

An Assessment of the Clean Air Zones (CAZ) Implementation in Developing Contexts: Social Equity Report for the City of Johannesburg

Abdulrasaq Ajadi Ishola, Trynos Gumbo, Tafadzwa Clementine Maramura

(Dr. Abdulrasaq Ajadi Ishola, University of the Free State, Bloemfontein, 2029985302@ufs4life.ac.za)

(Prof. Trynos Gumbo, University of Johannesburg, Johannesburg, tgumbo@uj.ac.za)

(Dr. Tafadzwa Clementine Maramura, University of the Free State, Bloemfontein, maramuratc@ufs.ac.za)

1 ABSTRACT

In the City of Johannesburg (CoJ), the proposed Clean Air Zones (CAZs) initiative, aligned with the C40 framework, promises substantial public health gains through air pollution reduction. However, without equity-centered design, CAZs risk deepening entrenched socio-economic disparities inherited from apartheid-era spatial planning. This study analyzes CAZ implementation pathways and their differential impacts across Johannesburg's seven administrative regions using datasets from the Gauteng City Region Observatory (GCRO), South African Census, and municipal reports. Five regulatory mechanisms comprising vehicle restrictions, solid fuel prohibitions, waste management formalization, industrial emission controls, and charging zones are examined through the lens of income inequality, service access gaps, spatial poverty, and environmental justice indicators. Findings reveal acute vulnerability concentrations: 71% of residents defaulting on utility bills cite unaffordability; 41% of Region G households experience meal-skipping; and declining service coverage (water satisfaction dropped from 79% to 59% between 2020/21-2023/24) compounds policy compliance capacity. A composite regional vulnerability matrix identifies Regions D and G as requiring priority equity interventions, while Regions B, E, and F demonstrate greater adaptive capacity. The study concludes that Johannesburg's CAZs must operationalize through phased geographic implementation, targeted subsidies for clean energy transitions, formalized inclusion of informal waste reclaimers, and participatory policy co-design with marginalized communities. This approach harmonizes environmental sustainability with social justice, advancing SDG commitments while preventing policy-induced displacement.

Keywords: Clean Air Zone (CAZ), Social Equity, C40, Environmental Justice, Vulnerability Assessment.

2 INTRODUCTION

The imperative to combat urban air pollution has mobilized cities globally toward Clean Air Zones (CAZs). Designated areas where vehicle emissions, solid fuel combustion, and industrial pollutants face stringent regulations to protect public health (Altarrazi et al., 2025; Bloss et al., 2025; Mebrahtu et al., 2025). As a C40 Cities member, Johannesburg has committed to implementing CAZs to address deteriorating air quality exacerbated by vehicle congestion, informal solid fuel use, and waste accumulation that undermines its “world-class African city” aspiration. Yet environmental policies designed without socio-economic analysis risk reproducing the very inequalities they claim to transcend (Druckman & Jackson, 2008).

South Africa's persistent inequality, rooted in colonial and apartheid spatial engineering, creates differential vulnerability to environmental regulation (Mashabela et al., 2025). Where European and North American CAZs operate within relatively robust social safety nets, Johannesburg must navigate a context where 48% of households depend on social grants, 11% default on utility payments, and informal economies provide survival mechanisms for populations excluded from formal employment (Götz & Seedat, 2024). In this landscape, policies restricting polluting fuels, informal waste picking, or high-emission transport without viable alternatives do not merely regulate environmental behaviour; they eliminate livelihood pathways and deepen material deprivation.

Recent research by Nabilla et al. (2025) through the Seriti Institute surveyed Johannesburg residents' perceptions of air pollution causes and health impacts, establishing public awareness of the CAZ rationale. However, this polling did not systematically assess households' capacity to comply with anticipated regulations or map vulnerability differentials across the city's socio-economic geography. This gap is critical: effective CAZ implementation requires understanding not whether residents support cleaner air, a near-universal preference, but whether they possess the economic resources, service infrastructure, and social capital to adapt to regulatory changes without catastrophic livelihood disruption.

This paper addresses that gap through socio-economic vulnerability assessment, analyzing how five CAZ regulatory mechanisms, vehicle restrictions, solid fuel prohibitions, waste management formalization, industrial emission controls, and charging zones intersect with Johannesburg's inequality landscape. Drawing on GCRO Quality of Life Survey 7 data (Tshuma et al., 2024), we map spatial patterns of income precarity, service access deficits, transportation dependence, and environmental injustice across the city's seven administrative regions. Our analysis reveals that CAZ regulations, if uniformly imposed, would function as regressive taxation on the urban poor, extracting compliance costs from populations least able to bear them while delivering environmental benefits disproportionately consumed by affluent communities already insulated from pollution exposure (Metheny et al., 2025).

The contribution of this study is threefold. First, we theorize the causal pathways linking CAZ regulations to household-level economic shocks, moving beyond correlation to a mechanism explanation. Second, we develop a composite regional vulnerability matrix synthesizing multiple deprivation indicators to guide geographically differentiated policy rollout. Third, we translate empirical findings into actionable implementation guidelines that harmonize environmental sustainability with social equity, demonstrating that these objectives, often framed as trade-offs, can be mutually reinforced through deliberate institutional design.

The urgency of this analysis extends beyond Johannesburg. As developing-world cities increasingly adopt environmental frameworks designed in Global North contexts, understanding adaptation requirements for settings characterized by informality, service deficits, and entrenched poverty becomes essential. Johannesburg's CAZ implementation will either demonstrate equitable environmental governance or reproduce colonial patterns where regulation serves affluent interests while criminalizing survival strategies of the marginalized. The evidence and framework presented here aim to ensure the former outcome.

3 LITERATURE REVIEW

Investments in environmental policies hold life-supporting potential in contemporary times due to the rapid environmental degradation. Despite their utility, inadequate assessment of their social costs could limit their effectiveness or even lead to social destabilization in societies. As governments strive to ensure that cities support healthy living, they must maintain social justice while doing so.

Cities around the world are implementing Clean Air Zones (CAZs) initiative, an embodiment of the global C40 framework for reducing air pollution and enhancing public health (Altarrazi et al., 2025; Bloss et al., 2025; Mebrahtu et al., 2025). Although this initiative is essential for ensuring urban resilience and environmental sustainability, if it is not properly planned and implemented in conformity with the socio-economic realities of the people, it risks exacerbating existing social inequalities. This is particularly true among South African cities, particularly Joburg, where deep-rooted social disparities continue to shape access to opportunities and resources (Metheny et al., 2025).

In the City of Johannesburg (CoJ), South Africa, the municipal government is trying to enhance city life through the implementation of the CAZ initiative. This need arises from the increasing erosion of public spaces by informal recyclers, homeless people, and the increasing waste accumulation in the city. Clearly, these emerging features negate the aspiration of Johannesburg as “a world-class African city”. To address this trend, public policies, particularly environmental policies in the city, must regulate pollution, waste management, and related urban activities that contribute to the current environmental challenges. While intervening policies in this regard are urgently necessary, such policies must consider the differing socio-economic disparities among the people. As posited by Druckman and Jackson (2008), without this consideration, developing inclusive policies for environmental sustainability and social justice could be difficult.

While the city, through a company, Seriti Institute, conducted a polling survey to aggregate residents' perception of the CAZ initiative (Nabilla et al., 2025), the focus was more on the causes and impacts of air pollution in the city than on the socio-economic realities of the people with the potential to impact the success of the initiative. This study extracts data on socio-economic indicators of people in the city of Johannesburg, mainly from the GCRO datasets, to assess the socio-economic realities of Joburgers and frame the implications of these on CAZ initiative implementation in the city.

4 METHODOLOGY

In conducting a socio-economic assessment of residents in CoJ, this study relied on existing data collected and analyzed by various government bodies in South Africa. Conducting this assessment using primary data could be more comprehensive but also resource-intensive. However, in the absence of budget coverage for this, existing data in documents such as the Gauteng City Region Observatory (GCRO) report (2024), South African Census Report, CoJ reports, etc., were adopted in assessing the prevailing socio-economic status of people living in the city to understand and adequately accommodate their needs and peculiarities in the programs of the city, particularly the implementation of the CAZ initiative. Five indicators relevant to the successful implementation of CAZ, while ensuring social equity and justice, were adopted. These indicators were: income and employment status, access to basic public services, spatial inequity as regards poverty and transportation, waste management, and social inclusion.

5 FINDINGS

5.1 Socio-Economic Indicators

In understanding the socio-economic life patterns of the people of CoJ, the indicators of income & employment, public service access, spatial inequality spread, environmental justice, and digital & social inclusion were adopted. It is based on these indicators that the subsequent sections of the report were discussed.

5.1.1 Income and Employment

Income is strategic to the conditions of living of households as it funds their daily and seasonal needs. Furthermore, it dictates the extent to which paid basic public services can be accessed. In economics, three levels of income earners exist. While there are high- and middle-income earners, there are also low-income earners. In the CoJ, a GCRO QoL Survey 7 explored the percentage of residents with unpaid utility bills (water/electricity) and the reasons for defaulting. In the survey (see Figure 1), it was found that 11% of respondents have unpaid utility accounts, with 71% reporting that they cannot afford to pay. Additionally, 14% respondents reported not knowing whether their household owes money for water or electricity (not shown in the graphs). In addition, the highest percentage of respondents with unpaid bills (22%) was recorded in Region D, highlighting significant affordability challenges in this area. Region B has the lowest proportion, at 4%, indicating fewer payment issues in this region. On average, therefore, 11% of residents in the city have unpaid utility accounts, with 71% of them citing an inability to pay as the reason for the default. This indicated a growing financial incapacity among residents of the city.

This financial condition could be explained by the rate of unemployment in the city (see Figure 2). For instance, 505 of the respondents sampled in the GCRO QoL Survey 7 were unemployed or not working for various reasons. Approximately 2% reported being appointed to a new job they had not started yet. Among those not working, over half (53%) are looking for work, while a quarter (25%) never secured a paying job, with 54% of respondents are retired.

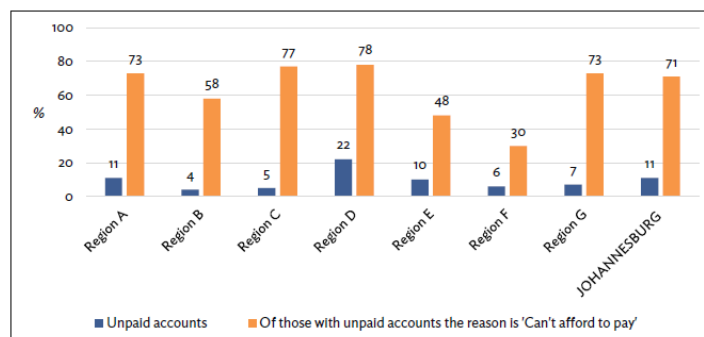


Figure 1: People with unpaid utility accounts (water/electricity) in the CoJ.

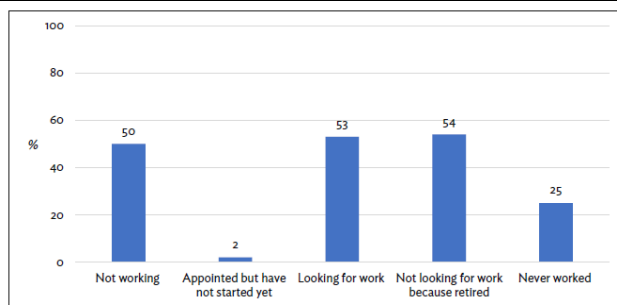


Figure 2: Employment status of GCRO's Survey respondents in CoJ. Source: GCRO's Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

Invariably, the majority of Joburg residents are unemployed and lack a steady source of income, resulting in their inability to pay their utility bills. Furthermore, this limits the extent to which people have access to basic public services.

5.1.2 Access to Basic Services

Public service delivery in South Africa has been characterized by widespread dissatisfaction over the years (Götz & Seedat, 2024). Before focusing on the City of Johannesburg, this paper provides an overview of the public service delivery trend in Gauteng province, a broader context for CoJ, as presented in Figure 3.

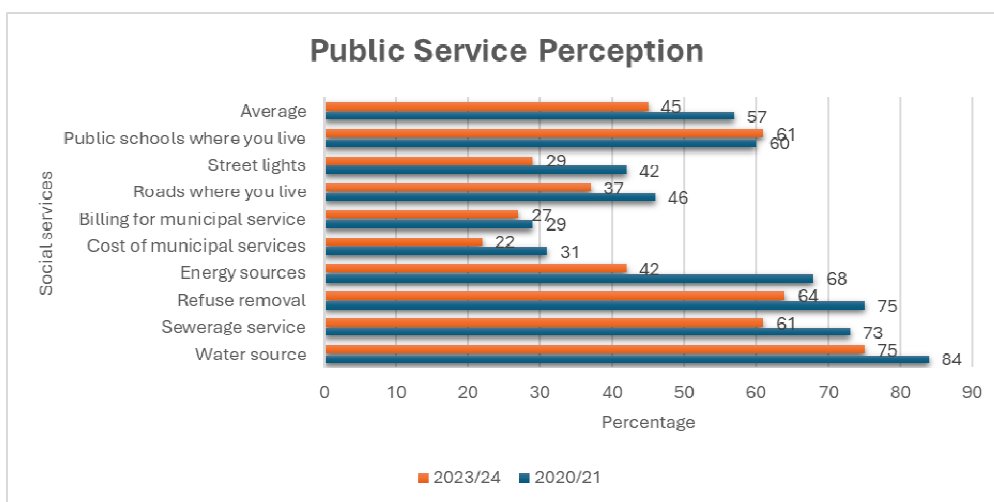


Figure 3: Public satisfaction with basic services in Gauteng. Source: GCRO QoL 7 Survey (Götz & Seedat, 2024).

Indications from Figure 3 suggest that access to public services in Gauteng province has steadily declined over time. In 2020/21, 57% of the population reported satisfaction with service performance; however, by 2023/24, this figure had dropped sharply to 45%, despite a modest increase in the number of public schools in the province. A closer examination of individual cities reveals a similar downward trend.

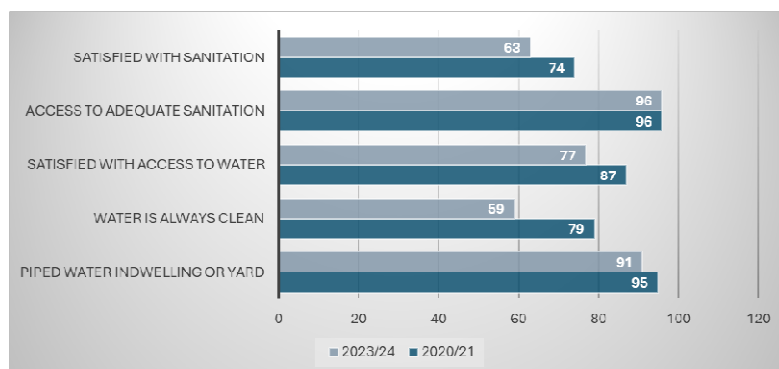


Figure 4: Perception of CoJ residents on water/sanitation service delivery. Source: GCRO's Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

In the City of Johannesburg, Figure 4 highlights the situation regarding water and sanitation services. Satisfaction with these essential services has continued to deteriorate. For example, access to piped water within dwellings has declined: in 2020/21, 95% of residents reported access, but this fell by 4% in 2023/24. Likewise, satisfaction with water quality dropped significantly, from 79% in 2020/21 to 59% in 2023/24. Dissatisfaction with overall water service delivery also increased, with 77% of respondents expressing concern in 2023/24, 10% more than in 2020/21. The same pattern is evident in sanitation services, where confidence has continued to erode, even as the proportion of households with adequate sanitation remained unchanged between 2020/21 and 2023/24.

Another important social service that was investigated in the GCRO’s QoL Survey 7 was the supply of electricity to the 7 regions in CoJ (see Figure 5). Basically, electricity functions as both a source of lighting and energy. For lighting, between 202/21 and 2023/24, the percentage of residents in the city that relied on it for lighting drops from 94% to 82%, indicating either an increase in loadshedding/interruption or a reduction in the capacity of residents to afford it, thereby switching to alternative light sources such as candles, solar, etc.

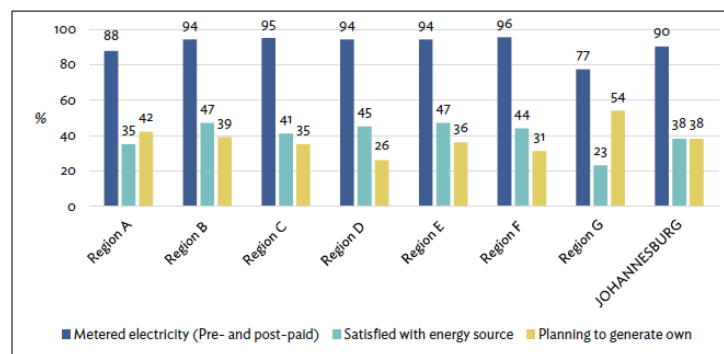


Figure 5: Perception and plans of CoJ residents on electricity supply and consumption. Source: GCRO’s Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

Access to metered electricity (both pre- and post-paid) is high across all regions, as depicted in Figure 5, with over 90% of households connected to the grid, on average, except in Region G, where the rate is 77%. In Region F, the highest proportion of households (96%) with metered electricity access was recorded, followed by Region C at 95%. Satisfaction with the energy sources varies widely: Regions B, D, E, and F report higher satisfaction levels (44% to 47%) compared to other regions. Region G has the lowest satisfaction at 23%. Notably, 54% of Region G residents plan to generate their own electricity, likely in response to lower access to metered electricity or general dissatisfaction with energy sources.

Healthcare is equally an important social service that governments, at all levels, commit to ensuring unhindered access to. This is given its connection to healthy living and its support for building an agile workforce necessary for achieving economic growth and development. In the City of Johannesburg, access to healthcare facilities is based on proximity, affordability, and belief system. This suggests the availability of three healthcare categories, consisting of public and private healthcare facilities, and traditional/spiritual healers that attract rural dwellers, mostly, given their belief in spirituality. Figure 6 below shows the spread of residents in the city across these healthcare options.

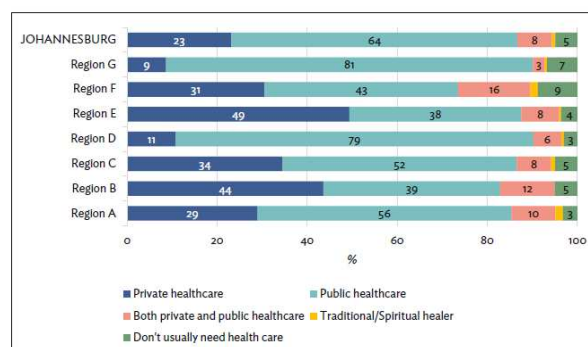


Figure 6: Healthcare service access in CoJ. Source: GCRO’s Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

In the figure above, while 5% of Johannesburg residents do not patronize any of the healthcare categories, nearly one in four residents access private healthcare facilities, whereas 64% use public healthcare facilities. An additional 8% use a combination of both. The use of private healthcare facilities is highest in Region E and lowest in Region G. Consequently, Region G has the highest reliance on public healthcare, at 81%. This trend suggests that Region E could be a suburb comprising educated and middle-income earners with the capacity to afford orthodox healthcare service, and with the direct opposite in Region G.

Furthermore, the survey provides data explaining the motivation for the growing acceptance of alternative healthcare providers in the city. Basically, the survey showed a decline in the level of satisfaction with the public healthcare services. As presented in Figure 7, a 38% dissatisfaction rate was reported with public healthcare services. This rate becomes significant when converted to the number of people involved. At the individual regional comparison in the city, 77% satisfaction rate, the highest in the city, was observed in Region B, while the lowest, 39%, was reported in Region G. This corroborates the earlier submission of the growth of patronage for alternative/native healthcare systems in Region G.

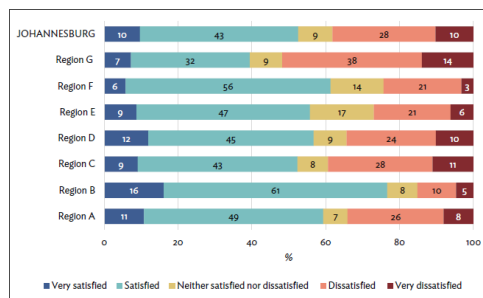


Figure 7: Perception of respondents on public healthcare service access in CoJ.

5.1.3 Spatial Inequity (Poverty & Transportation)

Characteristically, poverty has been explained to be the inability of an individual or group of people to have the wherewithal to provide themselves or their dependents with the necessities of life. These necessities include food, shelter, healthcare, education, transportation, and others. Given the centrality of food/hunger to categorizing poverty, this report, relying on the GCRO data on the prevalence of hunger among Johannesburg residents, presents the spatial poverty spread among regions in the city (see Figure 8).

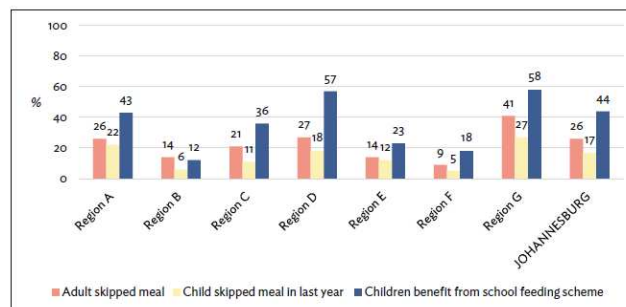


Figure 8: Hunger spread among residents in the CoJ.

In the figure above, the data were based on the criteria of “any member of the household who has skipped meals in the last 12 months owing to inability to afford food,” and “the number of children within the household that benefit from a school feeding scheme.”

Hunger remains a significant challenge in the CoJ, given the rate of adults (26%) and children (17%) who skipped meals in the last 12 months. Furthermore, Region G has the largest proportion of households where adults have had to skip meals (41%), followed by Regions D and A, at 27% and 26%, respectively. Region F reported the lowest proportion, at 9%. In total, 66% of Johannesburg households have one or more children, with 17% of these skipping at least a meal in the past year due to insufficient money for food. Regional variation is slightly less pronounced compared to households where adults skipped meals. In cushioning the effect of this trend, on average, 44% of Johannesburg households have children benefiting from a school feeding scheme. The highest levels of such support are in Regions D and G, where 57% and 58% of

households with children reported benefiting from these schemes. Region B has the lowest proportion, at 12%.

To further address the spreading hunger and poverty, a social grant scheme to support households facing difficulties was introduced. In Johannesburg, 48% of households have at least one member receiving a social grant (see Figure 9). Additionally, 41% of respondents live in households registered as indigent. In terms of monthly household income, around one in five Johannesburg respondents (22%) live in households with a total monthly income of less than R3,201. In some regions, the proportion of households receiving a social grant aligns closely with the proportion registered as indigent, while there are notable disparities in other regions. For example, in Region D, 67% of households receive a social grant, compared to 46% registered as indigent. In contrast, in Region F, only 26% receive a social grant, with 53% registered as indigent. This disparity may indicate that many households are unaware of how to register as indigent. Overall, these indicators highlight a particular concentration of poverty in Regions D and G.

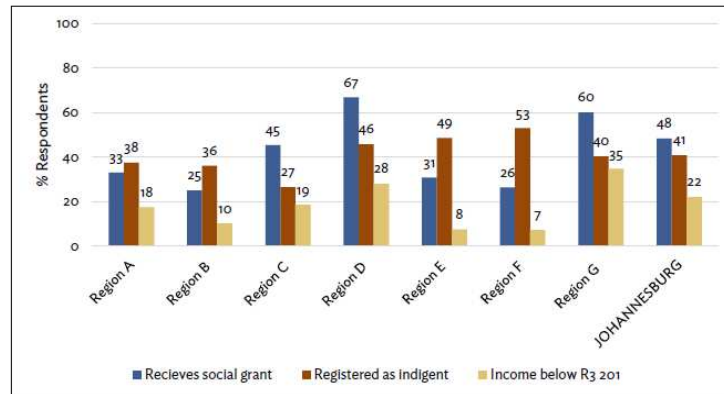


Figure 9: Social grant spread in the CoJ.

In the daily commuting of residents in Johannesburg, there exist many means of transportation, with each indicating the socio-economic status of the people concerned. This is not a clear-cut generalization; rather, it is an attempt to understand the living conditions of the people through their means of transportation on a regular basis. As found in the GCRO’s QoL Survey 7 dataset, public transport was the most used mode of transport (47%), followed by cars (33%) and walking (18%) (Figure 10). Cars are more frequently used by respondents in Regions B, E, and F, with over 50% reliance. Public transport usage is highest in Region G, at 62%, while Region D has the highest proportion of respondents who walk, at 25%.

This mobility pattern could explain the socio-economic status of people in the various regions of the city. While residents of Regions B, E, and F with cars as their most frequent mode of transportation could be explained to be of the upper income class, given their ability to afford cars and fuel them, it could also be the absence or inadequacy of public transportation routes in their areas. Understanding this more deeply would require the examination of the public transportation route in the CoJ. Nevertheless, there appears to be a general low socio-economic status among residents of Regions D and G, given their reliance mostly on public transport and walking.

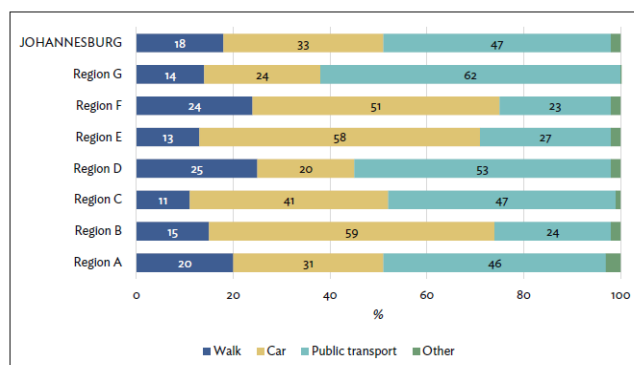


Figure 10: Transportation modes in the CoJ.

5.1.4 Environmental Justice

Regarding the CAZs initiative, waste management is central, given the impact of unsustainable waste management practices on environmental pollution. In the City of Johannesburg, there exists an organized waste collection scheme, and in gauging the frequency of weekly waste collection and the overall satisfaction with the service, GCRO’s QoL Survey 2023/24 was conducted (see Table 1). Findings from the survey indicated that in 2020/21, 89% of the surveyed residents confirmed that their household waste was regularly removed on a weekly basis. This figure dropped to 84% in 2023/24, showing a contraction in the service coverage of the waste management body in the city. This service decline justified the reduction in the level of people’s satisfaction in the service from 82% in 2020/21 to 80% in 2023/24.

Environmental justice indicators	2020/21	2023/24
Weekly refuse removal	89%	84%
Satisfaction with service	82%	80%

Table 1: Waste management scheme in CoJ. Source: GCRO’s Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

5.1.5 Digital & Social Inclusion

Access to information is assuming an important right of every individual, given its centrality to accessing opportunities and avoiding danger. In this mix, smartphones occupy a central position. With the increasing mobile applications for varied activities, the level of internet access can be measured using data on smartphone distribution in the City of Johannesburg. In Figure 11, the spatial variation in the proportion of households per ward in Johannesburg with access to a working smartphone is presented. Since most households have access to a smartphone, the spatial pattern does not vary much. Wards with low access (between 36% and 50%) are mostly in south Johannesburg, especially in wards around Soweto and some near the CBD. In the rest of Johannesburg, the proportion of households with access to a working smartphone is much higher (above 90%), with slight variations in and around townships such as Alexandra, and near Ennerdale in the far south.

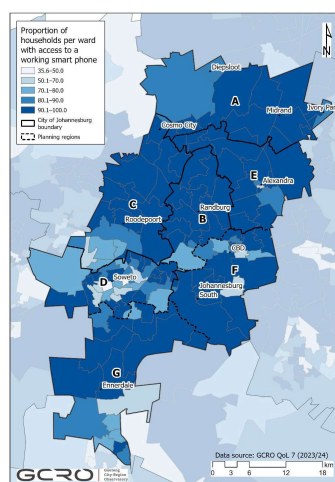


Figure 11: Smartphones spread in the CoJ. Source: GCRO’s Quality of Life Survey 7 (2023/24) (Tshuma et al., 2024).

6 DISCUSSION AND POLICY IMPLICATIONS

There are many pathways for operationalizing the Clean Air Zones initiative, with each capable of deepening existing disparities when imposed without equity safeguards (Druckman & Jackson, 2008). Understanding these pathways is critical for Johannesburg, where prolonged inequality creates a differential policy burden (Mashabela et al., 2025).

First, CAZ implementation required restricting high-emission vehicles disproportionately, with possible impact on the travelling experience of low-income commuters and informal transport operators. With 62% of Region G residents relying on public transport and 25% of Region D residents walking (Figure 10), CAZ-induced fare increases from fleet upgrades would compound existing mobility poverty. The 22% of households earning below R3,201 monthly cannot absorb these costs, forcing further service exclusion. Second, restricting cheap energy sources, such as coal and firewood for heating/cooking, directly threatens the 71% of residents unable to pay utility bills (Figure 1). In Regions D and G, where 41% experience adult meal-skipping and electricity satisfaction is lowest (23% in Region G), households depend on polluting fuels

as survival mechanisms, not lifestyle choices. Prohibition without subsidized alternatives forces impossible trade-offs between compliance and basic needs (Götz & Seedat, 2024).

Thirdly, formalizing waste collection threatens informal reclaimers' livelihoods, a population already marginalized by declining municipal service (84% coverage in 2023/24 vs. 89% in 2020/21). With 48% of households receiving social grants and 41% registered as indigent, informal waste picking provides critical income. CAZ restrictions on informal recycling eliminate this safety net without creating formal employment alternatives, exacerbating the unemployment crisis where 53% actively seek work (Figure 2). Furthermore, while regulating industrial emissions is necessary, these regulations impose compliance costs that formal businesses pass to consumers through price increases. For the 67% of Region D households on social grants, even marginal cost increases in essential goods deepen food insecurity and utility payment defaults.

These pathways interact synergistically: a household forced to abandon polluting fuels without affordable alternatives may default on electricity payments, lose waste-picking income from CAZ enforcement, face higher food prices from industrial compliance costs, and experience reduced mobility from transport restrictions, a cascading vulnerability spiral that transforms environmental policy into socio-economic destabilization (Metheny et al., 2025).

To explore the spread of vulnerabilities across the seven regions in the city, Table 2 is presented. The table synthesizes vulnerability indicators across Johannesburg's seven regions, revealing differentiated CAZ impact exposure. Regions are scored on key indicators, with darker shading indicating higher vulnerability.

Indicators/Regions	A	B	C	D	E	F	G
Unpaid utility bills (%)	11	4	9	22	10	8	18
Unemployment rate (%)	Moderate	Low	Moderate	High	Low	Low	High
Adult meal skipping (%)	26	15	18	27	12	9	41
Social grant dependency (%)	45	22	38	67	35	26	65
Public transport reliance (%)	45	28	42	52	32	35	62
Healthcare satisfaction (%)	62	77	68	58	71	65	39
Satisfaction with electricity (%)	38	47	42	44	45	46	23
Access to metered electricity (%)	92	94	95	91	93	96	77
School feeding scheme (%)	38	12	32	57	28	18	58
Composite vulnerability	Medium	Low	Medium	High	Low	Low	Very high

Table 2: Composite Regional Vulnerability to CAZ Implementation. Source: Compiled by the Authors

Table 2 presents the vulnerability spread across regions in the CoJ. Region G exhibits extreme vulnerability across all dimensions, the highest meal-skipping (41%), lowest electricity satisfaction (23%), weakest healthcare access (39%), and greatest transport precarity (62% public reliance). Region D follows with concentrated poverty (67% social grant dependency, 22% utility defaults). Conversely, Regions B, E, and F demonstrate resilience through lower poverty indicators and higher service satisfaction, though no region is immune to CAZ disruption.

This spatial concentration of vulnerability demands geographically differentiated CAZ implementation. Uniform policy enforcement would constitute environmental injustice, imposing disproportionate burdens on communities least equipped to adapt (Druckman & Jackson, 2008). The matrix provides an empirical foundation for a phased, equity-centered rollout that addresses Johannesburg's persistent inequality patterns (Götz & Seedat, 2024) while advancing environmental sustainability.

7 CONCLUSION

Johannesburg stands at a governance crossroads. The Clean Air Zones initiative can either exemplify equitable environmental leadership or reproduce historical patterns where policy serves affluent interests while criminalizing the survival strategies of marginalized communities. This study's evidence compels the former path. Most fundamentally, this study demonstrates that environmental sustainability and social equity are not competing values requiring tragic trade-offs. They are mutually dependent: environmental policies that deepen inequality invite resistance, undermine legitimacy, and ultimately fail to achieve ecological objectives. Conversely, equity-centered environmental governance mobilizes broad coalitions, generates compliance through capacity-building rather than coercion, and produces resilient systems benefiting all residents.

The time for transformative action is now. Johannesburg's CAZ implementation will be observed across the African continent and the Global South as cities navigate the tension between environmental imperatives and development justice. Success requires rejecting the false premise that cities must choose between breathable

air and livable livelihoods. By centering equity, through subsidies, phased rollout, participatory design, and service infrastructure investment, Johannesburg can demonstrate that its "world-class African city" aspiration is achievable precisely by prioritizing those historically excluded from such visions. Environmental resilience and social justice, implemented together, engender the foundation of urban excellence.

8 ACKNOWLEDGEMENT

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