



OPEN Co-creating micro-scale nature-based designs in Tshwane, South Africa: balancing stakeholder interests in the design process

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Rapid urbanization and climate adaptation pressures have escalated the need for co-created nature-based design solutions to address infrastructure challenges in urban green spaces. Yet, how diverse, cross-sectoral stakeholder expectations are navigated in these processes remains underexplored. This study investigates the feasibility of integrating co-creation into conventional landscape design practices, highlighting the associated stakeholder interests. The study took place in a South African marginalized peri-urban community and employed a multi-method approach including site surveys, focus group discussions, informal conversations, and co-design workshops. Our findings suggest that co-creation involves ascertaining buy-in from all stakeholders through a shared vision, inspiring capacity strengthening and empowerment, valuing knowledge exchange and reciprocal learning, identifying champions and bridging agents, and building bonds and maintaining trust. In co-creation, the designer becomes a facilitator rather than a creator, who must manage an extended co-design process that becomes part of the overall output. The feasibility of this process depends on managing degrees of co-creation through time, balancing desired outcomes between stakeholders, and focusing on dedicated engagement. Despite challenges, co-creating micro-scale nature-based designs can be used as a method of contextual inquiry and show potential to foster social inclusivity, reciprocal learning, and sustainable urban green space transformation.

Keywords Action-research, Landscape architecture, Nature-based solutions, Participatory design, Sub-Saharan Africa, Transdisciplinary

Declining biodiversity and deep social inequalities have strengthened the global call for more inclusive, socially grounded approaches to urban design and planning. Over the past decade, the co-creation of nature-based solutions (NbS) has emerged as an alternative to traditional top-down planning processes^{1–5}. Numerous examples of co-creation processes to develop such solutions are documented, particularly in the Global North, including initiatives such as Living Labs^{6–9}, and more recently, the “urban sandbox” approach¹⁰. NbS is considered an umbrella concept encompassing various ecosystem-based approaches^{11,12}. The International Union for Conservation of Nature defines NbS as “actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits”¹¹. While NbS remains a relatively young and evolving concept (see Seddon¹³ for a full account of its origins and applications), its strength lies in its contextual adaptability—it acknowledges local perceptions, values, and needs, contributing to the development or reinforcement of a sense of place^{8,14,15}.

However, some scholars critique the dominant framing of NbS for being apolitical, leading to “a narrow and idealised representation of nature”, undervaluing biodiversity and overselling the “solutions” offered by natural processes^{16,17}, while also unintentionally reinforcing a people–nature divide¹⁸. Such and other critiques have led scholars to call for regenerative human–nature relationships that move beyond merely managing ecosystems toward supportive forms of interdependence and co-existence¹⁹. This narrative shift emphasises that recognising how human and ecological systems shape one another can fundamentally reshape values, worldviews, and the practical approaches taken in research, policy, and practice²⁰. Despite these critiques, we chose to critically build on the literature that uses the term nature-based solutions (NbS), while using *nature-based design* specifically to describe NbS with an explicit design component aimed at improving the environment, and *micro* to indicate

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small-scale interventions. These distinctions are important because NbS can also include large-scale management and conservation approaches that are not directly linked to design and are beyond the scope of this paper.

In the design context, the field of landscape architecture has also been called upon to transform²¹. Historically, market-related landscape design approaches have often prioritised technical and financial considerations over social dynamics and community needs^{22–24}. This has frequently resulted in the exclusion of local knowledge and lived experiences, ultimately weakening the long-term sustainability and integration of projects²⁵. In response, the traditional “design for” model is increasingly being challenged in favour of more participatory approaches such as “design with” or “design by”²⁶. A growing body of research underscores the importance of deeper stakeholder engagement²⁷, requiring contemporary landscape architects to integrate diverse perspectives throughout the design process^{28–30}, thereby balancing human and ecological needs²².

Recent scholarship highlights co-creation as a valuable means of integrating diverse knowledge systems, including both scientific methods and traditional ecological knowledge¹⁸. The co-development of nature-based designs aims to meet public needs through cost-effective and often temporary interventions that can generate positive ecological and social outcomes³¹. Through tangible prototypes grounded in local knowledge, co-creation not only enhances the relevance and effectiveness of design outcomes but also facilitates reciprocal learning. This shift signals a broader transformation, positioning inclusive, participatory nature-based design as a mode of inquiry rather than solely a tool for spatial problem-solving.

With their training in systems thinking and expertise across social and ecological aspects, landscape architects are uniquely positioned to take on leadership roles in transdisciplinary urban planning and green space management, integrating diverse considerations and navigating complex decision-making processes^{22,23,32}.

Despite this potential, knowledge gaps persist in conceptual approaches and their applications to landscape planning and nature-based designs, particularly in Sub-Saharan Africa^{1,14}. Few studies have examined the *feasibility* of deeper and more inclusive public engagement²⁷ in co-developing nature-based design through co-creative processes. Specifically, the challenges of balancing differing stakeholder expectations and interests in such participatory processes remain underexplored.

In Sub-Saharan Africa, the public sector faces mounting pressures to deliver essential services amid large socio-economic inequalities, resource constraints, corruption, unregulated urban expansion, and political instability^{33–35}; yet, it has the directive to maintain public infrastructure, including essential green spaces³⁶. Restrictive regulations establish path dependencies for land use development across sectors³⁷, which can limit resident inclusion and affect the viability of public spaces. Furthermore, professional realities—such as tight timelines, business models, and limited resources—impact the extent to which practitioners can integrate participatory processes into their everyday practice^{22,24}. As a result, the practical challenges of balancing diverse stakeholder interests and expectations in co-created nature-based design remain significantly underexamined.

This paper addresses this gap through a transdisciplinary action research project in Tshwane, South Africa. We reflect on our collaborative nature-based design process to explore how researchers, landscape architects, municipal actors, and community members engaged in co-creation in practice on municipal-owned, public green space. Therefore, we ask:

(1) How do transdisciplinary stakeholders influence the potential of nature-based design co-creation processes by shaping, enabling or constraining collaboration, and (2) to what extent co-creation is feasible within micro-scale nature-based design in the South African context.

To answer these questions, we employed a qualitative action-research approach, utilizing two integrated procedures that overlapped and merged at various stages, namely the design process and the research process. Co-design is increasingly recognised as central to design thinking and strategic research³⁸. Such participatory design follows similar steps and principles to transdisciplinary action-research. Both rely on iterative, collaborative, and reflective processes, while design integrates structured inquiry through stages like stakeholder mapping, workshops, synthesis, prototyping, and reflection. These stages closely mirror research practices such as content analysis, qualitative data collection, thematic coding, and evaluation—highlighting potential methodological overlaps between the two fields^{26,39–41}. These “touchpoints” illustrate how design is repositioned as a mode of inquiry that incorporates more rigour by adopting inductive and deductive approaches.

By identifying the benefits, challenges, and limitations of co-creation, we demonstrate the differing roles and interests of stakeholders in both conventional and co-creation design processes and consider the role of co-design as a method of inquiry versus its feasibility in the current market economy. We map the process and outcomes for co-creative nature-based design and provide guidance for designers in their role in this process for achieving a more socially grounded yet balanced and context-responsive landscape architecture design practice, process and outcomes in the Global South.

Methods and context

Study area

Our case study is in Mabopane, a marginalized peri-urban area situated in the northwest of Tshwane, approximately 50 kilometres from the city centre (Figs. 1, 2 and 3). This research project focuses on city-owned open space, from now on referred to as the ‘Mabopane Green Space’ (MGS) (GPS coordinates: 25°31′18″S, 28°02′27″N), that covers approximately 100 hectares. The site, zoned as Public Open Space under the Tshwane Town Planning Scheme⁴², is situated in Ward 20 and shares boundaries with three neighbouring wards. The combined population of the four wards in Mabopane is 114,910⁴³.

A tributary of the Sand River flows east–west through the MGS, with several wetlands located along its course (see Fig. 2). The river is channel modified at the western and eastern ends, where stormwater is diverted from the adjacent residential areas into the green space. The dominant vegetation is savannah, with intermittent grassland patches⁴⁴. The site is designated as an Ecological Support Area in the Gauteng Conservation Plan 3–3⁴⁵. These areas may not be pristine ecosystems (see Fig. 3) but are vital for supporting Critical Biodiversity

SITE LOCATION

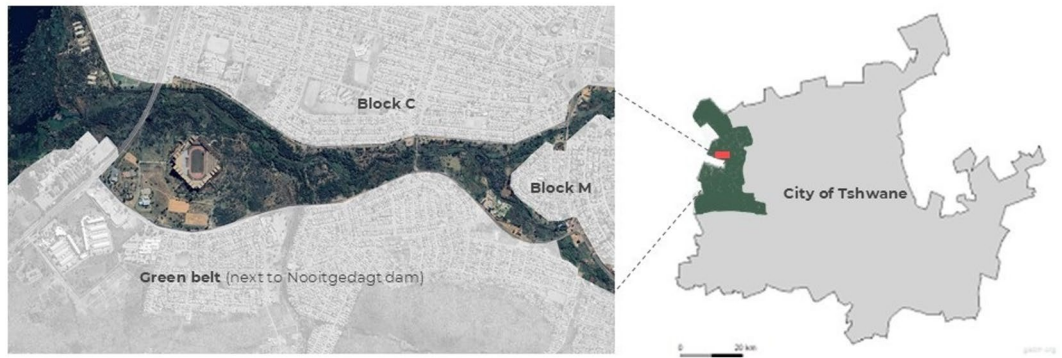


Fig. 1. Location of the Mabopane Green Space around a tributary of the Sand River, City of Tshwane, South Africa. ((Base satellite imagery adapted from City of Tshwane GeoHub, Maps & GIS (2024), map compiled using Google Workspace (Google Slides, 2024) by the University of Pretoria, Department of Architecture, Nature-based Design Studio Honours students (2024)).



Fig. 2. Image of the study site indicating the surrounding key land-uses. ((Base satellite imagery adapted from City of Tshwane GeoHub, Maps & GIS (2024), map compiled using Google Workspace (Google Slides, 2024) by the University of Pretoria, Department of Architecture, Nature-based Design Studio Honours students (2024)).

Areas⁴⁶. Critical Biodiversity Areas are defined as natural or near-natural terrestrial and aquatic areas, including irreplaceable sites, because of their unique biodiversity features, spatial relationships, and their importance for achieving biodiversity pattern and ecological process targets⁴⁵.

Some challenges currently faced in the MGS are encroachment, natural wetland deterioration, chopping of firewood, flooding, sewer leaks, safety risks, and dumping of solid waste⁴⁴ (see Fig. 3). The co-creation of micro-scale nature-based design prototypes hoped to foster environmental awareness and education by demonstrating how taking care of nature could provide tangible societal benefits.



Fig. 3. Bird's eye view of the study site looking west with the north-south river crossing in the centre and the Odi athletics stadium and Magaliesberg mountain range in the background. Dumping of domestic waste and building rubble can be observed along the green space edges and the river crossing (Photo credit: S Küssel).

Local context - landscape design in South Africa

Since South Africa's 1994 democratic transition, public participation in the built environment has grown in importance yet often remains limited to minimum legal requirements⁴⁷. Historically, top-down colonial and apartheid planning excluded communities, but post-apartheid legislation now mandates public involvement⁴⁸. Despite this, meaningful participation is hindered by public distrust and systemic barriers such as political and funding challenges. Restrictions such as prohibitions on planting vegetables on sidewalks in Tshwane⁴⁹, combined with insecure and unsafe urban green spaces⁵⁰, further constrain public participation in the design, planning, and management of green spaces. Constraints such as these, limit residents' ability to care for local green spaces, thereby reducing opportunities to foster a sense of ownership and to ease the operational and maintenance burden on municipalities²³. Addressing these difficulties requires innovative, cross-sectoral collaboration⁵¹.

In South Africa, the Department of Public Works and Infrastructure oversees the Council for the Built Environment, which regulates six built environment professions, including landscape architecture under the South African Council for the Landscape Architecture Profession (SACLAP)⁵². Governed by the Landscape Architectural Profession Act (45 of 2000), practitioners must be registered with SACLAP in one of four categories to work on government projects and use professional titles⁵³. SACLAP outlines required services across six project phases, such as liaising with clients and authorities, with no specific stakeholder engagement requirements.

Landscape architecture in South Africa typically prioritizes tangible project outcomes. Designers are commissioned based on predefined briefs and assess site-specific constraints to refine their proposals^{26,54}. Stakeholder engagement ranges from tokenistic to participatory²⁷, but in public green space development, it is often minimal or formalized, with input filtered through intermediaries like park managers or ward councillors⁵⁵. According to Du Toit, Dallimer³⁴ and Du Plessis and Breed⁵⁶, this trend can be attributed to the persistent deprioritization of environmental concerns in favour of seemingly 'more pressing' socio-economic challenges, particularly by political actors who shape municipal budget allocations. Since 1994, limited direct consultation with users has persisted, reinforcing a traditional model in which designers assume control over both ecological and socio-cultural aspects of space²². This reflects what Sanders and Stappers⁵⁷ describe as "designing for users" rather than collaboratively with them—a global issue.

Research context

This study forms part of a four-year action-research project with an integrative approach, which commenced in 2023 and will continue until the end of 2027. The project spans governance and community scales, supporting South Africa's National Development Plan⁵⁸. The research project, Collaboration on Nature-based Solutions for Sustainable cities (CONSUS), is funded by the Danish Ministry of Foreign Affairs through the Danida Fellowship Centre, (Grant no. 23-M02-AU), and brings together landscape architects, ecologists, and human geographers. The research aims to foster community buy-in, ownership, and stewardship of urban green spaces in Tshwane, thereby bridging the gap between local communities, academia, and local governments. This is achieved through co-creating micro-scale nature-based designs and ecological rehabilitation initiatives as small-scale experiments to activate sustainable green and blue spaces. Now in its second year, the project has built strong momentum, enhancing community engagement in the MGS.

The outcome of the design process encompassed *nature-based designs* that focussed on waste and water management and included gabion seats, walls, tables and erosion-control structures, constructed and artistically decorated using illegally dumped building rubble, broken tiles and discarded glass bottles; multi-purpose timber shelters with green roofs designed for social, cultural, and recreational activities; and, organic composting bins and related infrastructure to promote the recycling and reuse of household organic waste, supporting soil improvement and reducing pollution.

We focused on *micro-scale* prototypes, aiming to develop low-cost, up-scalable, technically simple designs that could be co-installed, co-managed, and jointly monitored with the community for their sustainability. This approach is suitable in such contexts where financial constraints and government support wane⁵⁹ and is more feasible in low-income communities where people need to initiate projects with limited support or finance. The greater ambition is that these micro-scale prototypes can be upscaled and outscaled to other parts of Mabopane, the city and the sub-continent.

The designs were co-created by nine Landscape Architecture and Architecture honours students from the Department of Architecture at the University of Pretoria. The students were guided by the first and fourth authors and were provided with design criteria based on the IUCN's Nature-based Solutions framework⁶⁰. According to the IUCN, these criteria offer "a framework for designing, implementing, and verifying that nature-based solutions are effective and sustainable"⁶⁰. The students' design criteria included co-creating micro-scale nature-based prototypes that address local needs and priorities, provide benefits for the broader community rather than individuals, and have appeal across genders and generations. Promoting environmental awareness (fauna and flora), reciprocal learning, balancing human benefits with ecological enhancement, reconnecting people with their natural environment, and incorporating local knowledge, practices, materials, and technologies (Indigenous Knowledge Systems) was emphasized.

Empirical approach

This study employed a qualitative action-research approach⁶¹, exploring the impact of transdisciplinary co-creation on stakeholder perspectives, roles, and interactions, as well as the feasibility of establishing co-creation as the new and improved process for landscape design²⁶. The action-research comprised two integrated processes that overlapped and merged at stages, namely the design process and the research process (see Fig. 4).

1. The design process included desktop reviews of existing studies, ground-truthing of existing site conditions and co-creation workshops to develop and revise the micro-scale nature-based prototype designs.

Primary data for the design process was collected by the first author, a research assistant, and the nine honours students from the University of Pretoria. The first author is a professionally registered landscape architect with over 35 years of experience in private practice, bringing extensive applied expertise to both the design and research processes. The data was gathered using six methods: eight site surveys and scoping exercises, mapping of existing site conditions on aerial photographs, photo documentation, and informal conversations with residents during site visits. In addition to focus group meetings with city officials, three co-creation workshops were conducted with the community. These methods provided a deeper understanding of the administrative, infrastructural, ecological and social opportunities, needs and constraints related to the study area. The process facilitated the preliminary identification of potential nature-based design development sites with on-site validation through the surveys and scoping exercises, and co-created concept designs for the micro-scale nature-based prototypes.

A comprehensive understanding of the study site was developed through a combination of desktop research, policy review, and spatial analysis. Secondary data included technical reports on vegetation, stormwater management, and engineering services, alongside spatial maps and zoning plans from the City of Tshwane. National, provincial, and municipal policies were reviewed to assess legislative frameworks for public engagement and environmental development. Socio-economic insights were drawn from data obtained from the Council for Scientific and Industrial Research, a leading South African research organisation that focuses on science, engineering, and technology innovation⁴³ as well as from informal conversations with residents. Using a layered site analysis approach⁶², data on topography, hydrology, vegetation, infrastructure, and land use were mapped in AutoCAD 2024 over high-resolution satellite imagery. This helped identify spatial constraints, development opportunities, and ecological dynamics. Together, these data sources formed an integrated knowledge base to support micro-scale, nature-based design and planning.

2. The integrated research process relied mainly on fieldwork conducted concurrently with the design process, which can be noted in the overlap.

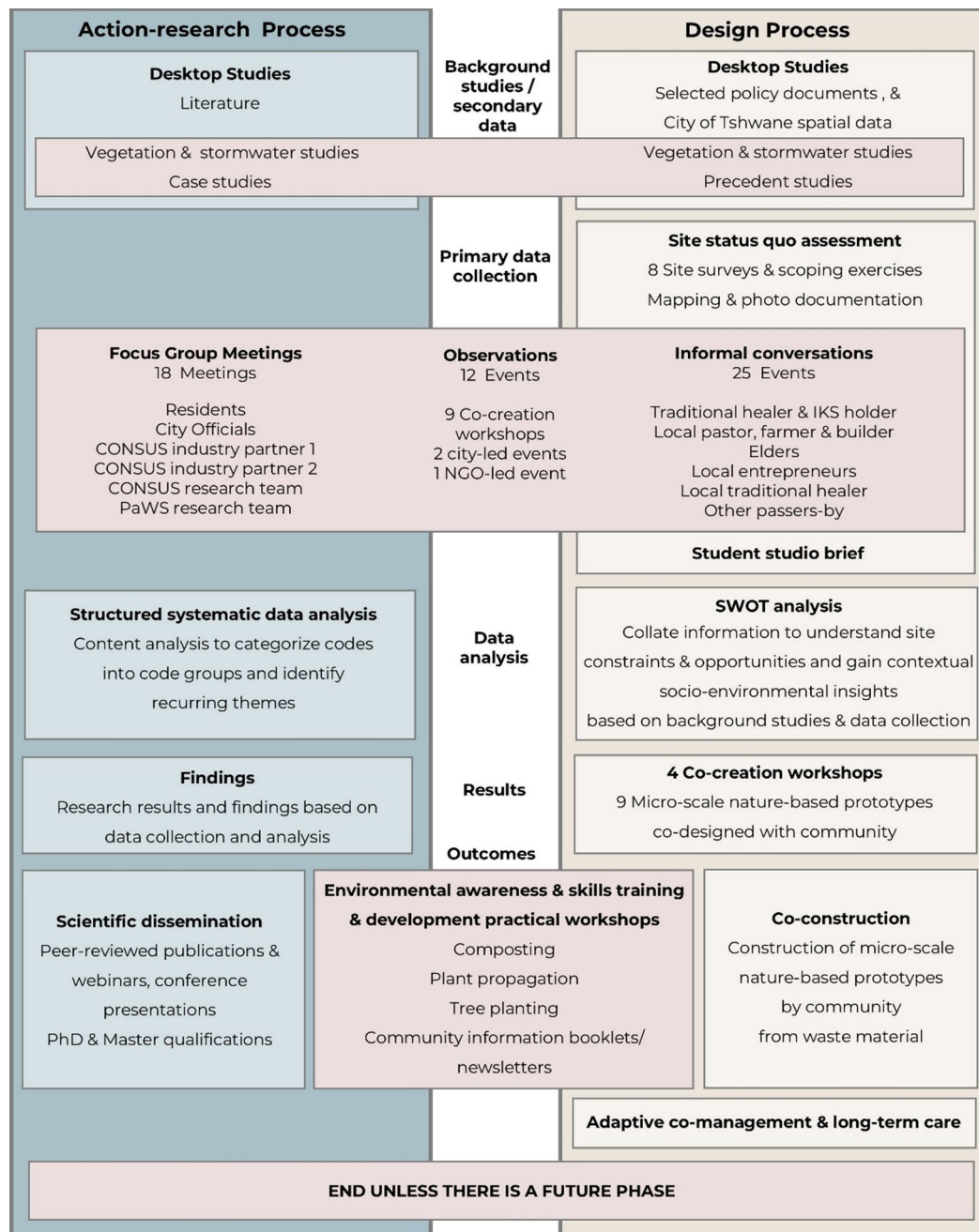


Fig. 4. The Research Design indicating the integrated research process and the design process (where blue indicates formal research, yellow purely design and the pink rectangles where the two processes merged).

Primary data was collected using focus group discussions ($n=18$), which were conducted across sectors to understand different stakeholder expectations and requirements to develop authentic community engagement and co-creation processes and activities. Stakeholder groups included city officials for insights into political and policy considerations, external expert partners for co-creation methods and processes, the research team to examine disciplinary approaches and viewpoints, an external research project team (same focus and funder, different South African city) to learn from their experiences, and community organisations. Twenty-five informal conversations were held with residents (convenience sampling during site survey and scoping events) such as members of a garden group, a farmer, traditional healers, builders, restaurateurs, elders and holders of Indigenous knowledge to gain an understanding of the local context and confirm community needs related to the green space. Participant observation was conducted during nine co-creation and skills training workshops, as well as a non-profit organisation-led and two city-led environmental awareness events, to assess the level of interaction, group dynamics, and overall community participation and buy-in (Fig. 4).

Participants		method	# of participants
Government officials	City of Tshwane	FG	12
	Gauteng Province	IC	1
Core research team's industry expert partners	Landscape architect Landscape architect/ archaeologist Ecologist Human geographer	FG	4
Researchers	Core research team (different disciplinary background)	FG	7
	External research project team	FG	4
Civil society	Residents	IC	25
	Local agricultural co-operative	FG	5
Students	University honours students (Architecture & landscape architecture)	FG	9
	International PhD scholar	FG	1
TOTAL participants			68

Table 1. Summary of participants FG = focus group meeting = | IC = informal conversation.

To avoid community contributions being lost in translation, an iterative design process was followed in which ideas and concepts were repeatedly discussed with the community and alternative solutions actively explored. Local problems, needs, and their locations were identified and marked on an aerial photograph with coloured dots during a mapping exercise. “Prompts” in the form of open-ended questions—focusing on community needs, challenges, and Indigenous Knowledge Systems—were prepared before workshops with the students to help them elicit the required information from the participants. Preliminary design ideas were later refined and discussed in focus groups, and final designs were pinned up for review and comment. Multiple methods were used to gather feedback, including focus groups—where participants of all ages and genders engaged enthusiastically—and informal, private conversations that created a ‘safe’ space for more candid input. Feedback was audio-recorded, and students and researchers took detailed notes throughout.

Data collection

This action-research project used a qualitative, multi-method approach to capture diverse perspectives and subjective experiences⁶³. While it aimed for broad representation across sectors, it does not reflect the full population of Mabopane or all South African built environment professionals.

A total of 68 stakeholders participated, including representatives from government, academia, civil society, and private practice (see Table 1). Participation was voluntary and conducted with written informed consent, in line with institutional ethical clearance received from the City of Tshwane Knowledge Management Unit, 03 January 2024, and the Faculty Committee for Research Ethics and Integrity, Faculty of Engineering, Built Environment and Information Technology, University of Pretoria, reference number: EBIT/5/2024, 03 March 2024. All methods were performed in accordance with the relevant guidelines and regulations as per the ethical clearance.

To strengthen validity and deepen understanding of the site, we used three main methods:

Focus groups ($n = 18$): Facilitated discussions with 3–7 people, lasting around 60 min. These sessions helped explore key questions and group perspectives⁶⁴.

Informal conversations ($n = 25$): Short (approx. 10 min) one-on-one or small group chats. This flexible format generated more natural, accessible insights⁶⁵.

Participant observation ($n = 12$): Co-creation workshops and events (2–3 h each, with 41–161 people) were documented through notes, photos, and audio recordings. This method helped us understand interactions between people, space, and activities⁶⁶.

Data analysis approach

The first author transcribed the voice recordings of the focus group discussions, informal conversations, and observations verbatim, cross-checked them with discussion notes for accuracy⁶⁷, and corrected any discrepancies⁶¹. The three data sources were systematically analysed using both deductive and inductive approaches, and the content was coded using descriptive coding⁶⁸. Content analysis⁶⁹ of the codes was employed to identify recurring themes, which were extracted and organized in an Excel sheet. The codes were categorised into code groups, interconnections within the literature and among the code groups and phrases were examined to derive themes⁶¹. The themes - enablers of co-creations, potential barriers, feasibility, participant interests - are expanded on in the results.

Results

In the following section, we present findings from our design and research process to co-create micro-scale nature-based designs with and for the community in the MGS. These included seating and shading areas, as well as composting structures made from on-site building rubble. Our results are structured around two research questions: first, the interests and influences of different stakeholders in the co-creation process; and second, the feasibility of co-creation within professional landscape design practice.

Stakeholder interests and influences on the co-creation process potential

Multi-stakeholder inclusion was a deliberate priority in the co-creation of the micro-scale nature-based designs, requiring the careful identification and engagement of individuals and groups genuinely committed to the collective goals of the initiative. Emphasis was placed on involving local stakeholders motivated by shared values and long-term community benefit, rather than personal or financial gain: *“Identify certain talents within the community, individuals that have a passion for plants and the environment, within the community and within the [local] government...”* (Local-8). Including a broad representation of residents living close to the MGS aimed to make space for diverse voices and mitigate entrenched power dynamics, to foster more equitable participation.

Below, we highlight aspects impinging on the process potential with a focus on the community, local government, and the research project team, then the emergent themes across the co-creation process, ending with the feasibility factors.

Community dynamics and buy in

Language and communication Setswana is the dominant language in Mabopane, not spoken by any member of the research team, which posed potential barriers to effective communication in the co-creation process. Differing vocabularies risked obscuring nuanced meanings embedded in the local vernacular, thereby limiting external understanding of how communities interpret key scientific concepts. Aware of the risk of misaligned expectations and marginalisation of local knowledge, the team prioritised addressing these linguistic and cultural complexities. Strategies included translating interview materials, newsletters, and signage into Setswana. We engaged a university-hired research assistant more closely in the project once we discovered that she was a “born and bred Mabopane girl”. In addition to our local ambassador, local Setswana-speaking research assistants were employed and community members assisted with verbal and written translations during meetings and workshops.

Community ownership Our research found that the potential of co-creation depended on community buy-in. Without active engagement and a sense of ownership among local stakeholders, long-term duration of the nature-based designs was unlikely due to vandalism. Achieving meaningful engagement required a deliberately slow, iterative process focused on building trust, strengthening social relationships, and developing a deep understanding of local needs, values, and priorities: *“They [the community] have that unity together because you can even see with the way they engage... They are now working together towards achieving whatever goal [design of micro-scale nature-based prototypes] it is ... even I think it [co-creation] helps because they influence one another positively”* (City official-6).

Our findings also point to potential unintended consequences from buy-in. As some individuals invested significant time and energy, a strong sense of ownership occasionally manifested as possessiveness: *“Each and every time when you guys [the researchers] are coming over, we’ve got new people [from the community] and new ideas. We don’t even know where the new people are coming from”* (Local-2). This could lead to efforts to control (or even derail) the project or exclude new participants.

Local government challenges and buy in

The local government faces significant resource constraints that hinder effective co-creation. While environmental policies are often strong, limited capacity, budget and current by-laws undermine facilitating long-term, community-driven initiatives: *“We are beggars from the politicians. The policies are good, we have some of the best, but the implementation is dololo [poor]”* (Local-8). Frequent shifts in political leadership further disrupt continuity in urban governance. Local stakeholders also perceived that lengthy bureaucratic procedures and restrictive regulations stifle innovation and slow down implementation. These challenges are compounded by a lack of trust between the city and its residents: *“Local governance is failing us [and] our people, that is a clear, clear statement”* (Local-8).

The co-creation process demonstrated potential in this regard by deepening municipal officials’ understanding of community needs and highlighting the value of participatory, rather than top-down or punitive, approaches: *“Not only the listening part but also understanding what would work best for the community in that space and incorporating it into the project... it was not just something that was imposed on them. As a city, I think we learned over the years, the hard way”* (City official-1).

Research project team challenges and strategies

Navigating disciplinary divides and contextual differences From the outset of the project, the research team recognised the potential for co-creation through sharing and combining disciplinary approaches, but also the risk of tensions and divergent approaches due to varying training backgrounds, perspectives and cultural differences. We found that disciplinary biases and differing methodological approaches can complicate the collaboration process, requiring deliberate efforts to foster interdisciplinary integration and mutual understanding, and may compromise the project’s success if not carefully managed. This was particularly relevant in our context, as the research team comprises a human geographer, a political ecologist, three ecologists, three landscape architects (one of whom is also an archaeologist), a landscape technologist who is both a resident of Mabopane and serves as our local ambassador, and an arts-based researcher.

A further key challenge was understanding lived realities across different research contexts—such as between the Global South and the Global North, or between local regions—which could compromise the relevance and applicability of proposed solutions: *“My views on things like culture and religion may be biased so I [cannot] comment on these, especially because I am not from around [Mabopane]”* (Researcher-1).

Team collaboration principles and values To foster a collaborative atmosphere and mitigate potential friction, the team participated in facilitated sessions led by an industrial psychologist to co-develop shared values and desired project outcomes at the outset of the project. These shared values were revisited in subsequent sessions, together with important guiding principles to enhance collaboration. At the same time, we collectively established ‘rules of engagement’, including aligning our authorship practices with the Vancouver guidelines.

Fostering a shared understanding of key concepts and embracing disciplinary pluralism About half a year into the project, however, we realised that we also needed clearer alignment around key terms that were central to our work. Although we had agreed on shared values early on, it became evident in our day-to-day collaboration that we sometimes meant different things when using concepts such as ‘co-creation’, ‘design’, ‘nature-based solutions’, or ‘restoration’. These differences stemmed from our disciplinary backgrounds and shaped the expectations we had of one another and the project tasks.

To address this, a co-author suggested to have dedicated “key term sessions” in our bi-weekly meetings to unpack these terms and make explicit what they entail in different fields. The design process, for example, was explained to non-designers on the team, who reported that this helped them understand how designers approach a project and the principles and methods they follow. These on-demand keyword sessions proved valuable in building a shared cross-disciplinary understanding of both concepts and desired outcomes, and in several instances led to new insights, deeper interpretations, and specific activities shaped by the diversity of academic backgrounds within the team.

Another insightful exercise was facilitated by a co-author during a team workshop, where each of us was asked to sketch our disciplinary research process in three minutes. The scientists drew a straight line, indicating a linear process that progresses as new data are collected and cannot revert to a previous phase without compromising the validity of their findings. The designers produced a circular, iterative diagram that continually loops back to reassess insights and adapt the process. The human geographers’ diagram combined elements of both approaches. This exercise highlighted marked differences in disciplinary research logics, which created friction at certain stages of the project, but being aware of these differences from the outset proved valuable. This proactive and reflective approach strengthened our co-creative teamwork and improved alignment across disciplinary boundaries.

We also engaged with a research team working on co-creation with local communities in marginalised areas in Cape Town to learn from their experiences and apply relevant lessons to our project.

Emergent themes across the co-creation process

Inspiring capacity strengthening and empowerment Workshop participants reported experiencing individual development, including practical skills acquisition and a growing sense of empowerment, which they felt would enable them to sustain their efforts beyond the lifespan of the project: “Each and every one of us has been empowered by all this knowledge... we can carry on, on our own...” (Local-5). The co-creation process also enhanced environmental awareness and promoted more responsible resource use. Participants expressed a strong desire to share their new knowledge within the broader community, particularly with schools: “My wish is to come every day [to the co-creation activities and learn] ... and pass it to someone. Especially to schools” (Local-13). In addition, the process generated local economic opportunities and strengthened community-led environmental care. This was achieved through environmental education and hands-on training in areas such as plant propagation, compost-making using organic waste, and the construction of multi-purpose shelters and gabion seating from building rubble: “You [researchers] are giving them a skill... one could take that and then start a small business or use it to train others” (City official-7).

Valuing knowledge exchange and reciprocal learning Through reciprocal learning with a similar research project in Cape Town (South Africa), we gained valuable insights and became aware of potential risks to the project. Key lessons included the importance of building on existing local initiatives, partnering with local businesses, offering tangible benefits like certified training, and sharing knowledge in accessible ways to foster trust and relationships. We also learned that progress is cyclical rather than linear, often relying on a local “champion” to maintain momentum. Importantly, the introduction of funding as incentive can bring complex power dynamics. Possible communication barriers, along with the fact that not all community members were familiar with governance processes, underscored the need for culturally attuned and inclusive engagement approaches.

With these lessons in mind, we approached the co-creation process with care and humility, recognising the community as experts in their own context. The research team, including students, prioritised learning from the community to meaningfully integrate local knowledge into design. This ethos shaped our small-group workshops, which emphasised dialogue and reciprocity: “Equal conversations mean everyone brings different, equally important knowledge” (Designer-3). Stakeholders valued this mutual exchange, viewing it as essential to co-creation. Ultimately, we learned that shared understanding should be meaningful, fun, and inspiring for all involved.

Identifying champions and bridging agents The presence of dedicated ‘champions’ - both within the community and at the municipality - was critical to sustaining the project’s momentum and ensuring its relevance beyond the research timeline. As one researcher noted, project success requires “...a [local] champion who has time and energy, who is not just about the money...” (Researcher-5). This need was addressed by appointing a university research assistant from Mabopane as the local project ambassador (as mentioned before), facilitating the establishment of a voluntary community organizing committee, employing and training local youth as research assistants, and partnering with locally based, environmentally focused non-profit organizations. While this increased

the potential of the process, it also meant placing people in power positions with constant need for check-ins on personal versus project interests.

Building bonds and maintaining trust The co-creation process potential was enhanced through fostering strong interpersonal relationships, strengthening community bonds, and building trust among participants. It also contributed to a growing sense of hope and confidence in local capacities. “...It [the co-creation process] has encouraged a lot of people to engage with one another ... discussions and sharing information overtime ... it's quite something you know on the social side of things; it has done something else, and you can see for yourself...” (Local-11). Sustaining trust required ongoing communication to maintain alignment of expectations. Participants noted that misalignment could quickly undermine confidence and cooperation. Regularly revisiting shared goals and “non-negotiables” in the co-creation process emerged as a key strategy for reinforcing mutual understanding and sustaining commitment throughout the process: “We must continuously reaffirm our non-negotiables and level and align expectations” (Designer-2).

Feasibility of co-creation

Managing degrees of co-creation across the design process

The practice of co-creation was underpinned by a shared ethos that valued all forms of knowledge—formal, informal, local, and scientific—as equally important to the design outcomes. Levels of stakeholder engagement in the co-creation process were found to be dynamic and phase-dependent, shifting between collaboration, co-designing and deep co-creation. Effective facilitation of the design process required the designers to remain attuned to the evolving dynamics of the process—knowing when to step back and allow community members to take the lead, and when to intervene with professional expertise: “We [the designer] provide the design and technical knowledge people need. We cannot put ALL the responsibility on the community. We interpret their needs” (Designer-3). These included moments of guiding, following, leading or adapting, depending on the needs of the process.

Balancing desired design outcomes

Nature-based design prototypes must balance human benefit with ecological improvement. Some Mabopane residents rely on nearby green spaces to collect firewood or for dumping excess and unwanted building rubble, garden and household waste. Providing guidance on the re-use of waste and the value of indigenous trees with viable, context-specific alternatives can encourage behavioural change and strengthen community buy-in: “That is why this is a better option where you're saying do not dump rubble. You can use it for gabions. Do not dump organic material. You can use it for composting. So, coming up with those [alternative] solutions that are going to benefit the community, it makes it easy for them to start adopting the new behaviour” (City official-1). Although the prototypes are constructed inside ecological support areas, they become catalysts as sites for learning that manage and confine environmentally harmful practices.

Within the research team, the political ecologists and human geographers prioritised the co-creative process—with particular efforts focused on community integration and supporting local capacities aimed at fostering “transformative change” in nature awareness, care, and connectedness. These outcomes are often intangible and less immediately visible. In contrast, the local landscape architects and public sector staff emphasised asset protection and the delivery of physical, functional nature-based designs, viewing the *production* of tangible outputs for the broader community as essential indicators of project success, especially in a marginalised context with desperate physical needs. Over time, the team moved toward a shared understanding that, within the specific context of Mabopane, both the co-creative process and the production of a concrete outcome were essential and mutually reinforcing elements of success: “The product and the process are both important and should be balanced” (Researcher-7).

Dedicated engagement and spread of funding

Our findings indicate that a co-creative landscape design approach requires substantial and sustained investment of time, financial resources to support ongoing engagement and meaningful collaboration, and human effort from all stakeholders, but specifically from the community. However, the high level of personal commitment demanded—particularly in terms of time, energy, and perseverance—can be difficult to sustain over extended periods. Differences in disciplinary and community approaches can complicate collaboration, requiring ongoing efforts to bridge gaps in perspectives and methodologies: “Collaboration is hard, it takes so much longer to take so many opinions into account” (Researcher-7). Achieving meaningful outcomes often requires time, communication, continued funding and flexibility that exceed what is typically considered feasible in private practice. The success of co-creation of micro-scale nature-based design prototypes is also highly context-dependent, meaning that strategies cannot simply be transferred to new communities without careful adaptation.

Discussion

The findings illustrate numerous challenges that may hinder the successful adoption of co-creation as a standard landscape design process for nature-based green space projects in Sub-Saharan Africa; however, they also highlight the potential for success when the appropriate contextual conditions are in place. Below, we summarize the key findings on stakeholder interests and the feasibility of the process and then discuss the primary distinctions between conventional and nature-based co-creation design processes, the role of the designer and the potential of co-design as a method of inquiry, concluding with some implications for co-creation in landscape design in Global South contexts.

Not surprising, the key factor we identified for successful co-creation was ‘buy-in’ from all participants, such as acceptance and willingness from the community, researchers, and the public sector to collaborate.

Correspondingly, facilitators played a central role in cultivating this buy-in by inspiring capacity strengthening and empowerment, valuing knowledge exchange and reciprocal learning, identifying champions and bridging agents, and building bonds and maintaining trust.

The transdisciplinary nature of co-creation⁷⁰ and intentional inclusion of multiple stakeholders inevitably introduces complexity. Participants brought varied interests, expectations, and institutional requirements, which occasionally led to tensions that challenged consensus-building and hindered progress. Addressing these differences proactively, while ensuring ongoing inclusive participation²⁷, was critical to maintaining a shared vision and sustaining momentum throughout the design process. Navigating this complexity required careful facilitation and adaptive strategies to uphold inclusivity without compromising the design process. The feasibility of this process depended on managing degrees of co-creation throughout the design process, balancing desired design outcomes among stakeholders, and a focus on dedicated engagement.

Many of the challenges we encountered stemmed from the need to better understand stakeholders by addressing cultural, language and communication barriers, identifying and balancing disciplinary biases, and understanding local lived realities across research contexts. To surmount this within the research team, we developed a strong, unified vision through collaboration principles and values, a shared understanding of key terms and learning from other similar projects on the ground.

Other elements we found that affect the feasibility of a co-creative, nature-based design approach corroborated with the literature, and included: addressing power dynamics⁷¹ that shape participation, knowledge integration and eventual (transformative) outcomes⁷²; deliberately implementing a bottom-up methodology that promotes community decision-making^{27,31,73}; creating space for conflict and negotiation⁵³; following an iterative, reflexive, “slow science”⁷⁴ process; the respectful integration of scientific and traditional ecological knowledge systems as advocated for by Bridgewater⁷⁵, Galafassi, Daw⁷⁰, and Kiss, Sekulova²⁷ which Hakkarainen, Mäkinen-Rostedt⁷² believe can also unlock transformative potential; facilitating environmental education, skills development for green jobs and other livelihood opportunities⁷¹; upholding equitable benefit-sharing and fostering social inclusivity must remain central objectives throughout the process²⁷. All these elements require adequate material and human resources, and flexible timelines^{27,70}, keeping in mind potential barriers and risks, such as buy-in turning into possessiveness and limited financial and human resources undermining desired outcomes. This aligns with the findings of Sarabi, Han⁷⁶, who highlight that implementing nature-based solutions is supported by adaptable institutional frameworks, long-term planning, and the inclusion of local knowledge. However, the authors also support our findings that inflexible funding models and limited project durations often impede transdisciplinary projects⁷⁷.

In this context, we examined the similarities and differences between the conventional landscape design approach and the (action-research) nature-based co-creation model in terms of clients, roles, site, owner, end-user, design brief, budget, fees, public engagement, timelines, construction and outcome (see Table 2). We aimed thereby to identify which aspects of co-creation can be integrated into the landscape architecture design process to unlock the benefits of deeper community engagement²⁷. While we recognise that practitioners often work

Aspects	Conventional landscape design process	Co-creative nature-based design process
Client	Private or public sector person or entity owner	Diverse role players (e.g. community, local government, the research team, funder)
Client role	Articulates needs and expectations for design, provides approvals, processes payment, and oversees management and maintenance post-construction	Community: Articulates needs and expectations for design, provides input and approvals, co-manages and co-maintains post-construction (with the owner = city) Local government: Adherence to service delivery mandates, municipal policies and by-laws Research team leaders: Manage payments, outputs and milestones
Designer role	Refine brief, consult with professional team, limited engagement with end-users, develop design and technical documents for tender purposes, tender adjudication, construction and maintenance period monitoring	Identify key stakeholders, facilitate community needs, conduct a site status quo analysis, co-develop design brief, co-design, facilitate skills development and training workshops and awareness activities, facilitate community construction and sustained co-management of designs
Site	Fixed- preselected by client or approved by client	Open space selection based on research funding criteria and stakeholders
Owner	Client	Public sector
End-user	The project location and brief will determine	Researchers ‘find’ the affected community (“the right people to involve”) in collaboration with the city
Design brief	Provided by client, refined by project team, approved by client	Developed by the community, based on community needs and lived experience, refined with the city, researchers and the community to bring environmental improvements
Budget	Determined by the client, often fixed funds	Fixed overall budget but more flexible timeline and broad deliverables
Professional fees	Fixed, based on hourly rate of time/ cost expenses	Flexible and extended human hours for appointed researchers
Public engagement	Stricter budgetary constraints, often only as much as is “legally” required	Extended time frames budgeted for deeper understanding, communication and connections, time-consuming and emotionally draining
Timeline	Determined by the client, often fixed to a financial year-end date or opening / sales date, normally (very) tight - time eats profit	Flexible to adapt to co-creation and co-construction processes and external factors -restricted by research project time frame and research outputs and milestone deliverables
Construction	By main contractor appointed by tender process	By community and contractor appointed by research team
Outcome	Tangible product, physical, practical and aesthetically pleasing	(Differing) emphasis on the (intangible) process versus (tangible) product/ outcome, micro-scale initiatives with hope for (beneficial) impact on the natural environment as well as socio-economically - Dual aim of capacity strengthening and new knowledge. Can include after-construction ecological monitoring.

Table 2. Comparison between the conventional landscape design process and the co-creative nature-based design process.

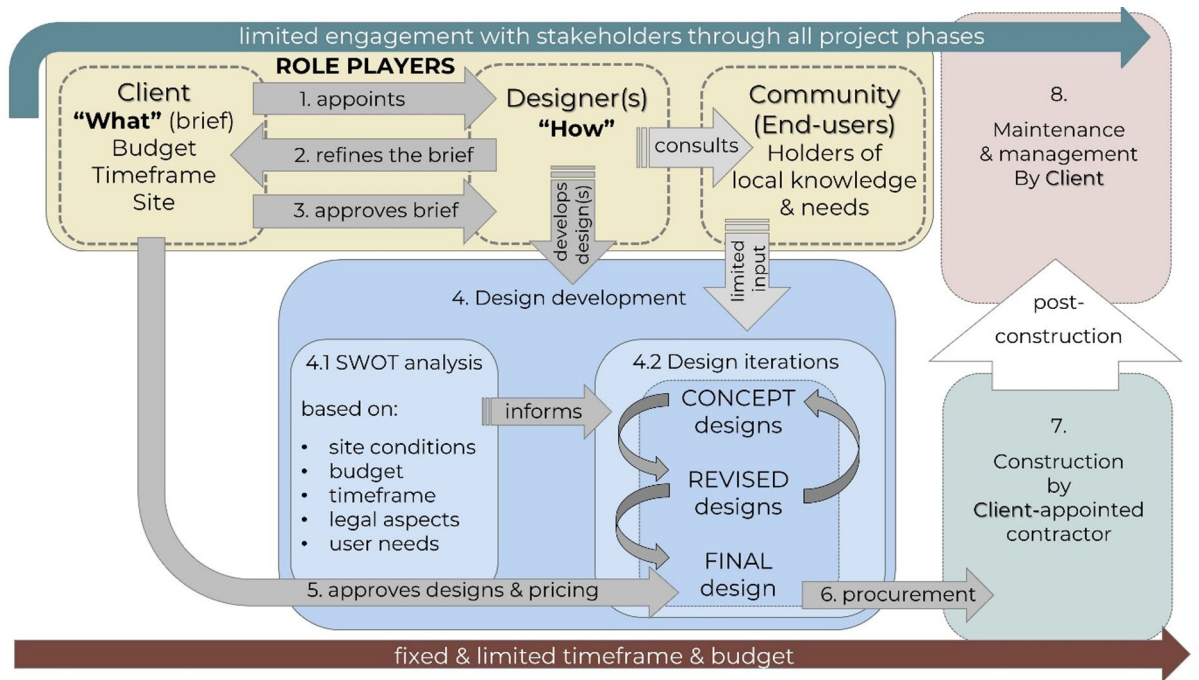


Fig. 5. Conventional landscape design process.

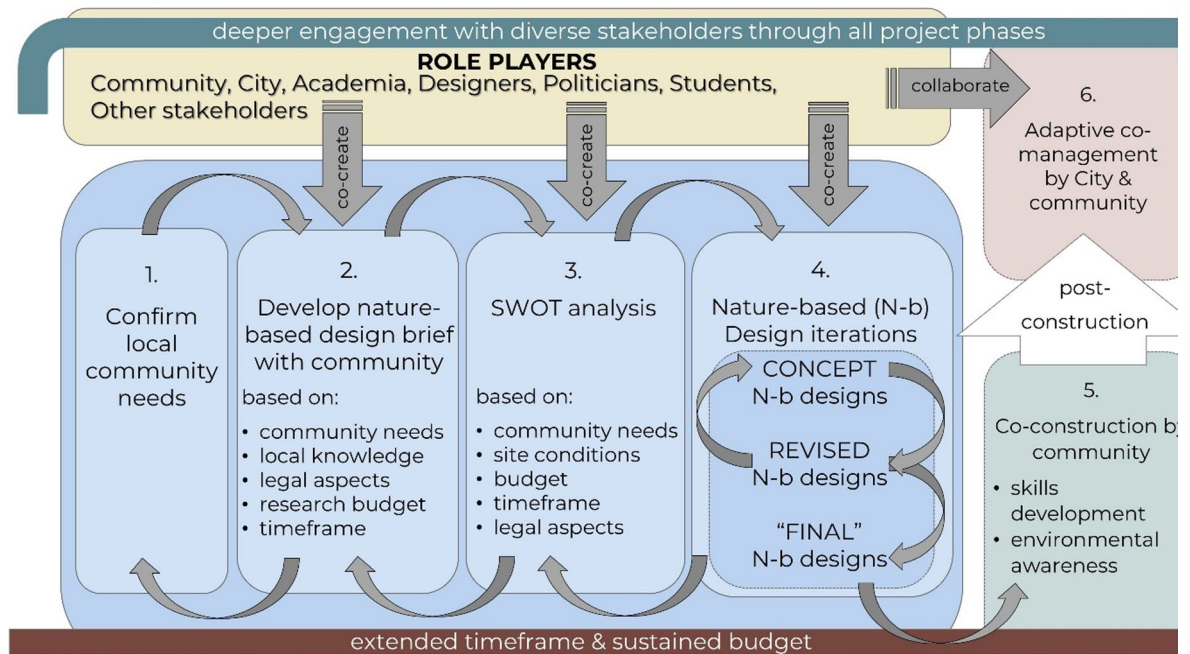


Fig. 6. Co-creative nature-based design process.

within challenging market conditions, such constraints need not preclude a stronger orientation toward socially just, community-driven design. By more intentionally balancing commercial considerations with context-specific commitments to equity and inclusion, professionals can play a meaningful role in addressing the spatial and historical injustices that continue to shape these environments (see Figs. 5 and 6).

Figures 5 and 6 illustrate the primary distinctions between conventional and co-creation design processes and, equally, the three areas for potential conflict that emerge with co-design: (1) Increased inclusivity and number of role players, who define the brief, focus and desired outcomes. The community and other stakeholders play an active, integral role throughout, while the designer assumes a more facilitative role rather than acting as the sole creator. (2) An extended and amplified co-design process, that allows for continuous input, capacity

strengthening, environmental education and awareness, even post-construction, with less formal (legal) approval processes and time restrictions. Importantly, the design process itself—an intangible but transformative component—becomes part of the overall output, not just a means to an end. (3) A shared vision, as outcome, less fixed and less certain, negotiated through role players (1) and process (2) to balance the various expectations that ensure long-term community uptake and sustainable transformation.

Such “deeper” stakeholder engagement as called for by Kiss, Sekulova²⁷, requires the integration of diverse perspectives throughout the design process^{28–30}, to balance human and ecological needs²². Randrup, Buijs¹⁹ argue that interdependence is a driver of transformation in beliefs, values, and practical applications.

We argue that the role of the designer changes from *decision maker* to *manager of decisions* along with other members of the (research) team. The designer also becomes the facilitator of the co-creation process. This requires constantly gaining input and buy-in from other stakeholders into design decisions. The designer’s work is not less but different, focussing equally on *what* and on *how*, this involves: working towards stakeholder buy-in across sectors; continuously clarifying and aligning the vision, goals, and desired outcomes of the project; embracing a flexible and adaptive design and research process; managing resources effectively; managing legal aspects; seeking transdisciplinary collaboration and support; and striving for long-term community uptake. This aligns with participatory design theory—particularly the work of Sanders and Stappers⁵⁷, who advocate a shift from designing *for* users to designing *with* them.

Reflecting on the greater emphasis of the design process as a method of inquiry, we argue that (nature-based) co-creative design can take inspiration from research methods at specific moments, especially when generating transferable insights and justifying process transparency, as supported by Sanders & Stappers^{54,57}. Participatory design and transdisciplinary action-research follow similar processes and principles with methodological overlaps between the two fields^{26,39,41}. These overlaps illustrate that abductive design inquiry could potentially incorporate deductive and inductive rigour. For example, co-design workshops could yield rich qualitative data akin to ethnography⁷⁸, and thematic synthesis mirrors grounded analysis^{39,79}. While iterative prototyping parallels hypothesis testing and action-research⁴⁰, reflective phases could echo methodological reflexivity^{79,80}.

We found that, although not part of the standard design process, this hybridity, when adopted by designers in research, supports a transdisciplinary, contextually embedded approach to knowledge production that is particularly suited to addressing complex societal challenges.

We acknowledge that, as the project is only halfway complete, emerging factors in the latter stages may influence the final findings and interpretations. At this stage of the project, we can conclude that a great majority of co-creation principles can feasibly be integrated into the design process provided that sufficient time, energy, and financial support (including professional fees) are available. We found that co-creative processes require sustained nurturing and relationship-building and are therefore inherently time-intensive. That said, we consider co-creation essential, as it directly addresses historical inequalities in which design processes were exclusive and unjust. Future research could benefit from retrospective analyses to assess the sustained impacts of co-creation, ideally revisiting sites and participants several years after project completion.

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Author contributions

Tania du Plessis (TdP), Kathy Berger (KB), Maya Pasgaard (MP), Christina Breed (CB) All authors were involved in developing the conceptual framework of this paper. TdP - acquisition, analysis and interpretation of data; CB - supervision; TdP First draft; All authors made substantive edits and revisions to this; MP, KB, CB - acquisition of funding.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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