ASSESSING THE INFLUENCE OF SUSTAINABLE URBAN TRANSPORT LOGISTICS ON CLIMATE CHANGE MITIGATION IN KIBRA, NAIROBI: THE MODERATING ROLE OF THE NATIONAL URBAN DEVELOPMENT POLICY

Brian Ombwori Onchiro.
Masters Student in Purchasing and Logistics Management, School of Business and Economics, Department of Management Science, Kisii University, Kenya.
Fridah Chepleting (PhD).
Lecturer, Department of Management Science, Kisii University, Kenya.
Enock Musau (PhD).
Senior Lecturer, Department of Management Science, Kisii University, Kenya.

International Academic Journal of Procurement and Supply Chain Management (IAJPSCM) | ISSN 2518-2404

Received: 2nd September 2025

Published: 9th September 2025

Full Length Research

Available Online at: https://iajournals.org/articles/iajpscm_v3_i2_448_466.pdf

Citation: Onchiro, B. O., Chepleting, F., Musau, E. (2025). Assessing the influence of sustainable urban transport logistics on climate change mitigation in Kibra, Nairobi: The moderating role of the National Urban Development Policy. *International Academic Journal of Procurement and Supply Chain Management, 3(2)*, 448-466.

ABSTRACT

Urban transport in informal settlements like Kibra, Nairobi, is often characterized by high reliance on polluting vehicles, inadequate infrastructure, and limited policy coordination, contributing to greenhouse gas emissions and worsening climate change. The main purpose of this study therefore was to assess the influence of sustainable urban transport logistics on climate change mitigation in Kibra, with a focus on the moderating role of the National Urban Development Policy (NUDP). It was guided by four theoretical frameworks: Sustainable Livelihood Framework (SLF), Urban Political Ecology Theory (UPE), Theory of Planned Behavior (TPB) and Ecological Modernization Theory (EMT). A mixed-methods research design was utilized. Quantitative data was gathered through standardized questionnaires distributed to 86 participants, comprising key institutional stakeholders that engage in sustainable urban transport and climate change mitigation efforts within Kibra and the broader Nairobi metropolitan area. The study was guided by one general objective and four specific objectives, focusing on evaluating effects of environmental, social, and economic sustainability aspects in transport, as well as examining the role of NUDP in enhancing these effects. The findings revealed that environmental sustainability practices, including the promotion of clean energy vehicles, non-motorized transport, and emission monitoring, significantly contribute to climate change mitigation. Socially sustainable transport, through inclusiveness, safety, and community engagement, and economically sustainable transport, through affordability, employment creation, and access to markets, also positively influence climate change mitigation. Additionally, the National Urban Development Policy was found to strengthen the impact of sustainable transport practices on climate change mitigation. The study recommended the adoption of integrated sustainable transport practices that are environmentally friendly, socially inclusive, and economically empowering, supported by robust policy frameworks. Authorities and transport operators should prioritize green transport solutions, inclusive planning, and innovative economic interventions, while ensuring full operationalization of NUDP to guide sustainable urban mobility.

Key Words: Environmentally Sustainable Urban Transport Logistics, Socially Sustainable Urban Transport logistics, Economically Sustainable Urban Transport logistics, National Urban Development Policy, Climate change Mitigation.

INTRODUCTION

This study originates from the historical oversight and systemic marginalization of informal urban settlements in transportation planning and investment (Castañeda-Pérez & Acuña, 2023; Salcedo et al., 2024). For decades, decisions on transportation investments have consistently overlooked the communities most in need of inexpensive and reliable mobility options, thereby exacerbating existing social imbalances (Boutros, Resler, & Field, 2023). Urban planning frameworks have often disregarded informal settlements, regarding them as peripheral or illegitimate components of the city, resulting in material implications for people, such as discrimination, eviction, and displacement (Dai, Tong, & Chu, 2023; Singh & Singh, 2024). This marginalization is exacerbated by policy procedures that omit informal settlements from urban decision-making, so relegating these communities to a position devoid of opportunity, investment, and service planning (Sekhani et al., 2022).

Numerous cities globally have exhibited the efficacy of synchronized investments in sustainable transportation networks. Copenhagen (Andersen, 2022), Amsterdam (Gulc, 2024), and various cities in India (Debnath, Majumder, & De, 2025) have demonstrated that the promotion of green mobility, encompassing electric buses (Debnath et al., 2025), pedestrian-friendly thoroughfares (Barmpas et al., 2021), and specialized bicycle infrastructure (Monti, 2022), can result in substantial reductions in emissions. Approximately 29% of Copenhagen's populace commutes by bicycle each day, resulting in an anticipated annual decrease of 90,000 tons of CO_2 (Elesawy, 2021). The transition from private car usage enhances environmental sustainability and yields economic advantages, including reduced road maintenance expenses and improved social justice through the provision of inexpensive transportation alternatives (Henriksen et al., 2023; Argyros et al., 2024).

Nonetheless, although these models illustrate the climate change mitigation capabilities of sustainable transport networks, underdeveloped nations encounter enduring obstacles to implementing analogous strategies. Primary challenges encompass finance deficiencies (Chiu & Zusman, 2018), restricted technical capabilities (Ajebo, Solomon, & Sonia, 2024), political limitations (Pradhananga, Elzomor, & Santi Kasabdji, 2021), and inclusion concerns that frequently disadvantage underrepresented groups (Tin et al., 2024). The Global Green Growth Institute (GGGI, 2021) reports that while more than 90 countries have made sustainable transport commitments under the Paris Agreement, less than 40% have formulated localized implementation plans that specifically cater to the requirements of informal urban areas (Janetschek et al., 2020).

Global instances further underscore the environmental advantages of sustainable transportation initiatives. In Turin, Italy, substituting current diesel and natural gas buses with biomethane and electric buses might diminish transport-related emissions by as much as 75% (Noussan, 2023). To meet Braga, Portugal's 2040 CO_2 emission reduction goal, it is necessary to transition 63% of trips to active transportation modes such as walking and cycling, and 32% to public transit (Ribeiro, Dias, & Mendes, 2024). In the United States, on-road traffic emissions are associated with approximately 79,400 premature deaths per year, highlighting the public health

implications in addition to environmental issues (Arter et al., 2024). These global examples collectively underscore the essential function of sustainable mobility methods in diminishing urban greenhouse gas emissions and promoting global climate change mitigation initiatives (Arnz, 2022).

In Sub-Saharan Africa (SSA), the difficulties of sustainable urban transportation and climate change mitigation are especially pronounced, propelled by unparalleled urban expansion that has surpassed the advancement of essential infrastructure and services (Smit, 2021). Accelerated urbanization, inadequate governance frameworks, and significant dependence on informal transportation systems hinder advancement towards sustainability objectives (Richmond, 2019; Smit, 2021). By 2050, Africa's urban population is anticipated to rise from 40% to 60%, predominantly inside informal settlements marked by congestion, insufficient regulation, and inadequate public services (Kerr, Snape, & Stuart, 2022; Oduwaye et al., 2024). The proliferation of these informal settlements is directly associated with the failure of municipal authorities to satisfy increasing demands for transportation infrastructure, mobility services, and environmental protections (Weaver et al., 2023). To tackle these difficulties, it is essential to implement more participatory governance processes and comprehensive strategies for infrastructure development that especially aim to enhance informal settlements (Parikh et al., 2020; Visagie & Turok, 2020).

In cities throughout Sub-Saharan Africa, informal transportation systems address the mobility deficiencies created by inadequate formal networks. In Lagos and Accra, informal minibus systems prevail in urban transportation despite their inefficiencies and safety issues (Alcorn & Karner, 2021), whereas in Kampala, unregulated minibuses referred to as danfos, trotros, or matatus constitute the principal means of public transit (Ndibatya & Booysen, 2021). Although these systems provide cost-effectiveness and adaptability, they frequently lack environmental sustainability, depending on outdated, pre-owned diesel vehicles that release considerable amounts of pollutants detrimental to human health and the ecosystem (Durant et al., 2023; Joseph et al., 2021; Mohammed & Senadheera, 2022; Kebede et al., 2022; Shaisundaram et al., 2022).

The environmental and health consequences of transportation emissions are significant. In Australia, transport emissions were associated with 1,000 to 2,550 premature fatalities and approximately 26,700 cases of cardiovascular hospitalizations, asthma exacerbations, and chronic obstructive pulmonary disease incidents in 2018, resulting in an economic burden of A$910 million (Li et al., 2024). In Africa, primary contributors to air pollution comprise domestic fuels, industrial discharges, and transportation emissions, disproportionately impacting vulnerable populations (Ababio et al., 2025; Atuyambe et al., 2024; Ayejoto et al., 2023). PM 2.5 concentrations exhibit significant variability over the region, ranging from a minimum of 1.76 $\mu g/m^3$ in Morocco to a maximum of 64.99 $\mu g/m^3$ in Cameroon, indicating an uneven distribution of environmental hazards (Capitanio et al., 2024).

Notwithstanding these concerning effects, a limited number of African nations have enacted proactive regulations aimed at urban transport emissions. Only 6 of the 54 African nations have

established formal urban transport emission reduction plans (Abera et al., 2020), and numerous current programs are either fragmented or ineffectual (Milku Augustine et al., 2023). Initiatives to advance sustainable transportation in Sub-Saharan Africa have had inconsistent results, frequently constrained by structural, political, and financial obstacles. South Africa's Bus Rapid Transit (BRT) system has yielded positive outcomes such as job creation and decreased travel time; yet, it faces challenges including low ridership, persistent congestion, and disparities in equity (Sekgale & Madonsela, 2020). The BRT system in Dar es Salaam, initiated in 2016, enhanced public transit ridership and decreased commuting times by 35% (Joseph et al., 2021, 2022; Andrew et al., 2022; Krüger et al., 2021). However, it has encountered service interruptions due to flooding and access inequities, favoring affluent residents while inadequately serving low-income communities (Bouraima et al., 2024; Mwesigwa et al., 2024). The implementation of electric motorbikes in Kigali, bolstered by legislative incentives and infrastructural expenditures, signifies a crucial advancement in modernizing the transportation sector and mitigating environmental impacts (Boutueil & Lesteven, 2024; Mudaheranwa *et al*., 2023). Nonetheless, issues concerning initial expenditures, infrastructure enhancement, and enduring sustainability must be resolved to realize the comprehensive climate change mitigation advantages of electric mobility (Aqmarina *et al*., 2024; Negara, 2024). Notwithstanding these innovations, the extent of such successes is constrained, particularly in informal settlements that frequently lie beyond the scope of targeted policies and investments. To attain widespread and equitable adoption of low-carbon transportation solutions, concentrated efforts are necessary to ensure that electric vehicles and sustainable mobility options are accessible and cheap for underprivileged populations (Gebremariam, 2024; Lazuardy et al., 2024).

Since the post-independence period, Kenya's urban development plans have predominantly benefited formal sectors and central business districts, resulting in communities such as Kibra being neglected and reliant on community-led initiatives to address service and infrastructure deficiencies (Mottelson, 2023). Nairobi's fast expansion in recent decades has resulted in the informal growth of Kibra, characterized by inadequate planning and ongoing intricate mobility issues (Enns, 2022; Luiu et al., 2025; Nyamai & Schramm, 2023). Inhabitants are compelled to traverse hazardous pedestrian conditions (Lucas et al., 2025; Ramesh & Surpuriya, 2021), inconsistent and expensive informal transportation options (Foley et al., 2022; Pinchoff et al., 2021), and extended exposure to pollutants from antiquated, inadequately maintained vehicles (Arbab et al., 2021; Luiu et al., 2025). These institutional failings have ingrained inefficiencies and injustices into the daily transportation experiences of Kibra's residents.

Significantly, these local transportation inefficiencies have wider environmental consequences that directly hinder the objectives of climate change mitigation. The interplay between transport networks and climate change is complex, encompassing both mitigation (diminishing greenhouse gas emissions) and adaptation (enhancing resistance to climate risks) methods (Sheina & Pasko, 2024; Tripathi et al., 2024). Despite Kenya's national commitments to climate action through frameworks such as the National Climate Change Action Plan (NCCAP), informal settlements like Kibra persist in utilizing carbon-intensive mobility systems (Ramirez-Guerrero et al., 2022) that produce excessive emissions, exacerbate environmental degradation,

and entrench unsustainable urban development trajectories. Simultaneously, socially exclusionary mobility arrangements (Purwar et al., 2024) further constrain residents' ability to participate in and gain from climate resilience initiatives, intensifying local vulnerabilities and undermining national and international sustainability objectives (Kamjou *et al.,* 2024; Henson *et al.,* 2020).

The transport sector globally contributes roughly 24% of CO_2 emissions from fuel combustion, with metropolitan regions accountable for more than 70% of this figure (Nguyen & Turner, 2024; Ribeiro, Dias, & Mendes, 2024). This significant contribution highlights the essential need for the development and adoption of more carbon-efficient transportation methods and the implementation of effective emission reduction strategies to achieve global climate change mitigation objectives (Ding & Wang, 2024). A significant portion of the sector's emissions is ascribed to private vehicle usage, urban expansion, and insufficient investment in public transport networks, which entrench cities in carbon-intensive mobility patterns.

The transport industry in Kenya significantly contributes to national greenhouse gas (GHG) emissions, representing over 20% of the overall emissions, with Nairobi disproportionately affected due to its substantial population and elevated vehicle density (Mbandi et al., 2023). In the city, mobility is primarily influenced by informal transport systems, particularly the matatu and boda industries, which collectively account for around 73% of CO_2 emissions in the central business district (CBD) due to ongoing traffic congestion and elevated vehicle activity (Sitati et al., 2022). In the absence of substantial policy and technological measures, emissions from Kenya's road transport sector are anticipated to escalate significantly, with projections suggesting an increase of four to thirty-one times from 2010 to 2050 (Mbandi et al., 2023).

The adoption of electric mobility, particularly for two- and three-wheelers, offers a viable solution for mitigating GHG emissions (Opiyo & Njenga, 2023); however, the lack of enforceable emission standards in public transport disproportionately endangers urban populations in informal settlements by subjecting them to detrimental air pollution (Musau et al., 2023). Inadequate road connectivity exacerbates accessibility issues, hence entrenching spatial and socioeconomic disparities (Irandu, 2022). Nairobi exhibits pronounced spatial inequality, with over 60% of its population residing in informal settlements like Kibra, Mathare, and Mukuru, which get less than 10% of transit infrastructure improvements (Akallah, 2022; Luiu et al., 2025). Consequently, residents encounter increased transportation expenses, inadequate service provision, and heightened vulnerability to environmental risks (Onyango et al., 2023).

Notwithstanding community-driven initiatives such as the Soweto East Project in Kibera, which enhanced access to water, sanitation, and local infrastructure (Meredith et al., 2021), transport infrastructure continues to be inadequate, marked by unpaved roads, insufficient lighting, and limited signage (Nyamai & Schramm, 2023; Oloo, 2018). As a result, residents rely significantly on boda bodas and pedestrian travel, which, although economical, frequently present safety and efficiency issues (Lucas et al., 2025; Nyachieo & Kayi, 2022). These

patterns have obvious consequences for climate change mitigation, as they entrap communities in carbon-intensive and inefficient systems.

The significance of urban development policy in influencing sustainability outcomes lies not merely in the existence of policies, but in the efficacy of their design, implementation, and enforcement. The empirical literature indicates that operational deficiencies such as bureaucratic inertia, funding constraints, exclusion of informal operators, and top-down policy approaches often undermine the effectiveness of sustainability interventions (JICA & Nairobi City County, 2019; Lucas, 2019; Global Green Growth Institute, 2021). For instance, Ethiopia's Addis Ababa Light Rail and South Africa's Cape Town NMT strategy illustrate how strategic investments can foster low-carbon mobility; however, critiques indicate that these initiatives have predominantly advantaged middle-income areas, neglecting informal settlements (World Bank, 2019). These observations underscore that National Urban Development policy serves as a vital moderating element, influencing the effectiveness of environmental, social, and economic sustainability programs in advancing climate change mitigation, especially in marginalized urban areas such as Kibra.

This study aimed to evaluate the impact of environmental, social, and economic aspects of sustainable urban transport logistics on climate change mitigation in Kibra, including National Urban Development Policy as a moderating element that may facilitate or obstruct development. This study sought to produce evidence-based suggestions for the formulation of inclusive, climate-resilient, and socially equitable urban transport systems, contextualized within both global and local policy frameworks, specifically addressing the conditions of informal settlements.

Statement of the Problem

Globally, the transport sector accounts for approximately 24% of CO_2 emissions from fuel combustion, with metropolitan areas responsible for over 70% of these emissions (Nguyen & Turner, 2024; Ribeiro, Dias, & Mendes, 2024). In the Sub-Saharan Africa, there is rising transport related emissions due to rapid urban expansion which continues to outpace the development of essential infrastructure and services showing how adoption of sustainable urban transport is limited. This imbalance has hindered efforts toward climate change mitigation (Smit, 2021).

Kenya reflects this trend. According to Mbandi *et al*. (2023), the transport sector is responsible for more than 20% of national GHG emissions, with Nairobi disproportionately affected due to its population size and high vehicle density. Emissions in Nairobi's central business district (CBD) are largely attributed to the matatu and boda boda sectors, which account for approximately 73% of transport-related CO_2 emissions in the city (Sitati *et al.,* 2022).

In Kibra, these challenges are pronounced. Poor road connectivity, unregulated informal transport, and reliance on pedestrian movement under unsafe conditions contribute not only to economic inefficiencies but also to excessive emissions and deteriorating air quality (Nyamai & Schramm, 2023).According to (UNEP, 2023), residents are disproportionately exposed to

ambient air pollution, with local PM2.5 levels in different parts of Nairobi including informal settlements like Kibra reaching as high as 60–80 µg/m³, far exceeding the WHO recommended limit of 15 µg/m³. These concentrations have been directly linked to increased rates of respiratory illnesses, cardiovascular diseases, and high child mortality.

Nairobi City County (2020) indicates that about 10% of transport infrastructure investment is allocated to informal settlements despite this region accommodating approximately 60% of the city's population. (Akallah, 2022; Luiu *et al.,* 2025). As a result, urban transport systems in these areas remain carbon-intensive, inefficient, and socially exclusive, hindering both climate change mitigation efforts and the achievement of sustainable development goals. Without inclusive and localized policy interventions, Kenya's urban transport sector is expected to see emissions rise from 4 to 31 times by 2050, further exacerbating the climate crisis and deepening socio-environmental inequalities (Mbandi *et al*., 2023).Comparative regional examples, such as the light rail system in Addis Ababa, demonstrate how robust governmental commitment and international collaborations can facilitate green mobility; however, detractors contend that these initiatives primarily benefit middle-income areas while overlooking informal settlements (World Bank, 2019).

Most studies have primarily concentrated on environmental or technological factors, frequently overlooking the interrelated social and economic dimensions, as well as the vital moderating influence encompassing of policy design, implementation, and enforcement in determining the efficacy of climate change mitigation initiatives. This study sought to investigate the causal impacts of environmental, social, and economic sustainability aspects of urban transport logistics on climate change mitigation in Kibra, Nairobi and the role of National Urban Development policy in moderating these linkages, offering critical empirical insights to enhance the effectiveness, inclusivity, and impact of urban transport sustainability measures in informal settlement environments.

RESEARCH METHODOLOGY

This study employed a mixed-methods research strategy, integrating both quantitative and qualitative methodologies to enhance the understanding of the study problem (Peña et al., 2023). Mixed approaches facilitate data triangulation, wherein quantitative results are enhanced by qualitative insights, yielding a more holistic perspective. This design was chosen for its ability to augment the validity of outcomes and encompass varied perspectives. Tashakkori and Newman (2022) assert that mixed methods design provides an enhanced comprehension of intricate research problems by integrating the advantages of both quantitative and qualitative data.

The study was conducted in Kibra, a densely populated informal settlement located approximately 6.6 kilometers southwest of Nairobi's central business district. As one of the largest slums in Africa, Kibra exemplifies the challenges of informal urbanization, including infrastructure deficits and environmental risks. Over 38% of residents live in extreme poverty, and the area faces high unemployment, poor health outcomes, and elevated insecurity. Infrastructure is severely lacking, particularly in water, sanitation, electricity, and

transportation. Roads are mostly unpaved, and mobility relies heavily on informal, unsafe, and environmentally harmful modes like boda bodas and walking.

Results and Discussions

The study sampled 86 respondents, out of which 77 completed and returned the questionnaires, representing a response rate of 89%. A response rate of 89% is considered excellent for survey-based research. According to Mugenda & Mugenda (2003), a response rate of 50% is adequate, 60% is good, and above 70% is considered excellent. Babbie (2010) notes that a response rate of 70% and above is generally acceptable in social science research. The high response rate in this study indicates strong participant engagement and effective follow-up during data collection.

Effects of environmentally sustainable urban transport logistics on climate change mitigation

This section examines respondents' views on the influence of environmentally sustainable practices on climate change mitigation in Kibra. The statements were measured on a five-point Likert scale: SA = Strongly Agree (5), A = Agree (4), N = Neutral (3), D = Disagree (2), SD = Strongly Disagree (1). Higher mean scores indicate stronger agreement with the statement. The results were as tabulated below;-

Table 1: Environmentally Sustainable Urban Transport Logistics

Code	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev.
B1	Public transport systems in Kibra promote the use of clean energy (i.e., electric vehicles).	10.4	18.2	23.4	29.9	18.2	2.73	1.24
B2	Non-motorized transport modes (i.e., cycling, walking) are encouraged in Kibra.	22.1	35.1	18.2	15.6	9.1	3.46	1.21
B3	Roads and transport infrastructure are designed to reduce traffic-related pollution.	14.3	24.7	19.5	28.6	13.0	2.98	1.29
B4	Efforts are in place to monitor and manage vehicle emissions in Kibra.	9.1	20.8	18.2	31.2	20.8	2.66	1.26
B5	Public transport is integrated with green spaces and eco-friendly design.	13.0	23.4	22.1	28.6	13.0	2.94	1.24
B6	Transport planning in Kibra considers long-term environmental sustainability.	16.9	27.3	20.8	23.4	11.7	3.14	1.27

Source: Field Data 2025

The results indicated mixed perceptions of environmental sustainability in Kibra's transport system. The highest-rated statement was B2 (non-motorized transport modes are encouraged) with a mean of 3.46, suggesting moderate agreement. This aligns with Banister (2018), who

emphasizes that walking and cycling are cost-effective and low-emission modes critical to urban sustainability.

However, B1 (promotion of clean energy in public transport) recorded a low mean score of 2.73, indicating that respondents generally perceive limited adoption of electric or hybrid vehicles. This reflects broader challenges in Kenya's transition to green public transport, such as inadequate charging infrastructure (Gachanja, 2020).

Statements B4 and B5 also scored low means (2.66 and 2.94 respectively), suggesting weak implementation of emission monitoring and integration of green spaces in transport planning. According to Litman (2021), poor enforcement of emission controls can significantly hinder climate change mitigation efforts in urban areas. The findings show that while some environmentally sustainable practices particularly non-motorized transport are somewhat visible in Kibra, the adoption of clean energy vehicles, emission monitoring, and eco-friendly infrastructure remains limited. Addressing these gaps is crucial for enhancing climate change mitigation.

Impacts of Socially Sustainable Urban Transport Logistics on climate change mitigation

This section evaluates respondents' perceptions of the influence of social sustainability practices on urban transport logistics on climate change mitigation in Kibra. Social sustainability in transport focuses on accessibility, safety, inclusivity, affordability, and public participation, which are critical for equitable mobility and broader community well-being. The findings were as tabulated below;-

Table 2: Socially Sustainable Urban Transport Logistics

Code	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev.
C1	Public transport in Kibra is accessible to people with disabilities and the elderly.	14.3	23.4	19.5	27.3	15.6	2.94	1.30
C2	There are measures in place to ensure safety for women and children in transit.	16.9	28.6	18.2	23.4	13.0	3.13	1.29
C3	Residents of Kibra are involved in decision-making about transport infrastructure.	9.1	20.8	18.2	33.8	18.2	2.68	1.27
C4	Transport systems in Kibra reduce social exclusion and improve connectivity.	19.5	29.9	22.1	16.9	11.7	3.29	1.25
C5	Transport services are available and affordable to people from different social backgrounds.	22.1	35.1	18.2	15.6	9.1	3.46	1.21
C6	Community engagement is actively sought in urban transport development processes.	13.0	26.0	20.8	24.7	15.6	2.97	1.28

Source: Field Data 2025

The highest-rated statement was C5 (availability and affordability of transport services for different social backgrounds) with a mean of 3.46, indicating moderate agreement among respondents. This reflects the role of low-cost public transport options, such as matatus, in improving mobility for low-income residents a finding consistent with Pojani and Stead (2015), who argue that affordability is key to inclusive urban mobility. C4 (transport reduces social exclusion and improves connectivity) also scored relatively high (mean 3.29), suggesting that transport systems in Kibra help integrate residents with economic and social opportunities. However, C3 (resident involvement in decision-making) recorded the lowest mean of 2.68, indicating that community participation in transport planning is perceived as limited. According to Arnstein's Ladder of Participation (1969), such low scores may indicate tokenism rather than genuine participatory decision-making.

C1 and C2 reveal mixed perceptions regarding accessibility for vulnerable groups and safety measures, suggesting partial compliance with socially sustainable transport principles. Lucas (2012) emphasizes that without addressing these aspects, transport systems risk perpetuating social inequalities and limiting their contribution to climate change mitigation. According to Lucas (2012), socially sustainable transport systems not only improve mobility but also reduce inequalities and support social cohesion.

Effects of Economically Sustainable Urban Transport Logistics

This section examines respondents' perceptions regarding the influence of economic sustainability in urban transport on climate change mitigation in Kibra. The results are as tabulated below;-

Table 3: Economically Sustainable Urban Transport Logistics

Code	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev.
D1	Public transport in Kibra is affordable for most income groups.	21.0	35.1	18.2	15.6	10.4	3.42	1.18
D2	Investments in urban transport create job opportunities for residents.	18.2	29.9	21.0	20.8	10.1	3.23	1.21
D3	Transport infrastructure has boosted access to local businesses and markets.	19.5	33.8	17.0	18.2	11.7	3.28	1.22
D4	There are government subsidies or support mechanisms to promote sustainable transport.	12.9	21.0	19.5	27.3	19.5	2.71	1.28
D5	Public-private partnerships support infrastructure development in Kibra.	13.0	22.1	20.8	28.6	15.6	2.74	1.27
D6	Transport innovations (i.e., boda-boda digitization) promote economic empowerment.	17.0	30.0	21.0	20.8	11.2	3.17	1.23

Source: Field Data 2025

The findings indicated that affordability of public transport (D1) and enhanced access to local businesses (D3) are moderately perceived as contributing to economic sustainability, with mean scores of 3.42 and 3.28, respectively. This indicates that transport provision in Kibra helps low- and middle-income residents access work, education, and markets, which is essential for inclusive urban development (Pojani & Stead, 2015). Job creation through transport investments (D2) and innovations like boda-boda digitization (D6) also received moderate agreement, reflecting the economic role of informal transport sectors in urban livelihoods (Gachanja, 2020).

Conversely, government subsidies and support mechanisms (D4) and public-private partnerships (D5) were perceived as weakly implemented, with low mean scores (2.71 and 2.74). This indicates limited institutional support for sustainable transport investments, a challenge noted by Litman (2021) for developing urban areas. Strengthening financial support mechanisms and partnerships is essential to scale up sustainable transport initiatives and promote climate change mitigation through economic channels. Economic sustainability in transport emphasizes affordability, employment creation, business access, government support, and innovation, which collectively enhance community resilience and local development (Banister, 2018; Litman, 2021).

Descriptive Analysis on Moderating Role of National Urban Development Policy

This section examines respondents' perceptions of the moderating influence of the National Urban Development Policy (NUDP) on the relationship between sustainable urban transport logistics and climate change mitigation in Kibra.

Table 4: Moderating Influence of National Urban Development Policy

Code	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev.
E1	The National Urban Development Policy (NUDP) guides urban mobility planning in Kibra.	18.2	31.2	22.1	19.5	9.1	3.28	1.23
E2	NUDP has improved coordination between stakeholders in urban transport projects.	15.6	27.3	24.7	20.8	11.6	3.12	1.26
E3	The policy promotes sustainable and inclusive transport in informal settlements.	13.0	26.0	21.0	27.3	12.7	2.98	1.28
E4	Implementation of NUDP has enhanced climate-conscious infrastructure design.	16.9	28.6	19.5	25.0	10.0	3.11	1.25

Source: Field Data 2025

Respondents generally agreed moderately that NUDP plays a role in guiding sustainable urban transport in Kibra. The highest-rated statement was E1 (guiding urban mobility planning) with a mean of 3.28, suggesting that the policy is perceived as providing strategic direction. Coordination between stakeholders (E2) and climate-conscious infrastructure design (E4) were moderately rated (means 3.12 and 3.11), indicating some effectiveness in integrating policy goals into practice. However, E3 (promotion of sustainable and inclusive transport in informal settlements) scored the lowest mean (2.98), suggesting limited policy impact in addressing

inclusivity challenges in informal settlements. This aligns with findings from UN-Habitat (2013), which note that policy implementation often faces challenges in informal urban contexts due to resource constraints and limited enforcement.

The results indicated that NUDP has a moderate moderating effect on the relationship between sustainable urban transport logistics and climate change mitigation. Strengthening enforcement, awareness, and inclusivity measures could enhance the policy's impact in Kibra. Policies such as NUDP are intended to provide regulatory guidance, stakeholder coordination, and integration of sustainability principles in urban development (Republic of Kenya, 2016).

Descriptive Analysis on Climate Change Mitigation

This section presents respondents' perceptions of climate change mitigation associated with sustainable urban transport in Kibra, Nairobi.

Table 5: Climate Change Mitigation

Code	Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev.
F1	Local transport practices contribute to reductions in greenhouse gas emissions.	15.6	29.9	21.0	23.4	10.1	3.11	1.23
F2	There are observable improvements in air quality due to sustainable transport efforts.	12.9	24.7	23.4	26.0	13.0	2.93	1.26
F3	Local transport systems are more resilient to environmental shocks (e.g., floods, heatwaves).	14.3	27.3	19.5	25.0	14.0	3.04	1.27
F4	Community awareness of the climate impact of transport is improving.	16.9	31.2	20.8	20.8	10.3	3.18	1.22
F5	Local initiatives actively promote low-carbon transport choices.	13.0	26.0	22.1	25.0	13.9	3.01	1.25
F6	Transport services are adapting to climate risks through innovative practices.	15.6	28.6	21.0	23.4	11.4	3.11	1.23
F7	Greenhouse gas emission reduction targets are being met in the transport sector.	10.4	21.0	22.1	30.0	16.5	2.80	1.27
F8	Sustainable transport strategies are part of local climate change action plans.	14.3	27.3	20.8	24.7	13.0	3.05	1.25

Source: Field Data 2025

The results indicated moderate agreement that urban transport sustainability in Kibra contributes to climate change mitigation. The highest-rated statement was F4 (community awareness of transport's climate impact) with a mean of 3.18, suggesting that residents recognize the role of transport in environmental outcomes.

Statements F1, F3, and F6, relating to greenhouse gas reductions, resilience to environmental shocks, and adaptation through innovative practices, also scored moderately (means 3.04-3.11), indicating some effectiveness of sustainable transport interventions in mitigating climate impacts. However, F7 (achievement of greenhouse gas reduction targets) scored the lowest mean (2.80), suggesting that official targets are not yet fully realized. This aligns with studies in developing urban contexts, where lack of infrastructure, financing, and enforcement often limit the impact of mitigation strategies (IPCC, 2014; Banister, 2018). The findings suggest that sustainable urban transport in Kibra is positively contributing to climate change mitigation, but further investment, planning, and policy support are needed to enhance effectiveness and meet targets.

Correlation Analysis

Correlation analysis was conducted to examine the strength and direction of the relationship between the independent variables environmental, social, economic sustainability (X1–X3), and the National Urban Development Policy (X4) and climate change mitigation (Y). The Pearson correlation coefficient (r) was used, and significance was assessed at the 0.01 level (2-tailed).

Table 6: Correlation Matrix

		Y
X1	Pearson Correlation	.529**
	Sig. (2-tailed)	.000
	N	77
X2	Pearson Correlation	.716**
	Sig. (2-tailed)	.000
	N	77
X3	Pearson Correlation	.722**
	Sig. (2-tailed)	.000
	N	77
X4	Pearson Correlation	.715**
	Sig. (2-tailed)	.000
	N	77

Note: $p < 0.01$ (2-tailed)

Environmental sustainability (X1) showed a moderate positive correlation with climate change mitigation ($r = 0.529$, $p < 0.01$), indicating that environmentally sustainable transport practices contribute significantly to reducing emissions and enhancing resilience. Social sustainability (X2) was strongly correlated with climate change mitigation ($r = 0.716$, $p < 0.01$), suggesting that inclusive, safe, and community-oriented transport practices positively affect climate change mitigation.

Economic sustainability (X3) also demonstrated a strong positive correlation ($r = 0.722$, $p < 0.01$), highlighting the importance of affordability, job creation, and access to markets in enabling sustainable transport that mitigates climate impacts. The moderating role of NUDP (X4) was similarly strongly correlated with climate change mitigation ($r = 0.715$, $p < 0.01$), implying that policy guidance enhances the effectiveness of sustainable transport strategies. All independent variables were positively and significantly associated with climate change mitigation, supporting the hypotheses that sustainable urban transport logistics, along with supportive policy frameworks, play a crucial role in environmental outcomes (Banister, 2018; Republic of Kenya, 2016).

Model Summary

Multiple regression analysis was conducted to determine the extent to which environmental (X1), social (X2), and economic sustainability (X3) predict climate change mitigation(Y), and the moderating effect of the National Urban Development Policy (X4). The Model Summary provided information on the model's explanatory power.

Table 7: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.843	0.710	0.698	0.412

The multiple correlation coefficient ($R = 0.843$) indicated a strong positive relationship between the predictors (X1–X3) and climate change mitigation (Y). The coefficient of determination ($R^2 = 0.710$) showed that 71% of the variance in climate change mitigation is explained by environmental, social, and economic sustainability, along with the moderating effect of NUDP.

The Adjusted $R^2 = 0.698$ accounts for the number of predictors and indicates that the model provides a good fit to the data. The Standard Error of Estimate = 0.412 reflects the average distance between the observed and predicted values of climate change mitigation, suggesting reasonable predictive accuracy. The model demonstrates that sustainable urban transport logistics, when supported by policy interventions such as NUDP, significantly explains variations in climate change mitigation in Kibra, Nairobi (Banister, 2018; Republic of Kenya, 2016).

Analysis of Variance (ANOVA)

The ANOVA test was conducted to examine whether the regression model significantly predictsed climate change mitigation based on environmental, social, and economic

sustainability, with the National Urban Development Policy as a moderator. ANOVA tests whether the overall model fit is significantly better than a model with no predictors (Cohen et al., 2003).

Table 8: ANOVA Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	35.742	5	8.936	52.81	0.000**
Residual	14.592	72	0.203		
Total	50.334	77			

The regression model was statistically significant ($F= 52.81$, $p < 0.01$), indicating that environmental, social, and economic sustainability, along with NUDP as a moderator, reliably predict climate change mitigation. The large F-value suggested that the variability explained by the model is substantial compared to the unexplained variance, confirming the model's overall predictive power. The ANOVA results support the use of multiple regression analysis, showing that the combination of sustainable urban transport logistics and policy moderation significantly influences climate change mitigation in Kibra, Nairobi (Banister, 2018; Republic of Kenya, 2016).

Regression Coefficients

Multiple regression analysis was conducted to determine the effect of environmental sustainability (X1), social sustainability (X2), economic sustainability (X3) aspects of urban transport logistics, and the moderating effect of the National Urban Development Policy (X4) on climate change mitigation (Y).

Table 9: Regression Coefficients

Predictor	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
Constant	23.722	2.638	–	16.453	0.001**
Environmental Sustainability (X1)	0.412	0.074	0.431	3.920	0.000**
Social Sustainability (X2)	0.321	0.067	0.344	3.687	0.000**
Economic Sustainability (X3)	0.278	0.069	0.297	3.658	0.000**
NUDP (Moderator, X*M)	0.156	0.055	0.182	2.998	0.006**

The constant ($B = 23.722$, $p < 0.01$) indicated the baseline level of climate change mitigation in Kibra when all predictors are zero. Environmental sustainability ($B = 0.412$) suggests that for every one-unit increase in environmentally sustainable transport practices, climate change mitigation improves by 0.412 units, holding other variables constant. This aligned with studies

showing that greener transport practices reduce emissions and improve urban resilience (Banister, 2018; Pojani & Stead, 2015).

Social sustainability (B = 0.321) implied that a one-unit increase in social inclusion, safety, and accessibility in transport leads to a 0.321-unit improvement in mitigation outcomes. Inclusive transport has been shown to enhance community engagement and awareness in sustainability efforts (Marsden & Reardon, 2017).

Economic sustainability (B = 0.278) indicated that each one-unit increase in economic-oriented transport measures (affordability, job creation, market access) increases climate change mitigation by 0.278 units, supporting findings that economically accessible sustainable transport facilitates broader climate action (Banister, 2018).

The moderating effect of NUDP (B = 0.156) confirmed that policy guidance strengthens the impact of sustainable urban transport on climate change mitigation. This was consistent with literature emphasizing the importance of regulatory frameworks in achieving climate goals (Republic of Kenya, 2016). The results indicated that all predictors positively and significantly influence climate change mitigation, with environmental sustainability having the largest impact. Policy interventions such as NUDP enhance the effectiveness of sustainable transport practices, underscoring the need for integrated sustainability and governance approaches.

Conclusions

Based on the findings of this study, the following conclusions were drawn:

Environmental sustainability in urban transport plays a critical role in climate change mitigation in Kibra. The promotion of clean energy vehicles, non-motorized transport modes, and measures to monitor and reduce vehicle emissions contribute significantly to reducing greenhouse gas emissions and improving air quality.

Social sustainability positively influences climate change mitigation by ensuring that transport systems are inclusive, safe, and participatory. Accessibility for vulnerable groups, safety measures, and community engagement enhance the adoption of sustainable transport practices and foster awareness of the environmental impact of transport.

Economic sustainability supports climate change mitigation by making transport services affordable, creating employment opportunities, and promoting access to markets. Sustainable and economically inclusive transport practices encourage residents to adopt low-carbon transport options, thereby contributing to broader climate action objectives.

The National Urban Development Policy (NUDP) strengthens the relationship between sustainable urban transport logistics and climate change mitigation. Through providing guidance for urban transport planning, promoting stakeholder coordination, and encouraging sustainable and inclusive practices, the policy enhances the effectiveness of environmental, social, and economic sustainability measures.

Sustainable urban transport logistics comprising environmental, social, and economic dimensions significantly contribute to climate change mitigation in Kibra. The effectiveness of these measures is further reinforced when supported by coherent policy frameworks such as the NUDP. The study highlights the need for an integrated approach that combines sustainable practices with strong governance and policy interventions to achieve meaningful climate outcomes in urban informal settlements.

Recommendations

Based on the findings of this study, it recommended that efforts to enhance climate change mitigation in Kibra focus on integrating environmental, social, and economic sustainability in urban transport planning. Urban transport operators should prioritize environmentally friendly practices by promoting the adoption of clean energy vehicles and low-emission technologies. In addition, non-motorized transport modes such as walking and cycling should be encouraged through the provision of dedicated lanes and safe infrastructure, while authorities should implement regular monitoring and management of vehicle emissions to maintain environmental standards.

Social sustainability should also be strengthened by ensuring that transport systems are inclusive and accessible to vulnerable groups, including the elderly and persons with disabilities. Safety measures for women, children, and other at-risk populations should be incorporated into transport planning and operations. Furthermore, community engagement should be enhanced by actively involving residents in decision-making and planning of transport infrastructure, fostering ownership and support for sustainable transport initiatives.

Economic sustainability can be promoted by maintaining affordable and accessible transport services to encourage the adoption of low-carbon transport practices. Investments in transport infrastructure should aim to create employment opportunities and support local businesses. Innovative solutions, such as the digitization of informal transport services, can further empower communities economically while supporting sustainable urban mobility.

Finally, the National Urban Development Policy should be fully operationalized in Kibra to provide guidance on sustainable transport planning and to improve coordination among stakeholders. Policy frameworks should integrate environmental, social, and economic sustainability objectives to strengthen the effectiveness of urban transport initiatives on climate change mitigation. Collaboration among government, community members, and the private sector should be encouraged to ensure successful implementation and long-term sustainability of these measures.

REFERENCES

Ababio, P., Koomson, I., & Nyarko, S. (2025). Urban air pollution and health risks in Sub-Saharan Africa. *Environmental Research, 220*(2), 115–129.

Ajebo, K., Solomon, R., & Sonia, T. (2024). Technical capacity and sustainable transport in developing nations. *Journal of Transport Policy, 78*(1), 33–45.

Andersen, H. (2022). Cycling infrastructure and carbon reduction in Copenhagen. *Journal of Sustainable Mobility, 16*(3), 201–215.

Arnz, S. (2022). Global perspectives on sustainable transport networks. *International Journal of Climate Policy, 12*(4), 45–59.

Banister, D. (2018). *Transport for sustainable urban development*. Routledge.

Babbie, E. (2010). *The practice of social research* (12th ed.). Wadsworth Cengage Learning.

Boutros, L., Resler, K., & Field, S. (2023). Informal settlements and transport equity. *Urban Studies Review, 59*(6), 980–997.

Castañeda-Pérez, V., & Acuña, G. (2023). Marginalization in urban transport planning. *Urban Development Journal, 45*(2), 55–72.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.

Gachanja, J. (2020). The transition to electric mobility in Kenya: Challenges and opportunities. *African Journal of Transport Studies, 12*(1), 67–80.

Global Green Growth Institute. (2021). *Green mobility and sustainable development in Africa*. GGGI.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.

IPCC. (2014). *Climate change 2014: Mitigation of climate change*. Cambridge University Press.

Litman, T. (2021). *Transportation and environmental sustainability*. Victoria Transport Policy Institute.

Mugenda, O. M., & Mugenda, A. G. (2003). *Research methods: Quantitative and qualitative approaches*. Acts Press.

Mugenda, O. M., & Mugenda, A. G. (2019). *Research methods: Quantitative and qualitative approaches* (Rev. ed.). Acts Press.

Republic of Kenya. (2016). *National Urban Development Policy*. Government Printer.

Smit, W. (2021). Urbanization and transport challenges in Sub-Saharan Africa. *African Urban Studies, 18*(2), 101–120.

UN-Habitat. (2013). *Planning and design for sustainable urban mobility*. Routledge/UN-Habitat.

World Bank. (2019). *Sustainable mobility for all: Global roadmap of action*. World Bank Group.