

# Adoption of Green Roofs for Climate Change Adaptation in Nairobi CBD: *A Mixed-Methods Study*

\*Catherine Achieng, Sunday Abuje and Martin Mbidhi

<https://orcid.org/0009-0001-1769-1878>

Received on 4<sup>th</sup> February, 2026; Received in revised form 26<sup>th</sup> March, 2026; Accepted on 17<sup>th</sup> April, 2026.

## Abstract

Nairobi's Central Business District (CBD) is increasingly affected by environmental challenges, including the Urban Heat Island effect and flash flooding. Although green roofs offer effective solutions for temperature regulation and stormwater management, their adoption remains notably low. This study applied a mixed-methods approach, guided by the Diffusion of Innovations and Planned Behavior theories, to evaluate adoption factors among 110 stakeholders, including architects, developers, and regulators. Findings reveal a significant gap between positive perceptions and actual implementation. While stakeholders highly rate the aesthetic ( $M = 4.27$ ) and environmental ( $M = 4.19$ ) benefits of green roofs, they report limited practical exposure ( $M = 2.68$ ) and technical training. Although retrofitting is viewed as feasible ( $M = 3.87$ ), high initial costs—ranging from KSh 3,000 to 7,000/m<sup>2</sup>—remain a critical deterrent. The study concludes that favorable attitudes alone are insufficient for adoption, requiring mandatory regulations, standardized guidelines, and targeted financial incentives.

**Keywords:** Green roofs, climate change adaptation, adoption, urban heat island, green infrastructure, mixed-methods, Nairobi

## INTRODUCTION

Urban centers worldwide are confronting escalating environmental threats, a trend distinctly visible across sub-Saharan Africa. As cities rapidly densify and lose natural vegetation, the Urban Heat Island (UHI) effect worsens, which in Nairobi elevates localized temperatures by roughly 4–7°C compared to nearby peri-urban zones. Furthermore, an abundance of impermeable surfaces leads to frequent flash floods, compromised air quality, and surging energy requirements for indoor cooling (Ndolo, 2018; Mwangi et al., 2018, 2021). These combined factors severely risk the sustainability of dense urban cores, such as Nairobi's 6.5 km<sup>2</sup> Central Business District (CBD).

To combat these issues, green roofs which comprise plant life grown atop specialized waterproof membranes, serve as effective ecological interventions. International applications demonstrate that these systems can significantly

lower roof surface heat via evapotranspiration, capture substantial stormwater runoff to relieve municipal drainage, and decrease building cooling demands, alongside improving air quality and biodiversity (Getter & Rowe, 2006; Berardi et al., 2014). Driven by these environmental gains, cities worldwide have championed their implementation; for example, Toronto mandates their inclusion on major new builds, Singapore offers density incentives, and Berlin has implemented them on over 18,000 buildings (City of Toronto, 2019; Köhler & Kaiser, 2019).

While global progress is evident, local uptake remains uneven. In Kenya, the integration of rooftop greenery is slowly advancing, with approximately 200 installations and an annual growth rate of about 12% (Architectural Association of Kenya, 2025). However, within Nairobi's CBD, implementation hovers below 1% and is largely concentrated outside the

\*Corresponding author:

Catherine Achieng Jomo Kenyatta University of Agriculture and Technology Nairobi, Kenya

Email: [cachiengg@gmail.com](mailto:cachiengg@gmail.com)

commercial core. This lag is driven by multiple deterrents, including a lack of practical stakeholder exposure and steep upfront financial costs (KSh 3,000–7,000/m<sup>2</sup> compared to KSh 1,500/m<sup>2</sup> for conventional roofing). Furthermore, the city struggles with inadequate regulatory mandates and significant structural doubts regarding the retrofitting of older properties, given that about 60% of CBD buildings predate 1990 (Oduho et al., 2022; Wakhungu, 2021).

Mainstreaming urban greening aligns directly with broader strategic visions, including the United Nations' sustainable city objectives (SDG 11) and Kenya's Climate Change Act (2016) and National Climate Change Action Plan (2018–2027). Despite this strategic alignment, a critical research gap remains: although general barriers to green infrastructure are documented in the literature, there is a distinct lack of focused, empirical analysis on the specific technical, economic, and policy constraints hindering green roof implementation within the high-density, structurally aging context of Nairobi's CBD.

To address this gap, this study investigates the specific drivers and barriers influencing green roof adoption in Nairobi's commercial core. In this context, adoption is defined as the readiness and intent of industry stakeholders to implement

these systems, evaluated through their technical, financial, and regulatory perceptions. Additionally, the study assesses the strategy's capacity for climate change adaptation, specifically its perceived effectiveness in mitigating urban heat, retaining stormwater, and minimizing energy consumption. By systematically analyzing these dimensions, this research provides targeted, evidence-based recommendations to inform building code reforms, financial incentive structures, and future urban resilience initiatives.

### Study Area

Nairobi is geographically located in the south-central part of Kenya, within the eastern edge of the Great Rift Valley system as seen in **Figures 1 and 2**. It lies at an average altitude of about 1,600–1,800 meters above sea level, giving it a relatively cool climate compared to other regions near the equator. The city is situated between the highlands to the west and the lower plains to the east, which influences its topography of gently rolling hills and valleys.

Nairobi has a subtropical highland climate characterized by moderate temperatures, high solar exposure, and a bimodal rainfall pattern. The city experiences a mean annual temperature of approximately 18.8°C, with average daytime temperatures ranging between 23°C and 26°C and



**FIGURE 1**

Location of Nairobi in the context of Kenya

Source: Open Street Map, 2026



**FIGURE 2**  
 Map of Nairobi  
 Source: Open Street Map, 2026

cooler night temperatures of 12–15°C (Climate-Data, 2024; Weather Atlas, 2024). Despite these moderate averages, Nairobi receives high levels of solar radiation, with up to 3,000 hours of sunshine annually, contributing to significant heat absorption in built-up areas. This is particularly evident during the dry seasons (December–March and June–September), when reduced cloud cover intensifies the urban heat island effect and increases both surface and indoor temperatures. Rainfall in Nairobi follows a bimodal pattern, with the “long rains” occurring between March and May and the “short rains” between October and December. Annual precipitation ranges between approximately 800 mm and 1,100 mm, with peak monthly rainfall reaching about 125–160 mm during April (Nairobi National Park, 2024; Climate-Data, 2024). These intense rainfall events often result in significant surface runoff and overwhelm existing drainage systems, contributing to frequent urban flooding. For instance, extreme rainfall events exceeding 100 mm within 24 hours have been recorded, highlighting the city’s vulnerability to stormwater-related challenges.

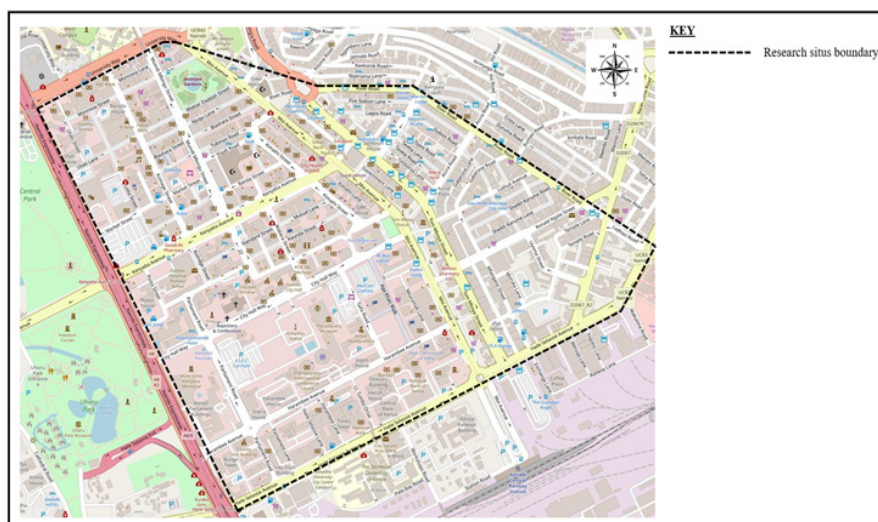
These climatic conditions collectively contribute to increased heat stress, higher energy demand for cooling, and recurrent flooding in Nairobi CBD. As a result, green roofs present a relevant and context-specific strategy for mitigating these impacts by reducing heat absorption, regulating building temperatures, and enhancing rainwater retention within the urban environment.

The study is focused on Nairobi CBD, bounded by University Way, Haile Selassie Avenue, Moi Avenue, and Uhuru Highway and targets the commercial core where impervious surfaces amplify UHI and flooding risks (Figure 3). With limited new construction, emphasis falls on retrofitting existing buildings, filling critical literature gaps in stakeholder views and feasibility data tailored to Nairobi County’s regulatory landscape.

## THEORY

Green roofs are vegetated systems installed on rooftops or other built structures, designed to integrate natural elements into urban environments. They may also be referred to as eco roofs, living roofs, or green infrastructure, and typically consist of traditional flat or sloped roofs modified to support plant growth. However, not all rooftops are suitable for such systems due to structural limitations, material constraints, or potential environmental risks such as corrosion and water contamination. Green roofs are composed of multiple functional layers, including vegetation, substrate, filter, drainage, and waterproofing layers, all of which work together to support plant life, manage water, and protect the building structure as seen in Figure 4.

Foundational literature broadly categorizes these infrastructures into extensive, semi-intensive, and intensive typologies, defined by their

**FIGURE 3**

Extent of the study area

Source: Open Street Map, 2026

**FIGURE 4**

Typical Green Roof Layout

Source: Vijayaraghavan (2016), Renewable and Sustainable Energy Reviews

varying substrate depths, structural demands, and ecological benefits (Cascone, 2019). While extensive systems are frequently championed in urban sustainability discourse for their lightweight, cost-effective, and drought-resistant profiles (Getter & Rowe, 2006; Breulmann et al., 2025), intensive roofs offer greater biodiversity and recreational value at the cost of significant structural reinforcement (Oberndorfer et al., 2007).

However, a critical review of the existing literature reveals that the bulk of academic focus remains heavily skewed toward the structural mechanics,

thermal performance, and plant physiology of these systems (Berardi et al., 2014; Zhang et al., 2021). While previous studies emphasize technical performance and environmental efficiency, they often fail to address the socio-economic and institutional constraints influencing real-world adoption. Contradictions therefore exist between the demonstrated technical viability of green roofs and their limited uptake in practice, particularly within developing urban contexts.

While the technical efficacy of green roofs in managing stormwater and reducing urban heat is well-documented globally, there is a distinct

lack of empirical literature examining the intersection of these technical requirements with the socioeconomic and regulatory realities of developing cities. Specifically, studies often fail to synthesize how structural complexities and maintenance demands act as practical barriers for stakeholders in aging urban cores. This study addresses this gap by shifting the analytical focus from the technical viability of green roofs to the human, financial, and institutional constraints hindering their adoption in Nairobi CBD.

**Theoretical Framework**

To effectively analyze these implementation barriers, this research integrates two complementary behavioral models: the Diffusion of Innovations Theory and the Theory of Planned Behavior. At the macro-level, Rogers’ (2003) Diffusion of Innovations Theory posits that the systemic spread of a new technology is contingent upon user perceptions of its relative advantage, compatibility, complexity, trialability, and observability. While this framework is useful for understanding why robust policy support and visible demonstration projects accelerate adoption in developed regions, it lacks the granularity to fully explain individual stakeholder hesitations in resource-constrained environments.

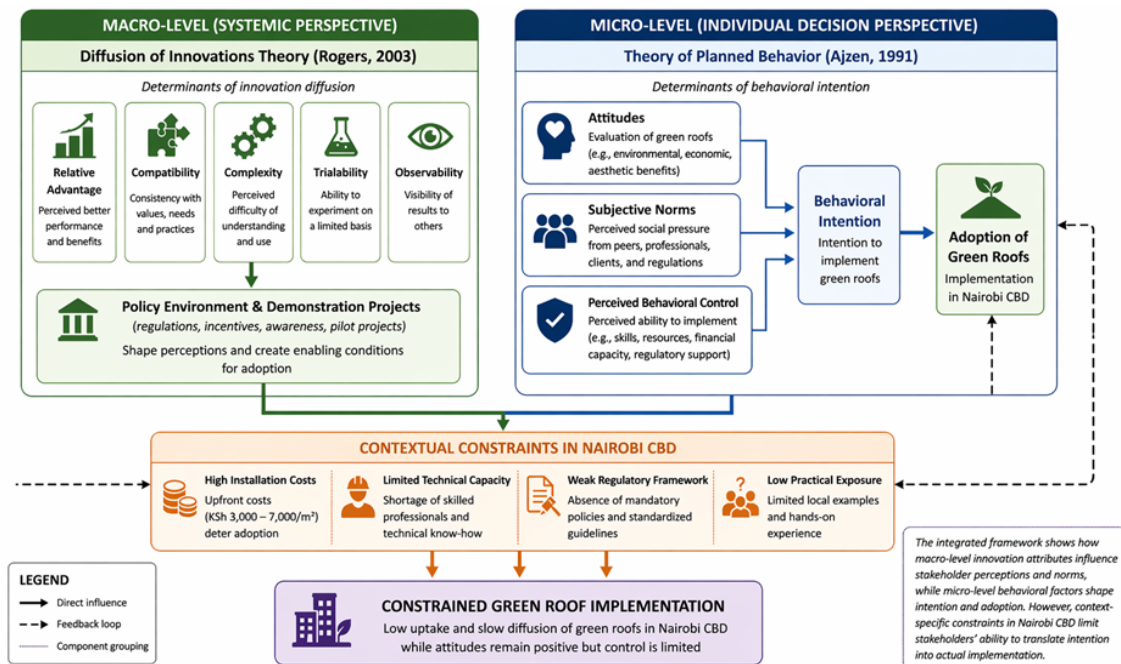
Therefore, this study embeds Ajzen’s (1991) Theory of Planned Behavior (TPB) to scrutinize micro-level decision-making dynamics. TPB argues that behavioral intention is governed by attitudes, subjective norms, and perceived behavioral control. Applied to the Nairobi context, this integrated framework allows for a nuanced critique: while local stakeholders may hold highly favorable attitudes regarding the environmental benefits of green roofs, their perceived behavioral control is severely constrained by limited technical capacity, prohibitive installation costs, and weak regulatory frameworks.

By synthesizing these theories, the study moves beyond a descriptive inventory of adoption challenges to structurally analyze how systemic policy gaps and individual resource constraints collectively constrain green roof implementation (Figure 5).

**RESEARCH METHODS**

**Research Design**

This study employed a descriptive cross-sectional, mixed-methods design to evaluate green roof adoption in Nairobi’s CBD. By integrating quantitative surveys with qualitative interviews,



**FIGURE 5**  
 Integrated framework linking Diffusion of Innovations and Theory of Planned Behavior to green roof adoption in Nairobi CBD  
 Source: Author’s conceptualization (2026)

this approach facilitated methodological triangulation, allowing for both statistical breadth and contextual depth regarding stakeholder decision-making.

### Population and Sampling

The target population consisted of approximately 200 key built-environment decision-makers, including architects, engineers, developers, and regulatory officials with active portfolios in the CBD. This cross-sectional snapshot enables cost-effective comparison across these crucial groups (Babbie, 2020; Creswell & Creswell, 2018). Applying Yamane's (1967) formula at a 5% error margin, a sample size of 133 was established. Participants were selected using stratified random sampling via professional registries (e.g., BORAQS, EBK) and county databases, resulting in 110 valid responses—an 82.7% response rate as seen in **Table 1**.

Additionally, purposive and snowball sampling were utilized to select 8 key regulatory informants for interviews, while 10 commercial buildings were purposively identified for structural field observations.

### Data Collection and Analysis

Data collection spanned three weeks utilizing three distinct instruments. Structured questionnaires captured numerical data on stakeholder awareness, perceptions, and perceived barriers. Concurrently, semi-structured interviews explored institutional dynamics, and field observations, supplemented by Google Earth Pro where physical access was restricted, assessed building retrofit feasibility.

Quantitative survey data was processed using IBM SPSS (v27) to generate descriptive statistics (frequencies, means, and standard deviations) and conduct inferential Chi-square ( $\chi^2$ ), testing. Qualitative interview transcripts were systematically coded using thematic analysis to extract recurring patterns related to policy and financial constraints.

### Validity, Reliability, and Ethical Considerations

Instrument reliability was established through a pilot study of 20 professionals outside the primary study area, yielding strong internal consistency (Cronbach's  $\alpha = 0.72 - 0.95$ ). Content validity was ensured via expert review, methodological triangulation, and alignment with the constructs of the Theory of Planned Behavior (Ajzen, 1991) and Diffusion of Innovations (Rogers, 2003). The study adhered to strict ethical protocols following institutional board clearance, ensuring informed consent, participant anonymity, and secure data storage.

## RESULTS

### Factors influencing the adoptability of Green roofs in Nairobi CBD

#### i) Awareness and Knowledge of Green Roofs

Stakeholders demonstrated strong conceptual familiarity with green roofs ( $M = 4.05$ ,  $SD = 1.057$ ) and recognized their environmental benefits ( $M = 4.01$ ,  $SD = 1.079$ ). However, as detailed in **Table 2**, practical implementation knowledge was lower. Respondents reported limited training or exposure to these systems ( $M = 2.68$ ,  $SD = 1.483$ ) and low awareness of existing local projects ( $M = 2.85$ ,  $SD = 1.439$ ), as shown in **Table 2**.

**TABLE 1**

Response rate

Group	Sample Size (n)	Actual Respondents (n)	Response Rate (%)
<i>Architects</i>	35	30	85.7
Structural Engineers	35	30	85.7
NEMA Officials	9	9	100.0
Property Developers	21	8	38.1
Building Owners	21	21	100.0
County Planning Officials	13	12	92.3
<b>Total</b>	<b>133</b>	<b>110</b>	<b>82.7</b>

**Source:** Field survey data (2026)

**TABLE 2**  
 Descriptive statistics on awareness and knowledge of green roofs

Descriptive Statistics					
	N	Min	Max	Mean	SD
Familiar with the concept of green roofs	110	1	5	4.05	1.057
Understand characteristics/application of extensive green roofs	110	1	5	3.55	1.289
Understand characteristics/application of semi-intensive green roofs	110	1	5	3.34	1.350
Understand characteristics/application of intensive green roofs	110	1	5	3.38	1.361
Aware of environmental benefits associated with green roofs	110	1	5	4.01	1.079
Aware of technical/structural requirements for green roofs	110	1	5	3.28	1.362
Aware of existing green roof projects within Nairobi	110	1	5	2.85	1.439
Received training/exposure related to green roof systems	110	1	5	2.68	1.483
Valid N (list wise)	110	1	5		

Source: Field survey data (2026)

**ii) Perceptions and Attitudes**

Participants exhibited positive attitudes toward the adoption of green infrastructure. The highest mean values were recorded for aesthetic enhancement (M = 4.27, SD = 0.812) and alignment with sustainable urban development goals (M = 4.25, SD = 0.911). Table 3 presents these perceptual findings, including perceived effectiveness for urban climate challenges (M = 4.19, SD = 0.829).

**iii) Technical and Structural Feasibility**

As summarized in Table 4, participants rated retrofitting existing CBD buildings as moderately feasible (M = 3.87, SD = 0.968). Structural reinforcement requirements were rated at (M =

3.46, SD = 1.155), while maintenance demands were rated at (M = 3.83, SD = 1.065). Field observations show that flat-roofed concrete buildings are present, while structural readiness varies across buildings.

**iv) Economic and Financial Considerations**

Figure 6 reveals a strong divergence between perceived long-term economic benefits and short-term affordability constraints, reinforcing the financial barrier hypothesis. Respondents rated long-term economic returns from energy savings (M = 4.10, SD = 0.812) and property value increases (M = 4.11, SD = 0.805). Initial installation costs were rated lower (M = 2.27, SD = 1.149). Financial

**TABLE 3**  
 Descriptive statistics on perceptions and attitudes of respondents towards green roofs

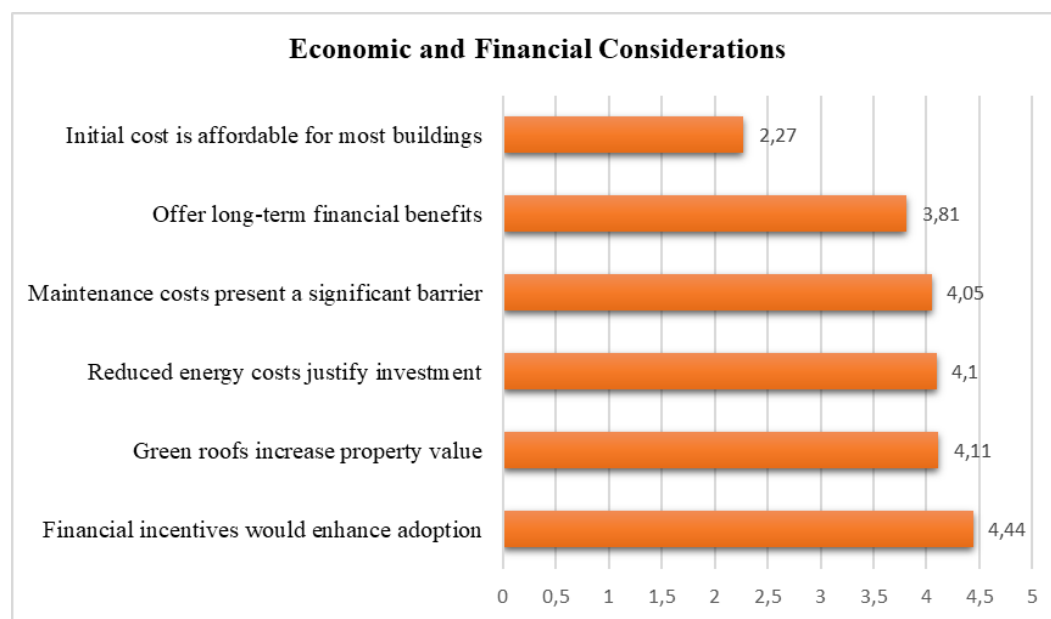
Descriptive Statistics					
	N	Min	Max	Mean	Standard Deviation
Green roofs effective for urban climate challenges	110	1	5	4.19	.829
Green roofs improve environmental performance of buildings	110	1	5	4.09	.894
Green roofs enhance aesthetic quality of urban buildings	110	1	5	4.27	.812
Green roofs suitable for high-density environments (Nairobi CBD)	110	1	5	4.09	.953
Green roof adoption supports sustainable urban development goals	110	1	5	4.25	.911
Valid N	110				

Source: Field survey data (2026)

**TABLE 4**  
Descriptive statistics of the technical and structural feasibility of green roofs

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Familiar with structural characteristics of buildings in Nairobi CBD	110	1	5	3.15	1.510
Many Nairobi CBD buildings can structurally support green roofs	110	1	5	3.45	.874
Retrofitting existing buildings with green roofs is technically feasible	110	1	5	3.87	.968
Structural reinforcement requirements limit adoption	110	1	5	3.46	1.155
Availability of local technical expertise influences adoption	110	1	5	3.96	.976
Maintenance requirements discourage adoption	110	1	5	3.83	1.065
Valid N (listwise)	110				

Source: Field survey data (2026)



**FIGURE 6**  
Stakeholder perspectives for economic and financial considerations

Source: Field survey data (2026)

incentives were rated highly as a factor influencing adoption (M = 4.44, SD = 0.736).

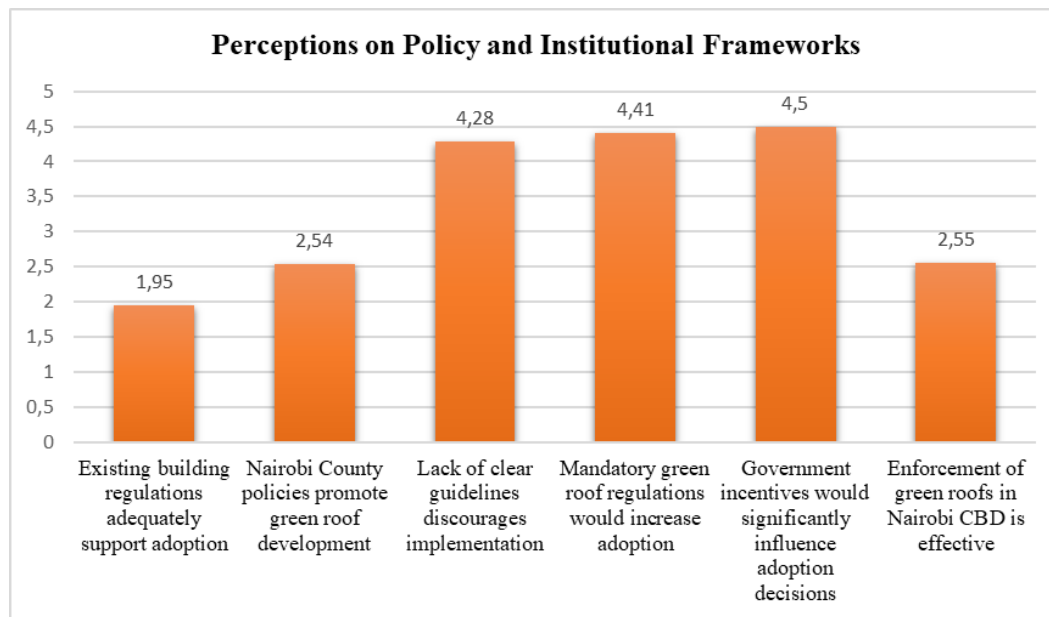
**v) Policy and Institutional Framework**

Institutional support was rated low as illustrated in **Figure 7**. Respondents rated existing regulations supporting adoption at (M = 1.95, SD = 1.087) and county policy support at (M = 2.54, SD = 1.114). Lack of clear guidelines was rated high (M = 4.28,

SD = 1.050). Government incentives (M = 4.50, SD = 0.787) and mandatory regulations (M = 4.41, SD = 0.860) were rated as important factors influencing adoption.

**DISCUSSION**

The findings reveal a significant dichotomy in Nairobi CBD that while general awareness and



**FIGURE 7**  
 Stakeholder perspectives for policy and institutional frameworks  
**Source:** Field survey data (2026)

environmental perceptions of green roofs are high, practical implementation knowledge remains deficient. This aligns with foundational studies indicating that positive attitudes toward green infrastructure do not automatically yield adoption where practical exposure is lacking (Oberndorfer et al., 2007; Berardi, GhaffarianHoseini, & GhaffarianHoseini, 2014). As highlighted by previous research, knowledge gaps continue to bottleneck widespread uptake in regions where such technologies are not yet mainstreamed (Wong & Yuen, 2005; Taib & Abdullah, 2012; Everett & Lamond, 2019). Therefore, conceptual awareness must be transitioned into actionable capacity through targeted technical training.

Technical feasibility in the CBD is present but heavily conditional. The caution expressed by respondents regarding roof-load capacities and maintenance reflects established literature citing these exact determinants as central to green roof viability (Clark et al., 2008; Cascone, 2019; Tolderlund, 2010). Financially, the perceived unaffordability of initial installation mirrors trends in other developing urban contexts, where high upfront costs overshadow long-term performance gains (Wong et al., 2010; Rahman et al., 2015; Everett & Lamond, 2019). This emphasizes that long-term energy savings alone are an insufficient catalyst without immediate financial support mechanisms.

Ultimately, this study confirms that the policy environment is the primary rate-limiting factor for adoption. The dissatisfaction with current enforcement and the strong demand for clear guidelines and mandatory regulations underscore a critical institutional void. For green roofs to evolve from isolated projects to a systemic climate adaptation strategy in Nairobi, voluntary adoption must be replaced or heavily augmented by structural policy reforms, integrated building codes, and aggressive government incentives.

## CONCLUSION

This study establishes that while built-environment stakeholders in Nairobi's Central Business District hold highly positive attitudes toward the environmental and aesthetic benefits of green roofs, actual adoption is heavily constrained by practical knowledge gaps, prohibitive upfront costs, and an inadequate institutional framework. Although retrofitting existing commercial structures is technically feasible in many cases, financial and structural uncertainties dictate that long-term economic returns alone are insufficient to stimulate voluntary implementation. Favorable perceptions cannot overcome these systemic hurdles in isolation. To transition green roofs from conceptual sustainability ideals to mainstream urban infrastructure, definitive policy interventions are mandatory.

## RECOMMENDATIONS

To address these findings and accelerate the adoption of green roofs as a climate adaptation strategy, the following actionable measures are recommended:

- **Formulate Clear Regulatory Guidelines:** The Nairobi City County should integrate specific green infrastructure mandates into the local building code, establishing standardized technical criteria for structural load assessments and waterproofing on both new developments and retrofits.
- **Institute Financial Incentives:** To immediately offset the high initial capital required for installation, policymakers must introduce supportive economic mechanisms, such as tax rebates, density bonuses, or subsidies for early adopters.
- **Develop Local Pilot Projects:** Establishing highly visible, public-sector demonstration roofs within the CBD will serve as practical training grounds, effectively bridging the technical exposure gap for local architects, structural engineers, and developers.

Ultimately, unlocking the full potential of green roofs to enhance urban resilience in Nairobi demands a decisive shift from passive awareness to active, state-supported implementation.

## CITED REFERENCES

**Ajzen, I. (1991).** The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)

**Architectural Association of Kenya (2025).** Green roof installations report. Architectural Association of Kenya.

**Babbie, E. (2020).** *The practice of social research* (15th ed.). Cengage Learning.

**Berardi, U., GhaffarianHoseini, A., & GhaffarianHoseini, A. (2014).** State-of-the-art analysis of the environmental benefits of green roofs. *Applied Energy*, 115, 411–428. <https://doi.org/10.1016/j.apenergy.2013.10.047>

**Braun, V., & Clarke, V. (2022).** *Thematic analysis: A practical guide*. SAGE Publications.

**Bryman, A. (2012).** *Social research methods* (4th ed.).

Oxford University Press.

**Cascone, S. (2019).** Green roof design: State of the art on technology and materials. *Sustainability*, 11(11), Article 3020. <https://doi.org/10.3390/su11113020>

**City of Toronto (2019).** *Green roof bylaw*. Retrieved from website: <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/>

**Clark, C., Talbot, N., Sneed, M., & Dong, L. (2008).** Green roof valuation: A Monte Carlo approach. United States Environmental Protection Agency.

**Climate-Data (2024).** *Nairobi climate data: Temperature and rainfall*. Retrieved from website: <https://en.climate-data.org/>

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

**Creswell, J. W., & Plano Clark, V. L. (2018).** *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

**Everett, G., & Lamond, J. (2019).** Making hay on rooftops: Property owner attitudes to, and motivations for, green roof implementation in urban climates. *Urban Forestry & Urban Greening*, 41, 95–103. <https://doi.org/10.1108/JCRE-11-2017-0044>

**Getter, K. L., & Rowe, D. B. (2006).** The role of extensive green roofs in sustainable development. *HortScience*, 41(5), 1276–1285. <https://doi.org/10.21273/HORTSCI.41.5.1276>

**Government of Kenya (2016).** *Climate Change Act (No. 11 of 2016)*. National Council for Law Reporting.

**Köhler, M., & Kaiser, S. (2019).** Green roofs in Berlin. *Urban Forestry & Urban Greening*, 41, 1–10. <https://doi.org/10.3390/atmos12030382>

**Ministry of Environment and Forestry (2018).** *National Climate Change Action Plan (2018–2027)*. Government of Kenya.

**Mwangi, J., Karanja, P., & Kamau, J. (2018).** Urban heat island effects in Nairobi CBD. *African Journal of Environmental Science and Technology*, 12(4), 123–135.

**Mwangi, J., Karanja, P., Kamau, J., & Letema, S. (2021).** Urban heat islands in Nairobi. *Journal of Kenyan Meteorology*, 15(1), 45–60.

**Nairobi National Park (2024).** *Weather and*

*precipitation data for Nairobi*. Retrieved from website: <https://www.nairobinationalparkskenya.com/blog/weather-and-climate-of-nairobi-national-park/>

**Yamane, T. (1967).** *Statistics: An introductory analysis* (2nd ed.). Harper & Row.

**Ndolo, M. (2018).** Flood risk assessment in Nairobi CBD. *JKUAT Journal of Environmental Studies*, 5(1), 34–48.

**Oberndorfer, E., Lundholm, J., Bass, B., Coffman, R. R., Doshi, H., Dunnett, N., Gaffin, S., Köhler, M., Liu, K. K. Y., & Rowe, B. (2007).** Green roofs as urban ecosystems. *BioScience*, 57(10), 823–833. <https://doi.org/10.1641/B571005>

**Oduho, F., Vikiru, M., & Mireri, C. (2022).** Green infrastructure adoption in Kenyan cities. *African Urban Planning Journal*, 7(2), 56–72.

**OpenStreetMap contributors (2026).** *Map of Nairobi Central Business District* [Map]. Retrieved from website: <https://www.openstreetmap.org>

**Rahman, M. A., Rahman, M. M., & Ahmed, T. (2015).** Barriers to green building adoption in developing countries. *Journal of Building Performance Simulation*, 8(4), 245–258. <https://doi.org/10.1080/19401493.2014.9815222>

**Rogers, E. M. (2003).** *Diffusion of innovations* (5th ed.). Free Press.

**Taib, M., & Abdullah, A. (2012).** Characteristics of green roofs and their adoption in urban environments. *Journal of Environmental Sustainability*, 14(2), 55–68.

**Tolderlund, K. (2010).** *Green roof technical manual*. Green Roofs for Healthy Cities.

**Vijayaraghavan, K. (2016).** Green roofs: A critical review on the role of components, benefits, limitations and trends. *Renewable and Sustainable Energy Reviews*, 57, 740–752.

**Wakhungu, J. (2021).** *Sustainable building practices in Kenya*. Kenya Green Building Society.

**Weather Atlas (2024).** *Nairobi, Kenya – Detailed climate information*. Retrieved from website: <https://www.weather-atlas.com/en/kenya/nairobi-climate>

**Wong, N. H., Chen, Y., Ong, C. L., & Sia, A. (2010).** Investigation of thermal benefits of rooftop gardens in the tropical environment. *Building and Environment*, 45(12), 2621–2624.

**Wong, N. H., & Yuen, S. (2005).** *Green roofs in Singapore*. National University of Singapore.