

RESEARCH ARTICLE

Climate Migration and Urban Resilience in Ghana: Linking Informal Settlements to Adaptive Governance**Pauline Agyeiwaa Twumasi & Dr. Susan Doofan Albert-Makyur & Turkson Agyin Benjamin**

WSL/2024/16045 (Ph.D. Candidate)

WASCAL RESEARCH PROGRAM-Federal University of Technology Minna, Niger State

&

Directorate of General Studies / Nile Online Digital Learning,

Nile University of Nigeria, Abuja

&

University of Fairfax

ABSTRACT

Climate-induced rural-urban migration is intensifying across West Africa, placing unprecedented pressure on receiving cities. Ghana offers a particularly instructive case, ecological stressors in the northern savanna regions are dismantling rural livelihoods and channelling migrants into Accra's expanding informal settlements, where compound climate vulnerabilities deepen existing social inequalities. Existing studies treat climate-induced migration and urban resilience as largely separate bodies of inquiry. No integrated conceptual architecture accounts for the full causal chain from ecological stress in source regions, through the dynamics of informal urbanisation, to the governance conditions that either amplify or attenuate urban vulnerability. This paper develops the CMIVGR framework, derives four theoretically grounded propositions, embeds both within a systems feedback analysis, and grounds the argument comparatively across five West African cities. A qualitative conceptual synthesis draws on an integrative review of 85+ peer-reviewed sources, international policy frameworks, and grey literature spanning climate migration, urban informality, resilience theory, and adaptive governance. The paper produces four original figures and five analytical contributions: (i) the CMIVGR Conceptual Framework (Figure 3); (ii) the Systems Dynamics Feedback Loop / vulnerability spiral (Figure 4); (iii) the Adaptive Governance Framework (Figure 5); (iv) a Multi-Level Governance Model (Figure 6); and (v) a comparative cross-city analysis across five WASCAL-region cities paired with a six-pillar governance roadmap for climate-resilient African cities. Durable urban resilience requires a fundamental shift from engineering-dominated, reactive governance toward participatory, polycentric adaptive governance that treats informal residents as co-producers of resilience and migration as a legitimate adaptive strategy.

Keywords: climate-induced migration, urban resilience, informal settlements, adaptive governance, Ghana, west africa

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Introduction

Climate change is no longer a future threat it is a present reality restructuring patterns of human settlement across the Global South. In sub-Saharan Africa, where adaptive capacity remains critically constrained and livelihoods are deeply embedded in climate-sensitive agricultural systems, environmental stressors are increasingly driving internal migration (IPCC, 2022; World Bank, 2021). Ghana presents a particularly instructive case: chronic slow-onset stressors in the northern savanna ecological zones are dismantling the livelihoods of smallholder farmers and pastoralists, compelling them to seek economic alternatives in southern cities, most prominently Accra (Teye et al., 2018; Afriyie et al., 2020).

Yet the scholarly conversations on climate-induced migration and on urban resilience have developed in largely parallel silos. Relatively few studies interrogate the mechanisms through which rural environmental vulnerability is systematically converted into urban climate risk via the mediating dynamics of informal urbanisation and governance failure. This gap has practical consequences: it produces cities that treat migrants as problems rather than agents, governance strategies that address symptoms rather than structures, and resilience investments that benefit the formally housed while leaving the informally settled ever more exposed.

This paper addresses that gap by developing the CMIVGR framework, deriving four theoretically grounded propositions, embedding both within a systems feedback analysis, and grounding the argument comparatively across five West African cities. It produces four original conceptual figures the CMIVGR Conceptual Framework (Figure 3), the Systems Dynamics Feedback Loop (Figure 4), the Adaptive Governance Framework (Figure 5), and the Multi-Level Governance Model (Figure 6) that together constitute a visual and analytical architecture for understanding and addressing urban climate vulnerability in the region.

The paper is organised as follows: Section 2 presents the methodology; Section 3 reviews the relevant literature; Section 4 establishes theoretical foundations; Section 5 develops the CMIVGR framework with four propositions and Figure 3; Section 6 presents the systems feedback spiral (Figure 4); Section 7 presents the Adaptive Governance Framework (Figure 5); Section 8 presents the Multi-Level Governance Model (Figure 6); Section 9 applies the framework to Accra; Section 10 develops the comparative cross-city analysis; Section 11 is the Discussion; Section 12 presents the Policy Roadmap; and Section 13 concludes with a statement of contribution.

Methodology

Research Design

This study employs a qualitative conceptual synthesis approach. Conceptual synthesis is an established methodology in theory-building research that draws on the systematic integration of existing knowledge to construct new analytical frameworks, identify theoretical gaps, and derive propositions for future empirical investigation (Torraco, 2005; Jabareen, 2009). It is appropriate when the objective is not to generate new empirical data but to produce a theoretically coherent account of relationships among phenomena previously studied in isolation.

The methodological approach combines an integrative literature review (Whittemore & Knafl, 2005) across four thematic streams, and a comparative case analysis following Yin's (2018) framework for case-based theory building. Original conceptual figures are constructed as part of the framework development,

providing visual representations of the theoretical architecture that serve both analytical and communicative functions.

Literature Search and Selection

Literature was identified through systematic searches of Scopus, Web of Science, and Google Scholar, supplemented by targeted searches of institutional repositories maintained by the IPCC, UN-Habitat, the World Bank, the Ghana Environmental Protection Agency, and WASCAL. The temporal scope prioritised sources published between 2010 and 2026, with seminal earlier works retained as theoretical anchors. Approximately 85 sources were retained for synthesis following inclusion/exclusion screening.

Table 1. Methodological Design Summary

Element	Description	Scope / Justification
Research Design	Qualitative conceptual synthesis	Integrative review (Torraco, 2005); conceptual framework (Jabareen, 2009)
Data Sources	Scopus, Web of Science, Google Scholar; IPCC, UN-Habitat, World Bank, Ghana EPA, WASCAL	Priority to peer-reviewed journals (2010-2026) and authoritative grey literature
Search Terms	Climate migration; urban resilience; informal settlements; adaptive governance; Accra; West Africa	Boolean combinations across four thematic streams
Inclusion Criteria	Sub-Saharan African urban context; relevance to migration-resilience nexus; governance analysis	Excluded: purely quantitative modelling without governance analysis
Synthesis Approach	Thematic coding of 85+ sources; theoretical triangulation	Adaptive governance, SES, and vulnerability frameworks applied deductively
Framework Validation	Inductive-deductive; themes mapped to components; propositions derived from synthesis	Validated against Accra evidence; stress-tested across four comparison cities

Source: Authors' own design, following Torraco (2005), Jabareen (2009), and Whitemore & Knafl (2005).

Literature Review

Climate-Induced Migration

The scholarly consensus on climate-induced migration has evolved from deterministic, alarmist framings toward more nuanced, multi-causal models (Black et al., 2011). Contemporary scholarship recognises that migration decisions are mediated by economic capacity, social networks, political conditions, and individual agency (Bardsley & Hugo, 2010), yet the IPCC (2022) confirms that climate variability meaningfully increases the probability of internal migration, particularly in agrarian communities with limited adaptive resources. The critical distinction between migration as adaptation and migration as distress (Black et al., 2011) has direct governance implications: where migration is reactive and need-driven, it deposits migrants in urban spaces with the fewest resources and the highest exposure to compound risks (Maduforo et al., 2024).

Informal Urbanisation and Spatial Inequality

In Accra, approximately 60 percent of the population resides in informal settlements on ecologically fragile, legally contested, and infrastructurally neglected land (Ghana Statistical Service, 2021). Amankwah (2017) and Cobbinah et al. (2019) emphasise that this spatial distribution reflects the systematic exclusion of the poor from formal housing markets, channelling settlement toward the most hazardous urban land. Population densities exceeding 500 persons per hectare, combined with metal-roofed structures and minimal green infrastructure, produce built environments that structurally amplify heat retention, accelerate surface runoff, and convert routine rainfall events into flood emergencies (Owusu et al., 2020).

Urban Resilience Frameworks

Engineering resilience the capacity to absorb shocks and return to pre-disturbance equilibrium dominated disaster risk management but has been critiqued for ignoring structural drivers of vulnerability (Meerow et al., 2016). Socio-ecological resilience theory (Holling, 1973; Folke et al., 2005) introduced a dynamic conception involving adaptation, self-organisation, and system learning. The distinction between adaptive and transformative resilience is critical: adaptive resilience involves incremental adjustments within existing systems, while transformative resilience requires fundamental restructuring of the socio-ecological arrangements that generate vulnerability in the first place (Birkmann et al., 2020; IPCC, 2022).

Governance Frameworks for Climate Adaptation

Adaptive governance theory (Folke et al., 2005; Ostrom, 1990) emphasises flexibility, multi-stakeholder collaboration, institutional learning, and polycentric decision-making as hallmarks of effective governance under uncertainty. Polycentric arrangements distribute authority across multiple overlapping institutions at different scales, producing systems more robust to single-point failures (Ostrom, 2010). Participatory governance adds the normative and epistemic claim that those most affected by climate risks should be constitutive partners in designing adaptation strategies (Chmutina & von Meding, 2019).

Theoretical Foundations

Adaptive Governance Theory

This paper takes adaptive governance theory (Folke et al., 2005; Ostrom, 1990, 2010) as its primary theoretical anchor. Adaptive governance theory holds that governing complex social-ecological systems under conditions of uncertainty requires flexibility and learning capacity, multi-stakeholder participation and legitimate authority, polycentric decision-making allowing simultaneous action at multiple scales, and feedback mechanisms that translate environmental signals into policy adjustments.

Socio-Ecological Systems Framework

Ostrom's socio-ecological systems framework (1990, 2009) conceptualises governance and ecological dynamics as co-evolving systems. Applied to informal urban settlements, the framework draws attention to relationships among physical urban ecologies, climate stressors, institutional arrangements, and residents who both depend on and shape these systems. The concept of fitting the degree to which governance arrangements correspond to the scale and dynamics of the ecological problems they seek to manage is the framework's most analytically productive contribution for the purposes of this paper.

The Vulnerability Framework

Wisner et al.'s (2004) pressure-and-release model argues that disasters are the product of the intersection between hazard and vulnerability, and that vulnerability is produced through root causes (social, political, and economic structures), dynamic pressures (urbanisation, governance failures), and unsafe conditions (physical exposure, lack of infrastructure). This framework reframes vulnerability as a socially produced condition rather than a simple function of physical exposure.

The CMIVGR Framework and Theoretical Propositions

Framework Overview

The CMIVGR framework posits a multi-stage causal pathway through which rural ecological stress is converted into urban climate vulnerability, and through which governance arrangements either amplify or attenuate this conversion. Figure 3 presents the complete conceptual framework, showing the forward causal chain, the adaptive governance moderating mechanism (indicated by teal brackets), and the two terminal outcome paths (maladaptation versus transformative resilience).

Figure 3. CMIVGR Conceptual Framework

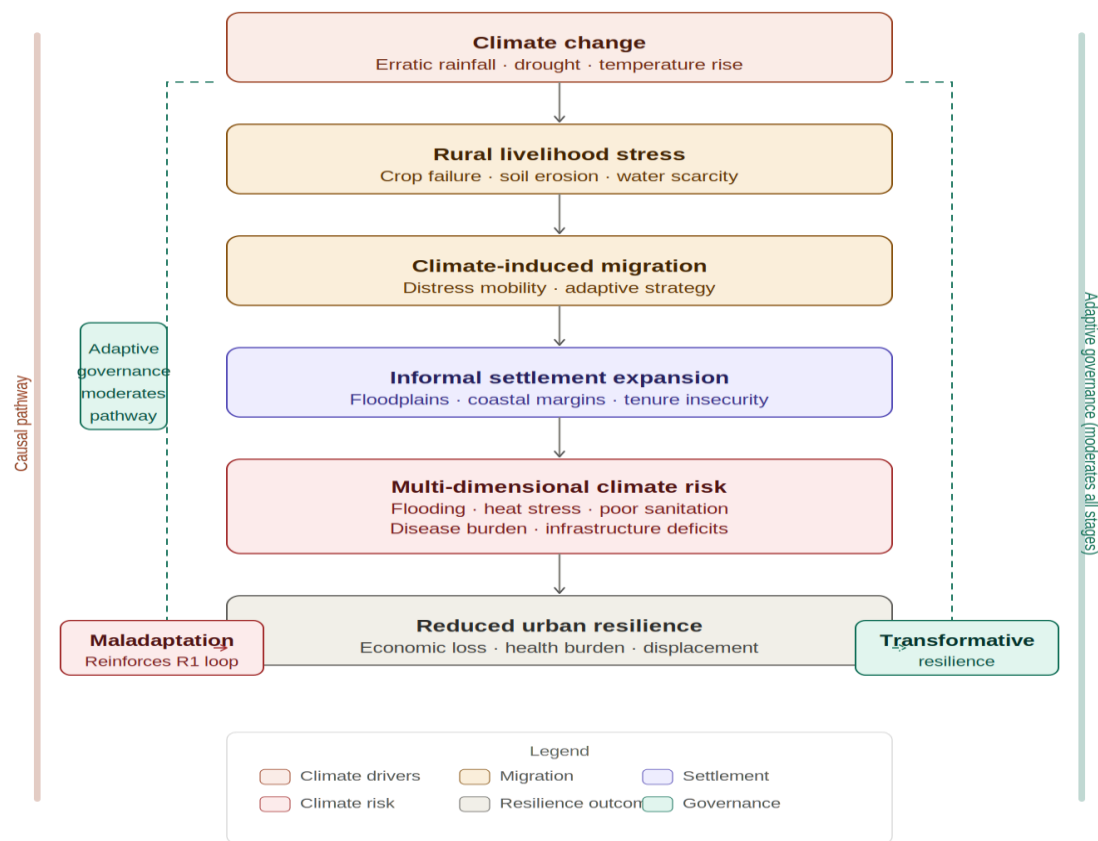


Figure 3. CMIVGR Conceptual Framework (Twumasi, 2026)
Adaptive governance (teal brackets) moderates the vulnerability pathway at every stage

Source: Authors' own conceptualisation. Adaptive governance (teal brackets) moderates the vulnerability pathway at every stage. Maladaptive governance reinforces vulnerability; adaptive governance enables transformative resilience.

Table 2. CMIVGR Framework: Components, Variables, Theoretical Lenses, and Governance Links

Component	Key Variables	Theoretical Lens	Governance Link
Climate Stress	Rainfall variability, drought, soil erosion, flooding	Climate risk theory (IPCC, 2022)	National adaptation policy
Migration Drivers	Push: crop failure, displacement; Pull: urban livelihoods	New Economics of Labour Migration (Stark & Bloom, 1985)	Migration governance
Informal Settlement	Housing deficit, land tenure insecurity, ecological location	Socio-ecological systems (Ostrom, 1990)	Urban planning and land use
Vulnerability Exposure	Flooding, heat stress, inadequate sanitation, disease burden	Vulnerability framework (Wisner et al., 2004)	Disaster risk reduction policy
Adaptive Governance	Polycentrism, participation, institutional learning, coherence	Adaptive governance (Folke et al., 2005)	Local government, civil society, donors
Urban Resilience	Engineering, ecological, socio-ecological, transformative	Resilience theory (Meerow et al., 2016)	Metropolitan governance

Source: Authors' own conceptualisation synthesised from cited literature.

Theoretical Propositions

Four propositions are derived from the CMIVGR framework through theoretical inference. Each specifies an expected directional relationship between framework components, is grounded in the synthesised literature, and constitutes a testable hypothesis for future empirical research.

Proposition 1: Climate-induced migration accelerates informal settlement expansion in ecologically vulnerable urban zones.

Rationale: Where housing markets exclude migrants from formal residential areas, spatial concentration in floodplains and coastal margins is structurally determined. As climate-induced migration volumes increase, density and spread of settlement in high-risk zones will increase correspondingly. Sources: Black et al. (2011); Amankwah (2017); UN-Habitat (2020).

Proposition 2: Informal settlement expansion in ecologically vulnerable locations increases urban exposure to compound climate hazards.

Rationale: Settlement on floodplains and coastal margins structurally amplifies flooding, heat stress, and disease burden relative to formally planned areas experiencing equivalent climatic events. Urban vulnerability is as much an output of settlement form as of climate intensity. Sources: Owusu et al. (2020); Nyamekye et al. (2021); Wisner et al. (2004).

Proposition 3: Adaptive governance moderates the relationship between informal settlement expansion and urban climate vulnerability.

Rationale: Coherent, participatory, and polycentric governance can interrupt vulnerability-generating dynamics through tenure regularisation, community-managed green infrastructure, and participatory hazard mapping. Fragmented, engineering-biased, and exclusionary governance reinforces vulnerability constituting maladaptation. Sources: Folke et al. (2005); Ostrom (2010); Meerow et al. (2016).

Proposition 4: Participatory planning that integrates informal settlement residents as co-producers of adaptation strategy improves urban resilience outcomes.

Rationale: Informal residents possess granular, experiential knowledge of local hazard patterns that formal technical assessments routinely fail to capture. Planning processes that systematically incorporate this knowledge produce adaptation strategies better calibrated to actual risk profiles. Sources: Chmutina & von Meding (2019); Folke et al. (2005); Ostrom (1990).

Systems Thinking: The Vulnerability Feedback Spiral

Reinforcing Loop R1

A critical limitation of conventional vulnerability assessments is their implicit linearity. Understanding urban resilience in Accra requires analysing how system outputs (deepened vulnerability, reduced household capacity) feedback as new inputs (renewed migration pressure, further settlement in the most hazardous available land), completing Reinforcing Loop R1 and making each cycle through the system more severe than the last. Figure 4 presents the complete systems dynamics feedback loop alongside the governance bifurcation that determines whether R1 is interrupted or sustained.

Figure 4. Systems Dynamics Feedback Loop -- Reinforcing Loop R1

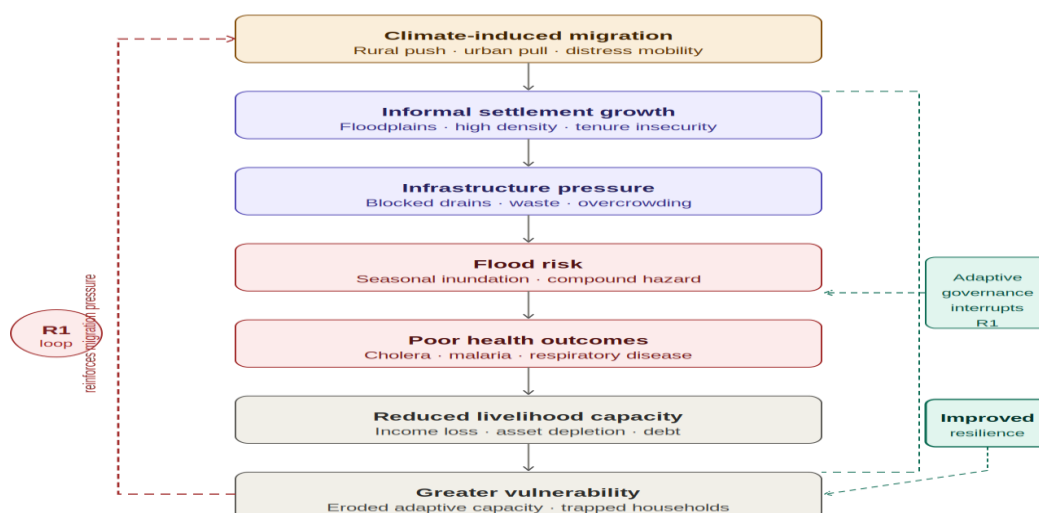


Figure 4. Systems Dynamics Feedback Loop — Reinforcing Loop R1 (Twumasi, 2026)
Red dashed spine = self-reinforcing vulnerability spiral. Teal dashed = adaptive governance interruption.

Source: Authors' own conceptualisation. The red dashed spine (left) traces Reinforcing Loop R1 the self-amplifying vulnerability spiral. The teal dashed path (right) shows how adaptive governance interrupts R1. The R1 badge marks the loop's analytical identity.

Reading the Feedback Spiral

Reading Figure 4 from top to bottom along the left column traces R1: climate-induced migration generates informal settlement growth, which creates infrastructure pressure, which intensifies flood risk, which produces poor health outcomes, which erodes livelihood capacity, which deepens vulnerability and which increases migration pressure from others in equivalent circumstances, completing the loop. Three dynamics obscured by linear analysis are made visible: R1 has no natural stopping point; it operates across scales from household to community; and it has temporal lags that require lag-sensitive monitoring systems in any governance response.

The Governance Bifurcation

At the governance response node, governance can take one of two paths. The maladaptive path forced evictions, siloed planning, infrastructure-dominated responses does not interrupt R1; it merely relocates vulnerable households while destroying their adaptive resources. The adaptive path participatory planning, incremental tenure regularisation, green infrastructure investment has the potential to break R1 by reducing the structural conditions that generate vulnerability in the first place.

The Adaptive Governance Framework

Five-Tier Architecture

The Adaptive Governance Framework (Figure 5) operationalises the governance component of the CMIVGR model by specifying the institutional architecture through which adaptive governance is delivered. The framework is organised as a five-tier hierarchy national policy, local government, community participation, adaptive planning, and urban resilience with three cross-cutting governance mechanisms (feedback loops M1, polycentric authority M2, and institutional learning M3) operating across all tiers. An upward accountability feedback arrow on the left spine indicates that the system is not a top-down hierarchy but a two-directional governance architecture in which local knowledge and community accountability flow upward to condition all higher-level decisions.

Figure 5. Adaptive Governance Framework for Urban Resilience

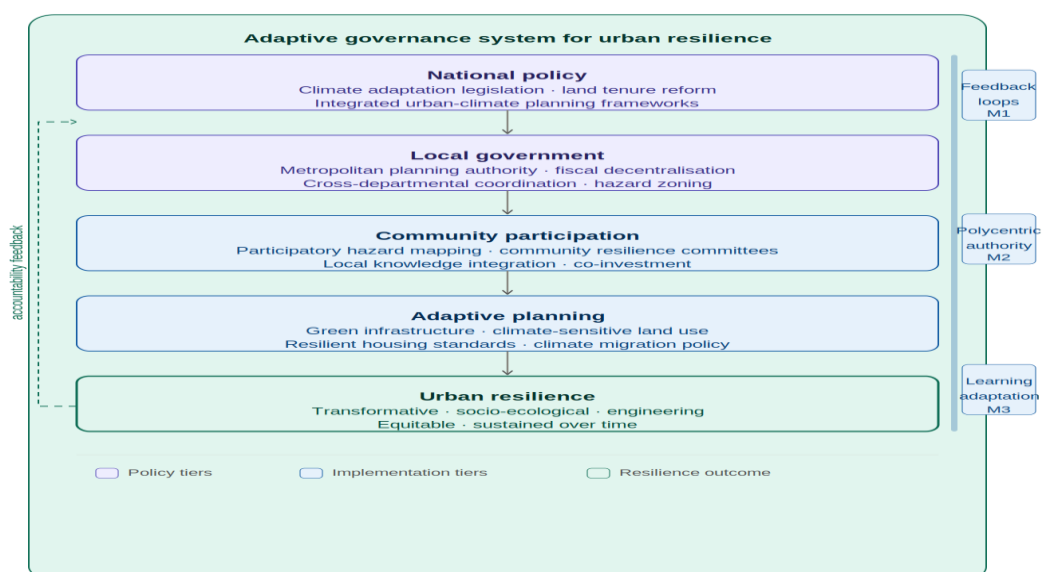


Figure 5. Adaptive Governance Framework for Urban Resilience (Twumasi, 2026)
M1-M3 = cross-cutting governance mechanisms. Upward dashed arrow = accountability feedback loop.

Source: Authors' own conceptualisation. M1-M3 = cross-cutting governance mechanisms (feedback loops, polycentric authority, institutional learning). The upward dashed arrow indicates accountability and local knowledge flowing upward through the governance system.

How the Framework Relates to the Propositions

Propositions 3 and 4 together specify the mechanism through which the Adaptive Governance Framework produces resilience improvement. Proposition 3 identifies adaptive governance quality as the decisive mediating variable in the CMIVGR pathway the factor that determines whether the settlement-vulnerability relationship is attenuated or reinforced. Proposition 4 specifies the epistemic mechanism: governance that integrates informal residents' knowledge into planning processes (Tier 3, Community Participation) generates adaptation strategies better calibrated to actual risk profiles, more likely to achieve community investment, and more sustainable over time than technically expert but community-exclusive alternatives. The Framework's five-tier architecture provides the institutional scaffolding through which both propositions can be operationalised in practice.

Multi-Level Governance Model

Nested Scales of Authority

The Multi-Level Governance Model (Figure 6) situates the five-tier Adaptive Governance Framework within the broader institutional landscape from which policy authority flows. The model is constructed as a set of nested containers: international institutions set the normative and scientific context (IPCC, UNFCCC, UN-Habitat, World Bank, WASCAL); national governments translate this context into legislation, fiscal arrangements, and regulatory frameworks; city and metropolitan authorities implement planning and service delivery; community organisations participate in and co-govern adaptation processes; and households make migration, livelihood, and investment decisions that both reflect and shape all higher scales.

Figure 6. Multi-Level Governance Model for Climate-Resilient Cities

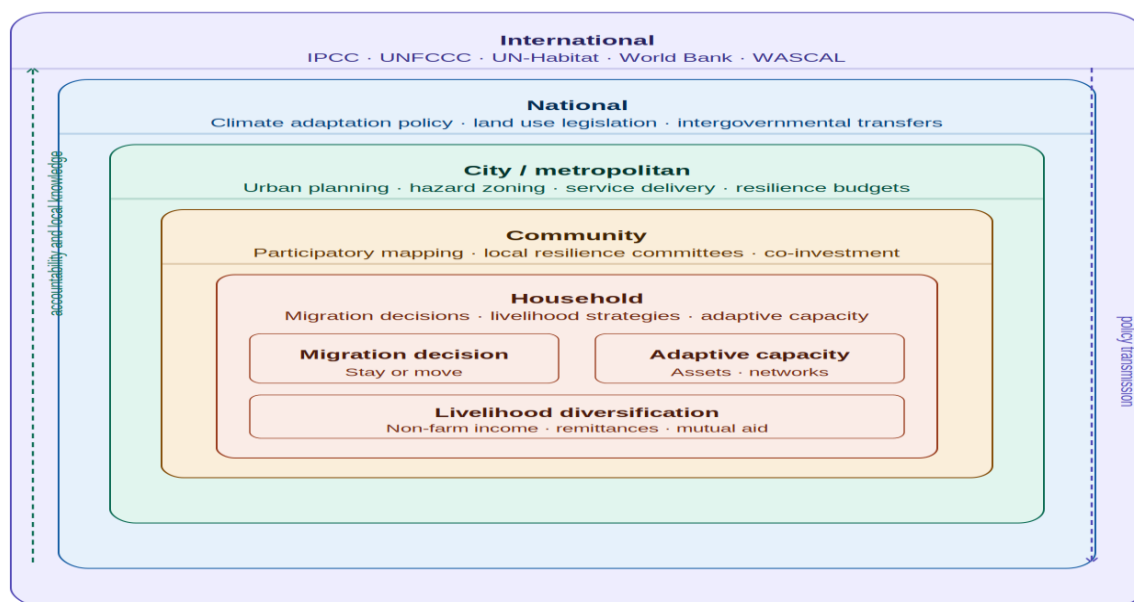


Figure 6. Multi-Level Governance Model for Climate-Resilient Cities (Twumasi, 2026)
Each scale contains and conditions inner scales. Downward dashed = policy; upward dashed = accountability.

Source: Authors' own conceptualisation. Each scale contains and conditions inner scales. The downward dashed arrow (right) indicates policy transmission from international to household levels. The upward dashed arrow (left) indicates accountability and local knowledge flowing upward. Nesting represents institutional containment: each scale operates within and is constrained by the scales that contain it.

Cross-Scale Dynamics

The Multi-Level Governance Model reveals three cross-scale dynamics that the five-tier Adaptive Governance Framework alone cannot capture. First, policy incoherence occurs not only within levels (between departments at the city level, as documented in Accra) but across levels (between national adaptation legislation and city planning frameworks, or between international donor priorities and local governance realities). Second, the household level the innermost scale is not merely a recipient of policy from above but an active generator of the migration, livelihood, and investment decisions that produce the informal settlement patterns that all higher scales must then govern. Third, the international level is not simply an external context but an active participant in governance failure: donor financing cycles, international reporting requirements, and development bank project modalities directly shape which governance investments receive funding, and which do not.

Framework Application: Accra, Ghana

Climate Stress and Migration

Northern Ghana's ecological zones are experiencing measurable shifts in precipitation patterns, with declining and more variable annual rainfall and increasing incidence of dry spell events within growing seasons (Ghana EPA, 2021). The Bagre Dam in Burkina Faso catalyses cyclical displacement that feeds rural-to-urban migration southward (Owusu & Afutu-Kotey, 2019). Government programmes such as One Village and One Dam have sought to address agricultural water insecurity in situ, but the evidence on their effectiveness is mixed they address water scarcity without engaging the broader structural reasons that young people leave (Teye & Yaro, 2021).

Informal Settlement Expansion

Old Fadama located on the floodplain of the Odaw River adjacent to the Korle Lagoon illustrates Proposition 2 with clarity. The settlement houses approximately 80,000 residents, many of whom are migrants from northern Ghana, and is inundated regularly during intense rainfall (Stoler et al., 2012). Its persistence and growth despite obvious hazardousness reflects the housing market exclusion mechanism theorised in Component 3: there is simply nowhere else affordable to go.

Multi-Dimensional Vulnerability

The 3rd of June 2015 flood-fire disaster in which simultaneous flooding and a petrol station explosion killed over 150 people stands as the most catastrophic recent illustration of compound vulnerability. Flooding severity has increased over the past decade (Nyamekye et al., 2021). Heat stress is amplified by the near-complete absence of green space and the prevalence of heat-absorbing metal roofing. When flooding occurs, the absence of sewerage infrastructure disperses faecal matter across settlement surfaces, creating conditions for cholera, typhoid, and malaria (Dsane-Selby et al., 2020).

Governance Failures and Maladaptation

The dominant governance response to flood risk in Accra has been engineering-oriented: drainage channel construction, flood barrier installation, and eviction of residents from high-risk zones. Forced evictions from Old Fadama merely relocate vulnerable households while destroying the social networks and

economic assets that constitute their primary adaptive resources (Owusu & Afutu-Kotey, 2019). This is precisely the maladaptive path in Figure 4: it fails to interrupt R1 and may accelerate it.

Comparative Cross-City Analysis

Rationale

Comparative analysis is an internal methodological requirement of the CMIVGR framework: if the framework claims generalisability, it must be tested against cases with different ecological zones, governance regimes, and economic profiles. The five cities selected provide precisely this variation while sharing rapid urbanisation, significant climate-induced in-migration, large informal settlement populations, and documented compound climate vulnerability.

Table 3. Comparative CMIVGR Analysis: Five West African Cities

Dimension	Accra	Lagos	Dakar	Abidjan	Freetown
Climate Stressor	Drought / Bagre Dam spillage	Desertification (Lake Chad); coastal erosion	Sahel drought; tidal coastal erosion	Rainfall variability; heat	Intense rainfall; deforestation-induced landslide
Key Settlement	Old Fadama / Agbogbloshie	Makoko / Badia East	Pikine Irregulier Nord	Abobo / Adjame	Freetown East End / Kroo Bay
Primary Hazard	Flooding + heat stress + disease	Coastal flooding + cholera	Tidal flooding + sanitation deficit	Urban flooding + heat island	Landslide + flooding + cholera
Governance Approach	Engineering bias; rural containment (1V1D); eviction	Federal-state incoherence; mass eviction	Post-disaster relocation; participatory upgrading pilots	Urban densification; limited tenure reform	Community-driven resilience (Build Back Better); donor-dependent
Governance Assessment	Predominantly maladaptive	Predominantly maladaptive	Mixed: pilots promising, scale limited	Mixed: upgrading underway, coherence weak	Adaptive elements present; sustainability fragile
Key Reference	Owusu & Afutu-Kotey (2019)	Ajibade et al. (2016)	Diagne (2007); Diouf et al. (2021)	Kone et al. (2019)	Sorg et al. (2018)

Sources: Adelekan (2010); Ajibade et al. (2016); Diagne (2007); Diouf et al. (2021); Fournet et al. (2020); Ghana EPA (2021); Kone et al. (2019); Owusu & Afutu-Kotey (2019); Sorg et al. (2018); World Bank (2021).

Cross-City Synthesis

Three cross-cutting findings emerge. First, the migration-to-informal-settlement mechanism theorised in Proposition 1 operates consistently across all five cities. Second, the governance bifurcation theorised in Figure 4 is empirically observed in all five cases, with Lagos at the maladaptive pole, Dakar and Freetown showing the most advanced movement toward adaptive governance, and Accra and Abidjan occupying a middle position of structural incoherence. Third, the comparative analysis reveals a boundary condition: the relationship between state institutional capacity and the achievability of adaptive governance. In low-capacity contexts like Freetown, the prerequisites for adaptive governance must themselves be built before the Framework in Figure 5 can be effectively operationalised.

The Resilience-Governance Bridge: Overcoming Institutional Inertia

The transition from mal-adaptive, engineering-heavy responses to the transformative resilience proposed in the CMIVGR framework faces a significant barrier: **Institutional Inertia**. In the WASCAL-region cities analyzed, governance structures are historically designed for stability rather than agility, making them poorly suited for the high-uncertainty, high-velocity dynamics of climate migration. To overcome this, the following three "bridge" mechanisms must be integrated into the governance architecture:

1. **Metric Redefinition:** Currently, city resilience is often measured by the completion of infrastructure projects (e.g., kilometers of drains). Transitioning to adaptive governance requires new metrics that track the *reduction of vulnerability* (e.g., changes in household income stability post-hazard events, or the percentage of residents with tenure-like security).
2. **Budgetary Flexibility (The "Resilience Fund"):** Standard municipal budgets are typically line-itemed by sector (e.g., housing, water, works). Establishing cross-sectoral, multi-year "Resilience Funds" allows for the simultaneous implementation of interventions—such as pairing drainage construction with community-led settlement upgrading—that single-sector budgets systematically prevent.
3. **Knowledge Hybridization:** The divide between "expert" (technical/engineering) and "experiential" (community-based) knowledge is a primary driver of maladaptation. The proposed framework advocates for the formalization of "Knowledge Hybridization Committees." These bodies would hold the mandate to reconcile conflicting technical data with local hazard experiences, ensuring that resilience investments are grounded in the lived realities of informal settlers, thereby minimizing project rejection and maximizing local co-investment. These bridge mechanisms transform the adaptive governance framework from a high-level conceptual model into an actionable, daily governance reality. Without them, policy roadmaps remain aspirational; with them, they become the engine of institutional transformation.

Discussion

Why Governance Characteristically Fails

The governance failures documented across all five cities are not primarily failures of knowledge or intention. They are structurally predictable outcomes of institutional arrangements poorly matched to the socio-ecological realities they are supposed to govern. Three structural mechanisms are identifiable. The revenue-legitimacy trap produces systematic underfunding of informal settlement resilience because local governments derive revenue from the formal economy while most of their population resides in the informal sector. Planning-adaptation disjunction means that climate adaptation policy and urban planning are developed through separate institutional processes, financed through different budget lines, and evaluated against different metrics generating the policy incoherence visible across all five cases. Donor-driven policy displacement means that international financing cycles systematically prioritise discrete,

measurable engineering deliverables over slower, less measurable institutional investments producing cities that are chronically over-engineered and under-institutionalised.

Why Engineering Solutions Are Insufficient

Engineering solutions address symptoms rather than causes. The flooding of Old Fadama is not primarily caused by rainfall intensity; it is caused by settlement on a floodplain with absent drainage infrastructure, which is itself caused by housing market exclusion, which is itself caused by rapid climate-induced migration and inadequate affordable housing supply. A drainage channel addresses the proximate cause while leaving the structural causes intact. Furthermore, engineering solutions are spatially and politically mismatched to the highest-vulnerability locations, which receive disproportionately little infrastructure investment. And they produce a false sense of achieved resilience that delays the institutional reform that transformative resilience requires.

Why Migration Should Be Viewed as Adaptation

The dominant policy framing treats mobility as a problem to be prevented through rural containment strategies. This is empirically questionable: migration often improves household welfare relative to the counterfactual of remaining in a deteriorating rural environment. Normatively, treating migration as failure implies that people should remain in place even when their environment can no longer sustain them placing the burden of climate adaptation on the most vulnerable populations in the most exposed locations. The reframing of migration as adaptation has direct governance implications: cities should develop explicit climate migration strategies that plan for managed in-migration as a legitimate outcome rather than a policy failure.

Why Resilience Requires Institutional Transformation

The forms of resilience achievable through governance-as-usual are insufficient to interrupt Reinforcing Loop R1. Only transformative resilience in the sense of fundamental restructuring of the socio-ecological arrangements that generate vulnerability can accomplish that. And transformative resilience, by definition, requires institutional transformation: changes not merely in what governance does but in how governance is organised, who participates in it, and what interests it is structurally designed to serve. Four dimensions are implied: redistributed authority, changed performance metrics, lengthened time horizons, and repositioned informal settlement residents from objects to subjects of governance.

Policy Implications: A Six-Pillar Governance Roadmap

The Discussion identifies institutional transformation as the necessary condition for breaking Reinforcing Loop R1 and achieving transformative urban resilience. The following six policy pillars translate this theoretical claim into a governance roadmap. The pillars are presented as an integrated system rather than a menu of options: their power comes from their interaction, and implementing one without the other risks substituting a new form of partial solution for the engineering bias the roadmap seeks to replace.

I Climate-Sensitive Land-Use Planning

Integrating climate hazard mapping into all phases of urban land-use planning designating ecologically hazardous zones as priority exclusion zones with binding development restrictions, while simultaneously designating affordable housing development zones in ecologically safer locations. Hazard-adjusted development standards must be mandated in national urban planning legislation and evaluated against population distribution metrics rather than hectares zoned.

II Resilient and Affordable Housing

Scaled public investment in affordable serviced housing in ecologically safer locations to absorb incoming migration without channelling it to exposed areas; in situ upgrading of existing informal settlements with materials-based resilience standards; and financing innovations (community mortgage instruments, incremental building loan products, cooperative land-tenure structures) that allow informal residents to invest in housing improvement without the tenure security that formal mortgage systems require as a precondition.

III Green Infrastructure at Settlement Scale

Urban forestry, bioswales, permeable pavement, rooftop greening, and community gardens restore natural systems that provide flood attenuation, temperature regulation, and stormwater management as ecosystem services. Green infrastructure delivers multiple co-benefits simultaneously a bioswale attenuates flooding and reduces heat island effects making it among the highest-return adaptation investments available to WASCAL-region cities operating under fiscal constraint.

IV Participatory Planning and Community Knowledge Integration

Institutionalising community participation in mandatory planning processes with legal standing, adequate resourcing, and genuine decision-making authority. Concretely: formalising community-based hazard mapping as a required input into municipal risk assessments; establishing community resilience committees with formal seats in metropolitan planning bodies; allocating participatory resilience budgets; and designing monitoring systems that capture community-reported vulnerability trajectories alongside technical hazard metrics.

V Climate Migration Policy

At the source end, rural adaptation programming should be designed to make staying viable for those who choose to stay, while also designing for managed out-migration as a legitimate outcome. At the destination end, cities should develop explicit climate migration strategies: projected in-migration volumes under different climate scenarios; land and housing supply responses scaled to those projections; rapid integration programmes for newly arrived migrants; and monitoring systems that track migrant settlement patterns to enable early intervention before informal settlements on ecologically hazardous land become entrenched.

VI Integrated Urban Governance

Creating cross-sectoral metropolitan resilience bodies with genuine authority over land use, infrastructure, housing, and adaptation investment; redesigning intergovernmental fiscal arrangements to provide municipal governments with the revenue base to sustain long-horizon institutional investments; integrating climate risk assessment into all infrastructure investment decisions; and developing regional governance platforms building on WASCAL's existing infrastructure that enable cross-city learning and coordinated policy development across the nine WASCAL-member countries.

Conclusion: Statement of Contribution

This paper sets out to integrate four disconnected research streams climate-induced migration, informal urbanisation, urban resilience, and adaptive governance into a single coherent analytical framework capable of explaining both why vulnerability is produced and what governance would need to do to interrupt its production. The CMIVGR framework, the four theoretical propositions, the four original

figures, the systems feedback analysis, the comparative five-city analysis, the strengthened discussion, and the six-pillar policy roadmap together constitute a theoretical and practical contribution more than the sum of its parts.

C1 **Integration of four disconnected research streams**

The climate-induced migration literature, the urban informality literature, the urban resilience literature, and the adaptive governance literature have each generated important insights that have largely developed without reference to one another. The CMIVGR framework is among the first to construct an explicit multi-component architecture specifying the causal mechanisms connecting all four domains, creating a shared analytical vocabulary through which scholars and practitioners across all four streams can engage with evidence and arguments from the others.

C2 **A new conceptual framework with four original figures and testable propositions**

The paper produces four original visual figures the CMIVGR Conceptual Framework (Figure 3), the Systems Dynamics Feedback Loop (Figure 4), the Adaptive Governance Framework (Figure 5), and the Multi-Level Governance Model (Figure 6) alongside four falsifiable propositions that together constitute a theory-building contribution and a structured research agenda for cumulative knowledge development.

C3 **Migration as a causal pathway linking rural climate stress to urban vulnerability**

The paper conceptualises migration not as a separate phenomenon to be explained by climate change, nor as an autonomous driver of urban risk, but as the causal pathway through which rural ecological stress is converted into urban climate vulnerability. This framing resolves a puzzle in the existing literature: why urban vulnerability in Accra and comparable cities is so closely correlated with migration flows, and why in situ urban adaptation investments that do not engage with the migration-housing market-settlement dynamic consistently underperform.

C4 **A governance roadmap for climate-resilient African cities**

The six-pillar roadmap climate-sensitive land-use planning, resilient and affordable housing, green infrastructure, participatory planning, climate migration policy, and integrated urban governance is grounded in theoretical analysis and validated against comparative evidence from five cities. It is presented as an integrated system that specifies not just what cities should do but how governance must be reorganised to make doing it structurally possible constituting a governance transformation agenda for the WASCAL region.

The path toward climate-resilient cities in West Africa is long, politically demanding, and unlikely to be travelled without sustained commitment from national governments, municipal authorities, regional platforms like WASCAL, and international development partners. The CMIVGR framework, its six figures, and its governance roadmap do not make that path shorter or easier. But they make it clearer which is the precondition for beginning to walk it.

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