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Planning for quality and sustainable sanitation infrastructure post-apartheid South Africa: insights from Cosmo City

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The extent to which apartheid policies deliberately affected and disadvantaged the non-white race through racial planning enabled this paper to explore the strategies employed in the development of sanitation infrastructure in post-apartheid South Africa. Racial spatial planning and infrastructure neglect in disadvantaged settlements created deep-rooted historical injustices that are still entrenched in the post-apartheid era. The post-apartheid government has implemented various measures and strategies intended to address these historical imbalances. However, the gaps and challenges that the disadvantaged communities experienced in the pre-apartheid regime are being perpetuated by the post-apartheid government. It is clear that the pre-apartheid regime set the stage, and the post-apartheid government did less to break or redress systemic failure. The provisions of inclusive, reliable, and sustainable sanitation infrastructure remain a critical concern today. Systemic gaps and spatial injustices are evident within communities. Cosmo City in Johannesburg is experiencing these systemic challenges in the form of deteriorating infrastructure, legacies of infrastructural neglect, and incapacitated institutions meant to address the needs of the communities. The study employed a qualitative method where qualitative interviews, observations, policy and planning analysis, and a literature review were conducted. The study findings showed the complexity and interrelated issues of planning for quality and sustainable sanitation infrastructure, which expose limited financing, inadequate institutional capacity, and political will. These issues have highlighted a lasting impact on social wellbeing, the environment, health, and implementation. The study contributed to various lessons, such as the impact of community engagement and participation in decision-making processes in fostering project ownership, acceptance, and sustainable objectives and success.

KEYWORDS

sustainable development, planning, infrastructure, resiliency, sanitation

Introduction

The social, economic, and environmental development challenges that South Africa is facing today are ingrained in the policies and laws of the apartheid era. Transitional measures have been designed and implemented to herald a new era of promises and aspirations for a better, ecologically healthy, and livable community. The post-apartheid

government has vehemently embarked on this journey to dismantle the institutionalized segregation and oppression and foster inclusive, reliable, and sustainable development. At the core of this, was to address the glaring disparities in accessing essential services such as adequate housing, sanitation, and infrastructure in settlements. Urban planning has been entrusted to lead this goal and ensure the design and development of quality and sustainable infrastructure in cities that will enable the provision of these services. One key area that has garnered attention is the provision of sanitation infrastructure to previously disadvantaged communities. The areas that had previously been neglected have been targeted and concentrated in those areas that were subjected to neglect, intentionally designed systemic poverty levels, and limited access to essential services. This led the authors to analyze and explore the strategies that can be used to ensure inclusive, quality, and sustainable sanitation infrastructure provision to all communities.

Sanitation has emerged as a critical focal point in the urban planning discourse of post-apartheid South Africa. The absence of sanitation exposes the communities to poverty levels to which the apartheid regime had subjected the disadvantaged groups. Sanitation provision cannot be isolated from infrastructure development. Ekeocha et al. (2021) pointed out that infrastructure is crucial in that it is the backbone of any nation's growth. Infrastructure development is the foundation of socio-economic development, community growth, connectivity, and the required foundation for community wellbeing and public health. This implies that investing in infrastructure development eliminates systemic gaps, improves public health, promotes economic development, reduces poverty levels, and reduces environmental deterioration. Thacker et al. (2019) pointed out that investing in infrastructure can seem motivated by the desire to address these aspects; however, it has become imperative that infrastructure directly or indirectly leads to the attainment of the Sustainable Development Goals (SDGs). Infrastructure investment addresses systemic challenges and reflects a positive commitment to the future generation. The infrastructure investment is motivated by sustainability.

The literature has widely documented that infrastructure development should be holistic in approach. The infrastructure planning and development must integrate sustainability principles, which include social, economic, and environmental aspects. A discussion to explore the importance of sustainable infrastructure is required to determine its role in promoting public health, livability, and community wellbeing. The conceptual framework will outline the challenges that communities are experiencing with inadequate, unsustainable infrastructure, considering that the post-apartheid government is on a mission to eliminate the social and economic injustices of the past. This paper outlines the research methodology used for the study, presents the results, summarizes the findings, and suggests future steps to guarantee high-quality, long-lasting infrastructure that will improve the community's resiliency, wellbeing, and dignity for all.

Conceptual framework

Infrastructure is positioned in SDG 9; however, it is interlinked and highly influential in all 17 SDGs. Sanitation is positioned in

SDG 6 and closely linked with the environment, public health, economy, and human dignity (World Health Organization, 2024). This entails that sanitation infrastructure brings together various aspects of urban life, and a deficiency in this discipline threatens the lives of the citizens. According to Bazaanah (2020), poor sanitation prevents a significant portion of the quality of life linked with dignity, health, access to clean water, and healthy ecosystems. Silveti and Andersson (2019) asserted that cities fail to provide a quality and sustainable sanitation system that meets and satisfies the needs and demands of the population. According to Silveti and Andersson (2019), the biggest obstacles to cities in providing quality and sustainable infrastructure, especially those in the Global South, include financing capacity, lack of resources, mismanagement of available resources, and lack of political will. Such provision is crucial in addressing basic human needs, but it also plays a critical role in promoting public health and reducing inequalities, child deaths, and hunger (McFarlane, 2019).

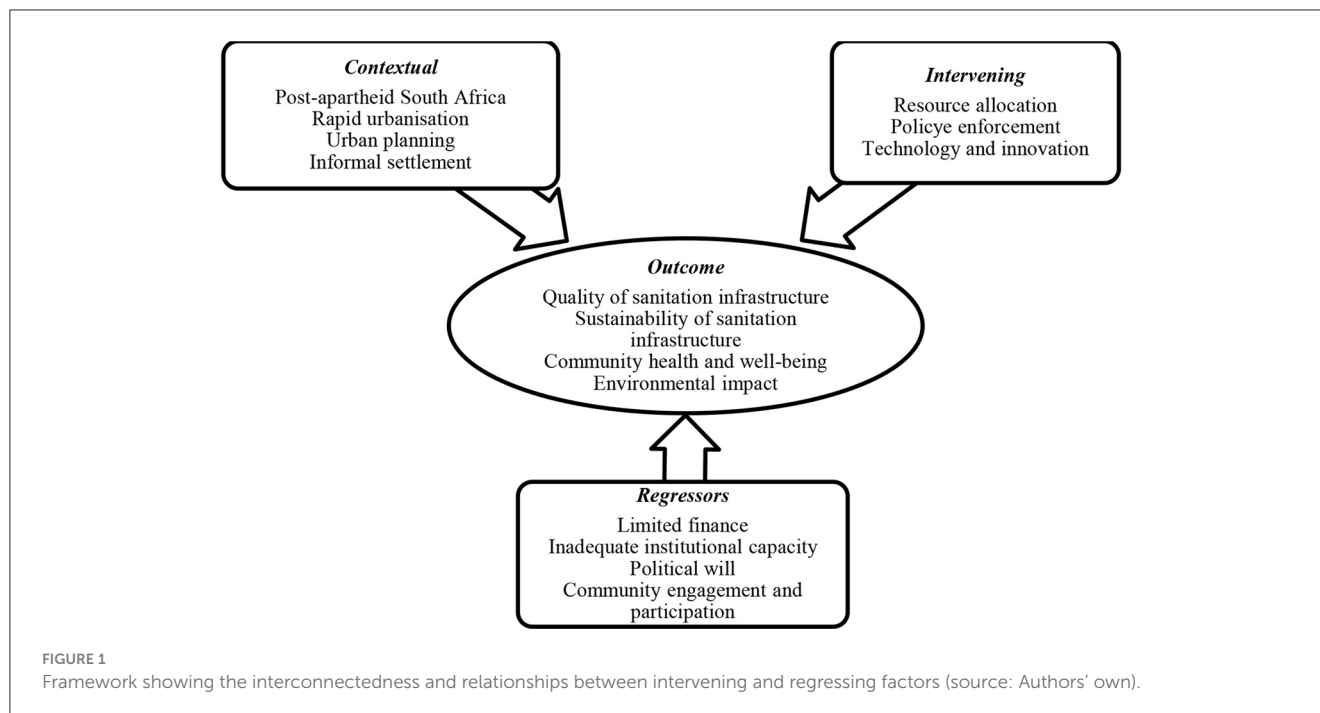
To understand this study, it is critical to highlight the interconnectedness and relationships between intervening and regressing factors that impact and influence the planning for quality and sustainable infrastructure. The framework builds on insights from the diagram in Figure 1.

With a fast-growing urban population, South Africa is one of the most urbanized nations in Africa. According to the World Bank (2022), 68.33% of South Africans moved from rural to urban areas in 2022. In 2024, it was believed that over 42.5 million people lived in urban areas (World Bank, 2022). This reflects a remarkable growth of approximately 6.5% from 2022 to 2024. Statistics strongly highlight that the wave of urbanization is making ground on a year-by-year basis. This migration results in urbanization-related challenges like urban sprawl, urban poverty, housing affordability issues, rising inequality, and environmental degradation (Zhang, 2016). According to Rogerson et al. (2017), South Africa experiences urbanization on a different scale. This reflects a crisis that manifests in the growth of informal urban life and affects infrastructure and the functionality of cities (Parnell and Pieterse, 2014). Rapid population growth and urbanization exert much pressure on cities, leading to *regressors* such as limited finance and failure by the local institutions to provide adequate sanitation infrastructure. The attainment of SDG 6 and 11 is threatening, subsequently affecting the lives and wellbeing of the communities.

Bazaanah (2020) noted that an African challenge has always been its failure to provide adequate sanitation services to ensure people's dignity and quality of life for all. African cities, like Johannesburg in South Africa, have been found wanting, as they are characterized by inadequate institutional capacity, lack of funding, ineffective monitoring and evaluation systems, inefficient land use, and urban planning (Kaamah et al., 2023). There is a need to critically evaluate and change how sanitation planning and service provisions are approached.

The sanitation-related challenges have called for urgent solutions to mitigate or reduce the negative impact on communities. To best map the way forward, this study reviewed two case studies and findings by authors in Kenya and Zimbabwe:

Kenya: A study conducted in 2022 by the Stockholm Environment Institution in five of Nairobi's major informal settlements highlighted a deficiency in policies and maintenance by the responsible local authorities



(Stockholm Environment Institution, 2022). The policies were neither available nor enforced. There was a significant lack of desire to ensure accessibility to better sanitation. These challenges, however, had a high impact on the health and wellbeing of the residents. Richard (2025), in his findings, highlighted that, apart from a lack of policies and political will, the communities were not involved in any sanitation development. He stressed that there was a need for the communities to be involved to ensure ownership of sanitation-related projects and the government must play a crucial role for scalability.

Zimbabwe: According to a study conducted by Nhapi (2015), Zimbabwe was experiencing problems related to a lack of finance, ill-defined institutional frameworks, and a lack of institutional capacity. As a result, Zimbabwe has been plagued by various sanitation-related diseases, such as cholera. The disease disproportionately affected and killed nearly 4,300 out of the 99,000 being affected. Such a statistical value shows how grave the absence of proper sanitation infrastructure can be. Studies have shown that Zimbabwean cities suffer from aged infrastructure and limited financing. This has proven to be the primary barrier to accessing sustainable sanitation infrastructure. This case study provides crucial insights into how *regressors* are drastic constraints in realizing the desirable *variable outcomes*, enables high quality and sustainability of sanitation infrastructure in Cosmo City, Johannesburg, and the World.

In short, through the insights from the case studies, the literature explored showed that to achieve *variable outcomes*, cities need to critically analyze *regressing variables*. The common issues have been financial limitations, institutional capacity, political will, and poor governance that have bedeviled cities in Kenya, Zimbabwe, and South Africa with Johannesburg as an example.

By understanding these variables and their interrelation and connectedness, planners and policy planners need to develop

appropriate *interventions* that will enhance the sustainability and effectiveness of sanitation infrastructure in cities.

Community-led total sanitation infrastructure

According to Tortajada (2020), poor sanitation infrastructure has adverse effects on the economy and disproportionate affects the health and dignity of women and vulnerable groups (see also Khanna and Das, 2015). As a response, the community-led total sanitation approach was developed. The focus was on uplifting the community through knowledge that affects behavior change. The communities were encouraged to recognize the impact of poor sanitation practices and initiate collective action to foster sustainability. The approach empowers communities to influence behavior change and develop locally defined sanitation infrastructure projects. These include training, workshops, community mapping, and the development of infrastructure projects with the help of the government and the private sector.

Social cognitive theory

The social cognitive theory was developed by Bandura (1986). The emphasis in his approach was based on the dynamics of interaction between people, who he identified as personal factors, their behavior, and the environment. The social cognitive theory explores the influence of individual experiences, actions, and environmental factors. The theory suggests that people learn by observing and assessing the actions

of others. According to [Luszezynska and Schwarzer \(2005\)](#), the social cognitive theory involves adaptive behavior, initiation, and maintenance by individuals and communities to emulate the practices that increase the adoption of innovative and sustainable infrastructure solutions. The social cognitive approach influences how individuals, communities, and organizations approach and implement sustainable sanitation infrastructure.

Methodology

The choice of Cosmo City was of fundamental interest as the community represented a typical radical departure from the inequalities and racial segregation housing of pre-apartheid, and it acted as a pilot project of South Africa. Cosmo City represented an integrated social housing project and mixed land use that breathed hope, paradise, and a dream for the poor and marginalized informal settlements of Itsoseng, Zevenfontein, and Riverbend. The area of the study is situated in the northern parts of Johannesburg. It is strategically located 12 km from Lanseria Airport. Cosmo City was initially a bare farmland partially owned by ABSA Bank and politician-cum-farmer, Robert van Tonder. Cosmo City was officially opened 2005 after several court cases over objections to the development. The wealthy property owners of the Jukskei–Crocodile Catchment Area Forum objected, stating that the intended development would devalue their properties ([Sowetan Live, 2007](#)). This was a clear indication of spatial racial segregation that still existed post-apartheid, which the City of Johannesburg, then the Northern Metropolitan Local Council, was fighting to eradicate.

Behind this choice was to generate data that would be exploratory, analytical, and non-statistical ([McNabb, 2004](#), p. 341). The perceptions of the residents of Cosmo City on the deteriorating infrastructure and ongoing sanitation infrastructural projects were part of the reasons that made the researcher opt for a qualitative research method. According to [Creswell \(2014\)](#), a qualitative approach emphasizes the notions of the respondents, key ideas, and objectives are explored, while fresh insights ([Gibbs, 2007](#)), new facts ([Pandey and Pandey, 2015](#)), and detailed views of information that are not documented come to the fore. The study used open-ended questionnaires and interviews to obtain the data. The questions that guided the study were:

- How does one explain Cosmo City, a new community occupied in 2005–2010, and by 2023, the sanitation infrastructure is already suffocating and collapsing?
- Which approaches can enhance the design and implementation of high-quality, long-lasting sanitation infrastructure in Cosmo City?

The study also engaged in snowball sampling, where the ward councilor helped to identify two members of the Ward Committee, and the members referred the researcher to more residents who were senior community leaders within Cosmo City. Given the qualitative nature of the study, 31 participants were involved. The total sample size was strongly backed and justified by [Vasileiou et al. \(2018\)](#). The participants comprised 22 residents who were interviewed face-to-face; six community leaders, including

the ward councilor and his committee members; two municipal officials who were interviewed telephonically; and a town planner from Urban Dynamics was interviewed via Teams. This sample size was motivated by the fact that the population of people living in Cosmo City was unknown; there was no statistical data or estimation available to guide the researcher to adopt other techniques provided by researchers such as [Lincoln and Guba \(1985\)](#) and [Morse \(1994\)](#). The target group of the initial residents or occupants of Cosmo City was critical in that the information collected was fully informative, first-hand, factually detailed, and nuanced based on lived experience from inception to date.

The research paper arose from the context of planning for sustainability that promotes dignity, respect, and a healthier lifestyle. The aim was to develop a sustainable sanitation infrastructure framework that sought to eradicate poverty, good health and wellbeing, and sustainable cities and communities. The data collected in this study were analyzed based on legislation, policies, and published and unpublished literature.

Results and discussions

Cosmo City has faced unending sanitation-related challenges since its inception, mainly due to infrastructural deterioration. Questions have been raised regarding the planning of such infrastructure, its quality, sustainability, and resilience to ever-growing challenges.

Factors that led to the collapse of the sanitation infrastructure in Cosmo City

Rapid urbanization and population growth

The interviewees' responses revealed that the wave of urbanization leading to overpopulation was the main cause. *"Since 2009, our city has been infested with people from all over Africa. Imagine, here in South Africa, we have people from rural areas who come here to look for jobs. Now we have other people coming from other countries to squeeze us on the very few resources,"* one resident reiterated, as the wave of urban migration from across Africa. Another resident pointed out: *"I bought this house in 2009, and do you know by 2014, the sewer pipes were already bursting? What do you call that? Yes, we might blame the municipality, but this place is overwhelming the pipes."*

The migration exerted pressure on the available resources in Johannesburg to fight the challenges of sanitation infrastructure dilapidation. The sad part is that the municipality is statistically unarmed, and there is blame-shifting. The officials pointed out that it is the responsibility of the national government to control and manage the population influx. *"The municipality has no jurisdiction in controlling or managing the borders. We wouldn't be experiencing such if the government could play its part. There are so many illegal foreign nationals that are unaccounted for, and that put much strain on the infrastructure."* However, taking a closer look at the Local Government: Municipal Systems Act 32 of 2000, municipalities are tasked with ensuring that all residents, regardless of the population, must provide "core principles, mechanisms, and processes that are necessary to enable them to

move progressively uplifting communities toward the social and economic development”.

The failure by the local municipalities to provide such a mechanism results in what Nzimakwe (2020) described as enormous pressure exerted on local governments to provide adequate sanitation infrastructure to the communities. The United Nations Development Programme (2020) also concurred that population density due to urbanization strains the sanitation infrastructure and services, resulting in inadequate waste management systems and the spread of waterborne diseases. The planning process lacked cognizance of the urbanization wave. The sole mandate was to provide housing for the limited number of people, without widening the pool for the ever-growing population.

Inadequate financial capacity

The study explored how inadequate financial capacity impedes infrastructure development in Cosmo City. One municipal official stated: *“The main problem we are facing is the financial muscle to deliver as mandated. Most people staying in Cosmo City do not pay rates or electricity. Where do you expect money to come from?”* The financial deficiency in African cities is alarming, and addressing the demand is similarly crucial. A case study in Zimbabwe explored that limited finance hinders equitable access to essential services (Nhapi, 2015). Van der Walt (2020) also reiterated that there is a need to explore financing models to bolster government funding. This requires all stakeholders—government, private, and communities—to be engaged to map the best possible model that ensures sustainable sanitation infrastructure.

Lack of community engagement

During interviews with the residents, it was evident that one aspect affecting sanitation infrastructure development was the lack of engagement in the planning and implementation processes. One resident echoed, *“You see that is a knock-on effect of their purported project. We, as the community, were not informed; we just saw people with big machines digging those trenches. They dug them and left them open as is. We have had accidents there, and as you see, people defecate in those trenches; it’s a mess created by the City of Johannesburg. You can see the waste water is flowing to that trench, no one cares.”* Nelson et al. (2021) argued that community engagement in issues concerning water and sanitation infrastructure is the backbone of sustainable development. The community embraces the planning, design, and maintenance of sanitation infrastructure. The findings highlighted the need for engagement between the municipality and the community. The residents of Cosmo City noted that there is *“no engagement from the city authorities, in terms of the projects that are meant to help and address the issues of sanitation infrastructure. The only time the councilor and his people come to us is when a tender is given to some company. We have serious sanitation issues here, and people have solutions.”* The study discovered that communities are not supportive and do not engage in any project or sanitation development. As a result, grave consequences and unruly behavior by the resident are experienced, including open defecation.

Strategies to improve the planning and implementation of quality and sustainable sanitation infrastructure

The study highlighted multifaceted strategies that can be adopted to improve the planning and implementation of quality and sustainable sanitation infrastructure. These can be viewed as *intervening variables* for the quality and sustainability of sanitation infrastructure:

Community engagement and participation: The residents also highlighted the lack of involvement in issues that concern sanitation, which has a direct bearing on their actual needs. As one resident stated: *“We have serious sanitation issues and we have solutions.”* Community-Led Total Sanitation offers community-led planning that can be a lasting solution to this challenge. According to Richard (2025), Rwanda is one of Africa’s cases of success stories, leading with sanitation and hygiene through Community-Led Total Sanitation. The government’s commitment and strong policy implementation fostered one success story. The approach in Rwanda focused on behavioral change. Although challenges have been faced in ensuring a total response to behavioral change, remarkable improvements in sanitation infrastructure have been made from 2018 to 2022. Community-led approaches ensure long-term success, quality, and sustainable sanitation infrastructure systems.

Technology and innovative design and planning: As urbanization continues to exert pressure on already dilapidating sanitation infrastructure, fresh thinking is required. One resident noted that *“such issues boil down to planning. I do not think the municipality properly planned to cater to such a population in Cosmo City. Remember, this location is very young. You cannot plan and not consider that people will multiply and not have a plan to cater for the future growth.”* There is a clear gap in designing and planning for sanitation infrastructure in Cosmo City, and this gap requires a new paradigm approach that will address the long-term needs of the ever-growing population. The new approach must ensure that the local initiatives are integrated with technology. This will offer new opportunities and improve the designing, planning, and implementation of sustainable sanitation infrastructure in Cosmo City. The real advantage of such integration is that it helps planners and decision-makers anticipate the need and schedule for infrastructure upgrading and maintenance. The town planner interviewed echoed: *“The City of Johannesburg is failing the residents of Cosmo City. There is no maintenance plan. Infrastructure has a life span, and if you neglect its life cycle, it is bound to deteriorate faster than expected. That is exactly what is happening in Cosmo City under the City of Johannesburg.”*

Conclusion

Planning for sanitation infrastructure in post-apartheid South Africa, particularly within the context of Cosmo City, is a testament to the multifaceted challenges and the strides made in pursuing quality and sustainable solutions. Sustainable solutions have been scanty, and efforts to redress historical imbalances have only marginally improved or addressed the community’s contemporary needs. In Cosmo City, Johannesburg, a microcosm of the broader

efforts, highlights that the problems associated with sanitation infrastructure that affected the people of Zevenfontein resettlement are being experienced. The similarities in this are that the apartheid regime perpetuated the segregation and discriminatory approach in disadvantaged areas, and post-apartheid government is leading a neglecting approach in providing these essential infrastructures. In short, the inadequate sanitation infrastructure experienced during apartheid due to discriminatory laws is being experienced post-apartheid due to a lack of political will, inadequate institutional capacity, and simple neglect.

The findings indicated that post-apartheid South Africa has made significant efforts to redress the inequalities in sanitation infrastructure. The commitment has been reflected in several regulations and policies implemented to ensure quality and sustainable infrastructure. However, the implementation of these policies has been very limited or non-existent. The policies currently implemented do not encompass inclusivity and participative planning. This means that the needs and concerns of the residents of Cosmo City are not taken into account, and the quest to provide an effective, sustainable, and resilient community is compromised. It is critical to state that planning for quality and sustainable infrastructure without applying a community-led total approach is devoid of the very principles of sustainable urban planning. Given such a background, it suffices to say that the Cosmo City case exemplifies the complexities of planning for quality and sustainable sanitation infrastructure, and the perpetuated challenges in post-apartheid South Africa can be addressed through meaningful planning. Local municipalities should take the initiative to work closely with the residents to offer scalability. Cities should also leverage Community-Led Total Sanitation initiatives, social cognitive approaches, and technological approaches in ensuring quality and sustainable sanitation infrastructure planning.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The following research project has been reviewed and approved by the Ethics and Plagiarism Committee (FEPC)

of the Faculty of Engineering and the Built Environment at the University of Johannesburg. Participation in this research was voluntary, and there was no compulsion to take part in the study. A consent form was offered to the participants for signing should they decide to participate, however, the participants decided against signing to protect their identity.

Author contributions

MM: Writing – original draft, Writing – review & editing. TM: Supervision, Writing – review & editing. AM: Formal analysis, Writing – review & editing.

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