Innovation in Informal Settlement Upgrading: A Case of Johannesburg

Siphiwe Mbatha, Trynos Gumbo

(Dr Siphiwe Mbatha, University of Johannesburg, 37 Nind street Doornfontein Johannesburg 2028, gmbatha@uj.ac.za)
(Prof Trynos Gumbo, University of Johannesburg, 37 Nind street Doornfontein Johannesburg 2028, tgumbo@uj.ac.za)

1 ABSTRACT

Globally, rapid movement from one state to another, mostly from under-developed areas to developed areas takes place. When this movement happen, there is a need for provision of accommodation. Due to lack of proper housing affordability and socio-economic inequalities lead to formation of informal settlements. In Johannesburg there is an increase of informal settlements across the city and now some of these informal settlements developments emerge close to the Central Business District (CBD). Accordingly, the increasing of these settlements create challenges for urban development and service delivery. Traditional approaches to informal settlement upgrading have often fallen short in addressing the complex and dynamic needs of residents. The aim of the study is to explore innovative strategies and technologies being implemented to improve living conditions in Johannesburg's informal settlements, focusing on infrastructure development, housing solutions, and community participation. A case study research approach is deployed to examine key upgrading initiatives, including in-situ upgrades, smart infrastructure, and participatory planning approaches. Consequently, assesses the effectiveness of these interventions in enhancing access to basic services, and promoting social inclusion. Technological innovations stategies have demontrated the ability to improve housing quality and urban resilience, challenges such as land tenure security, policy constraints, and resource limitations persist. The findings of the study aim to provide insights into the evolving landscape of informal settlement upgrading in Johannesburg, offering recommendations for scalable and sustainable solutions that can be replicated in other urban contexts.

Keywords: urban innovation, participatory planning, informal settlements, service delivery, sustainability

2 INTRODUCTION

Accomodation is a need for all individuals. The Republic of South Africa is a developing country working towards being a transitional country. The republic is trying in various aspects to provide high quality infrastucture. There are various housing projects to ensure that there is enough housing in the republic. However, most of these housing developments are not afforded by all South African residents. Therefore, leading to some individuals opting for informal housing. The City of Johannesburg afford various economic opportunities to various individuals which attracts many people to the city. As more people move in, there is a need for accomodation to all these indivisuals whom are from different classes regarding socio-economic status ranganging from low class income, middle class income to high class income. Some individuals afford proper housing accomodations such as apartments and bond housing. Some individuals do not afford proper housing accommodation and to those who do not afford they settle for backyard rooms, backyard shacks and informal settlements. Due to some informal settlements become populated, more formation of informal settlements emerge. The city has struggled for many years to curb the growth of informal settlement formation which in a long run they lead to various challenges in the city straining the available infrastructure. However, due to the informal settlements have emerged and many people are living in these areas. There is a need to upgrade these settlements and provide proper service delivery, and infrastructure to ensure functionality. Accordingly, technological innovations have proved to play a critical role in various disciplines to improve efficiency and functionality. With this, the study aim to identify suitable methods and technologies that coud be used to enhance informal settlements using the City of Johanneburg as case study.

3 BIBLOMETRIC LITERATURE REVIEW

The use of biblometric mapping of literature has been adopted for this study. This is to identify suitable literature for this study and identify most of the common themes researched on related to informal settlement upgrade, technological innovation and South Africa. This provides a summary of themes that are most studied and or that need attention.

Figure 1: Keyword co-occurrence network visualisation

The above figure1 indicates a biblometric mapping of literature about authors keywords. These keywords indicate the most used keywords related to the study. There are 9 items (keywords), 3 clusters, 11 network links, 12 total link strength, and there is a total of 27 occurences by the top 9 keywords selected for this study. The top keywords are Cape Town, informal settlements, South Africa, challenges, informal settlement, off-grid energy, open data, sanitation, and innovative technology. Accordingly, links indicate the connection between various keywords in the biblometric mapping of literature, and the occurences shows how much a keyword has appeared in the networks. Furthermore, the total link strengths highlights that which keywords are most connected to other keywords indicating that most author's studies focuses on such.

The authors keywords formed 3 clusters that are indicated by different colours. Each cluster has subfields that most authors work focuses on. In cluster 1, there are four keywords indicated by red node which include challenges, off-grid energy, informal settlement and innovative technology. This cluster indicates that some of the works done focused on challenges to provide off-grid energy to informal settlements and or deploying innovative technology to provide solutions for informal settlement challenges. In cluster 2, there are three keywords represented by a green node which include Cape town, informal settlements, and open-data. This cluster highlights that various studies focused on trying to push the notion of the provision of open-data of informal settlements in Cape town. In cluster 3 there are two keywords represented by a blue node which include sanatation and South Africa. The cluster indicates that there is a connection of works conducted in South Africa and sanisation, which this highlights that there is a need of proper sanitation for many areas or informal settlements in South Africa. In cluster 4 represented by a yellow node, there are also five keywords such as carsharing, jitneys, micromobility, paratransit, and station cars.

Figure 2: Keyword co-occurrence overlay visualisation

The above figure 2 highlights the publication themes that were most trending from the year 2018 to the year 2022. Consequently, this indicates that studies on informal settlenment upgrading with the use of technological innovations started to gain traction from the year 2018 to date. However, there are very few studies conducted related to this study which highlights that there is more research that could be done in this area. As seen on the above keyword co-occurrence overlay visualisation, there are few keywords that are creating a network of authors keywords, indicating that this research area in South Africa has not been explored sufficiently to assist provide positive impact using this approach of informal settlement upgrading through technological innovations. During 2018, studies conducted related to the study focused on improvements of sanitation in the City of Cape town. Around 2019 and 2020, there was increased of studies focusing on provision of off-grid energy and proper sanitation for informal settlements in Cape town, South

Africa. In 2021, there was a significant boost in moving towards publications that focus on introducing technological innovations to provide solutions for challenges in informal settlements. From 2021 to 2022, more research studies were conducted on the provision of off-grid energy in informal settlements, in South Africa. Consequently, some of the studies focused on the provision of open data for informal settlements in Cape town.

4 APPROACH AND METHODOLOGY

The use of biblometric mapping of literature has been deployed for this study. The use of biblometric mapping of literature assist to identify common research areas related to informal settlements, upgrading, technological innovation and South Africa, and this allow the study to identify a literature gab. 42 publications were downloaded on scopus which included conference papers, journal articles and book chapters. The keywords selected were informal settlement, upgrading, and South Africa. Only three keywords were used to ensure that the researcher obtain most suitable publications and also if more keywords are added no publication is obtained. During the data cleaning process, the abstracts of all publications generated were examined and 8 publications were ommited due to not being relevant to the current study. Therefore, 34 publications were selected and exported to a excel sheet csv document to provide a suitable file that VOSviewer allow for biblometric mapping of literature. Accordingly, the excel sheet was inserted in the VOSviewer to start the process of biblometric mapping of literature. Accordingly, the type of analysis chosen is co-occurrence and the unit of analysis selected are authors keywords. Consequently, the threshold chosen is based on the number of occurrences of a keyword should appear twice. Initially, 142 keywords were generated, and when the threshold was selected, only 9 keywords meet the threshold. These keywords included Cape town, informal settlements, South Africa, challenges, informal settlement, off-grid energy, open data, sanitation, and innovative technology. Therefore, the results produced figure 1 representing keyword of co-occurrence network visualisation and figure 2 representing keyword co-occurrence overlay visualisation.

Further, a case study research design was deployed focusing on the City of Johannesburg informal settlements due to the rising settlements across the city. Accordingly, a qualitative approach was deployed where semi-interviews were conducted with informal settlement dwellers and key officials, as well as the use of biblometric analysis. A non-random sampling was used to selected 60 informal settlement dwellers from 4 different settlements, and in each settlement, 15 semi-interviews were conducted. Consequently, A random and snowball sampling was selected as 5 Town planners were purposively selected and 5 references of Town planners were provided.

5 RESULTS AND ANALYSIS

This section provides the results and analysis of informal settlement dwellers and the key officials responses from the semi-interviews conducted regarding this study.

5.1 Informal settlement dwellers responses

Informal settlements provide accommodation to many individuals in the City of Johannesburg and there are over 312 informal settlements sheltering 7.2% of the city's population (Huchzermeyer et al., 2014). These settlements are associated with the low income class and need interventions of urban innovations to improve the quality of life for individuals occupying these spaces. Below is figure 3 indicating the informal dwellers responses based on the semi-interviews conducted based on the questions related to decisions led to relocating in these spaces, daily leaving experience to understand the routines and conditions, technological innovations capabilities to improve the living conditions, and if whether community members are involve in planning processes of the informal settlements.

The above figure 3 indicates the responses of informal settlement dwellers. 90% of the dwellers have indicated that it is important for them to move in the City of Johannesburg as there are many economic opportunities and resources that could lead to success. However, moving to a new environment, there is need for accommodation and living in formalised settlements is not easy due to affodability, the cost of living in such neighborhoods is expensive and they can not afford decent housing, and rentals due to their unemployment status, and if employed the amount they get paid is not sufficient to cover their montly expenses and rent or pay for bond housing. Therefore, this led most of them ending up relocating to informal

settlements as there are limited options for them. Consequently, 5% of the dwellers indicated that they have moved out from they homes where they grew up living with family to start a new life, and due to high cost of decent housing, opting for moving to informal settlement is not a bad option as they know after sometime the government provide certain informal settlement upgrading projects which could then provide better housing. Accordingly, other 5% of dwellers have indicated that they have always lived in informal settlements and to them it is all they know as some move from one informal settlement to the next, which they feel like its how they suppose to leave they lives.
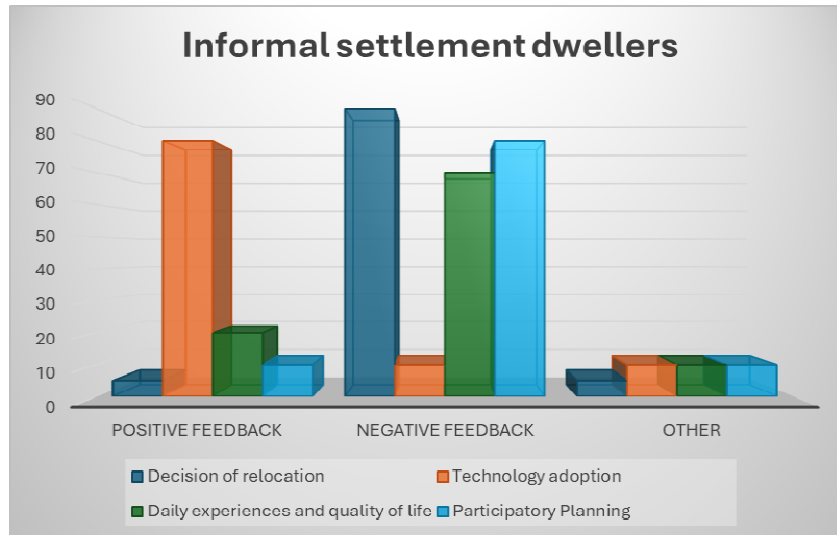

Figure 3: informal settlement dwellers responses

Consequently, 70% of the dwellers have indicated that leaving in informal settlements is hard as they feel like they are not regarded as citizens of the country due to being under treated by the government. Various informal settlements have poor informal settlements basic infrastructure such as proper sanitation, water and electricity. Dwellers indicated that there is a lot of them living in these settlements, however, there is few provision of communal toilets which are then strained at some point leaving them and chidren vulnerable. Accordingly, there is lack of drainage systems making it hard to navigate around the area when its raining, and waste management which makes the environment conditions poor. Consequently, the shared water supply have no proper drains which leads to water run-off making uncomfortable when accessing the taps. Inline, there is lack of proper connection of elctritiry supply which makes them not to have any appliances that needs power and also making areas unsafe at night. Further, in other informal settlements where there is delivery of basic services, dwellers indicated various aspects that are not pleasing in the area.

Further, 80% of informal settlement dwellers responses indicated that they are aware of the capabilities of technological innovations that they bring in urban areas and they could be delighted if these technologies could be deployed as they will provide a positive change in enhancing their areas of habitation. 10% of the responses highlighted the need of sufficient basic service delivery and proper housing development, but less interest in provision of technological innovations. Inline, another 10% of informal dwellers indicated that technology will be good for informal settlement, however, there is a need first for provision of sufficient service delivery. Accordingly, 80% of the informal settlement dwellers have indicated that they are involved in planning stages of projects that are implemented as there are initiatives in various instances. However, 5% highlighted that these projects implemented are already decided by stakeholders who are financing these project, as when a project is to be conducted dwellers are notified that a certain project is to take place rather than what type of project does the settlement need.

5.2 Key officials responses on challenges on in-situ upgrading

Informal settlement upgrading is a difficult project to complete successfully in South Africa without passing through various challenges. These kind of projects include various stakeholders wereby in some instances there are conflicts and decisions takes time to materialise. The below figure 4 indicates the responses received from key officials regarding challenges on in-situ upgrading.
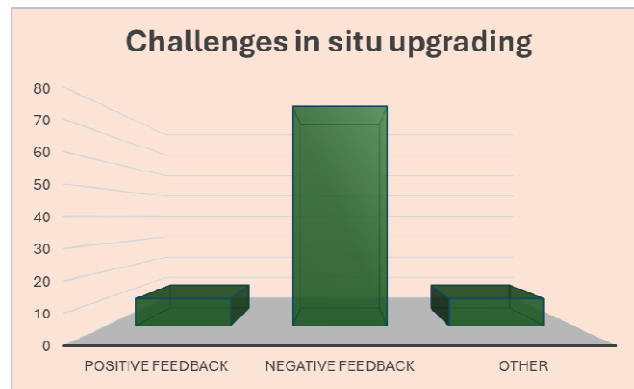
Figure 4:Challenges in situ upgrading

Many of the housing related projects have their own challenges and agendas. 5% of the key officials have indicated that when in-situ upgrading takes place, there is a certain aspect that they focus on and deliver it to a particular informal settlement, and mostly they deliver what is needed by the community. 80% of the key officials indicated that there are various issues with upgrading informal settlements, firstly indicating the issue of many informal settlements that are found across the city and which need similar attention. Secondly, informal settlement dwellers want all services to be developed at the same time, which is difficult to deal with, and a possibility is to deal with one challenge at a time. Consequently, there is lack of sufficient resources to ensure that informal settlements needs are met all the time. When basic services are provided, infrastructure is provided, it get strained due to the increase of the settlements. Accordingly, when a housing project is implement, there is re-development of informal settlement that emerges next to the formal housing that is being developed, population growth increases, and households that get provided with formal housing develop outside informal building in the yards. Further, there are challenges associated with land tenure, and some settlement are to big to provide all individuals with property ownership.

5.3 Key officials responses on strategies and methods for in situ upgrading

The are various strategies and methods to approaches of upgrading informal settlements, and process that need to be followed to ensure successful adoption for this strategies. In the below figure, it is the responses of key officials on strategies and methods on in-situ upgrading.

Figure 5: Strategies and methods on in-situ upgrading

Key officials indicated that there is a need to provide proper services that are required by the community and there is a need to identify first which services need to be provided . Some of the approaches used to know the needs is through conducting pilot studies which provide insights and the needs of the informal settlements. Accordingly, there is a need for public-private patnerships which this brings different contributions and can accelerate productivity. 45% of the key informants responses highlighted that knowing first what needs to be provided in the community assist to provide correct services for a particular community. Accordingly, there is a need to study an area sufficiently. 45% of responses highlighted that some of the strategies that are used might not be successful due to shortage of resources. Mostly, approaches used are similar leading to the same results, and this calls for a need to establish more substantial approach.

5.4 Key officials responses on technological integration

Technology speed up the process of tackling activities and provides support to areas that could be problematic with only the manual operations of activities, and it is important for technology to be integrated in informal settlements development. Below, figure 6 represent key officials responses on the usage of technological innovations in upgrading informal settlements.
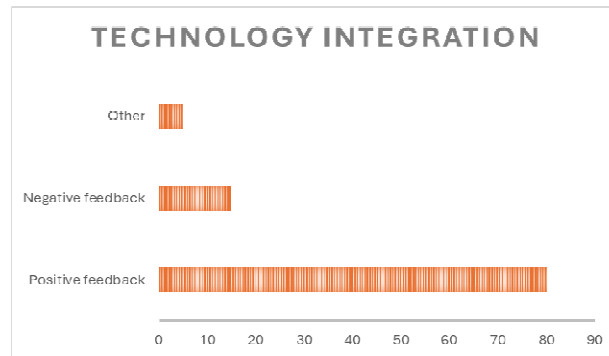

Figure 6: Technology integration

Technology has had a break through in many operation in different fields providing solutions to difficult challenges and circumstances that would seem to be impossible. 80% of the key officials indicated that informal settlements are very difficult to manage and upgrade due to various aspect associated with them and there is a need for accuracy to ensure that they function effectively to avoid many negative impacts that arise from these areas. It has been indicated that there are smart phone applications that infromal dwellers use to share communication about any conditions that need the attention of the government for example if there are damages or infrastructure maintanance required, the community members take photos of such and upload in the online platforms for attention which this also contribute to public participation. Accordingly, there are issues of electricity in many of these communities and there is implementation of solar powered street lights to ensure that the areas are not completely dark which assist with prevention of criminal activities. Consequently, there are smart water meters that are installed which detect the cleanliness of the provision of water to communities which has been an issue in previous years were informal dwellers are exposed to contaminated water. Further, it has been indicated that there is usage of GIS mapping that is used to monitor change, level of concentration and assist with anticipating future condition and be able to take suitable cause of action. 15% of key officials responses have indicated that integration of various technologies in informal settlements is expensive and there is already shortage of resources, and some informal settlements still require basic services. Therefore, this, reduces resources that could be used to provide sufficient basic services.

5.5 Key officials responses on participatory planning

Participartory planning is the involvement of community members in urban development and planning to ensure transparency and inclusion leading to trust between all the involve stakeholders. The figure below indicates the participatory planning responses from the key officials.

Figure 7: Participatory planning

Participartory planning is a critical process in planning and cannot be over looked. 70% of key officials have indicated that for informal settlements upgrading to be successfully developed, there is a need to engage with

the community members. This assist with knowing the needs of the particular community and by showing that views of the community are included in the planning process the implementation becomes easy and there is protection of the infrastructure implemented by the community members. Accordingly, it has been indicated that most of these community engagements are positive and common grounds are mostly met but this differs from one community to the other. However, 20% of the key informants have indicated that in some instances community members become negative towards various projects especially if it is not providing land ownership and housing. Informal dwellers want to dictate the terms of the projects and what needs to happen. Further, 10% of key officials indicated if communities are not involved in the decisions of a project taking place, especially, when the informal dwellers do not see it as a priority, it becomes very difficult to carryout the project and in some instance this becomes unsuccessful. Inline, if such incidents takes place communities end up not wanting to participate in other activities. Consequently, the protests emerge which this destruct functionality of urban areas, areas of protest, and their daily activities that they must carryout as officials. In addition, the key officials highlighted that when there is proper involvement of community members, there is accessibility to these communities, communities comply to government requests and after the completion of a project community members provide a feedback which assists to improve the projects going forward.

6 DISCUSSIONS

There is a need for urban innovations to ensure functional and sustainble informal settlements. Informal settlements provide accommodation to a large number of the population across the city. The living conditions of informal settlements as a whole are very poor. Government is trying various initiatives to ensure that these areas are habitable and functional through the provision of various service deliveries and housing programmes developed. There is a need for implementing various types of technologies to try solve various informal settlement challenges and enhance these areas. Technologies that could be deployed are (i) infrastructure monitoring sensors: this could ensure that the available infrastuctuure is not strained or what kind of infrastructure does the area require to provide prompt response before a challenge emerge. For example (a) electricity: if there is a strain in power supply and illegal connections are taking place, and or lack of service provision of power supply creates negative impacts such as crime, (b) waste management: if the environment is experiencing more than what it should regarding proper functioning, the sensors could provide signals for attention and assist plan for locations that could provide a service for future prevention, (c) sensing drainage systems: this could provide awareness of blocked drainages for example by solid waste materials, and could notify the service providers that there is a need of maintanance before heavy storms.

Accordingly, (ii) landscape sensors: the sensors can assist with monitoring areas that could be affected by heavy storms and provide solutions of the types of drainage systems that need to be implemented. Many informal settlements are affected by both minor rains as there is difficulties of moving around in these areas due to flooding and heavy storms which leads to mortality and loss of property. (iii) informal settlement locator sensors: this could provide suitable areas wereby informal settlement development could be established, and these areas are not prone to natural disasters and there is provision of basic service delivery, and control. One may argue that this could promote informality, however, there is a need to realise that informal settlements are growing and are housing many people but are established in poor areas that leads to loss of life. Consequently, when sufficient resources are available such areas could be upgraded. (iv) online platforms: enhanced platforms supporting the current existing one's, which this could allow informal settlement dwellers to log enquiries direct to the department that deals with specific area of location and services, and prompt response provision through communication on the specific challenge or service delivery provision, and however, this will always vary to availability of resources.

Provision of such technological innovations can assist enhance informal settlements across the City of Johannesburg. Such technologies could be improved to function better and provide more, and wider services overtime. The use of technology is playing a critical role in housing development and should not be over looked but a need to fully utilise such innovations as they provide solutions to simple challenges the proffesionals, services providers and individuals face.

7 CONCLUSION

The City of Johannesburg has many informal settlements that have emerged due to many individuals lacking proper housing affordability. Many people live in dire conditions in these settlements, and most of the informal settlement dwellers are permanent residents of these settlements. There is a need for enhancement in various aspects of strategical approaches to enhance informal settlements in the City of Johannesburg. The study advocates for technolocal innovations to be deployed as they provide efficient services in ensuring that informal settlements are sustainable.

8 REFERENCES

Amin, A., & Cirolia, L. R. (2018). Politics/matter: Governing Cape Town's informal settlements [Article]. Urban Studies, 55(2), 274-295. https://doi.org/10.1177/0042098017694133

Armitage, N., James, W., & Hendricks, H. (2006). Towards a new stormwater management approach [Article]. Water Wheel, 5(5), 25-27. https://www.scopus.com/inward/record.uri?eid=2-s2.0-33748859195&partnerID=40&md5=543de5ff195f6f0e1a974ec4d8769bcf

Ashipala, N., & Armitage, N. P. (2011). Impediments to the adoption of alternative sewerage in South African urban informal settlements [Review]. Water Science and Technology, 64(9), 1781-1789. https://doi.org/10.2166/wst.2011.746

Bobbins, K., Caprotti, F., de Groot, J., Pailman, W., Moorlach, M., Schloemann, H., Densmore, A., Finlay, K., Fischat, E., & Siwali, S. (2024). Beyond the Grid: The Micropolitics of Off-Grid Energy in Qandu-Qandu, South Africa [Article]. Antipode, 56(1), 49-71. https://doi.org/10.1111/anti.12963

Chagunda, M. F., Ruhiiga, T. M., & Palamuleni, L. G. (2023). Evaluation of energy generation potential from municipal solid waste in the North-West province, South Africa [Article]. International Journal of Renewable Energy Development, 12(5), 832-841. https://doi.org/10.14710/ijred.2023.52248

Chitimira, H., & Magau, P. T. (2021). A legal analysis of the use of innovative technology in the promotion of financial inclusion for low-income earners in South Africa [Article]. Potchefstroom Electronic Law Journal, 24. https://doi.org/10.17159/1727-3781/2021/V24I0A10740

Cinnamon, J., & Noth, T. (2023). Spatiotemporal development of informal settlements in Cape Town, 2000 to 2020: An open data approach [Article]. Habitat International, 133, Article 102753. https://doi.org/10.1016/j.habitatint.2023.102753

Cirolia, L. R. (2017). Overcoming the disjunctures: Competing discourses on informal settlements in South Africa [Article]. International Development Planning Review, 39(4), 443-459. https://doi.org/10.3828/idpr.2017.17

Dumont, K. B., Hildebrandt, D., & Sempuga, B. C. (2021). The "yuck factor" of biogas technology: Naturalness concerns, social acceptance and community dynamics in South Africa [Article]. Energy Research and Social Science, 71, Article 101846. https://doi.org/10.1016/j.erss.2020.101846

Eales, K. (2011). Water, Sanitation and Wastewater Management: Some Questions for National Water Security in South Africa. In Global Issues in Water Policy (Vol. 2, pp. 73-96). Springer. https://doi.org/10.1007/978-90-481-9367-7_4

Ebekozien, A., Aigbavboa, C., Samsurijan, M. S., Radin Firdaus, R. B., Ayo-Odifiri, S. O., & Amadi, G. C. (2024). Disasters recovery and rehabilitation in informal settlements: the role of fourth industrial revolution technologies [Article]. International Journal of Construction Management, 24(11), 1155-1165. https://doi.org/10.1080/15623599.2023.2230397

Franks, L., & Prasad, G. (2014). Informal electricity re-selling – Entrepreneurship or exploitation? Proceedings of the 22nd Conference on the Domestic Use of Energy, DUE 2014,

Holtzhausen, L. (2004). Township sanitation project flushes out disease [Article]. Water Sewage and Effluent, 24(4), 22-25. https://www.scopus.com/inward/record.uri?eid=2-s2.0-4644278445&partnerID=40&md5=1d6ee8530bdd6c34fb4da480526f1297

Huchzermeyer, M., Karam, A. and Maina, M. (2014). Informal settlements. Changing space, changing city: Johannesburg after apartheid, pp.154-75.

Jiusto, S., & Hersh, R. (2009). Proper homes, toilets, water and jobs: A new approach to meeting the modest hopes of shackdwellers in Cape Town, South Africa [Article]. WIT Transactions on Ecology and the Environment, 120, 743-757. https://doi.org/10.2495/SDP090692

Kareem, B., Lwasa, S., Tugume, D., Mukwaya, P., Walubwa, J., Owuor, S., Kasaija, P., Sseviiri, H., Nsangi, G., & Byarugaba, D. (2020). Pathways for resilience to climate change in African cities [Review]. Environmental Research Letters, 15(7), Article 073002. https://doi.org/10.1088/1748-9326/ab7951

Kovacic, Z. (2022). Governing informality through representation: Examples from slum policies in Brazil and South Africa [Article]. Cities, 125, Article 102122. https://doi.org/10.1016/j.cities.2018.07.009

Lawrie, D., Payne, H., Nieuwoudt, M., & Glencross, D. K. (2015). Observed full blood count and lymphocyte subset values in a cohort of clinically healthy South African children from a semi-informal settlement in Cape Town [Article]. South African Medical Journal, 105(7), 589-595. https://doi.org/10.7196/SAMJnew.7914

Levenson, Z. (2018). The road to TRAs is paved with good intentions: Dispossession through delivery in post-apartheid Cape Town [Article]. Urban Studies, 55(14), 3218-3233. https://doi.org/10.1177/0042098017735244

Manga, M., Bartram, J., & Evans, B. E. (2020). Economic cost analysis of low-cost sanitation technology options in informal settlement areas (case study: Soweto, Johannesburg) [Article]. International Journal of Hygiene and Environmental Health, 223(1), 289-298. https://doi.org/10.1016/j.ijheh.2019.06.012

Mitchell, H., & Odendaal, N. (2015). From the fringes: South Africa's smart township citizens. In Citizen's Right to the Digital City: Urban Interfaces, Activism, and Placemaking (pp. 137-159). Springer Singapore. https://doi.org/10.1007/978-981-287-919-6_8

Muanda, C., Goldin, J., & Haldenwang, R. (2021). Challenges and solutions for the eradication of sanitation backlogs in the policy context of Free Basic Sanitation [Article]. International Journal of Biological and Chemical Sciences, 15(7), 1-9. https://doi.org/10.4314/ijbcs.v15i7.1S

Muswede, T. (2022). Contours of Urban Violence and Insecurity: Digital Media Technologies and Mitigation of Urban Violence Among Undocumented African Migrants in South Africa [Article]. Frontiers in Sustainable Cities, 4, Article 891104. https://doi.org/10.3389/frsc.2022.891104

Onatu, G. O., Ogra, A., & Okafor, J. (2012). Energy efficiency improvement strategy in mixed income housing development: A case of Cosmo City Johannesburg. 2012 Southern African Energy Efficiency Convention, SAEEC 2012,

Pailman, W., Caprotti, F., Bobbins, K., & de Groot, J. (2024). The informality-energy innovation-finance nexus: Sustainable business models for microgrid-based off-grid urban energy access [Article]. Energy Research and Social Science, 118, Article 103749. https://doi.org/10.1016/j.erss.2024.103749

Ricker, B., Cinnamon, J., & Dierwechter, Y. (2020). When open data and data activism meet: An analysis of civic participation in Cape Town, South Africa [Article]. Canadian Geographer, 64(3), 359-373. https://doi.org/10.1111/cag.12608

Robins, S. (2019). 'Day Zero', Hydraulic Citizenship and the Defence of the Commons in Cape Town: A Case Study of the Politics of Water and its Infrastructures (2017–2018) [Article]. Journal of Southern African Studies, 45(1), 5-29. https://doi.org/10.1080/03057070.2019.1552424

Roma, E., Buckley, C., Jefferson, B., & Jeffrey, P. (2010). Assessing users' experience of shared sanitation facilities: A case study of community ablution blocks in Durban, South Africa [Article]. Water SA, 36(5), 589-594. https://doi.org/10.4314/wsa.v36i5.61992

Sindall, R. C., Cottingham, R., Arumugam, P., Mercer, S. J., Sutherland, C., Alcock, N., Buckley, C. A., & Gounden, G. (2021). Lessons learned from operating a pre-commercialisation field-testing platform for innovative non-sewered sanitation in durban, south africa [Article]. Water SA, 47(4), 385-395. https://doi.org/10.17159/WSA/2021.V47.I4.3880

Sonnenberg, N., Erasmus, A., & Schreuder, A. (2017). Consumers' Eco-Friendly Choices in the South African White Goods Industry: An Abstract. In Developments in Marketing Science: Proceedings of the Academy of Marketing Science (pp. 449-450). Springer Nature. https://doi.org/10.1007/978-3-319-47331-4_82

Sutherland, C., Reynaert, E., Sindall, R. C., Riechmann, M. E., Magwaza, F., Lienert, J., Buthelezi, S., Khumalo, D., Dhlamini, S., Morgenroth, E., & Udert, K. M. (2021). Innovation for improved hand hygiene: Field testing the Autarky handwashing station in collaboration with informal settlement residents in Durban, South Africa [Article]. Science of the Total Environment, 796, Article 149024. https://doi.org/10.1016/j.scitotenv.2021.149024

Taing, L. (2017). How sociopolitical factors affected the implementation of Cape Town's vacuum sewer [Article]. Environmental Science: Water Research and Technology, 3(3), 513-519. https://doi.org/10.1039/c6ew00089d

Van Wyk, R. (2009). A review of health and hygiene promotion as part of sanitation delivery programmes to informal settlements in the city of cape town (South Africa). Proceedings of the 2007 National Conference on Environmental Science and Technology,

Williams-Wynn, C. (2021). Applying the fit-for-purpose land administration concept to South Africa [Article]. Land, 10(6), Article 602. https://doi.org/10.3390/land10060602

Ziervogel, G., Waddell, J., Smit, W., & Taylor, A. (2016). Flooding in Cape Town's informal settlements: Barriers to collaborative urban risk governance [Article]. South African Geographical Journal, 98(1), 1-20. https://doi.org/10.1080/03736245.2014.924867