

Review

Moving on to Greener Pastures? A Review of South Africa's Housing Megaproject Literature

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Abstract: South Africa is a leader in the scholarship on green urbanism in the Global South, but academic progress has not translated to broad implementation. Notably, government-subsidized housing projects have produced peripheral developments featuring low build quality, conventional gray infrastructure, and deficient socio-economic and environmental amenities. Declining delivery and increasing informal settlement spawned a 2014 shift to housing megaprojects to increase output and improve living conditions, socio-economic integration, and sustainability. The shift offered opportunities for a normative focus on greener development mirrored in the discourse surrounding project descriptions. Yet, the level of enactment has remained unclear. In reflecting on these points, this paper employs environmental justice as a theoretical framework and completes a comprehensive review of the academic literature on housing megaprojects and the depth of their greener development commitments. A three-phase, seven-stage review protocol retrieves the relevant literature, and bibliometric and qualitative content analyses identify publication trends and themes. Results indicate limited scholarship on new megaprojects with sporadic and superficial references to greener development, mostly reserved for higher-income segments and private developments. In response, this paper calls for more determined action to launch context-aware and just greener megaprojects and offers corresponding guidance for research and practice of value to South Africa and beyond.

Keywords: large-scale development; human settlements; catalytic projects; green planning; sustainability; resilience



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1. Introduction

Sprawling urban footprints, intensified activities, and more sophisticated needs will increasingly stress social and natural systems in the Anthropocene [1–3]. In recognition, conceptualizations around sustainability towards an equitable balance between economic, social, and environmental systems have buttressed development nomenclature internationally [4]. The turn to sustainability spawned the ‘green agenda’, initially focused on mitigating and adapting to climate change [4] but now representing varied approaches to environmentally responsible socio-economic development. Examples include reducing greenhouse gas emissions, more sustainable consumption patterns and lifestyles, environmentally friendly technologies, waste recycling and reuse, green building, energy efficiency, and the conservation and restoration of environmental resources and ecological processes [5,6].

In meeting the green agenda, nature-based solutions (NBS) have been championed. NBS interpretations and implementations have included the USA's Low Impact Development, the UK's Sustainable Urban Drainage Systems and Blue-Green Cities, Australia's Water Sensitive Urban Design, New Zealand's Low Impact Development Urban Design, China's Sponge Cities, and Asian Eco-cities [7–10]. Most approaches focus on stormwater management but also on the multifunctional benefits derived from green infrastructure (GI). GI refers to interconnected networks of natural, semi-natural, and constructed green–blue spaces that preserve ecosystem functions, support biodiversity, and deliver socio-economic benefits to humans through ecosystem services (ES) [1]. GI applications may include assorted spaces like recreational and institutional green spaces, street trees, verges and fragmented natural habitats, gardens, urban agricultural uses, and gray–green elements that combine vegetation with engineered technical structures like permeable paving, green roofs, green walls, rain gardens, bioswales, or constructed wetlands. ES have been categorized as provisioning, regulating, cultural, and habitat/supporting services [1,10]. In contrast, ecosystem disservices (EDS), which are ecosystem-generated attributes that negatively affect humans, have been noted as having aesthetic, ecological, economic, health, psychological, and cultural impacts on wellbeing [11]. Collectively, ES and EDS function within, and affect, socio-ecological systems and are highly context-dependent [12].

As the examples of NBS intimate, the bulk of NBS activity has emanated from the Global North (GN), where international development agendas are set and resources may allow for innovation and implementation. The thrust of research has followed this geographic focus [13]. Yet, population growth and urbanization in the GN are slowing and are dwarfed by current and projected growth in the Global South (GS), specifically in Asia and Africa [3]. In comparison, these processes are linked to outwardly expanding cities of lower densities, often via informal settlements that degrade the environment through land occupation and impromptu servicing [14]. Cities of the GS will increasingly accommodate more at-risk populations vulnerable to environmental hazards and socio-economic inequalities in access to services and amenities [6,15], impacted severely by the effects of climate change on temperature and precipitation. Watson [4] states, ‘...the rate and scale of this growth, coupled with impending issues such as climate change and resource depletion, pose...serious problems...and requires specific intervention if large-scale urban disaster is to be avoided’.

Within the context of the green agenda in the GS, the South African situation is intriguing. South Africa is often billed as rather exceptional in the developing world considering its sophisticated economic and legal system, international political role, cosmopolitan cities, and progressive Constitution [16]. With China, South Africa is recognized as the most prolific research subject and instigator of scholarship on NBS in the GS that explores conceptual and theoretical applications and local case studies [1,3,17,18]. The country's current population is estimated at 64 million people, projected to reach 70 million by 2030. South Africa is already nearing the 70% urbanization mark, and its cities and towns will bear the brunt of future pressure to accommodate natural population growth and the impacts of migration [19]. In this, South Africa is not unique and will continue to contend with many issues faced around the GS. Key challenges include struggling with the repercussions of colonialism; political and economic instability; poverty and unemployment; inequality; racism and xenophobia; institutionalized corruption; a failing healthcare system; a national electricity shortage; large vulnerable populations of females (51%), youth (27.5%), and the elderly (9.7%); gender-based violence; environmental degradation; urban sprawl; dated infrastructure; dumping and pollution; flooding, droughts, and fires; and the contradictions of a neoliberal but developmental state [20–25].

Many of these challenges are encapsulated in an escalating housing crisis that currently sees 12.3% of citizens residing in informal dwellings; the country's continuous responds through state-subsidized housing projects. Given the scale of the housing challenge, the normative direction taken in housing commitments locks South Africa into definitive patterns of land and natural resource consumption, affects its contributions to climate change, impacts equality in access to socio-economic opportunities, and shapes identity, citizenship, and vulnerability [3,26]. This is distressing, following the country's controversial 2014 turn to megaprojects to deliver on its Constitutional mandates for housing [27] and the opportunities presented to support an alternative, potentially greener, agenda that draws on intensifying local research and experience in NBS.

To reflect on this potential, this paper aims to review the academic literature to (i) determine the breadth of scholarship on South Africa's housing megaprojects after 2014 and (ii) identify the depth of engagement with a greener agenda in megaproject development. This paper first engages with environmental justice as a theoretical framework. This scaffolds an exploration of the motivations and shortcomings in South Africa's housing landscape to contextualize the move to megaprojects. Section 4 describes accompanying aspirations, including elusive directives for more sustainable, environmentally driven development with sporadic references to NBS. The pessimism with which the megaproject turn was received is explored and validated following the poor track record of international megaprojects and the environmental injustices realized from two well-established South African housing megaprojects, the N2 Gateway Project (N2GP) and Cosmo City. The discussion supports an empirical review of the academic literature on South Africa's housing megaprojects to capture the coverage of and assess the progress and representation of a greener agenda in discourse and delivery. Section 5 details the review protocol employed. A discussion of bibliographic and thematic results follows. Final reflections close this paper to direct future research and practice towards a robust understanding of housing megaproject outcomes and the inclusion of a more decisive, nuanced green agenda rooted in environmental justice as a normative and procedural guide.

2. Environmental Justice as Theoretical Framework

As instruments of the green agenda, NBS have increasingly been considered through the lens of environmental justice as a barometer of intention and outcome. Yet, the literature on NBS and issues of justice is still emerging, and the relationship between these concepts remains underexplored [2,28,29]. Environmental justice is fundamentally informed by the unequal socio-spatial distribution of environmental goods and hazards [30,31]. Within an evolving understanding, procedural issues of inclusiveness and fairness in democratic participatory action have become central concerns [31]. Such conceptualizations contribute an ethical dimension to decision-making and support a human rights-based approach to account for those typically excluded and disadvantaged [32], thereby placing societal norms and socio-political narratives under scrutiny and calling on planning to return to certain founding social and environmental objectives [4]. An environmental justice framework may illuminate the subverted or glaringly negative outcomes related to environmental deliverables like NBS, partly encapsulated under EDS and including risk, exclusion, or manipulation [31]. For example, under the green agenda, the foreboding narratives surrounding climate change and global Armageddon to motivate greener development may be criticized as an apparatus to regear capitalist growth through new investments in technocratic eco-innovation in international urban laboratories [15]. Whilst environmental concerns are legitimate and demand intervention, and the green economy can be positively regarded as a new source of capital accumulation and employment, certain associated policy measures are criticized for neglecting the foundational causes of environmental

crises and issues of justice and equity in their preoccupation with ecological modernization, global competitiveness, and the reproduction of Eurocentric best practice [5]. Greenwashing is a prominent critique of the green agenda, symbolized by the nomenclature of green neoliberalism and its variations of eco-capitalism, green consumerism, and a bioeconomy [5,33]. In line with an environmentally just approach, greening should not only serve the purpose of competitiveness or growth but should also advance redistributive justice in recognition of past and present inequities [5]. As such, it must confront issues of aesthetic place-making, land devaluation and green rent gaps, green dispossession and accumulation, green exclusion, and green gentrification and displacement [34]. A consideration for environmental justice within the contemporary discourse on decolonization further highlights the normative and geopolitical hegemony of the GN in the green transition. New green commitments are made and globally enforced that ultimately support the position of the GN as moral steward whilst advancing the technical solutions pioneered there [33]. Thus, colonial legacies and debates on climate or ecological debt remain muzzled, discounting the externalized social and environmental costs borne by the GS in producing and reproducing the cleaner and greener environments manifested in the GN [35]. In recognition, Anguelovski et al. [34] call for the decolonization of the green city to counter prevailing issues of environmental injustice for the marginalized, whilst Perera et al. [2] reflect on the need to consider local history, context, ecological systems, and indigenous knowledge systems for just NBS where issues of exclusion and neoliberal urban governance are contentious. South Africa presents such a context.

South Africa is the earliest and largest center for discussions on environmental justice in sub-Saharan Africa [36]. Its democratic Constitution supports environmental justice for redress and progress [2] whilst committing to adequate housing for all [37]. Yet, as the next section demonstrates, the South African government's ability to reconcile such commitments has been limited. With the turn to housing megaprojects discussed in Section 4, a more critical application of environmental justice provides both a framework to guide future development and a reflective lens to evaluate outcomes should a greener agenda be followed in megaproject development. Figure 1 captures the environmental justice framework that informs the remainder of this paper based on the above discussion.

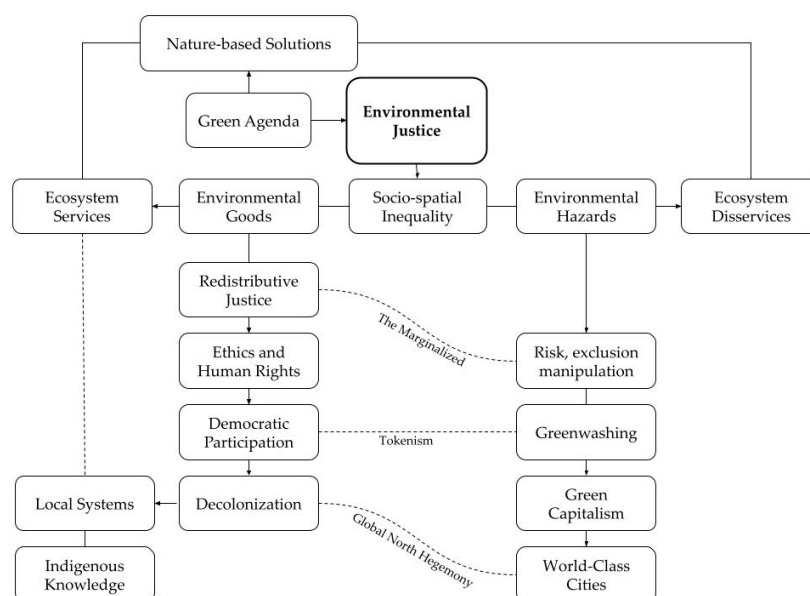


Figure 1. Environmental justice framework for South African housing megaprojects.

3. South Africa's Historic Housing Challenges

South Africa continues to grapple with the legacy of its colonial and apartheid past, poignantly illustrated by a lack of affordable housing [38]. Apartheid's policies relegated the majority black population to peripheral 'townships', as tenants in state-owned homes, or to ten rural homelands established for different tribes [39,40]. As apartheid weakened in the 1980s, relaxed influx controls led to mass black urbanization with new migrants settling in informal settlements and informal backyard rentals [41]. After a landslide victory in 1994, South Africa's first democratically elected government adopted progressive housing policies to meet new Constitutional commitments, address past injustices, and house the nation in sustainable human settlements [27]. The approach largely relied on housing subsidies to present the indigent with homeownership and accompanying basic electricity, water, and sanitation services. Efforts have also focused on in situ upgrading in informal settlements. These provisions represented newly acquired rights to the South African city and, until recently, cemented the hegemony of the ruling political party. Consequently, the post-apartheid government succeeded in the delivery of approximately 3.8 million stand-alone and multiunit dwellings and serviced stands [42]. Most projects were delivered at a relatively small scale. Around 2014, 11,000 housing projects were in different stages of completion. Only 6 delivered more than 5000 units and 91 more than 1000 housing opportunities [43].

Delivery numbers peaked at 321,000 units in 1997/1998 but dwindled to 103,000 by 2009/2010. The housing waiting list now includes over 2.5 million prospective beneficiaries settled in informal settlements or informal backyard rentals [44,45]. The volume of past supply and future demand creates path dependencies with long-term consequences for beneficiaries and resource consumption [46], being characterized by sprawling peripheral greenfield developments, often as extensions of existing apartheid-era 'townships' that have failed to integrate South African cities socially or economically [47,48]. Developments have been populated by matchbox homes of low build quality that continue to exert unsustainable pressures on infrastructural networks and natural resources, set in neighborhoods with limited economic or commercial opportunities, amenities, or greenery [49–51]. In fact, in most cases, green spaces are nearly non-existent [52]. Following South Africa's neoliberal agenda, greenery has become a privatized commodity reserved for those who can afford to access it [52], contributing to what Venter et al. [50] term 'green apartheid'. These conditions continue to mar the loaded promise of sustainable human settlements that would 'exhibit economic growth and social development in balance with the carrying capacity of the natural systems they depend on...and result in sustainable development...and equity' [27]. In the new South Africa, most citizen-led protests, drawing on a tradition of public demonstration against apartheid, have revolved around issues of eviction, inadequate housing, service access, and equity [26,53,54].

4. South Africa's Turn to Housing Megaprojects in 2014

Responding to critique and frustration, the Minister of Human Settlements announced a unilateral shift to housing megaprojects, or catalytic projects, in July 2014 that would accommodate at least 10,000 dwelling units and 5000 serviced stands each. Some 150 proposals followed, later filtered to 48, to deliver 1.5 million homes within five years [43] and leverage an investment of ZAR 90 billion (USD 50 million) into ZAR 150 billion (USD 80 million) in private sector spending [55]. A total of 29 new 'nodes', of which 15 projects overlapped with national catalytic projects, were projected for Gauteng, South Africa's smallest but most populous province. These investments were to generate substantial economic spinoffs and trickle-down effects through construction and employment supported by the diverse sectors they would lure in administration, agri-

culture, agri-processing, manufacturing, mining, and financial services [55]. These new post-apartheid cities would constitute a tabula rasa [56] for ambitious goals to deliver housing at scale in dense, compact, and integrated new cities that address socio-economic inequality. Public–private partnerships, efficient intergovernmental collaboration, and fewer bureaucratic obstacles were envisioned for expedited development [43,57,58]. Principles like mixed uses, transit-orientated layouts, mixed-income residents, diverse housing typologies, regeneration, and sustainability buttressed by economic growth, social inclusion, and environmental awareness articulate the new zeitgeist [43,57,59,60]. These attributes speak directly to visions presented by the National Development Plan 2030 to produce socio-economically mixed developments with tenure choice, sufficient public space to encourage social mix, and better-managed infrastructure to provide clean water, food and electricity via more efficient systems, and sustainability-minded dwellings [61]. In support, recycling, energy-saving technology, urban agriculture, and urban greening have featured in certain megaproject plans [62,63]. For example, the proposal for the yet unrealized mixed-income Lanseria Smart City, aiming to accommodate upwards of half a million residents, was designed to ‘interface with nature’ and feature benchmarks for GI to lead NBS in Africa and beyond [64].

The Minister’s ambitious 2014 announcement encountered surprise, confusion, and contestation, as the declaration was uninformed by prior consultation with relevant stakeholders or those responsible for implementation [58]. Some private developers circumvented local and provincial authorities by submitting proposals directly to the national government. Many schemes copied visions for modern cities from places like China [65] to be established on the urban outskirts, where large greenfield sites were economical and available. Local authorities were thus left grappling with decisions taken at a more executive level and to reconcile concerns for context, scale, urban morphology, capacity, funding, and sustainability encapsulated in their own long-standing strategic plans [54,58,60,66]. Skepticism and anxiety regarding the feasibility and eventual outcomes of projects presenting renders of glass skyscrapers and verdant public spaces loomed over municipal planning offices rooted in a widespread apprehension towards megaprojects based on international and past local experiences. Globally, ambitious megaprojects are often justified by exclamations of innovation, streamlined economies of scale, synergistic collaboration, cutting through red tape, prestige, and long-reaching economic stimuli. Yet, most international examples have become infamous for cost and time overruns, poor economic performance, and issues of social and environmental injustice [67–71]. To counter negative public relations and appeal to the market, a greener approach to megaprojects has been increasingly sought internationally, often in reference to sustainability ‘best practice’. The Middle East and Asia have led, illustrated by flagship infrastructural schemes and eco-cities [10,15,59,72]. Such projects prioritize green approaches in construction, infrastructural development, and operation, often through targeted NBS (see Section 1) and more environmentally conscious management practices [10].

Yet, these commitments have often been superficial and have failed to camouflage the fundamental injustices perpetrated. Undemocratic top-down approaches have trademarked specific projects, whilst a lack of collaboration and engagement in others have accompanied fast-tracked exogenous planning processes that circumvent standard social and environmental impact assessments [10]. Reports of evictions and displacement, gentrification, and exclusivity are rife [15]. Marginalized groups are often disenfranchised by their relocation to peripheral sites that present reduced social, economic, and environmental opportunities [52]. These new (green) enclaves are frequently separated from most of the local populace by high property prices or physical barriers to access as exclusive gated communities, or are symbolically ringfenced by references to innovative green es-

capex in city branding strategies that target international investors and the eco-conscious elite [10,50,73]. Detachment may be further enforced by alienating or generic modern architecture that removes projects from their context and local sense of place [10,74–76]. The notion of large-scale, often greenfield development sits uncomfortably alongside environmental awareness and conservationism. Various projects have been lambasted for ecological disruption, deforestation, air and marine pollution, introducing invasive alien species, or contributing to vast carbon footprints through the import of building materials and labor, or for commuter miles during and after construction. Others mock their green credentials with synthetic flora to maintain the green dream without the upkeep (or benefit) of natural vegetation [10,15,76,77].

Yet, arguments in support, often bolstered by fuzzy cost–benefit analyses and aspirations for world-city status, dominate negative records of accomplishment. Megaprojects have grown in popularity and are becoming progressively ambitious in a phenomenon that Flyvbjerg et al. [78] coined the ‘megaproject paradox’. Africa, as ‘the last development frontier’ [79], has provided fertile ground for new speculative schemes that conjure utopian images [52,80] but are far removed from local context and ground-level priorities [81].

4.1. South Africa’s Housing Megaprojects Before 2014

The 2014 announcement was not South Africa’s first foray into housing megaprojects. In the early 2000s, three exceptionally large projects, Cornubia in Durban, KwaZulu Natal, the N2GP in Cape Town, Western Cape, and Cosmo City in Johannesburg, Gauteng, emerged [58]. The two most prolific examples, the N2GP and Cosmo City, are explored here to further contextualize the move to megaprojects and provide a preliminary exploration of successes, critiques, and lessons.

4.1.1. The N2 Gateway Project, Cape Town, Western Cape

South Africa’s successful 2004 bid for the 2010 FIFA World Cup sparked multiple megaprojects [54,82]. The event would attract hundreds of thousands of spectators, requiring new stadia, a novel high-speed train line, and certain cosmetic adjustments to mask the apparent poverty suffered by South Africans [47,54,82]. This was exemplified in 2005 by Cape Town’s N2GP and its redevelopment of dense informal settlements abutting the N2 highway connecting the Cape Town International Airport with the city bowl [47,83]. With poor living conditions, residents were especially vulnerable to fire, flooding, and crime [84]. The disturbed nature of the site due to informal occupation partially meant that no significant environmental issues were identified in the fast-tracked environmental impact assessment (EIA) completed in six months instead of the two years commonly required. As a consequence, the development received the green light shortly after conceptualization [21].

The project aimed to redevelop sections of these informal settlements following a renewed focus on in situ upgrading and new construction on other greenfield portions [26]. The location presented significant links to the rail network and proximate employment opportunities [21] but remained on the outskirts of the city [83]. The flagship project aspired to hastily deliver 25,000 mixed-tenure, one-, two-, and three-story units following the newly released Breaking New Ground Policy [85]. Optimistic claims of access to community facilities, social amenities, and new economic opportunities were made. In 2006, the project budget allowed for ZAR 53 million (USD 3 million) to spend on parks, gardens, and the like, whilst ZAR 333 million (USD 19 million) was allocated towards schools, clinics, and other supporting provisions [84].

The N2GP drew special consideration as a collaboration between national, provincial, and local government, raising hopes for improved alignment and fast-tracked development

facilitation [21]. Most decisions were, however, taken by a small steering committee dominated by higher levels of government. Community and other stakeholder input was severely neglected throughout in favor of limited tokenistic participation efforts [48]. Scholars criticized the project's official discourse as manipulative and idealistic in its promises of economic growth and opportunity to smooth non-democratic development practices [47].

Before phase one of construction commenced, existing residents were forcibly relocated to Temporary Relocation Areas (TRAs). This was met with great local opposition owing to increased transportation costs that jeopardized livelihoods, fractured community ties, uprooted pupils, and sparked outrage over inadequate community, economic, and transport infrastructure [47,86]. Many also opposed TRAs, called concentration camp-like for their informal dwellings and poor living conditions [47], as experience had shown TRAs to become *de facto* permanent settlements [87]. The community turned to mass protest in various stages, including demonstrations, a blockade of the N2 highway, and litigation [88]. The case for evictions was eventually brought before the Constitutional Court, resulting in eviction orders discharged under special conditions.

Once beneficiaries occupied completed units in the first phases, complaints over small, unadaptable units, substandard building work, leaking roofs, faulty plumbing, poor ventilation, rising damp, security concerns, and much higher rents than agreed upon were voiced and later expressed in a march to parliament [21,88]. Resistance to the project's *modus operandi* presented the most significant example of community mobilization until that time in post-apartheid South Africa [84,87,89].

In positive contrast, later project stages implemented sustainable initiatives, including higher-density clusters of twelve to eighteen double-story units with communal courtyards for socializing. The design improved thermal performance through reduced external wall exposure, insulated ceilings, and roof overhangs. Savings were partly facilitated through efficient water heating using gravity-fed solar water heaters and compact fluorescent lamps. Lighting in communal courtyards was powered by solar photovoltaic systems. The clustered design followed a hierarchy of public open spaces and a preference for narrower pedestrianized streets to promote walkability and safety whilst delivering cost savings in road and curb expenditure to counter increased top structure costs. The densified typology also led to reduced water, storm water drainage, and sewage costs per household following reduced frontages [90]. Whilst the N2GP emphasized urban design and adequately equipped public open-space networks, limited funding left such spaces barren, unattractive, and underutilized in implementation and maintenance phases [91]. Much of the project is today characterized by sand-swept streets and liminal empty 'space left after planning' [84]. Contemporary aerial images depict starkly lacking vegetation apart from scattered street trees.

4.1.2. Cosmo City, Johannesburg, Gauteng

Another housing megaproject, Cosmo City, arose in Johannesburg, Gauteng, around 2004 [43]. Cosmo City was first conceived in 1997 as a greenfield project of 1150 ha situated 35 km from Johannesburg's central business district but in relative proximity to other economic nodes and development corridors. The project was launched as a public-private partnership to house informal settlers [92] and to accommodate mixed-income households in mixed-tenure dwellings to simultaneously promote racial and economic integration [92–94]. Cosmo City has also been highlighted for its focus on environmentalism and sustainability [52]. In support, and influenced by varied processes of public participation [91], the project provided for roughly 12,300 units and accompanying commercial, educational, religious, and medical facilities and a 40 ha industrial park [92]. Of particular

interest are the 43 parks and recreational sites of 47.4 ha and the 300 ha environmental area outlined in the masterplan [91]. The layout was guided by the need to conserve a wetland found to host Giant Bullfrogs by the mandatory EIA. A green belt was established to conserve grassland, streams, and the wetland to maintain the integrity of the natural ecosystem. The green belt was ultimately enclosed by a 2.4 m² perimeter fence to restrict arbitrary access as part of the conservation effort [94], but residents have routinely removed fence sections for access. Through these access points, the green belt fulfils multiple services, delivering aesthetic qualities, grazing for livestock, medicinal plants, a venue for religious ceremonies, encouraging bird watching, and retreat from the summer heat [94].

Environmental considerations extended to greening by the developer planting 22,000 trees and a further 10,000 indigenous and fruit trees donated by a nonprofit organization (NGO). The NGO also extended support over time through gardening training and replacing trees where original plantings failed [94]. Initially, the developer provided environmental education workshops to teach residents about environmental awareness, tree planting for shade and carbon sequestration, waste management, energy efficiency through solar applications, and gardening for food security and employment [52,93]. Gardening efforts were further encouraged by a gardening competition [94]. Whilst these actions spoke to a more environmentally focused approach, multiple critiques emerged.

The green belt functioned as a physical barrier between income groups, echoing apartheid's green buffers [93] and disconnecting communities from the natural environment. Openings created in the perimeter fence led to several intersecting informal pathways that demonstrate a desire for access but also a lack of adequate pedestrian integration in a road design [94] that followed modernist suburban principles [93]. The green belt has furthermore been associated with EDS like insect plagues, dumping, blocked and burst sewerage lines, crimes like mugging and molestation, and providing a refuge for criminals [94].

Of the 43 parks earmarked, only 10 equaling 3.8 ha were eventually developed, with only 2 in low-income areas. Others were not established at all or continue to present inadequate facilities [52]. Consequently, Cosmo City presents 2.9 m² of green space per capita compared to national guidelines calling for 40 m² [94] with a disproportional distribution in favor of higher-income residents. Cosmo City has thus reproduced divisions via the unequal distribution of developed green space [52]. The parks provided, though valued by the community and used extensively, are overcrowded and host loitering and substance abuse, sometimes resulting in damage to vegetation and facilities [94].

Some guerrilla gardening occurs in the green belt [52], but many residents have not established, or have abandoned, domestic gardening efforts, citing rodent pests, the NGO's tree-planting engagements which excluded those who were unavailable, or a lack of time and other resources, including water, to commit to gardening [94]. An increasing number of homeowners also use any additional space for the construction of backyard structures for rental and commercial purposes despite efforts to keep Cosmo City 'backyard shack free' [52,91]. Subsequently, the gardening competition was short-lived [94]. Aversions to green space, also termed 'bio-phobic experiences', potentially exacerbate disadvantage and deprivation in Cosmo City and reduce the contributions of urban green space to poverty alleviation and integration. Here, interpretations of poverty exceed a narrow focus on economic indicators to include a broader definition based on access, opportunity, and prospects commensurate with understandings under environmental justice [94].

5. Methods and Materials

The scientifically approached review is an invaluable resource to those searching for baseline information, experts expanding their existing understanding [95], educators wishing to expose students to a single up-to-date and peer-reviewed source, or the decision-

maker who relies on concise high-level evidence [96,97]. Reviews dealing with new and emerging issues, like this one, may be more concise, with a focus on a fresh theoretical foundation for the development of conceptual models to frame the issue under investigation [98]. Generally, literature reviews in urban and regional planning have failed to adequately report procedure, calling into question the generalizability and reproducibility of results. In reaction, Xiao and Watson [99] call for the urban planning discipline to increase its rigor in literature reviews to follow other fields in engaging in discussions on quality. This review attempts to address such limitations by providing a detailed account of the processes and protocols followed.

The generic literature review often follows three phases and eight steps [99,100]. These include the following: (i) planning, constituted by problem formulation, followed by protocol development and validation; (ii) conducting the review by searching for the literature, screening for inclusion, assessing quality, and extracting, analyzing, and synthesizing data; and (iii) reporting findings. After due consideration, a three-phase, seven-stage approach was proposed for this study, illustrated by Figure 2.

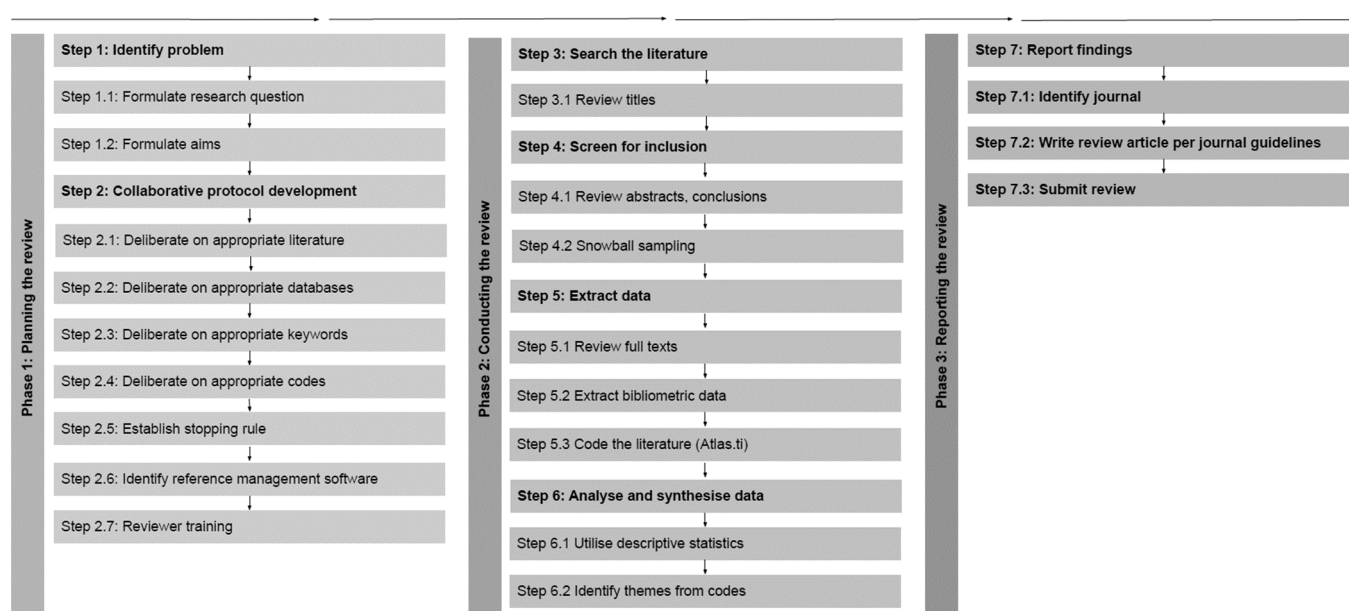


Figure 2. Review approach followed.

As suggested by Wanden-Berghe and Sanz-Valero [101] and Page et al. [102], the research team comprised experts united under the research topic, including tenured professors in urban and regional planning and urban ecology and relatively novice researchers who contributed a fresh perspective. The protocol was developed following several circulations between authors, with the final version reflecting consensus [100,103–105]. Table 1 summarizes the protocol criteria set for phase 2.

The limitations of the approach followed in Table 1 must be noted. Although attempts were made to cast as wide a net as possible using expanded keyword searchers and Boolean operators, it is conceded that certain relevant studies employing a different lexicon or not published in English would not have been identified. Only open-access publications and those covered by institutional library subscriptions were further accounted for. Quality was not considered in the criteria. Furthermore, the exclusion of gray literature left the review blind to possible contributions. Whilst every effort was made to limit bias, the potential for subjectivity amongst reviewing authors is still recognized. Yet, the extensive discussion of the review protocol and noting of limitations represent transparency and rigor, whilst the significant number of publications identified in the initial sample and

limited sample finally reviewed showcase comprehensiveness and depth to support the validity and reproducibility of results.

Table 1. Summary of review protocol phases.

Phase	Review Steps	Description
Phase 1: Planning the review	2.1 Deliberate on the appropriate literature	Gray literature was excluded and only scholarly works (journal papers, conference proceedings, and book chapters) were considered [106].
	2.2 Deliberate on appropriate databases	Systematic searches of multiple databases were prescribed [106]. The databases often used in urban planning scholarship include EBSCO, ProQuest, and IEEE Xplore, whilst Google Scholar has increasingly been consulted [99]. Google Scholar and the library portals of the three institutions to which authors are affiliated were selected for this review. The review focused on the period 2014 to 2023.
	2.3 Deliberate on appropriate keywords	Keyword identification initially pursued comprehensiveness [101] guided by the research question to identify an initial paper sample from the first five pages from Google Scholar based on title relevance. Boolean operators (NOT, AND, OR) in search strings [104] reflected variations and preferences in search statements [96]. A review of the preliminary literature added more keywords to the search criteria.
	2.4 Deliberate on appropriate codes	Deductively, codes were identified from the research question, aims and objectives, and the background investigation conducted (see Sections 1–5 and Figure 1). An inductive approach delivered new content-related codes from the literature [106].
	2.5 Deliberate stopping rule	Sample identification was deemed complete when no new results emanated from repeated database searches [98,99], with 390 publications retrieved. The publications reviewed up to saturation were reviewed again using the complete code list.
	2.6 Identify reference management software	Mendeley, as a bibliometric platform, hosted individual folders per database, also consolidated in a main folder to identify duplicates [100]. Records in each database were distributed amongst reviewers to apply screening criteria for full review. Reviewers received overlapping folders to control bias, with each folder screened by two reviewers. Publications failing selection criteria were moved to subfolders based on motivation for exclusion to allow for reconsideration when review decisions were reassessed [100].
	2.7 Reviewer training	Upon protocol finalization, two online training workshops and mock reviews delivered last adjustments to ensure methodological uniformity.

Table 1. Cont.

Phase	Review Steps		Description
Phase 2: Searching the literature	3	Search the literature	Databases were searched following the above steps and the protocol established. The date parameters were applied and only open-access English texts included based on titles.
	4	Screen for inclusion	Following initial inclusion, further relevance to the research question was considered, firstly by reviewing titles again for suitability, leading to the identification of 47 publications.
	4.1	Review abstracts and conclusions	A review of these 47 abstracts was completed. If abstracts provided some doubt, conclusions were consulted [104], and 26 publications remained following a predominantly inclusive approach [103,104].
	4.2	Snowball sampling	Snowball sampling [95,98,99] via backward and forward citation searching of titles and screening abstracts and conclusions followed. Backward citation searching yielded 3 sources, narrowed to 2, and forward citation searching delivered 16, narrowed to 5 additional sources. A total of 33 publications for full review were thus identified.
	5	Extract data	
	5.1	Review full text	A review of the sample content followed.
	5.2	Extract bibliographic data	Firstly, bibliographic data were extracted from the sample to document authors, affiliations, world region, and citation numbers (see Table 2).
	5.3	Code the literature	Deductive and inductive coding using Atlas.ti followed. After the 14th publication saturation had been reached. The publications reviewed to the point of saturation were rereviewed using the complete code list. Codes were subsequently used to identify themes.
	6	Analyze and synthesize data	
	6.1	Apply descriptive statistics	Bibliographic data were analyzed using descriptive statistics (see Table 2).
	6.2	Thematic and content analysis	Content analysis through themes was supported by memos to document running commentary and note connections, similarities, differences, and points of interest.

Table 2. Bibliometric results.

	Year	Author(s)	Affiliation	GS/ GN	Journal	Citations	Backward Searching	Forward Searching
1	2014	Juta, L.B. ¹ , Moeti, K.B. ¹ and Matsiliza, N.S. ² [86]	1 Tshwane University of Technology, Tshwane, SA. 2 Cape Peninsula University of Technology, Cape Town, SA.	GS	<i>Journal of Public Administration</i>	5		
2	2014	Cirolia, L.Z. ¹ [72]	1 African Centre for Cities, University of Cape Town, Cape Town, SA.	GS	<i>Urban Forum</i>	37	X	
3	2015	Sutherland, C. ¹ , Sim, C. ¹ and Scott, D. ¹ [107]	1 University of KwaZulu-Natal, Durban, SA.	GS	<i>Habitat International</i>	38		
4	2015	Jordhus-Lier, D. ¹ [87]	1 University of Oslo, Oslo, Norway.	GN	<i>Habitat International</i>	79		
5	2015	Herbert, C. ¹ and Murray, M. ¹ [108]	1 University of Michigan, Ann Arbor, USA.	GN	<i>International Journal of Urban and Regional Research</i>	116		
6	2016	Turok, I. ¹ [60]	1 Human Sciences Research Council, SA.	GS	<i>Local Economy</i>	69		
7	2017	Ballard, R. ¹ , Dittgen, R. ² , Harrison, P. ² and Todes, A. ² [109]	1 Gauteng City-Region Observatory, Johannesburg, SA. 2 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Transformation</i>	50		
8	2017	Harrison, P. ¹ and Todes, A. ¹ [57]	University of the Witwatersrand, Johannesburg, SA.	GS	<i>Transformation</i>	28		
9	2017	Ballard, R. ¹ and Rubin, M. ² [43]	1 Gauteng City-Region Observatory, Johannesburg, RSA. 2 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Transformation</i>	59		
10	2017	Cirolia, L. ¹ and Smit, W. ¹ [110]	1 African Centre for Cities, University of Cape Town, Cape Town, SA.	GS	<i>Transformation</i>	10		
11	2017	Charlton, S. ¹ [111]	1 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Transformation</i>	20		
12	2018	Howe, L. ¹ [56]	1 Eidgenossische Technische Hochschule, Zurich, Switzerland.	GN	<i>International Development Planning Review</i>	5		
13	2018	Van Noorloos, F. ¹ and Kloosterbroer, M. ² [80]	1 Utrecht University, the Netherlands. 2 Addis Ababa University, Ethiopia.	GN + GS	<i>Urban Studies</i>	273		
14	2019	Brill, F. ¹ and Reboredo, R. ² [79]	1 University College London, UK. 2 Trinity College Dublin, Ireland.	GN	<i>Urban Forum</i>	31		
15	2019	Pieterse, E. ¹ [22]	1 African Centre for Cities, University of Cape Town, Cape Town, SA.	GS	<i>Journal of Urban Affairs</i>	58		
16	2019	Harrison, P. ¹ , Rubin, M. ¹ , Appelbaum, A. ¹ and Dittgen, R. ¹ [112]	1 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Journal of Planning Education and Research</i>	51	X	
17	2019	Reboredo, R. ¹ , Brill, F. ² [75]	1 Trinity College, Dublin, Ireland. 2 Bartlett School of Planning, London, UK.	GN	<i>China Perspectives</i>	5		
18	2020	Goosen, J. ¹ and Fitchett, A. ¹ [113]	1 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Urban Forum</i>	4		
19	2020	Ballard, R. ¹ and Harrison, P. ² [114]	1 Gauteng City-Region Observatory, Johannesburg, SA. 2 University of the Witwatersrand, Johannesburg, SA.	GS	<i>Environment and Planning A: Economy and Space</i>	26		
20	2020	Horn, A. ¹ [115]	1 Stellenbosch University, Stellenbosch, RSA.	GS	<i>Urban Forum</i>	9		X
21	2020	Todes, A. ¹ and Robinson, J. ² [116]	1 University of the Witwatersrand, Johannesburg, SA. 2 University College London, London, UK.	GS + GN	<i>Environment and Planning A: Economy and Space</i>	45		X

Table 2. Cont.

Year	Author(s)	Affiliation	GS/ GN	Journal	Citations	Backward Searching	Forward Searching
22	2021	Ballard, R. ¹ , Jones, G. ² and Ngwenya, M. ¹ [117]	1 Gauteng City-Region Observatory, Johannesburg, SA. 2 London School of Economics, London, UK.	GS + GN	Urban Forum	9	
23	2021	Reboredo, R. ¹ [65]	1 Metropolitan University Prague, Prague, Czech Republic.	GN	Progress in Development Studies 21	3	
24	2021	Rubin, M. ¹ [58]	1 University of the Witwatersrand, Johannesburg, SA.	GS	Refractions of the National, the Popular and the Global in African Cities	1	
25	2021	Meth, P. ¹ , Goodfellow, T. ¹ , Todes, A. ² and Charlton, S. ² [118]	1 University of Sheffield, UK. 2 University of the Witwatersrand, Johannesburg, SA.	GN + GS	International Journal of Urban and Regional Planning Research	33	
26	2022	Mvuyana, B. ¹ and Nzimakwe, T. ² [71]	1 Mangosuthu University of Technology, Durban, RSA. 2 University of KwaZulu-Natal, Durban, SA.	GS	Journal of Local Government Research and Innovation	1	
27	2022	Williams, G. ¹² , Charlton, S. ² , Coelho, K. ³ , Darshini, M. ³ and Meth, P. ² [66]	1 University of Sheffield, UK. 2 University of the Witwatersrand, Johannesburg, SA. 3 Madras Institute of Development Studies, Chennai, India.	GN + GS	Housing Studies	29	
28	2022	Mhlongo, N. ¹ , Gumbo, T. ¹ and Musonda, I. ¹ [119]	1 University of Johannesburg, Johannesburg, SA.	GS	Proceedings of Word Building Congress	1	
29	2022	Hofer, E. ¹ , Musakwa, W. ² , van Lanen, S. ³ , Gumbo, T. ² , Netsch, S. ¹ and Gugerell, K. ⁴ [23]	1 University of Applied Sciences Salzburg, Kuchl, Austria. 2 University of Johannesburg, Johannesburg, SA. 3 University of Groningen, Groningen, The Netherlands. 4 University of Natural Resources and Life Sciences, Vienna, Austria.	GN + GS	Journal of Housing and the Built Environment	6	
30	2022	Howe, L.B. ^{1,2} [54]	1 University of Liechtenstein, Vaduz, Liechtenstein. 2 ETH Zurich, Zurich, Switzerland.	GN	Antipode	5	X
31	2022	Robinson, J. ¹ , Wu, F. ¹ , Harrison, P. ² , Wang, Z. ³ , Todes, A. ² , Dittgen, R. ² and Attuyer, K. ⁴ [120]	1 University College London, London, UK. 2 University of the Witwatersrand, Johannesburg, SA. 3 University of Sheffield, UK. 4 Xi'an Jiaotong-Liverpool University, China.	GN + GS	Urban Studies	17	X
32	2023	Culwick, F. ^{1,2} and Patel, Z. ¹ [46]	1 University of Cape Town, Cape Town, RSA. 2 University of the Witwatersrand, Johannesburg, SA.	GS	Local Environment	2	
33	2023	Seseni, L. ¹ , Thaba, S. ¹ , Mbowha, C. ¹ and Madonsela, N. ¹ [121]	1 University of Johannesburg, Johannesburg, SA.	GS	Proceedings of the 6th European Conference on Industrial Engineering and Operations Management		X
Total:					1125	2	5

6. Results and Discussion

6.1. Bibliometric Results

Table 2 details the 33 sources identified for the final review sample and summarizes and quantifies bibliographic elements.

As Table 2 demonstrates, a stream of research publications on South Africa's housing megaprojects followed the Minister's 2014 announcement. Several journals hosted these outputs; except for special issues, the journal *Urban Forum* produced the most publications included for review. This includes five (15.15%) papers appearing between 2014 and 2021, written by Cirolia [72]; Brill and Reboredo [79]; Goosen and Fitchett [113]; Ballard et al. [117]; and Horn [115]. More coordinated research interest in South African megaprojects was first shown in earnest by a 2015 special issue of *Habitat International*, entitled: *Megaprojects, Settlement Dynamics and the Sustainability Challenge in Metropolitan Cities*. Two papers (6.06%) from this issue were included in the review sample, including Sutherland et al. [107] and Jordhus-Lier [87]. This was followed by *Transformation's* 2017 special issue on megaprojects for South Africa's settlements, including five (15.15%) submissions by Ballard et al. [109]; Ballard and Rubin [43]; Cirolia and Smit [110]; Charlton [111]; and Harrison and Todes [57] selected for review. Richard Ballard served on the editorial board and again as guest editor for a special issue of *Environment and Planning A: Economy and Space*, focusing on 'the work of developers', which produced two papers (6.06%) included in this review (Ballard and Harrison [114] and Todes and Robinson [116]). Ballard, responsible for four papers (12.12%), was affiliated with the Gauteng City-Region Observatory (GCRO), a partnership between the Gauteng Provincial Government, University of Johannesburg (UJ), and University of the Witwatersrand (WITS), Johannesburg. WITS is linked to 13 (39.39%) publications in the sample, aided by the work of Phillip Harrison (5 publications/15.15%). Other notable WITS scholars include Todes (five/15.15%); Charlton, Dittgen, and Rubin with three (9.09%) each; Meth with two (6.06%); and Culwick Fatti, Fitchett, Goosen, Ngwenya, and Williams with one (3.03%) each as main or co-authors. The second most represented institutions were the African Centre for Cities (ACC) at the University of Cape Town (UCT) (four/12.12%) and UJ (three/9.09%). A total of 19 (57.56%) publications emanated entirely from the GS, 7 (21.21%) as collaborative efforts between institutions from both the GS and GN (GS+GN); and 7 (21.21%) produced entirely at institutions based in the GN. The total number of citations generated by the sample totaled 1125 as of May 2024. Publications entirely from the GS attracted 469 (41.68%) citations, those from a GS-GN collaboration attracted 412 (36.62%), including the most highly cited papers from van Noorloos and Kloosterbroer [80] (273/24.27%), whereas papers from the GN generated 244 (21.69%) citations. The GN institutions most involved included University College London and University of Sheffield, both in the UK, with three papers (9.09%), and one contribution each from the London School of Economics and University of Michigan (3.03%). Inter-GS collaborations were non-existent without a GN partner, with Williams et al. [66] bringing the University of Sheffield, WITS, and Madras Institute of Development, India, together; Robinson et al. [120] including University College London, WITS, and Xi'an Jiaotong-Liverpool University, China. The near absence of Chinese interest or partnership is interesting considering the country's stake in South Africa [65,80,122] and its growing reputation as a research powerhouse.

The following subsection discusses the main themes identified following textual analysis in Atlas.ti.24 after applying deductive and inductive codes to texts.

6.2. Identifying Main Themes and Findings

6.2.1. The Literature on South Africa's Contemporary Housing Megaprojects Is Limited and Unbalanced

Despite the significant number of sources initially identified ($n = 390$), the final review sample delivered a 6.67% ($n = 26$) return rate after applying practical exclusion and relevance criteria. The addition of results from snowball sampling increased the number to 33 sources. Publications averaged 3.67 per annum. Thus, despite the unfavorable impacts of past state-subsidized housing projects, the significant resources committed to the unilateral shift to megaprojects, and potential related impacts, explicit scholarly interest in the subject remains limited and fractured. Many existing studies have relied significantly on gray literature, drawing primarily on government reports and media articles [43,59,60,107–109,113,115,116], thus, further evidencing a lacking temporal academic literature base to inform more in-depth research.

A substantial proportion of publications emphasize past developments like the N2GP [87,110]; Cornubia [43,71,86,87,107,119]; Cosmo City [43]; and Lufhereng [46,111,118]. This indicates an expected preference for ex post facto scholarship to reflect on the construction phases of mature projects and outcomes after occupation, consequently leaving a vacuum in contemporary research on planned and ongoing projects but also avoiding speculation. A list of the national, provincial, or metropolitan housing megaprojects planned, under construction, or delivered is not provided by any source, nor could such a list be compiled from varied sources given the lacking diversity in projects discussed.

Limited interest is presented in projects outside Gauteng. Cirlolia [72] and Horn [115] are the only ones to discuss a megaproject in the Western Cape, that is, the un-built 200,000-unit WesCape development submitted to the City of Cape Town in 2011. Seseni [121] mentions the Durban Aerotropolis in KwaZulu Natal and the African Coastal Smart City in the Eastern Cape in an exploration of future South African smart cities. No projects in the remaining five provinces are discussed. A Gauteng-centric agenda is aptly represented by the ongoing Corridors of Freedom project, which is not a housing project but incentivizes infill housing development along its axes for inclusionary, transit-orientated development. The unrealized Sino-South African Modderfontein with smart city aspirations is also well represented [22,56,65,75,79,109,112,116,120]. Other Gauteng projects like Fleurhof are discussed by Hofer et al. [23], Mooikloof Megacity by Seseni [121], and Vaal River City by Howe [56], whilst Turok [60] mentions the Syferfontein, Droogeheuwel, Golden Highway, Boiketlong, and Sterkwater megaprojects briefly.

The attention garnered by Gauteng is unsurprising given its economic importance, its commitment to numerous future housing megaprojects [43], and it hosting renowned universities, well-connected researchers, and innovative research institutions (see Table 2). A 2015 map illustrating the relative location of Gauteng's proposed projects is included by Turok [60]. The map is useful in contrasting proposed locations with areas of unemployment and existing business nodes, showing that many proposed peripheral sites echo past approaches that duplicated apartheid's spatial structures [57]. The traditional tenets of sustainability have featured in several publications but with some imbalance between economic, social, and environmental considerations.

6.2.2. The Literature on South Africa's Housing Megaprojects Presents a Shallow Commitment to a Greener Agenda

Much of the literature invoking sustainability emphasizes economic, social, and then environmental concerns [82,123]. Economic considerations are primarily intertwined with locational decisions. Related apprehensions at the local government level include the funding requirements demanded by construction at this scale, maintenance requirements posed

by stretched infrastructural networks, the attraction of future investment, and the feasibility of the trickle-down benefits envisioned for the local, regional, and national economies. The Gauteng map showed that most projects would be in relative proximity to the unemployed but also at considerable distances from established economic concentrations [60]. The need for economic prospects to counteract the potential for peripheral new cities as dormitory commuter settlements of unemployment and deprivation is contentious [60,111,116,118]. In a foreboding tone, Turok [60] notes that Cosmo City waited more than a decade for the first formal retailers to establish themselves. Williams et al. [66] reiterate that in the Lufhereng case, many residents are now precariously located beyond an affordable commuting distance to their employment, exacerbated by lacking public transport infrastructure. More recently, despite Fleurhof's relatively central location, the private sector has been slow to invest, and limited business activity has led most to seek employment elsewhere in the city-region [23].

Such issues penetrate the social sphere as far-flung greenfield developments have habitually relocated beneficiaries and fractured livelihoods and communities, often partly due to a lack of meaningful preparatory participation. Sutherland et al. [107] report on lacking consultation with poor communities in Cornubia in the past, and Howe [56] documents tokenistic participatory practices in 'a precursory fashion and along political lines' for Vaal River City. In these engagements, the rate-paying middle class often emerges as the main contributor through not-in-my-backyard (NIMBY) lobbies against inclusionary housing projects [43,72,107,109,120]. Opposition is also encountered from profit-driven developers who prefer the security of mid- to high-income purchasers. In Modderfontein, the Chinese developer and local authority quarreled over the inclusion of a low-income housing quota [109,113,114]. Consequently, inclusionary housing has often been practiced through proximity rather than integration. Based on Lufhereng, Charlton [111] remarks on many projects, including Cosmo City, interpreting socio-economic integration as the discrete adjacency of different socio-economic groups separated by green space. Such manifestations often demonstrate the compromises negotiated by planners as they attempt to balance contradictory neoliberal and developmental agendas within a fragile political structure. South African megaprojects are, furthermore, positioned as vanity ventures in global city-making schemes or ploys in political grandstanding, and support for specific projects and objectives fluctuates within an unstable political landscape [43,46,58,109,116]. This presents further impetus for the adoption of strongly enshrined normative principles and strategies capable of addressing and defending economic, social, and environmentally just considerations sustainably and resiliently.

Turok [60] lamented that 'there is no mention of encouraging innovative, greener... urban designs, or planning for decent living and working environments' (in new megaprojects) shortly following the 2014 announcement. Several megaprojects engaged with environmental issues to varying degrees at various times. Environmental principles for the N2GP and Cosmo City are detailed in Section 4. The WesCape project was motivated to be holistic, ecologically regenerative, and design-led [72]. The development proposed 648 public open spaces (not all green spaces) and a neighborhood-scaled layout. Decentralized services to reduce ecological impacts were to be delivered via 'sustainability technologies' in solar and wind power, recycling, and graywater reuse. However, such claims encountered skepticism regarding high capital and operational costs that were unlikely to be met by low-income residents. WesCape generated various objections linked to the City of Cape Town extending its urban edge to include the agricultural land needed and the site falling within the evacuation zone of the Koeberg Nuclear Station [115] with related environmental justice concerns. Charlton [111] notes that in the 25,000-unit Lufhereng, a 2011 Economic Development Plan included subsistence and commercial farming with hydroponics and

aquaculture to support the green economy. The significant land area demarcated for agricultural activity responded directly to large dolomitic soil deposits resulting from nearby mining activities. In addition, the site, previously outside the City of Johannesburg's urban edge, also presented other environmental limitations like aquifers, a wetland, and grassland patches [46].

Despite megaprojects often fast-tracking or sidelining environmental management procedures, the 2015 Vaal River project stalled due to environmental compliance issues [56]. Conceptualizations around Modderfontein included aspirations to rehabilitate its industrial brownfield location and pursue environmental best practice for climate change resilience [43]. The inclusion of green spaces that would support biodiversity were actively proffered by the developer as motivation for project approval, and certain project renders hinted at green roofs and facades on glass skyscrapers [114]. Yet, as the masterplan progressed, the narrative evolved into fashionable interpretations of a smart eco-city that sidelined any actual environmental concerns [79]. In other post-2014 examples, the prospective location of new Gauteng cities on environmentally sensitive land as large greenfield projects drew attention [43]. The Corridors of Freedom's aims to reduce vehicular traffic and carbon emissions through transit-orientated development were also noted by several scholars [22,43,54,109,112,116,120]. However, no plans for a deliberate eco-city driven in all aspects by the green agenda for inclusionary or state-subsidized housing have been reported in the literature. The earlier reference to NBS and GI in the Lanseria Smart City is the exception that proves the rule. Lanseria's nature-based credentials were identified in media articles, with the only academic coverage provided by Seseni [121], who also cited a single media publication, mentioning the megaproject's intentions to harvest rainwater and utilize solar energy in addition to encouraging pedestrian and public transport options. Upon reflection, the project's green aspirations seem secondary to developing a competitive smart city for wealthier citizens commensurate with internationalization aspirations [124]. A dose of lower-income housing is feasibly included to comply with policy and facilitate development approval. The prestige of a green environment reserved for the affluent is underscored by two privately developed megaprojects in Gauteng, Waterfall City and Steyn City. As private developments, these projects should not be conflated with the state's megaproject commitments [60], but they do provide useful comparisons. Waterfall City, considered one of Africa's five smart cities and a manifestation of Howard's Garden City, features well-maintained green spaces, including parkland, a 300 ha indigenous greenbelt, and the province's largest artificial lake [23,79,108]. Steyn City also presents significant green space supported by 650,000 indigenous trees to form Johannesburg's largest woodland [43,109]. In contrast, mirroring Cosmo City critiques, megaprojects linked to the state's objectives have often failed to deliver basic quantitative or qualitative targets for the green spaces proposed. As an expression of this issue, Hofer et al. [23] exemplify Fleurhof, where the public spaces zoned, including playgrounds, sports fields, urban agricultural parcels, and a wetland, were found undeveloped or undermaintained, littered, dysfunctional, and crime-ridden.

6.3. Guidelines Towards Following a Greener Approach in South African Housing Megaprojects

6.3.1. Adopting an Expanded and Dedicated Research Agenda

Findings call for broader scholarly engagement with South Africa's housing megaprojects. As an issue of environmental justice, more rigorous research on South Africa's Constitutional and policy commitments to environmental justice, sustainability, and resilience, its past failures, and potential future challenges in realizing these objectives should be addressed if the business-as-usual approach is followed in megaproject development. Research must also explore the intra- and interinstitutional conflicts in government in the

enactment of the megaproject mandate and how local authorities have responded and adapted their own contradictory plans. The potential conflict between professional values and ethics and a deontological complacency to get the job done will also provide interesting research fodder. Case study research beyond Gauteng, including other metropolitan and medium-sized cities and towns with acute housing needs, is, furthermore, warranted following an ethnographic approach to engage with communities to be affected by, and those already living in, post-2014 megaprojects. Such research must also advance beyond quantifying green space inequality, as is currently the dominant focus, to explore technical and qualitative aspects of NBS suitable for lower-income contexts. This requires meaningful stakeholder engagement and incorporating indigenous knowledge to ultimately develop context-appropriate, low-tech, multifunctional green solutions.

6.3.2. Learning from Pre-2014 Housing Megaprojects

Past megaprojects like the N2GP and Cosmo City were not necessarily driven by a green agenda, but their wins and losses in terms of urban greening may provide significant guidance for more dedicated efforts in future housing megaprojects. For example, the N2GP presented the often-maligned practice of rushed environmental approval. Whilst this was partly facilitated by existing informal settlement, the checks and balances provided by comprehensive environmental impact assessments cannot be underplayed as a first step towards a greener development agenda. This is pertinent considering the proclivity for most new megaprojects to be developed on greenfield sites that may present environmentally sensitive resources. Cosmo City's location on previously undeveloped but relatively well-connected land serves as an example of more appropriate site selection. Greenfield development will circumvent the relocations enforced by the N2GP where community protest and litigation in opposition highlight the need for a bottom-up approach that engages the community from planning to beneficiary allocation and maintenance stages. This will be especially needed when greener alternatives are considered that challenge the status quo and expectations. The poor building standards reported in the N2GP, as with many other neoliberal state-led housing developments, is a matter of concern for resilience and sustainability that could be amplified by the size and pace of development needed to meet governmental housing targets. The same is true for the optimistic allocation of urban green spaces in the initial N2GP and Cosmo City masterplans and the eventual delivery of barren and underutilized communal greens due to funding and maintenance limitations. In Cosmo City, green space provisions now fall far below national targets, and an unequal distribution in favor of higher-income residents reserves access for those who can afford it. This is exacerbated by the enclosed green belt separating different income segments, reminiscent of an apartheid buffer zone, denying access to multiple ES, specifically in the social domain. Finding ways of following through on greener commitments and actively using public green spaces as multifunctional community hubs will be paramount in the future. Following Cosmo City, the hitherto unaddressed informal backyard rental sector and the domestic garden space it occupies must also be considered through either increased stand sizes, with lowered density ramifications and the potential to stimulate further backyard infill, or possibilities for vertical gardening contemplated in compensation. Such approaches may draw on the Cosmo City experience of environmental education, tree-planting, and gardening initiatives supported by NGOs.

6.3.3. Realigning Normative and Procedural Guidelines Towards an Appropriately Just Green Agenda

The practical implementation and maintenance of an environmentally just green agenda in the development of South African housing megaprojects will be significantly motivated at the local level if appropriate mandates are set and enforced by the National

Department of Human Settlements. This calls for a commitment towards the application of existing directives for sustainable development through practical guidelines suited to local context and people. Invoking environmental justice (Figure 1) may aid such approaches by providing a reflective lens to evaluate past projects and to direct quantitative and qualitative measures of NBS for future projects. In this regard, it is important to consider the retroactive greening of completed smaller and megahousing projects and setting criteria and indicators for new developments in the implementation of greener strategies in building design, public space, and infrastructural applications. Examples may include an aversion to deforestation and site clearing for development in favor of the use of natural remnants as green space, introducing tracts of self-seeding indigenous vegetation instead of barren public spaces or monofunctional lawns; simplified biosolutions to decentralized stormwater management and partial wastewater treatment supported by communities; the inclusion of communal urban agricultural practices to combat food deserts, create employment and foster social capital; and the consideration of green roofs on public buildings, vertical domestic gardening, and alternative construction materials that are locally produced, improve thermal performance, and translate into local skills development, employment, and entrepreneurship. In concert, such approaches may deliver a deeply South African development approach and vernacular that prioritizes the green agenda to represent more sustainable human settlements in contradiction to the anonymous modernist renders typically associated with megaproject proposals or the uninspiring subsidized housing projects delivered to date that rely on conventional gray infrastructure and impose untenable costs on the environment, government, and residents. The realization of such ideals will require a step outside the comforts of conventionality and disciplinary silos in research and practice spurred by targeted funding support, increased academic curiosity, and a willingness to translate innovation to implementation through non-tokenistic stakeholder engagement and experimental piloting.

In aid of clarification, the main themes and findings derived from this paper towards the adoption of an environmentally just approach to greener South African housing megaprojects are captured in Table 3.

Table 3. Summary of themes and findings.

Theme	Key Findings
Limited and unbalanced literature	- Heavy reliance on gray literature, limited academic focus, and a concentration on Gauteng. - Need for expanded research on environmental justice, sustainability, and resilience. - Explore intra-/interinstitutional conflicts and government responses. - Conduct ethnographic case studies in metropolitan areas and towns outside Gauteng. - Move beyond quantifying green space inequality to assess technical and qualitative aspects of NBS for low-income areas. - Include indigenous knowledge and low-tech, multifunctional green solutions.
Shallow commitment to green agenda	- Environmental considerations are often secondary to economic and social priorities. - Develop guidelines for retroactive greening and sustainability in megaprojects. - Focus on practical, low-cost solutions: biosolutions, indigenous vegetation, urban agriculture, green roofs, vertical gardening, and alternative construction materials.
Economic challenges	- Peripheral developments lack access to economic hubs. - Limited private sector investment. - Targeted funding and local entrepreneurial opportunities needed for cost-effective green solutions.
Social challenges	- Relocation disrupts livelihoods and lacks adequate stakeholder engagement. - Bottom-up approaches are required for planning, allocation, and maintenance. - Address informal backyard rentals through larger plots or vertical gardening. - Public green spaces should foster inclusion and community hubs.
Environmental challenges	- Fast-tracked projects bypass environmental compliance, leading to loss of biodiversity and poor green space delivery. - Avoid environmentally sensitive site clearings and prioritize natural remnants. - Use self-seeding indigenous vegetation, decentralized stormwater management, and wastewater treatment. - Ensure green space equity across income groups and address greenwashing.
Realigning guidelines	- Local implementation of green agendas requires national enforcement of sustainability mandates. - Evaluate past projects and set criteria for greener building designs, public spaces, and infrastructure. - Practical strategies: preserve natural remnants, introduce self-seeding vegetation, promote urban agriculture, implement biosolutions, and explore green roofs and vertical gardening amongst others. - Encourage innovation and non-tokenistic stakeholder engagement.

7. Conclusions

The green agenda and practical implementation measures through nature-based solutions (NBS) and green infrastructure (GI) can address diverse urban challenges when a balance is reached between the advantages of multifunctional ecosystem services (ES) and the impediments of ecosystem disservices (EDS). Whilst such benefits often motivate support for greener development, greenwashing may mask ulterior ambitions for world-class cities that appeal to upper-income residents and trendsetters. The dichotomy is expressed in the theoretical framework of environmental justice (Figure 1) that accounts for the disproportionate allocation of environmental hazards and assets, like GI, and the role of the eco-city as a new form of capitalist accumulation and domination by the Global North or ploy to attract elite investment or international recognition. This paper examines these tensions in South Africa, where housing delivery challenges prompted a shift to megaprojects in 2014, accompanied by vague environmental commitments and smart eco-city proposals loosely aligned with existing policies on sustainable development and a greener development agenda. Despite international and local criticism, the megaproject approach proceeded, with the N2GP and Cosmo City offering important pre-2014 lessons.

This context scaffolds a review of the academic literature on South Africa's housing megaprojects to ascertain the breadth and depth of scholarship and the actual commitments to a greener agenda reported. This review contributes to the limited scholarship on literature review methodology in urban and regional planning but transcends this arbitrary boundary, offering insight into a review process for various disciplines. The precise reporting of protocol development and enactment offers valuable guidelines for future research using varied literature typologies. As a limitation noted earlier, this review only considered the academic literature but found that most existing scholarship on South Africa's contemporary housing megaprojects relied on gray literature. Whilst gray literature is of immeasurable value as a source of up-to-date practice-based knowledge, the contribution of critical and innovative academic research cannot be substituted. The limited final sample identified substantiated the reliance on gray literature and a lacking breadth of academic scholarship on South African housing megaprojects. In addition, despite lofty ambitions, findings suggest limited focus on environmentally motivated development in the state's housing megaprojects, as greener approaches are often included amongst many superlatives in the spin for more sustainable human settlements after economic and social considerations. The only megaproject to mention NBS specifically, the Lanseria Smart City, is yet to materialize, and the sparse discourse surrounding it echoes aspirations for international recognition accompanied by futuristic visualizations that warn of exclusivity and privilege. Lufhereng's future incorporation of urban agricultural activities also bears merit, but these have yet to materialize. A more dedicated approach to green city building, albeit restricted to green space area and not necessarily NBS, is furthermore evidenced in some privately developed megaprojects where generous and meticulously maintained green spaces illustrate marketing campaigns.

This paper does not attempt to present the green agenda as a cure-all or to promote superficial greenwashing but highlights missed opportunities to use instruments like NBS and GI to alter path dependencies, resource consumption, sustainability, and resilience prospects through more environmentally just South African cities led by greener megaprojects. These contributions are equally important beyond South Africa as globalized eco-cities continue to manifest Flyvbjerg et al.'s [78] megaproject paradox and entrench environmental injustice to the detriment of a more sustainable Anthropocene.

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