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ARTICLE

Urbanisation with a Human Face: Lessons from Chinese Eco-Cities for Climate-Resilient Planning in Lilongwe, Malawi

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Abstract

Rapid urbanisation across sub-Saharan Africa presents both opportunities and challenges, with cities like Lilongwe in Malawi struggling to accommodate population growth while addressing climate vulnerability and infrastructure deficits. This paper examines the transferability of Chinese eco-city principles, particularly the Sponge City Programme and green infrastructure approaches, to the Malawian urban context. Drawing on constructivist theories of policy diffusion and South-South cooperation, the study employs qualitative comparative policy analysis to assess the institutional, financial, and governance conditions shaping eco-urbanism in both countries. The study draws on recent scholarship on community-based flood adaptation in informal settlements to contextualise Lilongwe's vulnerability within broader Global South patterns. The study finds that while Chinese eco-city models offer valuable technical innovations, their direct transplantation to Lilongwe is constrained by fundamental differences in institutional capacity, fiscal resources, urban governance structures, and land tenure systems. However, specific principles, including community-led green infrastructure, multi-functional public space design, and incremental retrofitting approaches, demonstrate potential for adaptation through what we term "Vernacular Eco-Urbanism." This concept refers to the contextual integration of global best practices with local knowledge systems, institutional capabilities, and existing urban fabrics; prioritising function over form, incremental over comprehensive implementation, and participatory over technocratic decision-making. The paper contributes to decolonising urban studies by challenging unidirectional North-South policy transfer frameworks and proposing a more holistic approach to South-South urban learning that centres local agency and institutional realities.

Keywords: Eco-Cities; Policy Diffusion; South-South Cooperation; Urban Resilience; Sponge City Programme

1. INTRODUCTION

Sub-Saharan Africa is urbanising at an unprecedented pace. By 2050, the region's urban population is projected to nearly triple, adding 800 million people to cities already struggling with infrastructure deficits, informal settlements, and climate vulnerability [35]. Malawi exemplifies these challenges. As one of the fastest-urbanising countries in Africa, its urban population grows at approximately 4.2% annually, with Lilongwe, the capital city, expanding from fewer than 100,000 residents at independence in 1964 to over 1.2 million today [24]. This growth has outpaced institutional capacity, leaving the city with fragmented infrastructure, inadequate stormwater management, and growing environmental degradation [31]. Manda [17] provides comprehensive documentation of Malawi's urbanisation trajectory, noting that the absence of coherent urban policy has perpetuated spatial inequality and infrastructure deficits since independence.

Simultaneously, China has emerged as a global laboratory for urban sustainability innovation. Since 2014, the Sponge City Programme has been implemented across more than 600 Chinese cities, representing the world's largest government-led initiative in green infrastructure [3]. Chikhi et al. [4] provide a comprehensive review of Sponge City implementation, documenting significant

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improvements in stormwater management and urban water quality across demonstration cities. Similarly, Han et al. [6] employ ArcGIS and econometric analysis to demonstrate that sponge city construction significantly enhances urban eco-efficiency, particularly in cities with higher implementation intensity. Further, Su et al. [34] affirm the programme's ecological value, finding that sponge city infrastructure increased urban plant diversity by over 50% in Wuxi City's demonstration zone, while Liu et al. [14] propose zoning construction strategies that align sponge city development with new quality productive forces in Suzhou.

The programme integrates blue-green-grey infrastructure to manage stormwater, enhance biodiversity, and build climate resilience through approaches ranging from rain gardens and bioswales to permeable pavements and wetland restoration [21]. Lu et al. [15] examine the development of roadside green swales within the Sponge City Programme, identifying both technical challenges and opportunities for integrating green infrastructure into urban transport corridors. Recent scholarship demonstrates that sponge city construction has increased urban plant diversity by over 50% in demonstration zones, positioning the initiative as a dual-benefit solution for flood control and ecological enhancement [40].

The convergence of Africa's urgent urban challenges and China's demonstrated innovations has generated considerable interest in South-South policy learning. As the United Nations Office for South-South Cooperation emphasises, developing countries increasingly seek to exchange solutions grounded in mutual experience rather than importing Northern models [36]. China's engagement in African infrastructure development has created channels for such exchange, yet questions persist about the transferability of Chinese urban models to fundamentally different institutional, economic, and social contexts [18].

This article focuses on the absence of systematic analysis examining how Chinese eco-city principles might inform urban planning in specific African cities. While literature on China-Africa urban cooperation has grown [20,28], most studies adopt macro-level perspectives on infrastructure financing or diplomatic relations. According to Watson [38] and Parnell & Pieterse [26], few investigate the micro-level transferability of specific urban innovations or engage deeply with recipient country institutions and knowledge systems. Bhanye [2] addresses this gap through a comprehensive review of community-based flood adaptation in informal settlements across the Global South, demonstrating that effective resilience-building must centre local knowledge and participatory approaches rather than imported technical solutions.

In this study, we focus on Lilongwe for three reasons. First, as Malawi's political and administrative capital, it concentrates national policymaking capacity and donor engagement, creating potential leverage for innovation. Second, the city faces acute climate vulnerabilities, including recurrent flooding in informal settlements and deteriorating water quality in the Lingadzi and Lilongwe rivers that traverse the urban area. Nazombe & Nambazo [25] document significant urban green space loss and fragmentation in Malawi's four major cities between 1986 and 2021, with Lilongwe experiencing particularly severe degradation of natural assets essential for climate resilience. This empirical evidence underscores the urgency of integrating green infrastructure into urban planning. Third, existing research on Lilongwe's planning challenges, including limited Geographic Information System (GIS) capacity, outdated regulatory frameworks, and weak inter-agency coordination [10,31], provides an empirical foundation for assessing transferability constraints. Kayuni [13] offers essential historical and contemporary context, demonstrating how development policy and politics in Malawi have been shaped by colonial legacies and post-independence power dynamics, creating path dependencies that continue to constrain urban policy options.

We therefore ask: Which principles from Chinese eco-city development are potentially transferable to Lilongwe's urban planning context, and what institutional, financial, and governance conditions shape their adaptability? We draw on constructivist theories of policy diffusion and South-South cooperation to address this fundamental question.

The paper proceeds in five sections. Following this introduction, Section 2 develops the theoretical framework integrating policy diffusion theory, Southern urbanism critiques, and institutional analysis. Section 3 outlines the qualitative comparative methodology. Section 4 presents findings on Chinese eco-city models and Lilongwe's urban planning context. Section 5 analyses

transferability across institutional, financial, and governance dimensions. Section 6 concludes with policy recommendations and research implications.

2. THEORETICAL FRAMEWORK

Understanding whether Chinese eco-city principles can inform Lilongwe's urban development requires analytical tools that move beyond simplistic benchmarking. This section develops an integrated theoretical framework drawing from three complementary bodies of scholarship. First, we engage constructivist approaches to policy diffusion, which illuminate how policies circulate globally not merely as technical solutions but as carriers of norms, ideas, and legitimacy. Second, we incorporate insights from Southern urbanism critiques, which challenge the applicability of Northern-derived urban models to African contexts characterised by informality, institutional fragmentation, and contested governance. Third, we synthesise these perspectives through an institutional compatibility framework that identifies specific regulatory, fiscal, capacity, and governance conditions shaping transferability. Together, these theoretical resources enable a textured analysis of what might transfer, what must adapt, and what cannot travel between fundamentally different urban contexts.

2.1. Constructivist Approaches to Policy Diffusion

Policy diffusion scholarship has evolved from rationalist models emphasising efficiency-driven adoption toward constructivist approaches attending to the social construction of policy legitimacy [32]. Constructivists argue that policies diffuse not merely because they work, but because they embody norms, ideas, and discourses that render them attractive to adopting jurisdictions [1]. This perspective highlights why Chinese eco-city models attract African policymakers. They represent successful development from a fellow 'Global South' nation, embed discourses of ecological civilisation and harmonious development, and arrive packaged with infrastructure financing [20,28].

However, as Stone [33] posits, constructivist diffusion theory has been criticised for neglecting the "translation" work that policies undergo as they move across contexts. Hassenteufel [7] develops this critique further, arguing that policy translation involves not merely adaptation but fundamental reinterpretation as policies encounter different institutional configurations, actor constellations, and meaning systems. This translational perspective is essential for understanding how Chinese eco-city principles might be recontextualised in Malawian settings. Policies are not discrete technical packages but assemblages of ideas, practices, and institutional arrangements that must be reinterpreted within new settings. This translation process involves what Mukhtarov & Daniell [22] term "policy adaptation," the creative modification of imported models to fit local conditions, institutional capabilities, and political dynamics.

2.2. Southern Urbanism and the Critique of Policy Transfer

Scholarship on Southern urbanism fundamentally challenges the assumptions underlying conventional policy transfer. Robinson [29] argues that urban theory has been distorted by over-reliance on Northern experiences, producing analytical frameworks ill-suited to cities where informality, infrastructure deficits, and institutional fragmentation are normative rather than exceptional. Anchoring on the same thought, Watson [38] demonstrates that attempts to transplant world-class urban models to African cities consistently fail because they ignore the everyday practices through which most residents access land, housing, and services.

This critique has particular resonance for eco-city transfers. Sponge city programmes in China operate within contexts of strong state capacity, formal land tenure, sophisticated technical expertise, and substantial fiscal resources [3,5]. African cities like Lilongwe feature weak institutional capacity, contested land rights, limited technical cadres, and constrained municipal finances. Satterthwaite et al. [30] provide extensive evidence that building climate resilience in informal settlements requires fundamentally different approaches than those appropriate for formal urban areas, emphasising community-led upgrading, secure tenure, and basic service provision as prerequisites for any resilience intervention. Similarly, John [12] demonstrates, through research in Dar es Salaam, that household-level adaptation in informal settlements is constrained by structural factors including insecure tenure, inadequate infrastructure, and limited institutional support, findings directly relevant to Lilongwe's

informal communities. Transferring technical designs without addressing these foundational differences reproduces what Parnell & Pieterse [26] term "policy tourism," the superficial circulation of best practices disconnected from implementation realities.

2.3. South-South Cooperation and Horizontal Learning

South-South cooperation frameworks offer alternative conceptualisations of policy exchange. Unlike North-South technical assistance, which often positions Northern countries as knowledge producers and Southern countries as recipients, South-South cooperation emphasises horizontal learning, mutual benefit, and respect for national sovereignty [37]. The United Nations Office for South-South Cooperation frames this as knowledge exchange among development partners rather than donors and recipients, creating space for more equitable policy dialogue [36]. Hendra et al. [8] provide a systematic review of vertical-horizontal actor collaboration in governance networks, demonstrating that effective South-South policy learning requires institutional mechanisms that bridge different scales of governance while respecting local autonomy.

However, critical scholars caution against romanticising South-South cooperation. Mawdsley [18] documents how Chinese engagement in Africa often reproduces asymmetrical relationships, with knowledge flowing primarily from China to Africa rather than bidirectionally. Echoing the same, Muñoz [23] argues that horizontal cooperation rhetoric can mask continued dependence on Chinese technical expertise, financing, and models, raising questions about whether genuine policy learning occurs.

2.4. Institutional Compatibility Framework

To operationalise these theoretical insights, we develop an institutional compatibility framework for assessing policy transferability. Drawing on historical institutionalism [27] and comparative public policy [9], we identify four institutional dimensions shaping transfer potential:

a) Regulatory compatibility: This is the alignment between policy models and existing legal frameworks, planning regulations, and administrative procedures. Chinese eco-city implementation relies on national guidelines [5], provincial mandates, and municipal enforcement capacity—institutional features that may not exist in Malawian contexts [19]. Malik et al. [16] examine challenges in implementing sustainable construction practices in Malawi, identifying regulatory gaps, enforcement weaknesses, and limited technical capacity as persistent barriers that would similarly constrain eco-city principle adoption.

b) Fiscal compatibility: The match between policy resource requirements and available financial capacity. Chinese sponge city construction has benefited from approximately ¥560 billion (US$80 billion) in investment during the 14th Five-Year Plan period [34]. Liu et al. [14] provide a detailed analysis of investment mechanisms, demonstrating how Suzhou integrated public and private finance to achieve sponge city objectives—a model that presupposes fiscal and institutional capacities unavailable in Malawian municipalities. In contrast, Lilongwe City Council collects less than K1.5 billion (US$860,000) monthly and struggles to finance even priority projects [10]. Hussein [11] further documents the challenges of local development planning in Malawi, revealing that district councils lack both the financial resources and technical capacity to implement statutory plans, let alone innovative green infrastructure initiatives.

c) Capacity compatibility: The alignment between policy technical requirements and available human resources. Chinese eco-city programmes deploy sophisticated geographic information systems, hydrological modelling, and engineering expertise [21]; Han et al. [6] demonstrate the integration of ArcGIS and econometric analysis in evaluating sponge city outcomes, illustrating the technical sophistication underlying Chinese implementation. Lilongwe's planning department has limited GIS capacity, leading to reliance on external consultants for mapping exercises [31].

d) Governance compatibility: The match between policy implementation models and existing decision-making structures. Chinese urban governance features strong central-local coordination, clear jurisdictional boundaries, and enforcement mechanisms [3]. Chikhi et al. [4] document how vertical integration across national, provincial, and municipal levels

enables coordinated sponge city implementation in China. Malawian urban governance, on the other hand, involves fragmented responsibilities among central government, city councils, traditional authorities, and informal actors, with limited enforcement capacity [10].

This framework guides our comparative analysis, enabling systematic assessment of where Chinese eco-city principles might transfer and where adaptation or alternative approaches are necessary.

3. RESEARCH METHODOLOGY

This study employs a qualitative comparative case study design examining policy transferability between Chinese eco-city programmes and Lilongwe, Malawi. China's Sponge City Programme serves as the source case, and Lilongwe's planning system as the recipient case. Data collection integrates documentary analysis of policy texts from both countries, peer-reviewed scholarship, and semi-structured questionnaires with seven key informants, including Chinese urban planning scholars, Malawian officials, and development practitioners. Thematic analysis within our institutional compatibility framework guides interpretation, with explicit attention to author positionality.

3.1. Comparative Case Study Design

The comparative case study design is appropriate for exploring complex, context-dependent phenomena where boundaries between phenomenon and context are unclear [39]. We treat China's national eco-city policy framework, particularly the Sponge City Programme, as the 'source case' and Lilongwe's urban planning system as the 'recipient case,' analysing transferability across the institutional dimensions identified above.

3.2. Data Sources and Collection

Data collection proceeded through three streams. First, we conducted documentary analysis of Chinese policy documents, including the Guidelines on Promoting Green Development in Urban and Rural Construction [5], Ministry of Housing and Urban-Rural Development technical standards, and municipal sponge city implementation plans. We also analysed peer-reviewed research on Chinese eco-city outcomes [3,4,6,14,15,21,34] and official reports on zero-waste city expansion.

Second, we analysed Malawian urban policy documents, including the Malawi National Urban Policy [31], Lilongwe City Council development plans, and academic studies of Lilongwe's planning challenges [11,13,16,17,25]. We also drew on media reports documenting infrastructure project implementation and governance issues.

Third, we distributed semi-structured questionnaires to seven key informants between November 2025 and January 2026. Informants included two Chinese urban planning scholars specialising in eco-city development; three Malawian urban planners and officials (two from Lilongwe City Council and one from the Ministry of Lands); and two international development practitioners working on urban resilience in Malawi. This sample provided broader perspectives on transferability constraints and opportunities, including practitioner insights on implementation realities. Our approach was informed by Bhanye's [2] methodological insights on studying community-based adaptation, emphasising the importance of capturing local knowledge and lived experience alongside technical expertise.

3.3. Analytical Approach

Data analysis employed thematic analysis within the institutional compatibility framework. We coded interview transcripts and documents for references to regulatory, fiscal, capacity, and governance dimensions, identifying themes related to compatibility, constraint, and adaptation. Analysis proceeded iteratively, moving between the theoretical framework and empirical materials to refine our understanding of transferability conditions. Drawing on Hassenteufel's [7] conceptualisation of policy translation, we paid particular attention to moments where policy principles were reinterpreted or recontextualised by different actors. We used NVivo software for data management and coding.

3.4. Positionality and Limitations

Both authors are graduate students in International Relations at a Chinese university, with one Chinese and one Malawian. This positioning offers advantages, such as access to Chinese-language

sources and Malawian contextual knowledge, alongside limitations. Our institutional location may shape interpretations of Chinese policy; we have addressed this through systematic engagement with critical scholarship and triangulation across diverse sources.

The study has several limitations. First, the sample of seven key informants remains modest for a qualitative comparative study. This limits the diversity of perspectives captured, particularly regarding informal settlement residents and private sector actors. Second, reliance on questionnaire data rather than extended fieldwork in either context constrains depth of contextual understanding, though we draw extensively on published empirical research to mitigate this. Third, the absence of direct observation of planning practices in either Lilongwe or Chinese municipalities means our analysis is mediated through documentary and interview accounts. Future research should address these limitations through extended fieldwork, participatory methods engaging community actors, and larger samples across multiple stakeholder groups.

4. FINDINGS

This section presents findings on the two case contexts, establishing the institutional foundations against which transferability must be assessed. We first examine China's eco-city policy architecture, focusing on the Sponge City Programme's design, implementation mechanisms, and documented outcomes. We then analyse Lilongwe's urban planning context, detailing the institutional fragmentation, infrastructure deficits, capacity constraints, and governance challenges that shape possibilities for eco-urbanism. These parallel accounts provide essential groundwork for the transferability analysis that follows.

4.1. The Chinese Eco-City Model

China's approach to eco-urbanism operates through multi-level governance combining national mandate, provincial coordination, and municipal implementation. The foundational policy document, Guidelines on Promoting Green Development in Urban and Rural Construction [5], establishes objectives for 2025 (establishment of green development systems) and 2035 (comprehensive achievement of urban-rural green development). Key mechanisms include the following:

a) National framework and local experimentation: The central government sets targets, provides technical guidance, and offers incentives while allowing municipal flexibility in implementation [3]. This centralised decentralisation enables innovation within national parameters, producing diverse local models while maintaining policy coherence. Chikhi et al. [4] provide a detailed analysis of this multi-level governance structure, demonstrating how national targets are translated into municipal action plans through performance contracts and fiscal incentives.

b) Sponge City Programme as a flagship initiative: The Sponge City Programme, launched in 2014 and expanded through successive five-year plans, represents the most comprehensive eco-city intervention [21]. As of 2025, over 600 cities participate, with the programme expanding to approximately 200 cities during the 2026-2030 15th Five-Year Plan period. According to Montezuma et al. [21], implementation combines green infrastructure (rain gardens, bioswales, permeable pavements, wetland restoration) with grey infrastructure upgrades and blue infrastructure (water bodies, channels). Lu et al. [15] examine the specific case of roadside green swales, identifying both the technical innovations and institutional arrangements that enable their widespread adoption across Chinese cities.

c) Performance measurement and accountability: Cities undergo annual physical examinations, assessing progress against indicators including flood control capacity, water quality improvement, and green space provision [3]. Han et al. [6] demonstrate how these performance assessments are integrated with ArcGIS and econometric analysis to evaluate eco-efficiency outcomes, providing empirical evidence that guides adaptive management. The results of these assessments influence promotional prospects for municipal leaders, creating strong implementation incentives.

d) Financial mechanisms: Funding combines central government transfers, provincial allocations, municipal budgets, and innovative financing, including green bonds and public-private

partnerships. The 14th Five-Year Plan period saw over 3,000 solid waste treatment projects implemented with a total investment of approximately ¥560 billion [34]. Liu et al. [14] provide a detailed case study of Suzhou, demonstrating how zoning construction strategies aligned with "new quality productive forces" enabled targeted investment in sponge city infrastructure across different urban districts.

Recent research documents substantial outcomes. In Wuxi City's 22.27-square-kilometre demonstration zone, sponge city infrastructure increased plant richness by over 50%, affirming the programme's ecological value. Further, the Three-Point Sponge Policy Approach, integrating design-driven adaptive solutions, has demonstrated effectiveness in enhancing flood resilience across diverse urban districts [21]. Han et al. [6] quantify these benefits through econometric analysis, finding that sponge city construction significantly enhances urban eco-efficiency, with particularly strong effects in cities with higher implementation intensity. Liu et al. [14] complement this with spatially explicit analysis demonstrating how different urban zones require tailored sponge city strategies based on land use, hydrology, and development intensity. These successes reflect not merely technical innovation but institutional capacity to coordinate across sectors, enforce standards, and mobilise resources.

4.2. Lilongwe's Urban Planning Context

Lilongwe's urban development trajectory reflects colonial legacies, post-independence planning choices, and contemporary governance constraints. Designed as a new capital in the 1970s, the city featured low-density development with separate areas for administrative, commercial, and residential functions. Subsequent rapid growth has overwhelmed this modernist template, producing sprawling informal settlements, infrastructure deficits, and environmental degradation. Kayuni [13] situates this trajectory within broader historical and contemporary dynamics of development policy in Malawi, demonstrating how colonial legacies and post-independence power constellations have created path dependencies that continue to constrain urban policy options.

a) Institutional fragmentation: Urban governance involves multiple actors with overlapping responsibilities: Lilongwe City Council (planning, local services); central government ministries (lands, housing, local government); traditional authorities (customary land administration); and development partners (project funding, technical assistance) [10]. Coordination mechanisms are weak, producing implementation gaps and accountability failures. Hussein [11] provides detailed evidence from district councils across Malawi, demonstrating that even statutory planning functions are compromised by fragmented institutional arrangements, limited resources, and weak vertical coordination. This institutional landscape contrasts sharply with the coordinated multi-level governance documented in Chinese sponge city implementation [4,8]. The Parliamentary Committee on Natural Resources recently criticised the council for failing to progress a US$37 million landfill project after seven years of planning, highlighting institutional paralysis.
b) Infrastructure deficits and climate vulnerability: Stormwater management relies on inadequate drainage infrastructure, causing recurrent flooding in low-lying areas. Nazombe & Nambazo [25] document significant loss of urban green space in Lilongwe between 1986 and 2021, with the fragmentation of natural assets that historically provided stormwater absorption and flood regulation. This empirical evidence demonstrates that ecological degradation compounds infrastructure deficits, increasing climate vulnerability. Bhanye [2] provides a broader Global South context, demonstrating that informal settlements face particular climate risks due to location on hazard-prone land, inadequate infrastructure, and limited institutional support, patterns clearly evident in Lilongwe's informal communities. Water quality in the Lilongwe and Lingadzi rivers deteriorates as untreated wastewater and stormwater runoff enter watercourses. In addition, solid waste management remains rudimentary, with the Area 38 dumping site operating beyond capacity while replacement remains unfunded.
c) Capacity constraints: Lilongwe City Council's planning department has limited technical capacity, particularly in geographic information systems and spatial analysis. Research on collaborative mapping of urban natural assets found that limited geographic information system capacity necessitated external consultant engagement, constraining local ownership and institutional learning [31]. Staff shortages, salary constraints, and limited professional

development opportunities compound these challenges. Malik et al. [16] identify similar capacity constraints in their study of sustainable construction practices in Malawi, noting that even when regulatory frameworks exist, limited technical expertise among council staff prevents effective enforcement and innovation. This contrasts sharply with the sophisticated technical capacity documented in Chinese municipalities implementing sponge city programmes [14].

d) Planning regulations and enforcement: Outdated planning laws, many dating to the colonial era, fail to address contemporary challenges, including climate resilience and green infrastructure [19]. Manda [17] traces these regulatory gaps to Malawi's urbanisation history, noting that colonial planning legislation was designed for population control and racial segregation rather than sustainable urban development, and subsequent amendments have failed to fundamentally reform this framework. Even where regulations exist, enforcement is weak due to political interference, resource constraints, and the contested nature of land rights. Developers often proceed without approval, with the city council unable to respond effectively [10]. Kayuni [13] demonstrates how these enforcement challenges reflect deeper political dynamics, with elite interests often benefiting from regulatory ambiguity and weak enforcement.

e) Fiscal constraints: Lilongwe City Council collects less than K1.5 billion (US$860,000) monthly in revenue, and recurrent expenditures consume most resources, leaving limited funds for capital investment. The council's inability to allocate funds for landfill compensation illustrates fiscal rigidity and limited discretionary capacity. Hussein [11] documents similar fiscal constraints across Malawian district councils, noting that locally generated revenue is insufficient to meet statutory responsibilities, creating dependence on central government transfers and donor funding that arrive unpredictably and with conditionalities that may not reflect local priorities. Hussein [10] also observes that external donor funding supports specific projects but creates dependency and misalignment with local priorities.

f) Project implementation challenges: Infrastructure projects consistently experience delays and cost overruns. For example, a key road upgrade in Lilongwe's Old Town, initiated five years ago by Japanese contractor Konoike Construction Company, remains incomplete due to utility relocation challenges, design revisions, and budgetary shortfalls. Malik et al. [16] identify similar implementation challenges in building infrastructure projects across Malawi, citing contractor capacity constraints, payment delays, weak project management, and inadequate supervision as persistent barriers to successful implementation. Such failures erode public confidence and demonstrate implementation capacity deficits.

5. ANALYSIS

Building on the findings above, this section analyses transferability across the four institutional dimensions framing our study. We examine regulatory, fiscal, capacity, and governance compatibility between Chinese eco-city models and Lilongwe's urban context, identifying where alignment exists, where adaptation is necessary, and where fundamental differences preclude direct transfer. The analysis then synthesises these insights into a proposed framework for "Vernacular Eco-Urbanism" that integrates global best practices with local knowledge and institutional realities.

5.1. Regulatory Compatibility

Chinese eco-city implementation operates within a regulatory environment characterised by strong central mandates, clear national standards, and effective enforcement mechanisms [3,5]. Chikhi et al. [4] demonstrate how this regulatory density enables coordinated action across jurisdictions, with national guidelines translated into binding municipal targets and enforced through performance assessment systems that carry career consequences for local officials. Municipal governments implement programmes within frameworks established by national ministries, with performance measured against standardised indicators. This regulatory density enables coordinated action across jurisdictions and sectors.

For its part, Lilongwe's regulatory environment differs fundamentally. Planning laws are outdated, with limited provisions for green infrastructure or climate resilience [19]. Manda [17] traces these gaps to the colonial origins of Malawi's planning legislation, which prioritised spatial separation and administrative control rather than environmental sustainability or climate adaptation. Malik et al. [16] provide contemporary evidence that even where progressive regulations exist, enforcement capacity is severely constrained by limited technical expertise, political interference, and resource shortages. National urban policy exists but lacks implementation mechanisms and enforcement capacity. The absence of mandatory green building standards, stormwater management requirements, or environmental performance targets means eco-city principles would operate in a regulatory vacuum.

However, this difference suggests adaptation rather than rejection of transfer. Rather than seeking to replicate China's regulatory mandate, transfer could focus on developing enabling frameworks appropriate to Malawian institutional realities. This might include incorporating green infrastructure provisions into updated planning legislation; developing voluntary guidelines that developers can adopt for expedited approval; and building council capacity to negotiate green infrastructure contributions from large-scale developments. Such approaches recognise that regulation works differently in contexts where state capacity is limited, emphasising incentive structures and negotiated outcomes rather than command-and-control enforcement.

5.2. Fiscal Compatibility

Chinese eco-city development has benefited from extraordinary fiscal mobilisation. The ¥560 billion invested during the 14th Five-Year Plan period represents resources unavailable to any African municipality. Liu et al. [14] provide a detailed analysis of how Suzhou mobilised investment across different urban districts, demonstrating the fiscal sophistication required for comprehensive sponge city implementation, including green bonds, public-private partnerships, and targeted allocations from municipal budgets. Han et al. [6] quantify the relationship between investment intensity and eco-efficiency outcomes, finding that cities with higher per capita investment achieve proportionally greater environmental benefits. Lilongwe's annual capital budget is minuscule by comparison, and even priority projects face funding shortfalls. Hussein [11] documents that Malawian district councils typically allocate less than 10% of their budgets to capital development, with most resources consumed by recurrent expenditures, including salaries and administrative costs.

Nevertheless, a fiscal comparison should not foreclose transfer possibilities. Rather than requiring equivalent investment, transferable principles may involve approaches that are inherently low-cost or that leverage private and community resources. Examples include the following:

a) Incremental retrofitting: Chinese experience demonstrates that sponge city implementation need not involve large-scale reconstruction; targeted interventions in existing neighbourhoods can yield significant benefits [21]. Lu et al. [15] provide evidence that roadside green swales, which can be implemented incrementally along existing transport corridors, offer cost-effective stormwater management benefits without requiring comprehensive neighbourhood redevelopment. For Lilongwe, this suggests prioritising strategic interventions: bioswales along drainage channels, permeable paving in flood-prone areas, wetland restoration at key sites that deliver visible benefits within limited budgets.
b) Community-led approaches: Research on collaborative mapping in Lilongwe demonstrates that community engagement can mobilise local knowledge and resources, compensating for limited official capacity [31]. Bhanye [2] provides extensive evidence from across the Global South that community-based flood adaptation, while requiring supportive institutional frameworks, can achieve significant resilience gains at low cost by mobilising local knowledge, social networks, and volunteer labour. Satterthwaite et al. [30] similarly demonstrate that participatory upgrading programmes in informal settlements achieve durable outcomes precisely because they build on existing community capacities and priorities. Transferable principles include participatory identification of priority interventions, community maintenance arrangements for green infrastructure, and integration of indigenous knowledge about local hydrology and flooding patterns.
c) Leveraging private investment: According to Su et al. [34], Chinese eco-city financing increasingly incorporates private capital through green bonds and public-private partnerships.

Liu et al. [14] demonstrate how Suzhou's zoning strategy enabled targeted private investment by creating clear investment pipelines and risk-return profiles attractive to institutional investors, an approach requiring sophisticated financial intermediation and regulatory frameworks absent in Malawi. However, simpler mechanisms such as requiring large commercial developments to incorporate green infrastructure as a condition of approval, or negotiating developer contributions to district-scale interventions, could achieve similar ends without complex financial engineering**.** Such approaches require council capacity to negotiate effectively and enforce agreements, capacities that would need strengthening.

5.3. Capacity Compatibility

Chinese eco-city implementation deploys sophisticated technical expertise across multiple domains, namely hydrological modelling, landscape architecture, civil engineering, and ecological monitoring [3,21]. Han et al. [6] demonstrate the integration of ArcGIS and econometric analysis in evaluating sponge city outcomes, illustrating the technical sophistication underlying Chinese implementation. Lu et al. [15] document the engineering expertise required for roadside green swale design and construction, including soil engineering, plant selection, and hydraulic modelling. Municipal governments employ cadres of professionals with relevant training, supported by national research institutions and technical guidelines. In contrast, Lilongwe's planning department lacks equivalent depth, with limited geographic information system capacity, few staff trained in green infrastructure design, and constrained access to technical guidance [10,31]. Malik et al. [16] identify similar capacity gaps across Malawi's construction sector, noting that even basic sustainable construction practices face adoption barriers due to limited technical expertise among both council staff and private sector practitioners.

This capacity gap might seem to preclude transfer, but it alternatively suggests focus on knowledge translation rather than technical replication. Rather than seeking to equip Lilongwe with Chinese technical capabilities, a lengthy and expensive process, transfer could emphasise the following:

a) Principles over specifications: Chinese eco-city experience offers principles, such as distributed stormwater management, multi-functional green space, and integration of blue-green-grey infrastructure, that can be adapted using locally available materials and skills. In addition, bioswales need not follow Chinese engineering specifications; they can be constructed using local labour, indigenous plants, and adapted designs. Bhanye [2] demonstrates that community-based adaptation in informal settlements often achieves resilience goals through locally-appropriate technologies that diverge from formal engineering standards but are nonetheless effective in context—a principle equally applicable to green infrastructure adaptation.

b) Building on existing knowledge: Lilongwe residents possess extensive indigenous knowledge about local hydrology, flood patterns, and drainage [31]. Collaborative mapping exercises have demonstrated the value of integrating this knowledge with technical approaches. John [12] provides evidence from Dar es Salaam that household-level adaptation strategies, while constrained by structural factors, embody valuable knowledge about local flood dynamics and coping mechanisms that formal interventions should incorporate rather than displace. Satterthwaite et al. [30] similarly argue that resilience-building in informal settlements must begin from existing community knowledge and priorities rather than imposing external technical solutions. Thus, transfer should recognise that knowledge flows need not be unidirectional; Chinese practitioners could learn from Malawian experience with community-based adaptation, informal settlement upgrading, and low-cost sanitation.

c) Targeted capacity development: Rather than seeking comprehensive technical capacity, strategic investments could develop specific capabilities essential for eco-urbanism. Such capabilities include geographic information system training for key planning staff, exchanges with Chinese municipal officials working on similar challenges, and partnerships with research institutions for technical support. Hendra et al. [8] provide evidence that vertical-horizontal collaboration in governance networks can facilitate capacity development by creating structured learning opportunities across different scales and contexts, insights applicable to designing China-Malawi municipal partnerships. These approaches, as Hussein

[10] acknowledges, recognise that capacity development is a long-term process requiring sustained commitment.

5.4. Governance Compatibility

On the one hand, Chinese urban governance features relatively clear hierarchies, functional differentiation, and enforcement capacity. Municipal governments have jurisdiction over urban territory, coordinate with relevant line agencies, and can implement decisions with reasonable effectiveness [3]. Chikhi et al. [4] document how vertical integration across national, provincial, and municipal levels enables coordinated sponge city implementation, with performance contracts, fiscal transfers, and career incentives aligning actor behaviour with policy objectives. Hendra et al. [8] provide comparative evidence that such hierarchical coordination, while effective in certain contexts, is not the only pathway to successful policy implementation; networked governance approaches can achieve similar outcomes where institutional conditions differ. Implementation of national programmes, such as the Sponge City Programme, proceeds through established administrative channels with performance incentives reinforcing compliance.

On the other hand, Lilongwe's governance landscape is more fragmented. Council authority is constrained by central government ministries, traditional authorities, and informal actors. Land administration involves customary tenure systems operating parallel to statutory frameworks. Enforcement capacity is limited, and political interference in administrative decisions is common [10]. Kayuni [13] provides essential historical context for understanding this fragmentation, demonstrating how colonial governance structures created parallel systems of authority that persist in modified form, with traditional leaders retaining significant influence over land and local affairs alongside formal state institutions. Hussein [11] documents how this institutional complexity complicates development planning at district level, with multiple actors claiming jurisdiction over the same territory and few mechanisms for resolving coordination failures. The recent landfill impasse, where council cannot proceed despite seven years of planning and evident need, illustrates governance paralysis.

These governance differences suggest that transferable models must be adapted to networked, negotiated implementation contexts. Rather than assuming hierarchical coordination, approaches should:

a) Engage multiple stakeholders: Eco-urbanism in Lilongwe would require engagement beyond the city council to include traditional authorities controlling customary land; central ministries responsible for infrastructure; development partners providing resources; community organisations representing residents; and private developers undertaking construction. Transferable principles must be translated into formats accessible to diverse actors with varying capacities and interests. Bhanye [2] demonstrates that successful community-based adaptation in informal settlements requires engagement with this full range of stakeholders, not only formal government actors, recognising that resilience outcomes are shaped by interactions across multiple scales and sectors.

b) Build on existing networks: Collaborative mapping research demonstrates that informal networks and relationships can facilitate coordination even where formal mechanisms are weak [31]. Transfer strategies should identify and strengthen such networks, creating platforms for ongoing dialogue and joint action. Hendra et al. [8] provide systematic evidence that vertical-horizontal collaboration in governance networks can compensate for formal institutional weaknesses by creating informal coordination mechanisms, shared problem-solving forums, and trust-based relationships that enable collective action despite fragmented authority structures.

c) Emphasise demonstration and learning: Given governance fragmentation, comprehensive city-wide implementation is unrealistic. An alternative approach should emphasise demonstration projects in specific neighbourhoods, learning from experience, and gradual diffusion of successful models. Chinese experience with phased implementation and learning from pilot projects offers relevant lessons [21]. Liu et al. [14] demonstrate how Suzhou's zoning strategy enabled phased implementation across different urban districts, with learning from early demonstration zones informing subsequent expansion—a model adaptable to Lilongwe's fragmented governance context.

5.5. Towards Vernacular Eco-Urbanism

Our analysis suggests that direct transfer of Chinese eco-city models to Lilongwe is neither feasible nor desirable given fundamental differences in regulatory environments, fiscal capacity, technical expertise, and governance structures. However, this conclusion should not foreclose learning; rather, it points toward a more textured approach we term "Vernacular Eco-Urbanism." We define Vernacular Eco-Urbanism as a contextually-grounded approach to urban sustainability that synthesises three core elements: (1) global best practices in green infrastructure and climate resilience, (2) locally-grounded knowledge about environmental conditions, social practices, and institutional capabilities, and (3) contextually-appropriate technologies and materials that can be deployed within existing fiscal and technical constraints. The concept prioritises function over form, incremental over comprehensive implementation, participatory over technocratic decision-making, adaptive over prescriptive design, and networked over hierarchical governance.

To illustrate how Vernacular Eco-Urbanism could be implemented in Lilongwe, consider stormwater management in the informal settlement of Mtandire, located in a flood-prone area along the Lingadzi River in the city of Lilongwe. Rather than attempting to install Chinese-style engineered bioswales requiring specialised maintenance, a vernacular approach would begin with participatory mapping exercises [31] to document existing drainage patterns and community knowledge of flood hotspots. Local materials such as hand-excavated infiltration trenches lined with river gravel, planted with indigenous wetland species (e.g., Cyperus papyrus and Phragmites mauritianus), could be constructed through community labour. Maintenance responsibilities would be assigned to neighbourhood committees trained by council extension workers. This low-cost, community-managed system would achieve the core functions of stormwater management and groundwater recharge, the same functions served by Chinese bioswales, but through locally appropriate means that build rather than bypass community capacity. The approach also integrates with existing informal settlement upgrading efforts, creating synergies with housing, sanitation, and tenure regularisation initiatives [2,30].

This example demonstrates the key principles of 'Vernacular Eco-Urbanism' in practice. It prioritises function (flood reduction) over form (Chinese specifications), proceeds incrementally (starting with one settlement), centres participation (community mapping and labour), adapts to local conditions (indigenous plants, local materials), and works through existing networks (neighbourhood committees, council partnerships).

This concept builds on Bhanye's [2] findings that successful climate adaptation in Global South cities integrates external knowledge with local priorities and practices, and on Satterthwaite et al.'s [30] demonstration that resilience-building in informal settlements must be grounded in community knowledge and priorities. It also responds to Kayuni's [13] call for development frameworks that engage seriously with Malawi's specific historical and institutional context rather than importing external models uncritically.

Vernacular Eco-Urbanism synthesises three elements, namely global best practices in green infrastructure and climate resilience; locally-grounded knowledge about environmental conditions, social practices, and institutional capabilities; and contextually-appropriate technologies and materials. This synthesis aligns with Hassenteufel's [7] conceptualisation of policy translation as creative reinterpretation rather than mechanical transfer, and with Mukhtarov & Daniell's [22] emphasis on adaptation as essential to successful policy learning. Key principles are explained as follows:

a) Function over form. Rather than replicating Chinese designs, focus on the functions that eco-city approaches serve, such as stormwater management, temperature regulation, biodiversity enhancement, and recreational space provision. These functions can be achieved through diverse means adapted to local conditions. Lu et al. [15] demonstrate this principle in the Chinese context itself, where roadside green swales are adapted to local climate, soil, and plant conditions across different regions, suggesting that functional flexibility is already embedded in Chinese practice and can be extended to cross-national adaptation.
b) Incremental over comprehensive: Given capacity and resource constraints, pursue phased implementation through strategic interventions that deliver visible benefits and build momentum for further action. Chinese experience with district-level demonstration projects offers relevant models [21]. Liu et al. [14] provide evidence that even in resource-rich Chinese

cities, phased implementation based on zoning strategies enables more effective learning and resource allocation than attempting comprehensive transformation simultaneously.

c) Participatory over technocratic: Engage communities in identifying priorities, designing interventions, and maintaining infrastructure. Collaborative mapping research demonstrates that participatory approaches can generate valuable knowledge and build ownership despite limited official capacity [31]. Bhanye [2] provides extensive evidence that community-based adaptation achieves more durable outcomes precisely because it builds on local knowledge, social networks, and priorities rather than imposing external technical solutions. Satterthwaite et al. [30] similarly demonstrate that participatory upgrading programmes in informal settlements succeed where top-down interventions fail because they engage residents as agents rather than recipients of development.

d) Adaptive over prescriptive: Design interventions that can evolve as conditions change and learning accumulates. Chinese experience with adaptive management in sponge city implementation, adjusting approaches based on monitoring and evaluation, offers transferable lessons [21]. Han et al. [6] demonstrate how performance monitoring and econometric analysis enable adaptive refinement of sponge city strategies in China—a principle applicable in Malawi, even if the specific monitoring tools differ.

e) Networked over hierarchical: Recognise governance fragmentation and build implementation approaches that engage diverse stakeholders through negotiation and coordination rather than command-and-control. South-South cooperation frameworks that emphasise partnership and mutual learning align with this principle [18,37]. Hendra et al. [8] provide systematic evidence that networked governance approaches, while requiring investment in relationship-building and coordination mechanisms, can achieve effective policy implementation even where formal institutional hierarchies are weak, insights directly applicable to Lilongwe's fragmented governance context.

6. CONCLUSION

This paper has examined the transferability of Chinese eco-city principles to Lilongwe, Malawi, through an institutional compatibility framework addressing regulatory, fiscal, capacity, and governance dimensions. Our analysis yields three main conclusions.

First, Chinese eco-city models are deeply embedded in institutional contexts that differ fundamentally from Malawian realities. The regulatory density documented by Chikhi et al. [4], the fiscal capacity quantified by Su et al. [34] and Liu et al. [14], the technical expertise demonstrated by Han et al. [6] and Lu et al. [15], and the governance coordination analysed by Chan et al. [3] cannot be assumed in Lilongwe, where institutional fragmentation [11,13], capacity constraints [16], and fiscal rigidity [10] fundamentally constrain implementation possibilities. The regulatory density, fiscal capacity, technical expertise, and governance coordination enabling Chinese implementation cannot be assumed in Lilongwe. Attempts to transfer technical designs without addressing these institutional foundations will likely fail, reproducing patterns of policy tourism rather than genuine learning [26,38].

Second, despite these differences, specific principles from Chinese experience offer valuable guidance for Lilongwe's urban development challenges. Distributed stormwater management, multi-functional green space, integration of blue-green-grey infrastructure, and adaptive implementation approaches all have potential relevance. Bhanye [2] and Satterthwaite et al. [30] demonstrate that similar principles, when translated through community-based adaptation frameworks, have proven effective in informal settlements across the Global South, suggesting that functional principles can travel even when technical specifications cannot. However, their application requires translation through local knowledge, adaptation to local materials and skills, and alignment with local institutional capabilities [22,33].

Third, this translation work points toward a model of "Vernacular Eco-Urbanism" that synthesises global best practices with local knowledge and contextually-appropriate technologies. This concept responds to Kayuni's [13] call for development frameworks grounded in Malawi's specific historical and institutional context, and builds on Bhanye's [2] demonstration that effective climate adaptation must centre community knowledge and priorities. It also aligns with Hendra et al.'s [8] evidence that

networked governance approaches can achieve policy implementation even where formal institutional hierarchies are weak. Such an approach recognises that genuine South-South learning is neither unidirectional transfer nor superficial borrowing, but creative adaptation grounded in mutual respect and sustained engagement [37].

Regarding specific elements of the Sponge City Programme most feasible for adaptation in Malawi, our analysis suggests that design practices (distributed stormwater management, green space integration, permeable surfaces) are more transferable than either governance mechanisms (performance contracts, career incentives) or financing models (green bonds, PPPs). Within design practices, low-tech, low-cost interventions such as roadside drainage swales [15], community-managed infiltration trenches, and protection of remaining wetland areas offer the greatest potential. These require minimal technical expertise, can be implemented incrementally, and align with existing community-based adaptation practices documented by Bhanye [2]. Governance mechanisms should focus on strengthening coordination between Lilongwe City Council and traditional authorities, rather than replicating China's hierarchical performance management systems. Financing should prioritise leveraging small-scale community contributions and developer exactions rather than seeking large-scale private investment that presupposes sophisticated regulatory frameworks.

For Malawian policymakers, this suggests focusing on enabling frameworks, strategic demonstration projects, and targeted capacity development rather than replicating Chinese models wholesale. Lilongwe City Council should prioritise building capacity in GIS, participatory planning, and project management [11,16]. For Chinese partners, moving beyond infrastructure financing toward institutional development, supporting exchanges, funding action research, and investing in local capacity would contribute more to sustainable urbanisation than replicating designs [8,37].

This study opens several avenues for future research. First, longitudinal studies tracking the adaptation of eco-city principles in African cities would elucidate implementation dynamics and outcomes over time. Second, comparative research across multiple African cities (e.g., Blantyre, Mzuzu, or cities in neighbouring countries) would identify how institutional differences shape transferability. Third, participatory action research engaging communities in adaptation experiments could generate practically relevant knowledge while building local capacity; Bhanye [2] and Satterthwaite et al. [30] provide methodological guidance for such approaches. Fourth, a deeper examination of political economy dimensions, including elite interests, donor dynamics, and land governance, would enrich the understanding of why certain principles gain traction while others do not. Finally, research on South-South knowledge exchange mechanisms themselves could explain the conditions under which horizontal learning becomes genuinely reciprocal rather than reproducing dependency [23].

Ultimately, this paper contributes to broader efforts to decolonise urban studies by challenging unidirectional policy transfer frameworks and centering institutional realities of Southern cities. Chinese eco-city experience offers valuable lessons, but these lessons must be translated through local knowledge, adapted to local capabilities, and owned by local actors. As Kayuni [13] demonstrates through historical analysis, durable development in Malawi requires frameworks that engage seriously with local institutional legacies and political dynamics rather than importing external models uncritically. Our concept of vernacular eco-urbanism offers one such framework, grounded in global best practices but responsive to local realities, adaptive rather than prescriptive, and committed to genuine partnership rather than unidirectional transfer. The harvest of sustainable urbanisation begins with seeds of sovereignty, planted in institutional soil and nurtured through genuine partnership.

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participants were allowed to ask questions, and all questions were answered correctly. We confirm that the individuals have not been coerced into giving consent, and the consent was given freely and voluntarily.

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