public satisfaction is closely linked to perceived municipal effectiveness in maintaining drainage infrastructure and mitigating flooding. Communities reported persistent concerns regarding system performance, delayed interventions, and associated health and safety risks, reflecting limited confidence in municipal progress. The findings align with frameworks of urban resilience and participatory governance, emphasising the importance of responsive and inclusive management strategies. The study concludes by recommending targeted municipal engagement, enhanced monitoring and maintenance, and community education to improve trust, resilience, and adaptive capacity in the face of rapid urbanisation and climate-related flood risks.

Keywords: Community Perception, Municipal Governance, Stormwater Management , Urban Resilience, Urban Flooding

2 INTRODUCTION

2.1 Background

Urban and peri-urban areas in South Africa, particularly in the eThekwini region, face increasing challenges related to stormwater management due to rapid urbanisation, ageing infrastructure, and the impacts of climate change (Grab, 2023). The intensification of extreme weather events, including increased rainfall and flooding, has exposed vulnerabilities in existing drainage systems. These issues are particularly evident in communities such as Umlazi, Wentworth, Amanzimtoti, Isipingo, Umdloti, and Tongaat, which experience recurrent flooding, compromised infrastructure, and health and safety concerns (Grab and Nash, 2023).

2.2 Introduction

This paper presents an in-depth analysis of survey data collected to assess public perceptions, experiences, and expectations related to stormwater drainage systems in urban and peri-urban areas. The findings illuminate critical themes such as infrastructure performance, flooding impacts, health and safety concerns, and public satisfaction. These insights contribute to the development of a robust framework for sustainable urban drainage systems (SUDS) and inform strategies to enhance resilience in the face of urbanisation and climate change.

The survey was conducted in the subject areas of Umlazi, Wentworth, Amanzimtoti, Isipingo, Umdloti and Tongaat, and was shared with public primary schools in the local communities. These public schools then shared the survey with members of the community and the survey link was closed once 200 responses were recorded. All survey responses were collected between February and July 2024, just after the expected rainy period of April in the eThekwini region.

2.2.1 Problem Statement

The rapid urbanisation and increasing frequency of extreme weather events in the eThekwini region have exacerbated challenges related to stormwater management in urban and peri-urban areas. Communities such

as Umlazi, Wentworth, Amanzimtoti, Isipingo, Umdloti, and Tongaat frequently experience flooding, infrastructure failures, and associated health and safety risks. Despite these challenges, existing stormwater drainage systems have not been sufficiently upgraded to cope with intensified rainfall patterns, leaving residents vulnerable to recurring impacts. A critical gap in addressing these issues lies in the lack of a comprehensive understanding of public perceptions, experiences, and expectations regarding stormwater management. Current approaches often fail to incorporate community insights, which are vital for developing effective and sustainable urban drainage systems (SUDS). Furthermore, limited local government interventions and inadequate public education exacerbate the situation, contributing to dissatisfaction and mistrust among affected residents.

2.2.2 Research Questions

(1) What are the public perceptions and experiences related to the performance of stormwater drainage systems in urban and peri-urban areas of the eThekwini region?

(2) How do flooding events impact the health, safety, and daily lives of residents in Umlazi, Wentworth, Amanzimtoti, Isipingo, Umdloti, and Tongaat?

(3) What are the key expectations of local communities for government interventions and public education to improve stormwater management?

3 THE PUBLIC PERCEPTIONS

The findings from the Survey Data are presented in 7 broad categories that inform an in-depth opinion from community members with reference to the current stormwater management system endured in the eThekwini region. The survey covered the following categories: Demographic Context, Awareness of Drainage Systems, Flooding, Healthy and Safety Concerns, Public Satisfaction and Municipal Accountability, Broader Infrastructure Challenges and lastly Community Engagement and Climate Resilience.

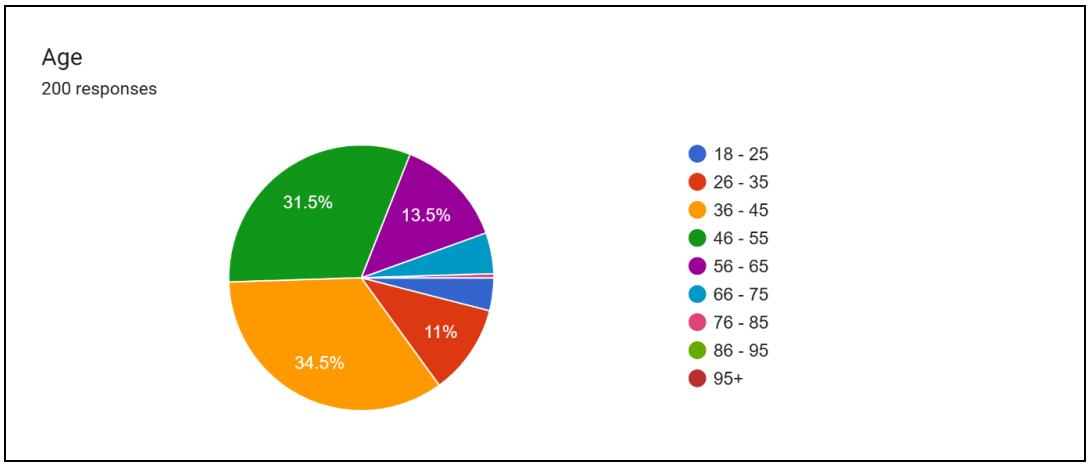

Figure 1: Survey Respondents Age, Moosa (2024)

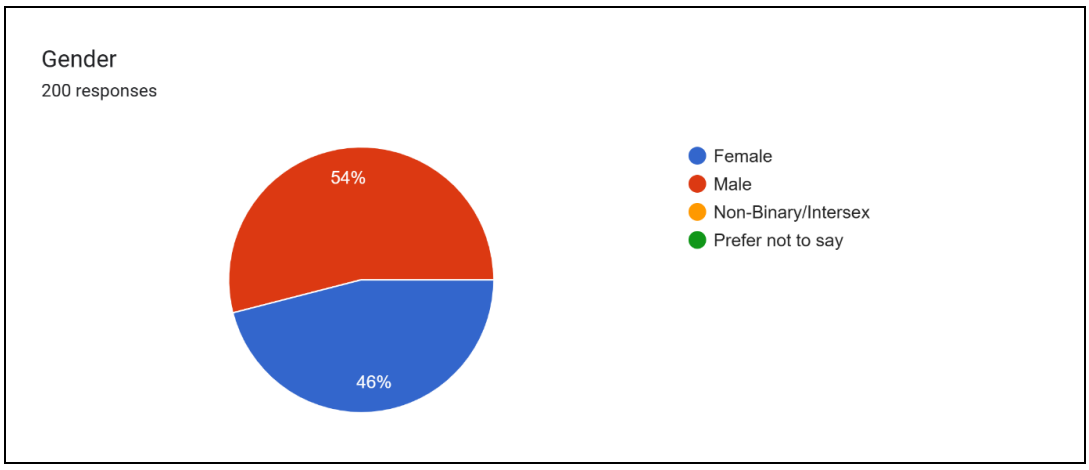

Figure 2: Survey Respondents Gender, Moosa (2024)

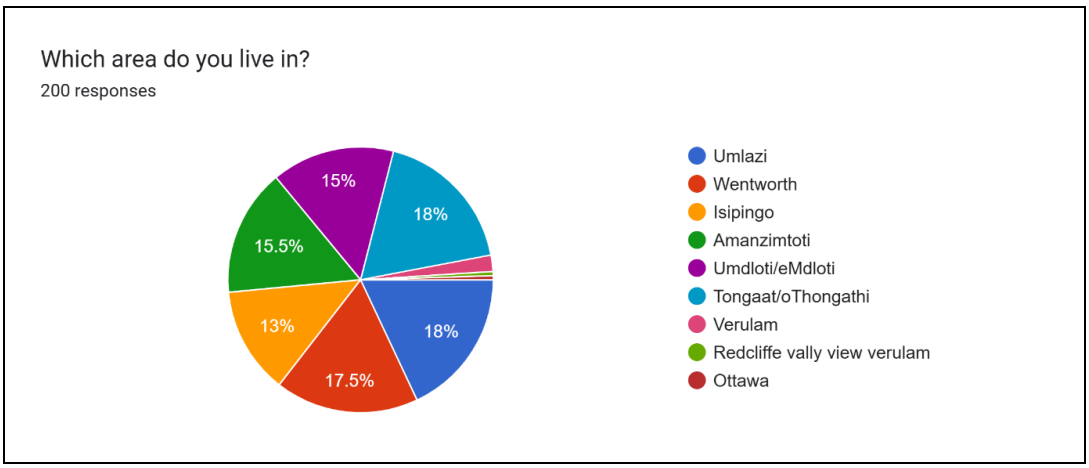

Figure 3: Survey Respondents Area of Residence, Moosa (2024)

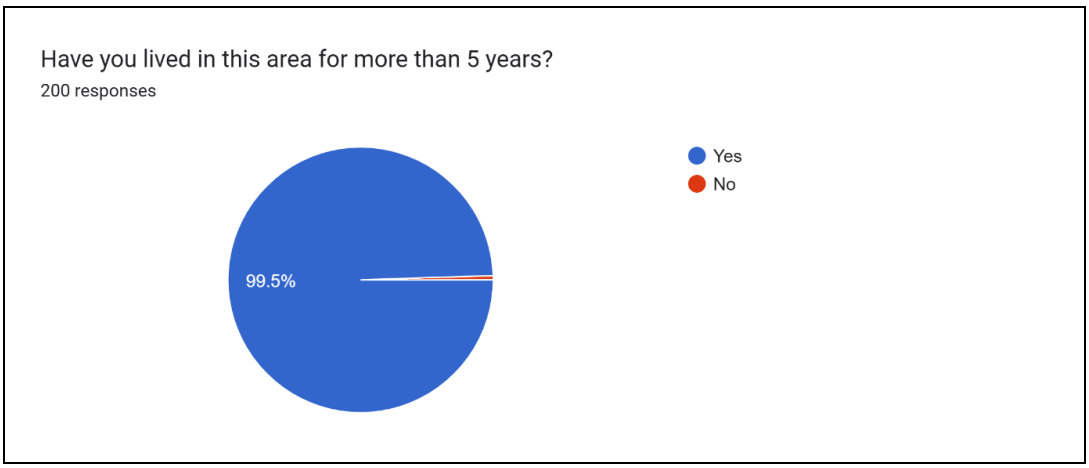

Figure 4: Survey Respondents Length of Stay in Area of Residence, Moosa (2024)

3.1 Demographic Context

The demographic analysis highlights that respondents span a wide age range, with a significant majority (26–55 years) representing active professionals and household decision-makers. Over 90% of respondents have lived in their neighbourhoods for more than five years, reflecting deep familiarity with local environmental and infrastructural conditions. This demographic stability ensures the reliability of responses and provides a longitudinal perspective on drainage system performance.

The above highlights the key demographic indicators to provide reliability to the responses received from the participants, 99.5% have resided in these areas for longer than 5 years, which provides a perspective of familiarity and also a sense of identity which enables accurate reporting. Out of 200 responses, 54% were male, and while the gender marker does not indicate any bias, it can be noted that male respondents were more interested in the infrastructural challenges their communities faced.

3.2 Awareness of Drainage Systems

A substantial portion of respondents (83.5%) reported being aware of the drainage systems in their areas, and 73.5% demonstrated an understanding of how these systems function. This high level of awareness suggests that the community is well-informed and capable of engaging in meaningful discussions about infrastructure improvements. However, the persistence of systemic issues such as flooding and poor maintenance highlights a gap between public awareness and effective municipal action.

The sample revealed that there is a requirement for community based education, improving the education within the public schooling system and improving community awareness related to drainage and stormwater management will improve residents interaction with municipal structures and infrastructure.

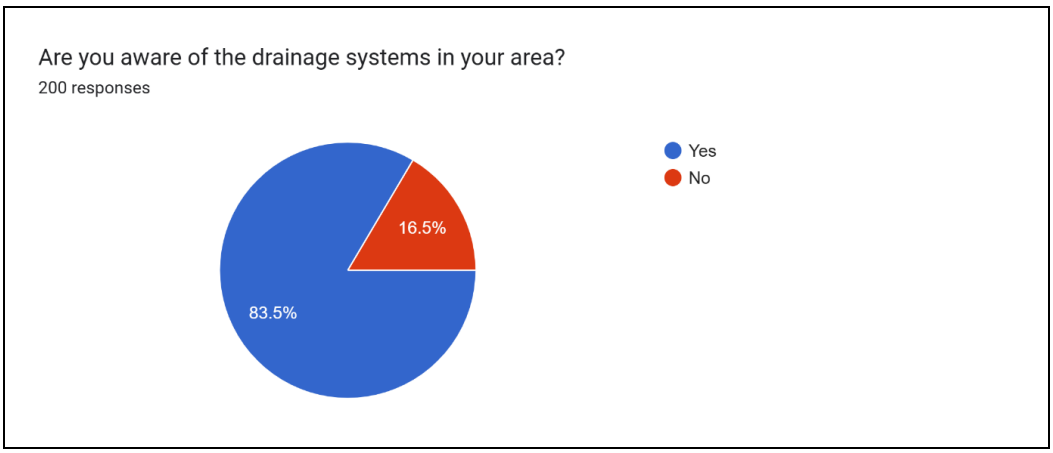

Figure 5: Survey Responses with Drainage System Awareness, Moosa (2024)

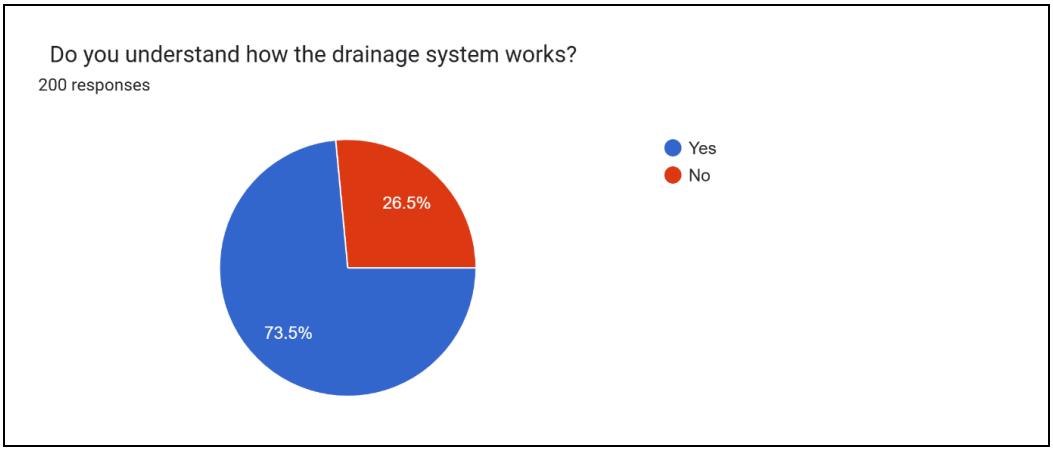

Figure 6: Survey Responses that Understand how Drainage Systems Work, Moosa (2024)

3.3 Flooding and Its Impacts

Flooding is a pervasive issue, with 99% of respondents reporting direct experiences. While some described minor disruptions during rainy weather, others noted severe consequences, including property damage, which affected 25% of respondents. These findings underscore the socio-economic vulnerabilities exacerbated by inadequate stormwater management. Frequent flooding not only disrupts daily life but also imposes financial burdens on households, amplifying the need for resilient infrastructure solutions.

An overwhelming amount of respondents (96.5%) displayed dissatisfaction with the current drainage system in their area – this response clearly depicts a need for improved systems to cope with the needs of the community. While 99% of respondents indicated that they have noticed flooding in their areas during rainy periods, only 25% of respondents have indicated being affected by the consequences of flooding on a daily basis. 25% of respondents expressed that they have experienced property damage due to drainage challenges.

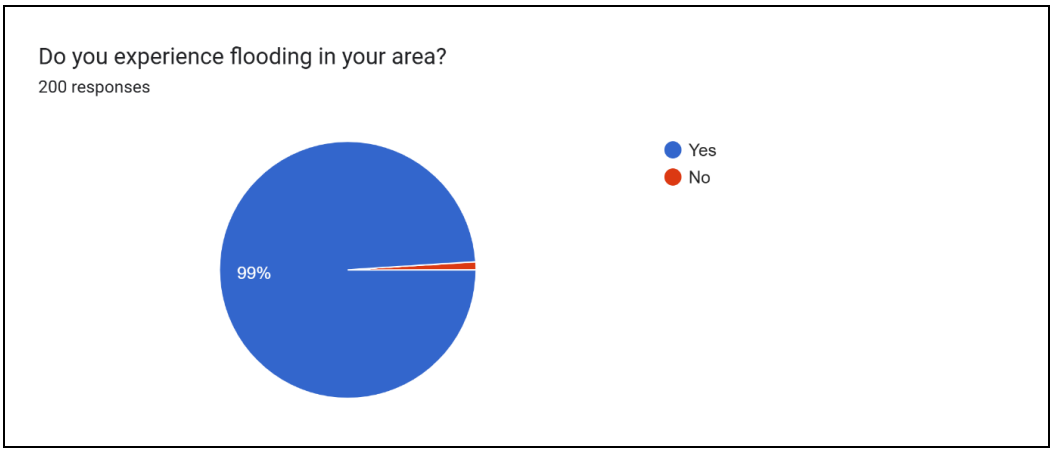

Figure 7: Survey Responses Regarding Flooding Experiences, Moosa (2024)

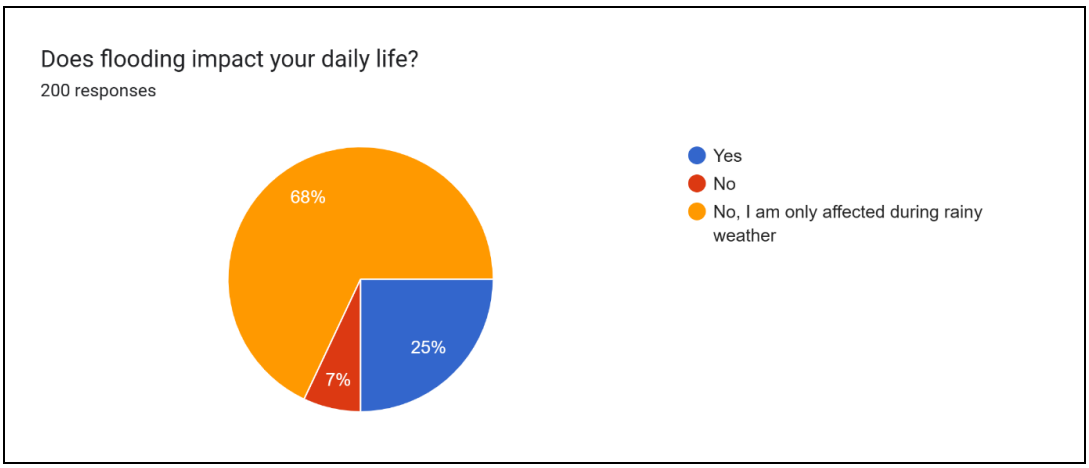

Figure 8: Survey Responses: Daily Life Impact of Flooding, Moosa (2024)

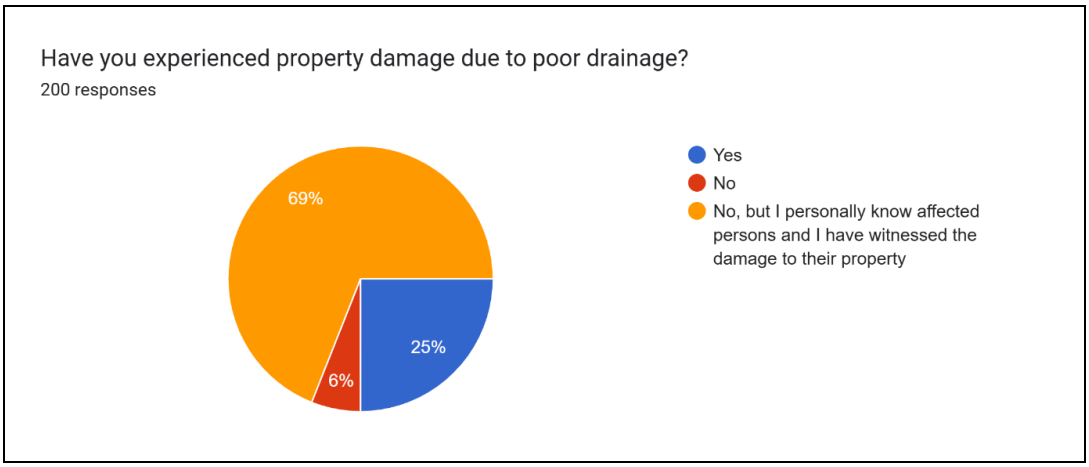

Figure 9: Survey Responses: Experiencing Property Damage due to Flooding, Moosa (2024)

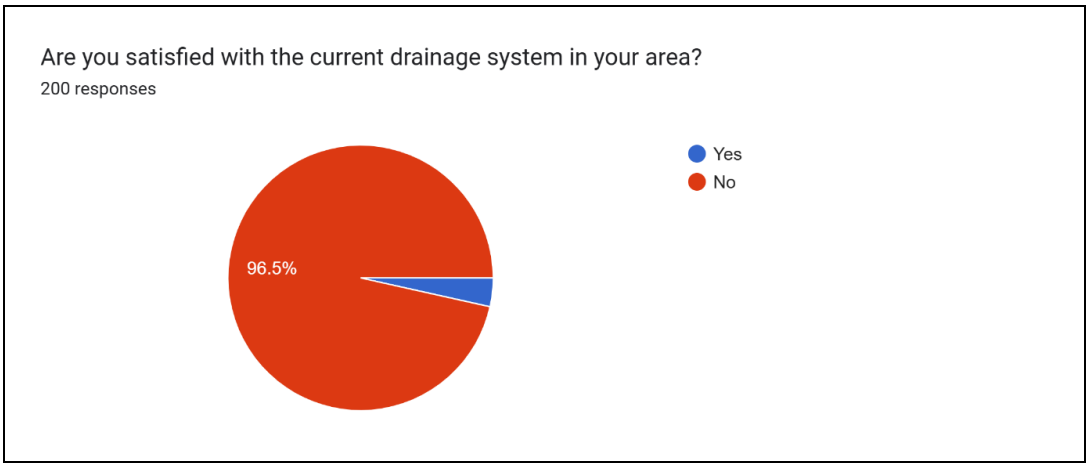

Figure 10: Survey Responses: Current Drainage System Satisfaction, Moosa (2024)

3.4 Health and Safety Concerns

Health risks associated with inadequate drainage were reported by 18% of respondents, while 100% expressed concerns about neighbourhood safety due to poor drainage. Stagnant water was frequently identified as a breeding ground for disease, compounding public health risks in already vulnerable communities. Additionally, flooding creates hazardous conditions, including increased risks of accidents and injuries. These findings highlight the critical intersection of drainage infrastructure, public health, and safety.

An overwhelming 100% of respondents indicated their fear of poor drainage and infrastructure affecting the safety of neighbourhoods. The roadside dumping, overgrown plants and grass impeding walkways and

blocking drains continuously affect the community and impede access to open spaces which should serve as community infrastructure that promote healthy neighbourhoods and safe environments.

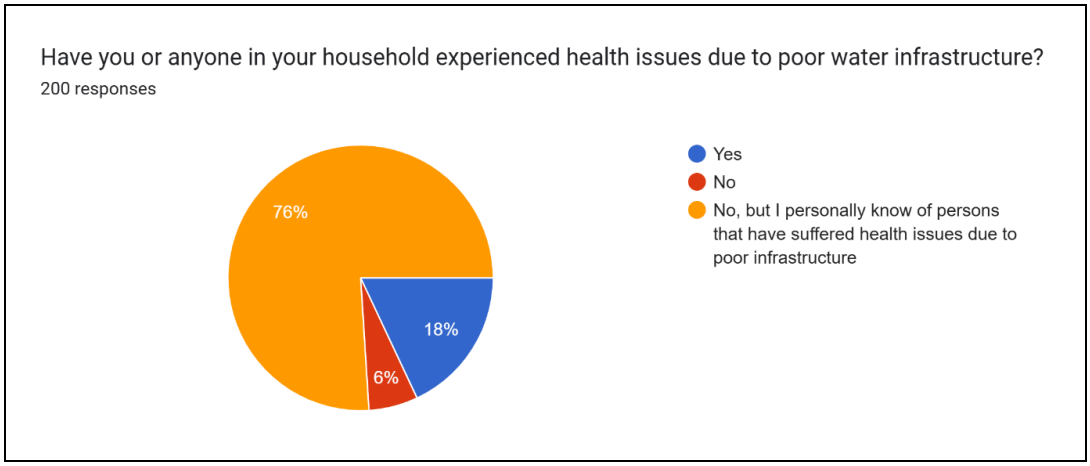

Figure 11: Survey Responses: Health Concerns Related to Flooding, Moosa (2024)

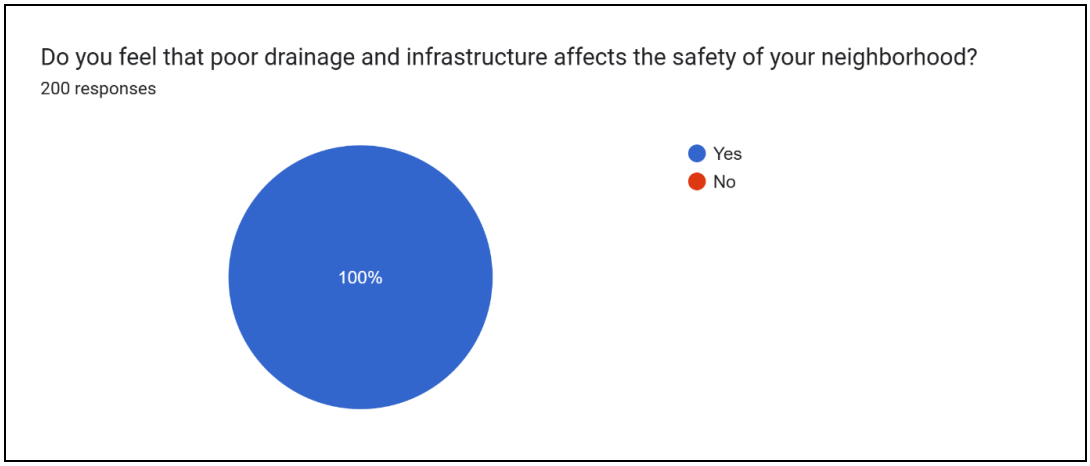

Figure 12: Survey Responses: Neighbourhood Safety due to Poor Drainage, Moosa (2024)

3.5 Public Satisfaction and Municipal Accountability

A striking 86.5% of respondents expressed dissatisfaction with existing drainage systems, citing municipal inefficiency and delayed responses to reported issues as major concerns. This dissatisfaction underscores a growing mistrust in local governance and a perception of systemic neglect. Addressing these concerns requires not only technical improvements but also enhanced governance frameworks that promote transparency, accountability, and public participation.

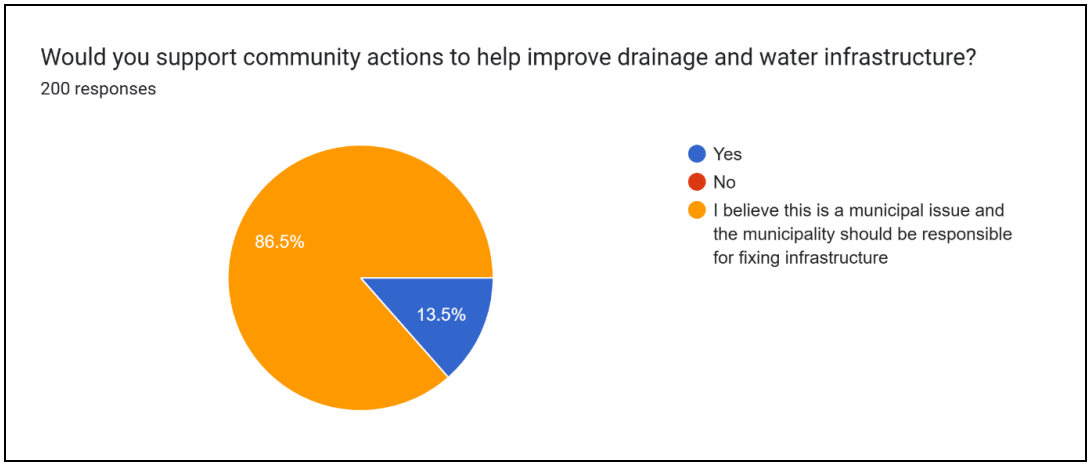

Figure 13: Survey Responses: Responsibility of Improving Drainage and Water Infrastructure, Moosa (2024)

The community sentiments generally indicate that residents believe water infrastructure and drainage systems are the responsibility of the municipality, citing that the community members pay property rates and taxes and expect the municipality to allocate funding for neighbourhood improvement.

4 METHODS

Fife-Schaw (2020) encouraged using a survey to gain insights into key theories within research make for an effective research design and answer the objectives of a study with reliable perspectives from the affected communities. Tomaszewski, Zarestky and Gonzalez (2020) emphasise that survey data should always represent the sample in the most responsible way to ensure high-quality data and insights that reflect the broader community in a considerable way, which holds the researcher to high standards of accountability and accuracy.

The survey was designed to capture quantitative and qualitative data from a diverse demographic of residents across selected study areas. A structured questionnaire focused on key aspects of stormwater management, including awareness, functionality, and community impacts. Participants were drawn from a range of age groups (18–85 years) and socio-economic backgrounds to ensure a representative sample. The data collection process prioritised inclusivity and anonymity, enabling respondents to share candid insights.

The survey was limited to 200 responses from Umlazi, Wentworth, Amanzimtoti, Isipingo, uMdloti and Tongaat – and neighbouring areas. For effective dissemination of the survey, public primary schools were approached within the subject areas and were requested to share the survey with their staff and immediate community. The limitation of 200 responses is intended to complement the findings from on-site observations and provide a reliable foundation for the recommendations made in this study.

The methodology behind the Community Survey on Drainage Systems is designed to gather insights into the impact of drainage systems on the community, contributing to the quality of the findings presented in this study. The survey aimed to assess how drainage systems affect residents, particularly in terms of flooding, property damage, health risks, and overall safety. By collecting this data, the research identified areas where the current systems can be improved and made recommendations for more effective stormwater management.

By targeting residents from specific areas such as Umlazi, Wentworth, Isipingo, Amanzimtoti, Umdloti/eMdloti, and Tongaat/oThongathi. These are regions that are directly impacted by drainage system failure (Grab, 2023), and the survey aims to capture the experiences of those living in these communities. The sampling method used was non-probability sampling, where the focus is on residents who were easily accessible for participation. However, some aspects of stratified sampling were considered to ensure that different demographic groups (such as age, gender, and location) are adequately represented in the data collection process.

To ensure a representative sample, the survey was widely distributed across multiple platforms. It was disseminated through local community networks, neighbourhood social media groups, and with the assistance of public primary schools operating in the subject areas. These groups were instrumental in encouraging participation and provided a platform for sharing the survey link. By leveraging these diverse distribution channels, the survey reached a broad spectrum of the population, including individuals who may not typically engage in municipal consultations or planning discussions.

A total of 200 valid responses were collected, yielding a dataset that included responses from a near-equal distribution of residents from the subject areas. This balanced representation allowed for a comparative analysis of the areas, highlighting any differences in perceptions, experiences, or needs between these communities.

The survey was designed with closed-ended questions that provide clear and quantifiable responses, mainly through "Yes" or "No" answers. This structure allows the identification of trends and patterns in areas like awareness of drainage systems, flooding experiences, property damage, and health issues. Some demographic questions (such as age, gender, and location) were considered to help segment the data for a more detailed analysis. In addition, a few questions allow for additional responses to capture some nuance in the participants' experiences.

Ethical considerations were integral to this study, especially given its focus on community perspectives. The survey was designed to protect respondents' anonymity, and no identifying information was collected to ensure privacy and data confidentiality. Participants were informed about the study's purpose and assured that their responses would be used solely for research purposes. Researchers approached this study with sensitivity toward the community, recognising that flooding is a disruptive issue that may involve traumatic experiences for some residents. Ethical approval was obtained from the University of Johannesburg prior to conducting the survey, ensuring that the study adhered to research ethics guidelines regarding informed consent, confidentiality, and respect for participants.

5 DISCUSSION

The survey findings emphasise the urgent need for policy reforms aimed at addressing governance inefficiencies, particularly in the management of urban infrastructure such as stormwater and drainage systems. Governance inefficiencies often manifest in the form of poor coordination, slow decision-making processes, lack of transparency, and inconsistent service delivery, all of which undermine public confidence and hinder the successful implementation of urban management strategies. These inefficiencies not only result in inadequate infrastructure but also exacerbate social inequalities, as marginalised communities are often the most affected by poor governance and urban planning failures.

To overcome these challenges, it is essential to introduce comprehensive policy reforms that focus on improving the efficiency, transparency, and accountability of municipal governance (Dierkes, Lucke and Helmreich, 2015). These reforms should be aimed at streamlining administrative processes, ensuring that resources are allocated effectively, and increasing responsiveness to community needs (Napier et al., 2018). By introducing more robust frameworks for monitoring and evaluation, municipalities can track progress, identify gaps, and ensure that their actions align with the long-term goals of urban resilience, sustainability, and inclusive development (La Rosa and Pappalardo, 2020).

Policies should encourage the adoption of modern technologies and data-driven decision-making processes that enable better planning, forecasting, and implementation of infrastructure projects (Pappalardo and La Rosa, 2020). Digital tools such as Geographic Information Systems (GIS) and real-time monitoring systems can enhance the ability of municipalities to manage urban drainage, predict flooding events, and allocate resources more effectively (Hoang and Fenner, 2016; Zhang, Wang and Gong, 2024).

The community survey conducted in Durban, KwaZulu-Natal, highlighted significant deficiencies in the current stormwater drainage infrastructure, revealing the widespread impact of flooding on residents' daily lives. Flooding is a frequent occurrence, particularly during periods of heavy rainfall, and has become a persistent challenge in these rapidly urbanising areas. The inadequacy of the existing drainage systems to cope with extreme weather events, compounded by the effects of climate change, has left many residents frustrated and feeling vulnerable to future flooding risks.

The survey analysis provides a comprehensive understanding of the challenges and opportunities in stormwater drainage management within the study areas. The findings illuminate the socio-economic and environmental dimensions of these challenges, offering valuable insights for designing sustainable solutions. This paper contributes to the broader goals of the thesis by bridging empirical evidence with theoretical development and practical implementation, laying the groundwork for resilient and inclusive urban water management frameworks. Although a majority of residents are aware of the stormwater drainage systems, they express dissatisfaction with their capacity and reliability. The ageing infrastructure, coupled with insufficient maintenance, has led to frequent blockages and inefficient water management during storms. This survey also reveals that while residents are aware of these problems, many lack a deep understanding of how stormwater systems function or what role they can play in their maintenance. This underscores the need for public education and greater community involvement in addressing stormwater challenges.

There is an overwhelming consensus among residents on the urgent need for infrastructure improvements. However, the results also show a readiness among the public to collaborate with municipal authorities in finding solutions. Residents are eager to participate in community-driven initiatives, particularly if they receive technical and financial support, indicating a fertile opportunity for partnerships between the community and local government. The survey findings illustrate both the scale of the problem and the potential for community-based solutions. By combining modern infrastructure improvements with public

education and local engagement, eThekwini can take important steps toward building flood-resilient communities that are better equipped to handle the intensifying impacts of climate change.

5.1 Recommendations for Resilient Urban Drainage Systems

The survey findings highlight the critical need for adaptive strategies to mitigate flooding risks and enhance urban sustainability in the face of climate change. Respondents consistently identified frequent and severe flooding as a significant concern, underscoring the strain on existing drainage systems and the vulnerability of urban communities. These insights emphasise that municipalities and urban planners must transition from reactive responses to proactive investments in adaptive and future-proof infrastructure.

Resilient infrastructure is essential for managing the intensified rainfall patterns associated with climate change (Ferdowsi & Behzadian, 2024). Urban drainage systems must be redesigned and reinforced to accommodate extreme weather events while aligning with broader climate adaptation, environmental sustainability, and urban development goals (García & Santamarta, 2022). This includes integrating robust stormwater systems, green infrastructure, and flexible designs capable of addressing both immediate flooding concerns and long-term climate challenges. Green infrastructure solutions, such as permeable pavements, bioswales, and green roofs, are vital components of these adaptive strategies. These natural approaches reduce runoff, improve water infiltration, and provide additional environmental benefits, such as enhanced air quality and recreational spaces. By complementing traditional engineering methods, green infrastructure offers a more sustainable way to manage stormwater and mitigate flooding risks.

Flood resilience in urban planning also plays a crucial role. This involves implementing zoning regulations, identifying flood-prone areas, and promoting flood-resistant construction techniques in vulnerable neighbourhoods. Improving urban landscapes to naturally absorb water and integrating flood resilience into planning processes can prevent urban development from exacerbating flooding risks. Real-time monitoring and forecasting systems further enhance flood preparedness. By tracking rainfall, drainage performance, and flood risks, municipalities can act proactively to address potential issues. Advanced forecasting tools enable early warnings and efficient resource allocation, ensuring that cities are better equipped to handle extreme weather events.

As climate change continues to alter global weather patterns, including more frequent and intense rainfall events, the demand for resilient infrastructure has never been more urgent (Leal Filho et al., 2023). Increasing rainfall intensity and the unpredictability of storm events are putting significant pressure on urban drainage systems, which were often designed based on historical weather patterns that are no longer reflective of current or future conditions (O'Neill et al., 2020). Inadequate infrastructure is not only unable to cope with the heightened frequency and volume of rainfall but also leads to increased flooding, infrastructure failure, and environmental degradation (Wang et al., 2023; He et al., 2024). Resilient infrastructure is critical to reducing the vulnerability of urban areas to these increasingly severe climate impacts (Kourtis and Tsihrintzis, 2021). Poorly managed stormwater systems lead to flooding, contamination, and the spread of waterborne diseases, all of which have far-reaching consequences for both individual and public health (Mukhtarov et al., 2019). Inadequate drainage systems can exacerbate health risks, cause injuries, and result in significant social costs, including loss of life, hospitalizations, and long-term health complications (Nguyen et al., 2024).

Community involvement is another key element of adaptive strategies. Engaging local communities in planning and implementation ensures that solutions align with local needs and priorities. Community-based disaster risk management initiatives can raise public awareness of climate risks, foster collective action, and empower residents to protect their neighbourhoods. Achieving long-term urban sustainability requires integrating climate change adaptation into all aspects of urban planning. This involves prioritising the needs of vulnerable populations, promoting equitable access to resources, and fostering environmental protection. By addressing these challenges holistically, municipalities can create cities that are not only resilient to climate change but also economically and socially sustainable. Ensuring that cities are better prepared for future climate impacts will require a combination of improved infrastructure, adaptive governance, and community involvement, all working in concert to reduce vulnerability and enhance resilience to flooding and other climate-related challenges (Yazdanfar and Sharma, 2015).

6 ACKNOWLEDGEMENTS

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