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Assessment of the Effectiveness of Planning and Building Regulations in promoting Climate Resilience in Human Settlement in Chibombo District, Zambia

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Abstract: *Uncontrolled construction and weak enforcement of planning and building regulations in Zambia are increasing household vulnerability to climate-induced hazards such as flooding and erosion. This study assessed the effectiveness of planning and building regulations in promoting climate resilience in Chibombo District, Central Province, Zambia, focusing on enforcement, public awareness, participation, and the governance complexities associated with customary and statutory land tenure. An explanatory sequential mixed-methods design was applied, combining a structured household survey of 200 respondents across township, peri-rural and rural settlement strata with eight key informant interviews and three focus group discussions. Quantitative data were analysed using descriptive statistics, chi-square tests, Pareto analysis, Principal Component Analysis for a composite Climate Resilience Index (CRI), and ordinal least squares regression. Results showed pronounced execution deficits: only 49.0% of respondents were aware of planning regulations, 71.5% had never received a building inspection, and 62.5% were structurally non-compliant. Customary tenure, held by 53.5% of respondents, was strongly associated with non-application for building permits (Cramer's V = 0.57). The district-wide mean CRI was 0.27 (0.43 township versus 0.18 rural), with awareness (β = 0.421), participation (β = 0.228), enforcement contact (β = 0.187) and tenure type (β = −0.274) as significant independent predictors (R^2 = 0.67). Despite low compliance, 56.0% of respondents expressed willingness to comply with stricter regulations, indicating an execution rather than an attitudinal gap. The study concludes that climate resilience in Chibombo District is constrained primarily by weak institutional execution capacity, the exclusion of customary land from statutory planning control, and limited awareness and participation, and proposes a phased programme of execution-focused interventions to close these gaps.*

Keywords: climate resilience, planning regulation enforcement, execution effectiveness, public participation, customary land tenure, Climate Resilience Index, Chibombo District, Zambia

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INTRODUCTION

Climate change is exerting growing stress on the built environment, infrastructure systems and human settlements, with urban and peri-urban areas facing escalating risks from floods, droughts and extreme heat (IPCC, 2022). As Sub-Saharan African cities expand rapidly, effective planning and building regulations have become central to climate adaptation and resilience (UN-Habitat, 2023), serving not only to guide spatial development but also to embed adaptive measures such as resilient infrastructure and risk-sensitive land-use zoning into urban systems (Ahern et al., 2019).

Despite the existence of formal planning instruments across much of the region, execution remains inconsistent because of resource constraints, political interference and low stakeholder participation (Adebayo & Olanrewaju, 2021). Customary land tenure systems further complicate the execution of building regulations, since they frequently fall outside statutory control (Kombe, 2019), allowing informal development to expand in climate-sensitive areas.

In Zambia, the National Climate Change Policy (2016) and the Urban and Regional Planning Act (2015) provide an adequate legal basis for climate-resilient spatial planning and building control, yet the execution of these instruments at district level has been severely constrained by institutional under-resourcing, weak inter-agency coordination, and a fundamental governance gap created by the co-existence of statutory and customary land tenure systems (Phiri & Chigara, 2022). Only two building inspectors served Chibombo District's 29,600 households at the time of this study, no dedicated inspection transport existed, and an estimated 53.5% of the district's housing stock sits on customary land largely outside statutory planning reach (Chansa & Tembo, 2022) — conditions that concentrate climate risk precisely in the communities least served by regulatory enforcement. This produces an 'execution gap': a situation where the regulatory architecture exists but is operationally inert, and where the households most exposed to flooding and erosion are also those least covered by the instruments designed to protect them. Despite the urgency of this configuration, few empirical studies have quantitatively measured how enforcement deficits, awareness gaps and customary tenure barriers jointly shape household-level climate resilience at rural district level in Zambia. This study addresses that gap.

The study was guided by four objectives: (i) to assess how enforcement mechanisms are executed in Chibombo District and the challenges affecting their effectiveness; (ii) to examine public awareness, compliance and community participation across customary and statutory land; (iii) to determine how enforcement and participation jointly shape household exposure to climate-related risk; and (iv) to propose practical strategies for strengthening execution of regulatory enforcement and community participation to support climate-resilient development.

MATERIALS AND METHODS

Study area

The study was conducted in Chibombo District, Central Province, Zambia, located between Lusaka and Kabwe. As a predominantly rural district, Chibombo has a settlement structure comprising a small district township (Chibombo Central), transitional peri-rural wards (Katuba and Mungule), and deeper rural areas (Kalola), making it representative of rural district contexts across Zambia and Sub-Saharan Africa where planning execution and customary tenure intersect. Data were collected across these four wards representing the district's three settlement strata: township, peri-rural, and rural.

Research design

An explanatory sequential mixed-methods design (QUAN → qual) was applied (Creswell & Plano Clark, 2023), with a structured household survey followed by qualitative interviews used to interpret statistical patterns. The study was underpinned by Adaptive Capacity Theory and Stakeholder Engagement/Deliberative Governance Theory.

Sampling

The target population comprised adult household residents (≥18 years) of Chibombo District. A minimum sample of 202 households was calculated using a finite-population formula ($Z = 1.96$, $P = Q = 0.50$, $e = 0.069$, $N = 29{,}600$ households); after accounting for non-response, a final valid analytical sample of $n = 200$ households was retained. A stratified multi-stage cluster design allocated sample proportionately across township ($n = 36$, 18.0%), peri-rural ($n = 101$, 50.5%) and rural ($n = 63$, 31.5%) strata, with enumeration areas selected by Probability Proportional to Size sampling and households selected by systematic random sampling. The quantitative phase was supplemented by eight purposively sampled Key Informant Interviews (planning and enforcement officers, traditional leaders and ward councillors, and NGO/development partner representatives) and three Focus Group Discussions of 8–12 participants, one per ward stratum.

Instruments and analysis

A structured household questionnaire captured sociodemographic characteristics, tenure type, regulatory awareness, compliance behaviour, climate hazard exposure and infrastructure quality, using five-point Likert, dichotomous and categorical items; pilot testing ($n = 20$) produced Cronbach's alpha values of 0.76 and 0.72 for the awareness and participation sub-scales

respectively. Semi-structured KII and FGD guides explored governance capacity, enforcement challenges and community perspectives on compliance.

Quantitative data were analysed in SPSS v.29 using descriptive statistics, Pearson chi-square tests with Cramer's V, Pareto analysis of compliance barriers, and Principal Component Analysis (PCA) to derive a composite Climate Resilience Index (CRI), calculated as $CRI_i = \beta1(AC_i) - \beta2(S_i) - \beta3(E_i)$, where AC, S and E denote household-level Adaptive Capacity, Sensitivity and Exposure scores and β values are PCA-derived standardised weights, scaled to a 0.0–1.0 range. Ordinary Least Squares regression modelled the CRI as a function of enforcement, participation, awareness and tenure, with diagnostics for multicollinearity (VIF) and heteroscedasticity (Breusch-Pagan). Qualitative data were analysed using Braun and Clarke's (2006) six-phase thematic analysis in NVivo 14 and triangulated with the quantitative findings.

RESULTS

Execution of enforcement mechanisms

Enforcement execution in Chibombo District was severely constrained by institutional under-resourcing. Only two building inspectors served an estimated 29,600 households (an inspector-to-household ratio exceeding 1:14,000, and an estimated inspector-to-active-site ratio of roughly 1:250 or worse), with no dedicated inspection vehicle. Only 28.5% of households had ever received a building inspection, 33.5% had obtained pre-construction plan approval, and 71.5% reported never having been inspected. Stop-work orders, although legally available under the Urban and Regional Planning Act (2015), were issued only three times district-wide in 2025, indicating that the penalty regime exists on paper but is operationally inert.

Awareness, compliance and participation

Only 49.0% of respondents were aware of building permit requirements, with marked spatial disparity (72.2% township versus 28.6% rural awareness). Some 66.5% had constructed without prior plan approval and 62.5% were structurally non-compliant. Community participation in planning processes was nominal: only 34.0% of respondents had attended a planning meeting, and just 23.0% believed their participation influenced planning decisions. Despite these execution gaps, 56.0% of respondents expressed willingness to comply with stricter regulations, against a backdrop of 76.5% current structural non-compliance, indicating that the shortfall is one of execution capacity and access rather than attitudinal resistance.

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Land tenure as a structural mediator

Customary tenure, held by 53.5% of respondents, was strongly associated with non-application for building permits. Only 9.3% of customary-tenure households had applied for a permit, compared with substantially higher rates among statutory-tenure households (Cramer's V = 0.57), confirming land tenure type as the dominant structural mediator of regulatory reach in the district.

Climate hazard exposure and infrastructure vulnerability

Flooding was the most frequently experienced climate hazard, reported by 41.0% of households, occurring against a backdrop of near-universal drainage inadequacy (95.5% of respondents reported inadequate drainage provision).

Climate Resilience Index

PCA extracted three components (KMO = 0.79; Bartlett's $p < 0.001$) explaining 68.4% of cumulative variance, used to construct the CRI. The composite CRI averaged 0.27 district-wide (0.0–1.0 scale), with a pronounced urban–rural gradient: 0.43 (urban), 0.27 (peri-urban) and 0.18 (rural) as shown in table 1. A one-way ANOVA confirmed that inter-stratum differences were statistically significant, $F(2,197) = 14.32$, $p < 0.001$, with all pairwise comparisons significant at $p < 0.05$ (Tukey post-hoc test). Table 1 further shows that the urban advantage was driven primarily by the adaptive capacity dimension (0.62 versus 0.32 in rural areas), reflecting higher regulatory awareness, participation, education and income, while rural households exhibited the greatest sensitivity (0.65), linked to structural non-compliance and drainage inadequacy. The table below shows summary of mean Climate Resilience Index (CRI) scores by settlement stratum.

Settlement stratum	n	Mean adaptive capacity	Mean sensitivity	Mean exposure	Mean CRI
Township	36	0.62	0.41	0.38	0.43
Peri-rural	101	0.44	0.58	0.52	0.27
Rural	63	0.32	0.65	0.46	0.18
District-wide	200	0.45	0.57	0.46	0.27

Table1.Showing Mean Climate Resilience Index (CRI) scores by settlement stratum (n = 200). Source: household survey data, own computation.

Determinants of the Climate Resilience Index

OLS regression explained 67.0% of variance in the CRI ($R^2 = 0.67$, Adjusted $R^2 = 0.66$, $F(6,193) = 65.18$, $p < 0.001$; maximum VIF = 2.14; Breusch-Pagan $p = 0.21$). Regulatory awareness was the strongest individual predictor ($\beta = 0.421$, $p < 0.001$), followed by customary tenure, which was negatively associated with resilience ($\beta = -0.274$, $p < 0.001$). Community participation ($\beta = 0.228$, $p = 0.001$) and having received a building inspection ($\beta = 0.187$, $p = 0.004$) were both significant positive predictors, alongside education ($\beta = 0.162$, $p = 0.003$) and income ($\beta = 0.141$, $p = 0.003$). These results indicate that awareness, participation, enforcement contact and tenure type are independent and significant determinants of household-level climate resilience, net of education and income.

Barriers to compliance

A Pareto analysis identified five barriers accounting for 73.9% of all reported compliance impediments: low awareness and lack of knowledge (17.8%), absence of drainage infrastructure (cumulative 34.5%), the customary tenure system (cumulative 49.5%), high permit cost (cumulative 62.5%), and lengthy permit processes (cumulative 73.9%). This profile is consistent with the regression findings, which identified awareness, tenure type and enforcement contact as the primary independent predictors of the CRI.

Governance capacity: qualitative findings

Key informant interviews confirmed that enforcement capacity was the principal constraint on execution: staffing was limited to two inspectors with no dedicated transport, and the last district-wide awareness campaign had been conducted in 2022. Ward Development Committees were functioning in only two of the four study wards and showed weak linkage to formal planning processes in customary areas. Traditional leaders allocated land independently of Council zoning, creating a dual-track governance system, and no formal climate risk criteria had been integrated into the district building inspection checklist as of mid-2026.

DISCUSSION

The findings confirm that the principal constraint on climate resilience in Chibombo District is execution capacity rather than the design of the regulatory framework itself. The Urban and Regional Planning Act (2015) and associated building inspection regulations provide an adequate legal basis for climate-resilient development control, yet enforcement instruments remain largely inert at district level due to institutional under-resourcing, consistent with similar 'implementation

gap' findings reported in rapidly urbanising contexts elsewhere (Satterthwaite et al., 2020; Olazabal et al., 2021).

The strong, independent effects of awareness, participation and enforcement contact on the Climate Resilience Index support Adaptive Capacity Theory, which holds that household-level resilience is built through accumulated access to information, services and institutional engagement rather than through regulatory text alone. The weak legitimacy of current participatory structures, with only 23.0% of respondents trusting that their participation influenced planning outcomes, is consistent with Stakeholder Engagement/Deliberative Governance Theory, which emphasises that genuine resilience gains require participation that is perceived as consequential, not merely procedural.

Customary land tenure emerged as the dominant structural mediator of execution reach, with a permit application rate of only 9.3% among customary-tenure households. This finding situates Chibombo District within a wider pattern of dual statutory–customary governance documented across Sub-Saharan Africa (Kombe, 2019), in which formal planning execution effectively excludes a majority land category from regulatory oversight, independent of household willingness to comply.

Perhaps the most execution-relevant finding of this study is the gap between high latent willingness to comply (56.0%) and low actual structural compliance (23.5%). This directly contradicts the regulatory resistance narrative that sometimes characterises discourse on informal settlements and customary land governance in African contexts (Satterthwaite et al., 2020), and instead delineates a precise intervention space: targeted, accessible, affordable and culturally appropriate execution mechanisms could convert this latent compliance potential into measurable resilience gains.

CONCLUSIONS AND RECOMMENDATIONS

Climate resilience in Chibombo District is constrained less by the absence of formal regulatory instruments than by weak institutional execution capacity, the exclusion of customary land from statutory planning control, and limited public awareness and participation. A phased, execution-focused programme is recommended, prioritising the following measures.

- Strengthen district-level enforcement capacity by increasing building inspector establishment from two to a minimum of eight, with dedicated transport, mobile inspection tools and consistent application of stop-work and penalty provisions.

- Launch a targeted, stratum-differentiated awareness campaign prioritising peri-rural and rural wards, delivered through ward meetings, mobile sensitisation teams and local-language broadcasts.
- Simplify and subsidise the building permit process through a lower-cost category for small residential structures on customary and peri-rural land, with processing capped at 10 working days and fee waivers for low-income households.
- Invest in public drainage infrastructure in peri-rural and rural wards, linked where possible to priority drainage access for permit-compliant households.
- Develop a customary land engagement protocol with traditional authorities, formalising the role of headmen and chiefdom councils in communicating construction guidance and referring households to simplified permit pathways.
- Mainstream climate risk criteria, including flood-zone mapping and drainage gradient provisions, into the district building inspection checklist and inspector training.
- Strengthen Ward Development Committees as participatory channels, with documented feedback loops between community input and Council decisions.

Future research should pursue longitudinal monitoring of the Climate Resilience Index to establish causal direction, geospatial validation of survey-based resilience scores against satellite-derived hazard data, comparative multi-district analysis of the customary tenure–execution dynamic, and action research co-designing the proposed customary land engagement protocol with traditional authorities.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the author used an AI-assisted writing tool to support reorganisation and language editing of content drawn from the author's own dissertation research. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the published article.

Highlights

- Building regulation execution, not regulatory design, drives resilience gaps.
- Customary tenure cuts permit applications to 9.3% (Cramer's V = 0.57).
- District-wide Climate Resilience Index averages 0.27, lowest in rural wards (shown in table 1).
- Awareness, participation and inspection jointly explain 67% of CRI variance.

- 56% would comply if barriers were removed, showing latent compliance.

CRediT author statement

Josereen Kabwe: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review and editing.

Declaration of competing interests

The author declares that she has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability statement

The household survey, KII and FGD data supporting this study are derived from the author's dissertation research and are available from the corresponding author on reasonable request, subject to participant confidentiality protections agreed during the original ethical clearance process.

Ethic Approval

Ethic approval was granted by Mulungushi University Research Ethical Committee under certificate number MU/DRI/REC/2026/037 in compliance with the National Health Research Act No. 2 of 2013, the Data Protection Act No. 4 of 2021, and the ethical principles of the Declaration of Helsinki.

Consent to Participate

Informed consent was obtained from all participants in accordance ethics approval granted by Mulungushi University Research Ethical Committee.

Consent to Publish

Not applicable

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