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ABSTRACT

The project is an impactful initiative that addresses multiple challenges, including pandemics, climate change, biodiversity loss, food insecurity and economic instability through Landscape Architectural initiatives like SITES. It renews degraded landscapes near a busy heritage train station and transforms them into sustainable urban agricultural hubs. This effort is focused on low-income neighbourhoods and involves a wide range of stakeholders such as governmental bodies, researchers, NGOs, international donors, and the community. The main goal is to create a public space to counter environmental degradation caused by mining and industrial agriculture and promote social, economic and ecological development through agroecological practices. As urban populations grow and available land decreases, the project aims to enhance the urban landscape by increasing aesthetic and productive green spaces and creating safe pathways and connections. Due to pre-apartheid town planning, the Germiston, Ekurhuleni, South Africa project area faces significant social, economic, and environmental challenges. The design approach focuses on revitalising and re-vegetating these damaged areas, turning them into productive agrarian spaces that support a circular economy through the adaptive reuse of run-down buildings and spaces. This plan integrates traditional African crops and food production, processing, distribution, and consumption, drawing from the rich traditional knowledge of the diverse Southern African cultures. The project promotes a sustainable urban agricultural model that enriches local biodiversity, reduces carbon emissions, and provides economic opportunities. The design concept includes establishing a multi-purpose safe corridor from the Germiston Train Station to the Hub, providing secure access for low-income communities and facilitating the convenient and efficient transportation of fresh produce. This transformation aims to repurpose mine waste into a revitalising agroecological tourism hub and promote sustainability and resilience. Significantly, it addresses urban inequalities, substantially contributing to social justice.

Keywords: Sustainable Urban Agriculture, Agroecology, Food Production, Circular Economy, Community Inclusion.



These systems lessen the vulnerability to climatic shocks, mitigating biodiversity loss and environmental degradation. This approach is relevant to South Africa, where, according to Rudolph and Muchesa (2023), industrial agriculture's reliance on input-intensive systems is unsustainable and insufficient in addressing issues like poverty, degraded livelihoods, and food insecurity; an agroecological shift, primarily focused on local and Traditional African Crops (TACs), is therefore essential to achieve sustainability, resilience, and equity in urban areas like Ekurhuleni (HLPE, 2019).

Addressing Polycrisis through Agroecology and Landscape Architecture

The UN's 2030 Agenda for Sustainable Development, delineated in 17 Sustainable Development Goals (SDGs), underscores a holistic approach incorporating economic, social, and environmental facets. This initiative adheres to these objectives, seeking to convert Ekurhuleni into a sustainable urban agricultural centre that tackles food security, climate resilience, and community welfare (IFLA, 2020). The design addresses challenges inherent to South Africa's urban and industrial environment, such as climate-related crises, socioeconomic disparities, and the enduring effects of industrial agriculture.

Borowski and Patuk (2021) emphasise that sustainability in landscape architecture is attained through the development of adaptive, ecologically responsible designs that value resource efficiency, biodiversity, and the interrelationship between humans and nature. This strategy is essential for Ekurhuleni, where food hunger, land degradation, and environmental pollution necessitate novel responses. Agroecology offers a framework that amalgamates social and ecological concepts, improving the interactions among flora, fauna, humans, and the environment to create a sustainable, community-oriented food system (FAO, 2018).

Environmental Challenges and Landscape Transformation

Ekurhuleni faces several environmental issues tied to its history of industrial activity, including severe pollution and land degradation. Industrial sectors like steel production and automotive manufacturing contribute significantly to pollution, degrading air quality and soil health (Van der Merwe et al., 2020). Urban agriculture (UA) is a crucial strategy for mitigating these issues by repurposing degraded lands into productive green spaces. The benefits of UA are multifaceted: it improves air quality, reduces urban heat islands, and fosters biodiversity, all of which are essential for ecological health in urbanised areas (Kanosvamhira, 2023; Peroni et al., 2022).

2030 Agenda for Social Development



Guiding Framework:

Provides a global framework that aligns the project with recognized Sustainable Development Goals (SDGs), ensuring that efforts contribute to widely accepted sustainability standards.

Environmental Sustainability:

Supports goals like Clean Water and Sanitation (Goal 6), Affordable and Clean Energy (Goal 7), Climate Action (Goal 13), and Life on Land (Goal 15), reinforcing the project's environmental objectives.

Social Inclusion:

Emphasizes social aspects, such as Zero Hunger (Goal 2) and Reduced Inequalities (Goal 10), making sure the agroecological hub benefits the entire community and fosters social cohesion.

Economic Development:

Encourages economic resilience and sustainable job creation (Goal 8), highlighting the potential for local economies to thrive through green practices and responsible consumption and production (Goal 12).

Interactive Agroecological Landscape



Community Education:

Provides a hands-on learning environment where community members can learn about sustainable practices, agroecology, and resource conservation.

Biodiversity and Ecosystem Health:

Promotes biodiversity through varied plantings, which attract pollinators and foster a healthy ecosystem.

Community Engagement:

Creates communal spaces for workshops and gatherings, increasing local participation and encouraging a shared responsibility for sustainability.

Health and Wellbeing:

Offers accessible green spaces that improve mental and physical health by providing areas for recreation, relaxation, and interaction with nature.

Closed Loop Circular Systems



Resource Efficiency:

Minimizes waste by reusing resources, such as composting organic waste to nourish soil, creating a self-sustaining ecosystem within the hub.

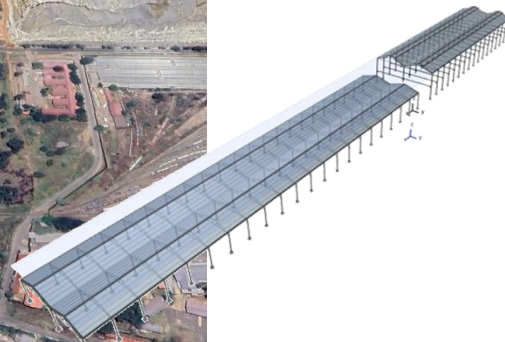
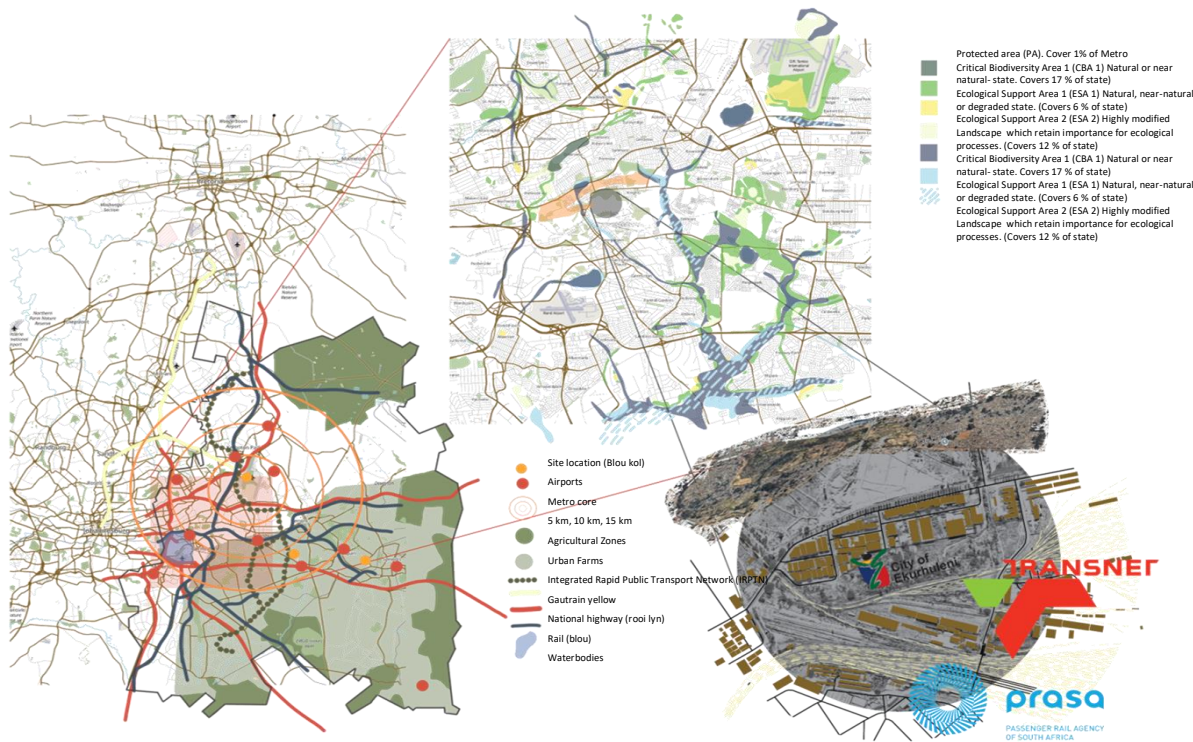
Soil Health and Regeneration:

Utilizes composting and nutrient cycling to maintain and improve soil fertility, essential for crop productivity.

Water Conservation: Reduces water usage through greywater recycling, rainwater harvesting, and efficient irrigation, enhancing drought resilience.

Economic Resilience:

Reduces dependency on external inputs, lowering operational costs and making the system more economically sustainable over the long term.



Train station



Low-income communities



Construction materials



Streetscape from station



Vendors on streetscape



Urban agriculture adjacent to site



Site
(Only 2 x steel structures remaining)



Existing structures



Water features



Dilapidated structure



Recycle hub



On-site material for repurpose

- What Landscape Architectural Initiatives should encourage Sustainable Urban Agriculture by means of Agroecology in the Urban Environment?

-How can Landscape Architecture and Agroecological principles educate the communities on the environmental, social and economical aspects of a sustainable and circular urban environment within the Germiston Agro Hub?

Water Scarcity and Management Solutions

Water scarcity is a significant problem in Ekurhuleni, intensified by pollution and insufficient stormwater management infrastructure. Kanosvamhira (2023) underscores the significance of water conservation in agroecological frameworks. Water scarcity is a significant problem in Ekurhuleni, intensified by pollution and insufficient stormwater management infrastructure. Kanosvamhira (2023) underscores the significance of water conservation in agroecological frameworks. This project's sustainable water management strategies encompass bioswales, bioretention ponds, and rainwater harvesting, effectively filtering and retaining water, hence diminishing reliance on municipal systems. This project's sustainable water management practices include bioswales, bioretention ponds, and rainwater harvesting, which naturally filter and retain water, reducing dependence on municipal systems. By incorporating stormwater infrastructure that captures and treats runoff, the landscape design mitigates flooding and recharges groundwater, addressing immediate and long-term water scarcity issues (Raymond et al., 2017).

Socioeconomic Inequality and Food Insecurity

The legacy of apartheid-era spatial planning continues to influence socioeconomic disparities in South Africa, leading

Limited access to essential services and a high prevalence of food insecurity in low-income neighbourhoods are prevalent issues (Hamilton et al., 2013). In Ekurhuleni, marginalised communities face significant challenges in obtaining fresh and affordable food, leading to severe food insecurity. This project seeks to tackle food insecurity by promoting agroecology and urban agriculture, creating local, healthy food options for disadvantaged communities (Bisaga et al., 2019). The initiative boosts community members by providing job opportunities in urban farming, market vending, and educational programs, which enhance economic resilience and stability.

Urban Sprawl, Housing Pressure, and Landscape Architecture

Urban expansion and housing demands in Ekurhuleni contribute to forming informal settlements, which often lack essential services such as clean water, sanitation, and access to green areas. These settlements are frequently located on ecologically fragile land, impacting local biodiversity and resources (City of Ekurhuleni, 2018). This project aims to mitigate urban sprawl by converting vacant and degraded lands into multifunctional green spaces, providing recreational and social areas that strengthen community ties. Additionally, the design features a green corridor linking the Germiston Train Station to the project hub, enhancing accessibility and ensuring safe movement for pedestrians.

Energy Efficiency, Resource Management, and Biodiversity Conservation

Water scarcity is a significant problem in Ekurhuleni, intensified by pollution and insufficient stormwater management infrastructure. Kanosvamhira (2023) underscores the significance of water conservation in agroecological frameworks. This project's sustainable water management strategies encompass bioswales, bioretention ponds, and rainwater harvesting, effectively filtering and retaining water, hence diminishing reliance on municipal systems. Repurposing abandoned buildings as storage and educational facilities minimises waste and preserves historical architectural elements, adding cultural value to the landscape (Davies & Fourie, 2017). Additionally, the landscape design incorporates native vegetation and wildlife corridors, which foster biodiversity by providing essential habitats and promoting ecosystem services like pollination and pest control (Threlfall & Kendal, 2018; Beninde, Veith & Hochkirch, 2015).

Landscape Architecture and Social Impact

The project strongly emphasises social inclusion, aiming to create spaces that are functional, accessible, and meaningful to the local community. Informal vendors benefit from designated market spaces, fostering economic justice and encouraging small-scale enterprises (Borowski & Patuk, 2021). Community members are also invited to participate in educational workshops held at the centre, where they can learn about sustainable agricultural practices and the benefits of TACs. This hands-on engagement fosters a sense of ownership, promotes local food knowledge, and empowers residents to adopt sustainable home practices (EMM Annual Report, 2023).

Conceptual Foundation: TACs and Agroecology

The project integrates TACs and agroecological principles to boost biodiversity, enhance food security, and promote local economic growth. TACs like amaranth, sorghum, and cowpeas are not only nutritionally rich but also drought-resistant and culturally significant, supporting both environmental and social sustainability by reducing reliance on external food systems and preserving traditional farming practices (Cloete & Idsardi, 2013). Moreover, the agroecological design leverages the SITES framework to restore degraded landscapes, enhance green infrastructure and promote urban biodiversity in areas previously affected by mining and industrial activity (SITES V2 Rating System, 2024).

Role of Landscape Architecture in Sustainable Urban Development

As per the International Federation of Landscape Architects (IFLA) in 2020, landscape architecture plays a distinct role in creating resilient urban ecosystems that integrate natural and cultural aspects. This project abides by these principles by designing spaces that meet practical requirements and promote long-lasting sustainability. By incorporating green infrastructure such as wetlands and floodplains, landscape architects help boost urban resilience by handling stormwater, boosting biodiversity, and fostering ecosystem health (Nassauer, 2011). Additionally, by incorporating native species and culturally significant plants, the project fosters a sense of place and community pride, aligning with the principles of biophilic design, emphasising connections to nature and enhancing social well-being (Beatley & Newman, 2013).

Climate Resilience and Nature-Based Solutions

To address the effects of climate change, nature-based solutions such as green roofs, permeable pavements, and bioswales have been integrated to lessen urban heat, enhance air quality, and manage stormwater. These approaches enable cities to adapt to climate-related challenges by utilising natural processes to reduce risks, aligning with sustainable urban resilience strategies (Kabisch et al., 2016). Raymond et al. (2017) also emphasise that nature-based solutions contribute to social equity by making green spaces more accessible and inclusive, thereby bolstering community resilience.

Biodiversity and Ecological Urbanism

McKinney (2008) and Beninde et al. (2015) emphasise the critical role of biodiversity in enhancing urban resilience. This project fosters ecological urbanism

by integrating wildlife corridors and various plant life that benefit pollinators and promote ecosystem stability. By re-establishing a connection between urban residents and nature, the project adheres to the tenets of ecological urbanism, which prioritises sustainability and resilience in urban planning (Mostafavi & Doherty, 2016).

The Germiston Agro Hub project represents an integrated strategy for sustainable urban development, combining principles of agroecology with landscape architecture. This initiative tackles environmental, social, and economic issues, creating a resilient urban system that enhances food security, strengthens local economies, and encourages community involvement. Focusing on resource efficiency, biodiversity, and inclusive design, the project aligns with the Sustainable Development Goals. It highlights the role of landscape architecture in fostering long-term sustainability and resilience in cities. Transforming Ekurhuleni into a diverse agroecological hub offers a model for addressing complex crises through sustainable, community-focused design.

DIT-DPD INTEGRATION AND INTERPRETATION

Germiston, located within the City of Ekurhuleni Metropolitan Municipality, South Africa, faces unique challenges and opportunities in sustainable urban development and landscape architecture. Historically an industrial and mining centre, Germiston's legacy includes land degradation, socioeconomic disparity, and environmental pollution, rooted in years of gold mining and heavy industry (EMM Annual Report, 2023). The remnants of apartheid-era spatial planning further exacerbate these issues, creating fragmented urban spaces and entrenched socioeconomic inequalities (Rudolph & Muchesa, 2023).

Opportunities in Sustainable Urban Agriculture and Green Infrastructure

One of Germiston's most significant opportunities lies in transforming underutilised, degraded spaces into productive urban landscapes serving the community and the environment. Integrating sustainable urban agriculture (UA) could improve food security by providing fresh, affordable produce to underprivileged communities. This is consistent with the findings of Bisaga et al. (2019), which highlight the importance of urban agriculture (UA) in improving access to healthy food in urban settings, especially in areas identified as food deserts. Furthermore, UA contributes to economic growth by generating job opportunities and facilitating skill development for local inhabitants, thereby promoting regional economic resilience (Hamilton et al., 2013).

The transformation of Germiston through landscape architecture also presents ecological advantages. Implementing green infrastructure could boost biodiversity, alleviate urban heat effects, and enhance air quality while addressing the critical need for stormwater management in light of climate variability (Kanosvamhira, 2023). These green areas may function as communal spaces, encouraging social cohesion and fostering engagement among diverse socioeconomic groups (Borowski & Patuk, 2021). Germiston's advantageous position near transportation hubs, such as the Germiston Train Station, facilitates the effective distribution of locally sourced produce, thereby establishing a sustainable urban food supply network (IFLA, 2020).

Challenges to Sustainable Development in Germiston

Notwithstanding these opportunities, Germiston encounters many obstacles to sustainable development. The legacy of mining has resulted in considerable land degradation and pollution. Prolonged industrial operations have polluted soils, resulting in abandoned landscapes necessitating extensive restoration. Insufficient financial resources and institutional backing exacerbate these challenges since economically limited communities such as Germiston frequently encounter difficulties obtaining the requisite money and policy support for extensive agroecological changes (Altieri, 2020; Rudolph & Muchesa, 2023).

A significant challenge, however, is socioeconomic inequality. Many residents of Germiston's low-income neighbourhoods face high unemployment rates and limited access to essential services, creating a cycle of poverty and food insecurity (Rudolph & Muchesa, 2023). The legacy of apartheid spatial planning has physically isolated these communities from economic opportunities and green spaces, making it challenging for them to benefit from UA initiatives and public amenities (Hamilton et al., 2013). A landscape architecture approach focused on equitable access and inclusivity is essential to address these disparities, ensuring all community members have access to the benefits of green, productive spaces (FAO, 2018).

Water scarcity adds another layer of complexity to Germiston's sustainable development. The region grapples with water management challenges, including pollution from industrial runoff and inadequate infrastructure for stormwater capture and recycling (Kanosvamhira, 2023). To enhance resilience, landscape architects must incorporate water-sensitive design elements like rain gardens, green roofs, and permeable pavements, which mitigate these challenges and prepare Germiston for future environmental stresses (Raymond et al., 2017).

Historical Context and Continuing Inequities

Cities have been critical in food production since early human settlements (Haysom et al., 2020; Steel, 2008). However, rapid urbanisation has exacerbated challenges related to food security, especially in under-resourced urban areas. UA is increasingly recognised as a viable solution to address these challenges, fostering resilience against socioeconomic disparities and environmental threats (Bisaga et al., 2019; Lovell, 2010). In South Africa, the legacy of apartheid-era policies continues to shape spatial inequalities, concentrating informal settlements on the fringes of cities and exacerbating food insecurity (Mabin, 2005; Rudolph & Muchesa, 2023). Over half of the population lives in areas with limited access to essential services and nutritious food, such as townships and informal settlements (Bisaga et al., 2019; Grangxabe, 2023).

Despite UA's promise to improve food security, its integration into urban planning remains limited, especially in underprivileged areas like Melusi in Tshwane. Melusi's socioeconomic vulnerabilities and lack of infrastructure highlight the need for innovative food production strategies to enhance community resilience (Rudolph & Muchesa, 2023; Kgoale, 2024).

Sustainable Urban Agriculture and Traditional African Crops (TACs)

Cultivating TACs within UA frameworks offers significant ecological, economic, and social potential, particularly for marginalised communities (Orsini et al., 2013; Shackleton et al., 2010; Akinola et al., 2020). These crops, renowned for their nutritional richness, resilience to local climate conditions, and cultural significance, present sustainable alternatives to exotic crops, paving the way for a more sustainable future (Shackleton, 2010; Cloete & Idsardi, 2013; Mabhaudhi et al., 2018). By prioritising TACs, Germiston can preserve traditional farming practices and reduce its dependence on imported produce, aligning with landscape architecture principles of sustainability and resilience (IFLA, 2020).

Environmental and Social Restoration through Landscape Architecture

Reviving Germiston's damaged lands provides a chance to envision the city's future with sustainable urban farming and eco-friendly infrastructure. Landscape architecture is vital in this change as it combines environmental restoration with community involvement, ultimately supporting a more diverse, adaptable urban environment (Borowski & Patuk, 2021). The project imagines a scenario where green infrastructure and urban agriculture work together, promoting biodiversity and offering crucial ecosystem services such as air cleaning and temperature

control (Kanosvamhira, 2023). Integrating green infrastructure such as bioswales, rain gardens, and permeable surfaces addresses water management issues while enhancing urban spaces' aesthetic and functional value. These elements fulfil dual functions, serving as stormwater management systems and recreational areas that foster social interactions among Germiston's many groups (Raymond et al., 2017). By employing these strategies, Germiston can alleviate the effects of climate unpredictability, fostering an urban environment that is both environmentally robust and socially harmonious. Conclusion: A Pathway to Sustainable Development

Conclusion:

Germiston presents considerable opportunities for transformation through sustainable urban agriculture and green infrastructure. Nonetheless, achieving this potential necessitates addressing several key challenges, such as land degradation, socioeconomic disparities, and water scarcity. By adopting a landscape architecture framework that emphasises ecological restoration, community involvement, and resilient urban planning, Germiston can serve as a benchmark for sustainable urban development in South Africa. Combining urban agriculture (UA) with Traditional African Crops (TACs), bolstered by green infrastructure, not only enhances local food security and economic stability but also reinforces community identity and well-being, creating a pathway toward a sustainable and inclusive urban future.

SPATIAL DESIGN AND TECHNOLOGY:

Germiston Agro Hub: Integrating Landscape Architecture and Agroecology

The Germiston Agro Hub integrates landscape architectural and agroecological strategies to enhance food security, community resilience, and environmental sustainability. This project emphasises cultivating Traditional African Crops (TACs) while restoring ecological balance, aligning with the Sustainable Development Goals (SDGs) for sustainable cities, zero hunger, and responsible consumption (IFLA, 2020).

Integration of Landscape Architecture and Agroecology

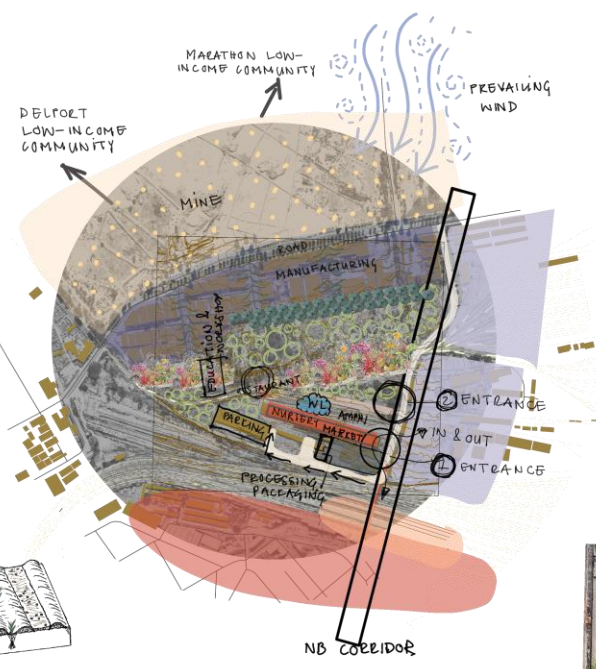
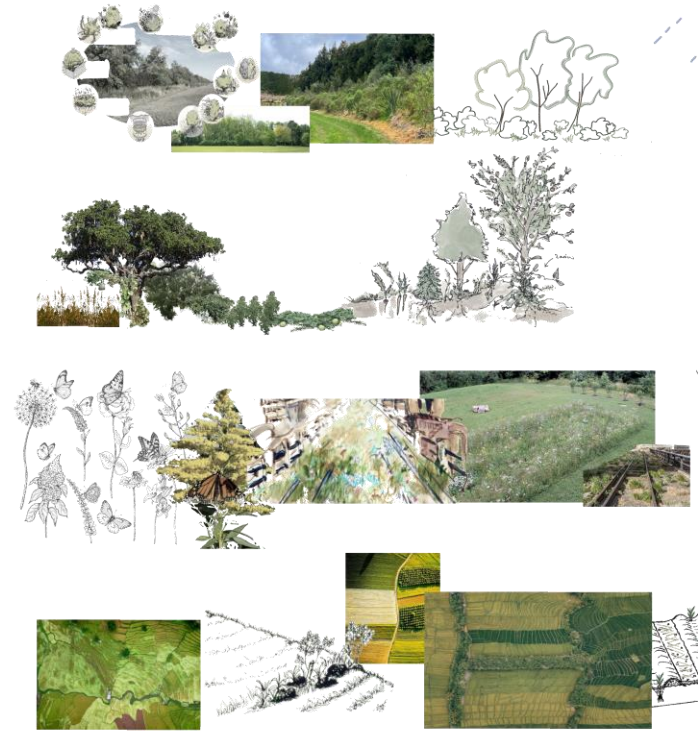
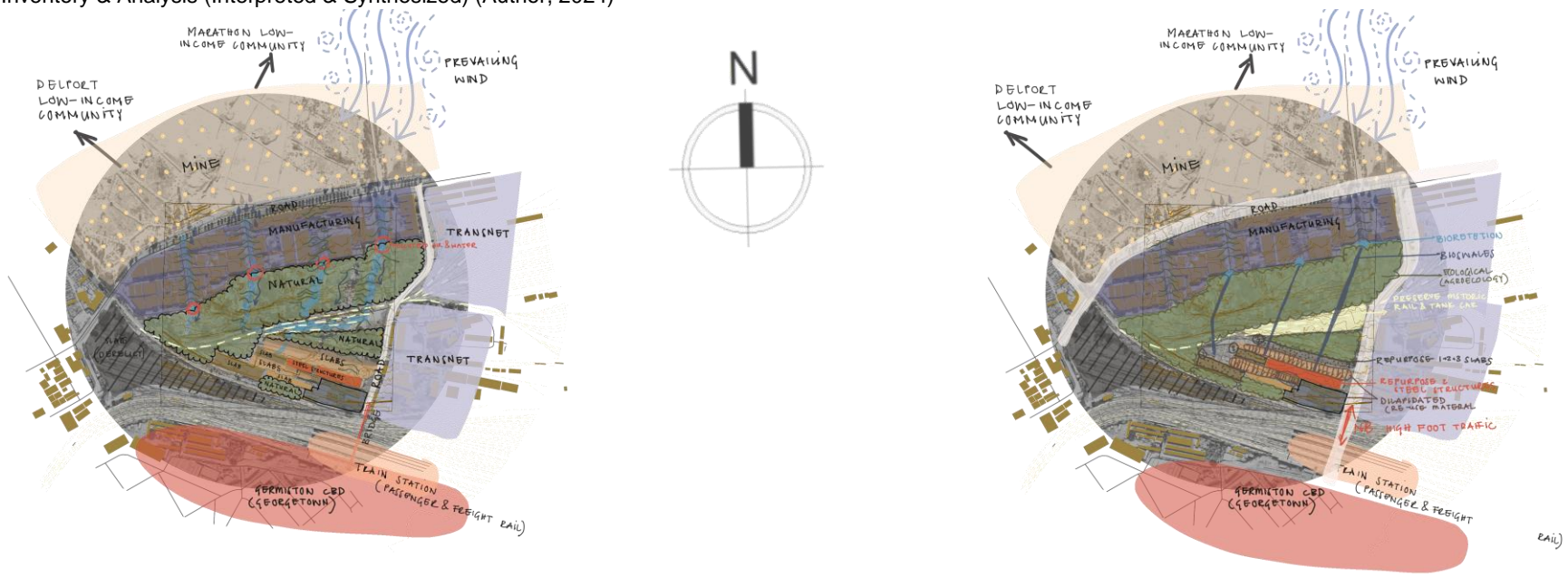
The Agro Hub's design promotes TAC cultivation within a structured, multifunctional landscape. Ecological zoning separates intensive TAC farming areas, community gardens, and naturalised spaces. This zoning creates a layered landscape that supports crop rotation, biodiversity, and resource efficiency. Thompson and Sorvig (2008) note that such zoning respects natural systems

enhances ecosystem services, and creates structural coherence, which is vital for resilience. By designing in harmony with the land's contours, the project minimises soil erosion and improves drainage, supporting long-term ecological stability (Van Niekerk et al., 2020).

Inspired by Agroforestry, the design uses a seven-layer vegetation structure—canopy trees, shrubs, herbs, and groundcovers—to create diverse habitats that mirror natural ecosystems." Agroforestry is a great example of agroecology. It's the practice of combining trees and farming; it demonstrates how food production and nature can co-exist" (Soil Association, 2024). These ecosystems benefit pest control, soil health, and nutrient cycling, which are essential for TAC growth (Altieri, 2015). These layers support pollinators and birds, boosting biodiversity and ecological resilience. The design prioritises ecologically beneficial and visually appealing species, enhancing human comfort through shaded areas, reducing glare, and creating cohesive spaces (IFLA, 2020).



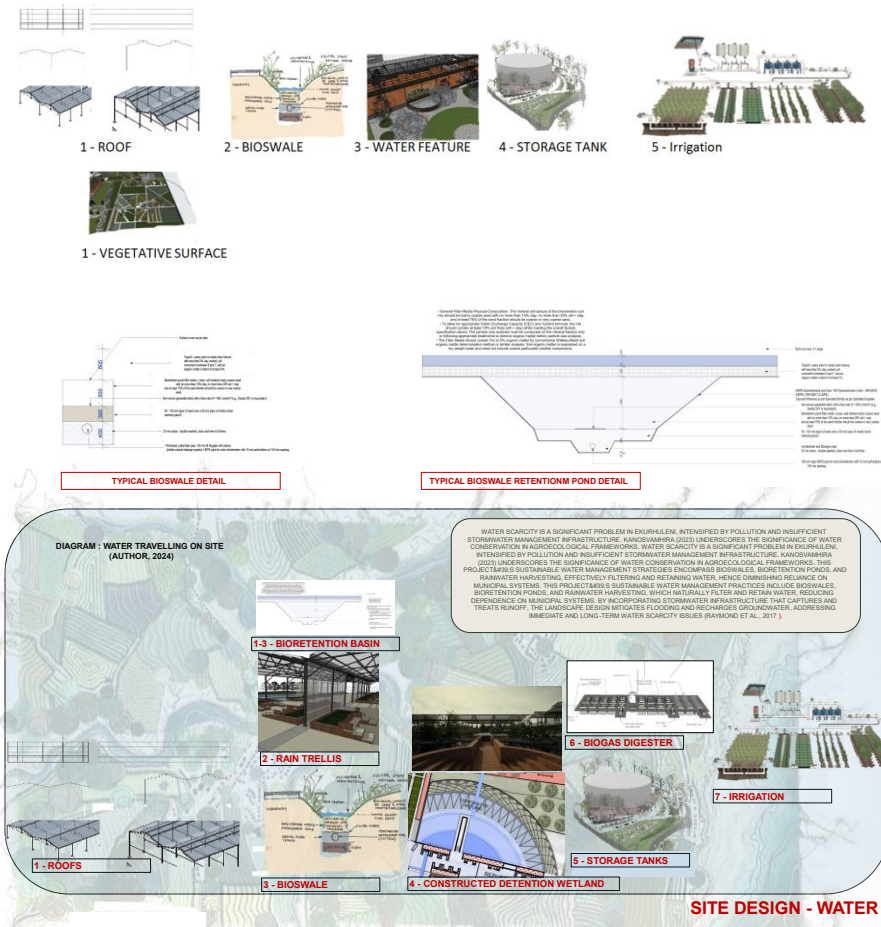
Image: Site Inventory & Analysis (Interpreted & Synthesized) (Author, 2024)



SUPPORTING DPD RESEARCH GOALS

Water Management:

The Agro Hub incorporates bioswales, retention ponds, and a detention pond to capture, filter, and release stormwater. These features are planted with native wetland species that filter pollutants and reduce erosion, aligning with sustainable water management practices recommended by the Sustainable Sites Initiative (SITES, 2019). The bioswales and rain gardens double as green pathways, adding aesthetic value and comfort (Van Niekerk et al., 2020). Designed as green corridors, these features provide shaded pathways, creating comfortable microhabitats for native species and inviting pedestrian exploration (Threlfall & Kendal, 2018; Kanosvamhira, 2023).



Soil Health and Vegetation:

The landscape employs low-impact soil management techniques like minimal tillage and organic composting to preserve soil structure and boost fertility. Composting stations throughout the Site recycle organic waste from TAC harvests, enriching the soil and promoting microbial health (Cilliers & Cilliers, 2016). The varied vegetation, including native grasses and TAC crops, serves both ecological and aesthetic purposes, contributing to a vibrant landscape and cooling visitors' greenery (Thompson & Sorvig, 2008). Crop rotation and composting integrate agricultural productivity with landscape aesthetics, supporting the soil's regenerative abilities and underpinning sustainable agriculture.

Image: Food Forest Crops System (Author, 2024)

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natal Plum	🌱	🌱	🍒	🍒				🌱	🌱	🍒	🍒	
Cleome		🌱	🌱	🌱	🌱			🌱	🌱	🌱	🌱	
Gynandra												
Brassica Carinata	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱
Wild Pomegranate	🌱	🌱	🍒	🍒			🌱	🌱	🌱	🌱	🍒	🍒
African Horned Cucumber		🌱	🌱	🍆	🍆			🌱	🌱	🍆	🍆	
Amadumbe	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱
Maula Tree	🌱	🌱	🌱	🌱	🍒			🌱	🌱	🌱	🌱	🍒
Wild Olive	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🍒	🍒
Amaranth		🌱	🌱	🌱	🌱			🌱	🌱	🌱	🌱	
Gunneraceae	🌱	🌱	🌱	🌱	🌱			🌱	🌱	🌱	🌱	
Spekboom	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱	🌱
Cow Pea		🌱	🌱	🌱	🌱			🌱	🌱	🌱	🌱	
Citrullus Lanatus	🌱	🌱	🌱	🍉	🍉			🌱	🌱	🍉	🍉	
Coleus Esculentus	🌱	🌱	🌱	🌱	🌱			🌱	🌱	🌱	🌱	

Legend:

- 🌱 - Planting season
- 🌿 - Growing season
- 🍒 - Harvest (for fruiting crops)
- 🍆 / 🍉 - Specific fruit



Soil Test Results & Interpretation:

Comments & Interpretation of Soil Test Results.

Fertilizer guidelines for African Indigenous Vegetables**(For attention: Me. Anrea Louw)**

FFM 168 version: 02, 2021-11-25

NviroTek Test Report

Nviro Business Hub unit 6, Ou Wapad road, Hatfield, Johannesburg, 2009 | Tel: 012 252 7888 | www.nvirotek.co.za

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Representative/Verspreewoordiger: ANREA LOUW
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 Order/Bestel nr.: anrea05@gmail.com
 Email:

Lab Number	Sample Reference	pH KCl	P Bray	P Bray K	Ns	Ca	Mg	EXCH	Ca's	Mg's	K's	Na's	ACID	Ca-Mg	Mg-K	S-VALUE	Na-K	T-VALUE	Dens.		
Lab Number	Monsterevenyng	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	%	%	%	%	%	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	g/cm ³		
G37-53975	1	5.74	68	150	150	19	2093	211	0.00	82.68	13.64	3.03	0.65	0.00	6.06	31.82	4.51	12.66	0.22	12.66	1.00

Lab Number	Sample Reference	S	Zn	Cu	Mn	Fe	CLAY	SILT	SAND	NHAN	NOSN	Resistance
Lab Number	Monsterevenyng	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	mg/kg	mg/kg	Ohm
G37-53975	1	80.85	120.63	9.51	13.17	71.09	10	17	73	2.65	2.85	1330

NOTAS / NOTES:

Verslag goedgekeur deur / Report approved by:

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 Technical Signatory

The soil test results include a particle size analysis indicating 73% sand, 17% silt and 10% clay indicating the soil to be a sandy loam which is generally classified to be good for gardening.

The soil reaction, as measured by pH (KCl) 5.74 is very good and falls within the ideal pH-range and there is no need for any agricultural lime. The pH (KCl) 5.74 corresponds to a pH (H₂O) of roughly 6.64 indicating that plant nutrients will be freely available for uptake by plants. The soil is also noted to have low salinity, with a resistance measured in a saturated water paste of 1330 ohms, indicating that plants having a low salt tolerance such as green beans and lettuce can also most likely be successfully produced.

Calcium and Magnesium:

The soil has high calcium content and in ratio to the group of bases calcium is also very high. Such a condition does go hand in hand with the possibility that growing plants may show signs of a magnesium deficiency with symptoms of the yellowing of the older bottom leaves. Such a scenario can be addressed by a topdressing of at least 250 kg of magnesium sulphate/ha. The high calcium content of the sandy loam soil will likely also lead to a boron deficiency and preventative measures are necessitated by the timeous fertilization of boron at a rate of roughly 600 grams of boron/ha applied to the soil during the early growth stages of the plants. 4 kg of Solubor (20%B)/ha can be sprayed to the soil surface before planting. Other application methods can be used but make sure that the Solubor is applied by the right way to prevent toxicity.

P (Phosphrus):

The soil has a high P content and is indicative of a good history of fertilization and there is no need for the fertilization of phosphatic fertilizers. The high phosphate content of the soil is often associated with induced deficiencies of the metal micronutrients; however, the soil test results show high levels of Iron, Copper, Zinc and Manganese showing a lesser need for the actual fertilization of these micronutrients.

K (Potassium):

The soil has a good potassium content, and it is doubtful that the further fertilization of potassium will be of any benefit to the Indigenous African Vegetables. However, a small amount of K could be necessary for some of the crops where no more than 60 kg K/ha will suffice.

N (Nitrogen):

The soil test results show very low residual inorganic nitrogen content and emphasizes the need for the fertilization of nitrogen and the amounts needed will depend on the crop to be planted.

Fertilizer guidelines for crops envisaged to be produced can be formulated by giving attention to matters as stated below:

Leafy crops like Cleome Gynandra and Amaranthus:

Based on the soil test results as discussed above it is recommended that 200 kg 1:0:1(48)/ha be broadcasted and then mixed in the topsoil of the plant beds to a depth of roughly 100 mm prior to planting.

As leafy crops generally require large amounts of nitrogen two topdressings of 150 kg limestone ammonium nitrate (LAN (28%N)/ha) can be applied at 3 and 7 weeks after planting.

Legumes like Vigna Unguiculata (Cowpea) and Vigna Subterranea (Bambara groundnut)

Legumes have a symbiotic relationship with nitrogen fixing bacteria specifically Rhizobia where atmospheric nitrogen is converted into a usable form and limits the need of applying nitrogen as a fertilizer. However, soil often has a low residual nitrogen content, and a small amount of nitrogen added when planting helps to sustain growth before actual nodulation of the roots occurs.

It is recommended that 150 kg 1:0:2(48)/ha be broadcasted and then mixed in the topsoil of the plant beds to a depth of roughly 100 mm prior to planting.

No further fertilization will be necessary.

It is recommended that information regarding Bambara groundnuts must be gathered about earthing-up from a knowledgeable source.

Brassicas like Brassica carinata (Ethiopian Kale):

Based on the soil test results as discussed above it is recommended that 200 kg 1:0:1(48)/ha be broadcasted and then mixed in the topsoil of the plant beds to a depth of roughly 100 mm prior to planting.

As brassicas generally require large amounts of nitrogen three topdressings of 150 kg limestone ammonium nitrate (LAN (28%N)/ha) can be applied at 3, 5 and 7 weeks after planting. A further top dressing of LAN (28%N) may be necessary.

Root crops like Colocasia esculenta (Amadumbe) and Coleus/ Plectranthus esculentus (Wild Potato):

Research done on different genotypes of Amadumbe grown under irrigation but with no added fertilizer, to simulate low-input agriculture, resulted in good Taro corn yields of just less than 5 tons/ha. However, as these yields were far less than world average yields of roughly 7.5 tons/ha researchers realized the need for improved nutrition. Based on the soil test results as discussed above with plant populations of roughly 16 600 plants/ha it is recommended that 200 kg 1:0:1(48)/ha be band placed to a depth of roughly 100 - 150 mm prior to planting. At least one topdressing of 150 kg limestone ammonium nitrate (LAN (28%N)/ha) can be applied at 4 weeks after planting and repeated at a later stage if deemed necessary. As no real knowledge is available about the production Plectranthus esculentus (Wild Potato) the same fertilizer guideline for amadumbe most likely will serve well. Research regarding the nutritional needs of these crops seems surely necessary.

Solanaceae like Solanum aethiopicum (African Eggplant):

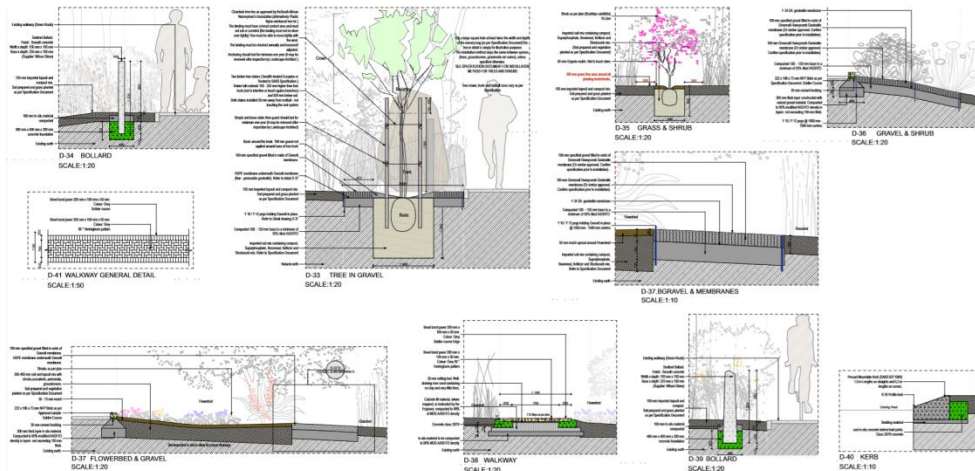
Based on the soil test results as discussed above it is recommended that 200 kg 1:0:1(48)/ha be broadcasted and then mixed in the topsoil of the plant beds to a depth of roughly 100 mm prior to planting.

A total of roughly 135 kg N/ha is likely necessary to meet the requirement of the crop and three topdressings of 110 kg limestone ammonium nitrate (LAN (28%N)/ha) can be applied at 4, 6 and 8 weeks after planting.

Air Quality Improvement:

Green corridors with tree-lined paths and vegetative barriers help filter airborne pollutants, improving air quality. These pathways also create visual rhythm through repeated planting, encouraging visitors to discover the outdoor scenery. According to Beninde, Veith, and Hochkirch (2015), trees and shrubs offer shady relaxing spots, serving as great city shelters. These verdant pathways improve visual and physical appeal by encircling views, lessening city noise, and enhancing guest enjoyment (IFLA, 2020).

Image: Streetscape(Author, 2024)



Energy-Efficient Vegetation:

Shade-providing trees and green roofs reduce heat absorption in built structures, minimising the need for artificial cooling. Vegetation strategically shades building facades, pathways, and seating areas, forming comfortable microclimates (GCRO, 2018). Green roofs on repurposed structures provide insulation, showcasing sustainable, energy-efficient design and visually connecting built elements with the surrounding landscape (Thompson & Sorvig, 2008).

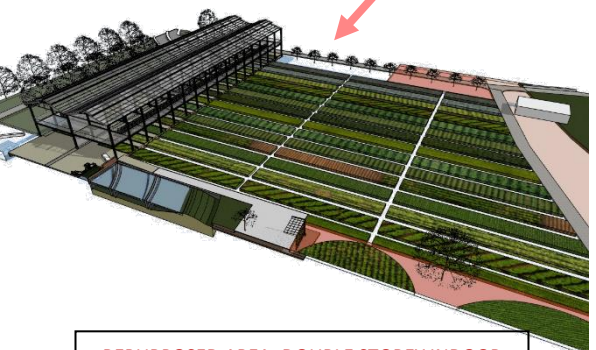
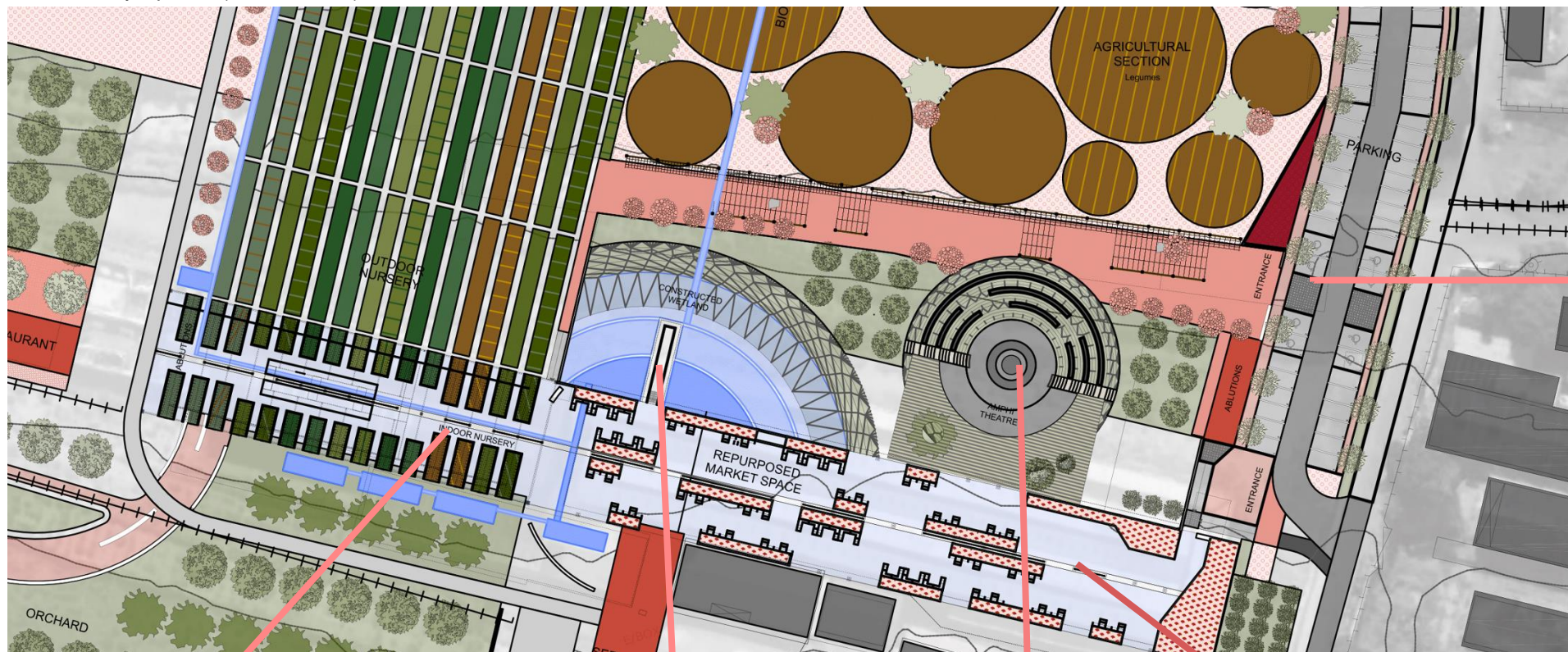
Community Spaces and Educational Initiatives (Wetland, Amphitheatre, Marketspace and Interactive Multi-Functional social and educational space and Green Roof)

The Agro Hub includes community-focused spaces to educate residents on sustainable practices. Near demonstration gardens and bioswales, the education centre offers hands-on learning opportunities in agroecological principles, such as water conservation and TAC cultivation (IFLA, 2020). This centre features open-air classrooms under shaded pergolas, constructed with natural materials that blend with the landscape, fostering community interaction and learning sustainably (Kanosvamhira, 2023; MILESTONE 4 u 29192910). The pathways to the education centre are made with permeable paving, highlighting water-sensitive design and enhancing visitors' understanding of sustainability. Featuring naturally sloped, shaded seating, the amphitheatre serves as a flexible venue for community events and gatherings, promoting social interaction and cultural exchange. Its central location emphasises the need for accessible public spaces, encouraging inclusivity and community involvement (IFLA, 2020). The amphitheatre's design, which includes native plants and seating near bioswales, adheres to the sustainable landscape architecture principles of the Site.

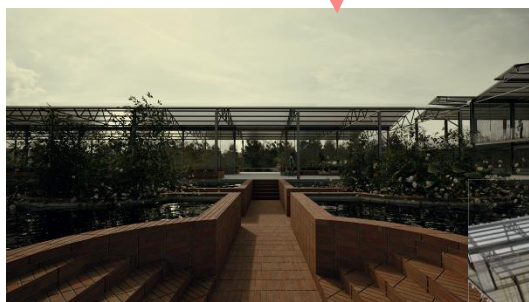
Image: Community Spaces (Author, 2024)



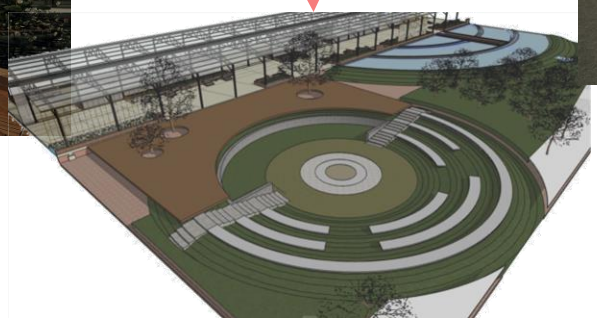
Image: Community Spaces (Author, 2024)



REPURPOSED AREA: DOUBLE STOREY INDOOR NURSERY & MARKET SPACE



CONSTRUCTED BIODETENTION WETLAND














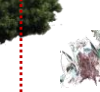



AMPHITHEATRE & DECK



REPURPOSED AREA: MARKET SPACE

PARKING & ENTRANCE

Image: Agroecological Crops and Companions(Author, 2024)

	Summer Crop Species								Winter Crop Species							
Crops																
Companion	<p>Helichrysum aureoventris Golden Everlasting) Squash</p>	<p>Lemon Balm Marigolds Marjoram</p>	<p><i>Euphorbia schinzii</i> Pax Family: Euphorbiaceae Common names: rock-milkbush, <i>Helichrysum petiolare</i> (Silver Helichrysum) Graptopetalum paraguayense (Ghost plant)</p>	<p>Lettuce Lactuca Taraxacifolia</p>	<p><i>Tulbaghia violacea</i> (Wild Garlic) Amaranth</p>	<p>Portulacaria Afra (Spekboom)</p>	<p>Tagetes minuta L. African marigold Tomatoes Runner beans cowpea, Bambara groundnuts, mung beans and marama bean. Cowpea</p>	<p>Tagetes minuta L. African marigold Tomatoes Runner beans</p>	<p><i>Helichrysum petiolare</i> (Silver Helichrysum)</p>	<p><i>Helichrysum petiolare</i> (Silver Helichrysum)</p>	<p><i>Tagetes minuta</i> L. African marigold Amaranth</p>	<p><i>Hypoxis hemerocallidea</i> star flower</p>	<p>Aloe arborescens (Krantz Aloe)</p>	<p><i>Coleus neochilus</i> smelly coleus</p>		
Uses	<p>Uses cowpea <i>Leaves:</i> cooked as relish, or added to porridge, dried as meat substitute <i>Seeds:</i> dried and used as coffee substitute, cooked in stews, soups 50-60cm</p>	<p>Uses <i>Lagenaria siceraria</i> Bottle gourd: Poisonous: Bitter fruits can cause poisoning. Medicinal: Used for respiratory, digestive, and headache treatments. Vegetable: Leaves and young shoots commonly eaten; sweet fruits cooked. Pipes: Calabashes used for pipe-making in South Africa. Instruments: Used in musical instruments globally. Containers: Used for water, milk, beer, and as ornaments. Historical: Found in the Mediterranean since the Bronze Age. Brazil: Used for food transport, instruments, and cooking. 5m.</p>	<p>Uses spekboom: <i>Leaves:</i> quenches thirst, used for cooking (in stews) <i>Medicinal:</i> increases breast milk of lactating mothers, treats heat stroke and exhaustion by sucking leaf. Chew leaves for sore throat. Rub crushed leaves on blisters and corns. Leaf juice is antiseptic used for sunburn 2-5m</p>	<p>Uses of <i>citrus</i> <i>lanatus</i> <i>Fruit pulp:</i> is eaten raw, made into syrups <i>Seeds:</i> used in soups and snacks <i>Medicinal:</i> juice of root stops bleeding 25-60cm</p>	<p>Uses Marula tree <i>Fruits:</i> eaten raw <i>Skin of marula:</i> coffee substitute <i>Inner bark:</i> ropes <i>Medicinal:</i> Powdered bark for malaria, rheumatism, diarrhoea, hemorrhoids, Root&Bark as laxative. Leaves are drunk as tea for gonorrhoea <i>Sum & Bark:</i> ink and dyes <i>Wood:</i> furniture 5m</p>	<p>Uses wild potato: <i>Tubers:</i> eaten like potatoes <i>Leaves and stems:</i> cooked like spinach or added to maize(cuku) <i>Medicinal:</i> asthma, arthritis, diarrhoea, internal hemorrhage, neurological disorders, and skin disorders 4.5- 5m vine</p>	<p>Uses Wild olive: <i>Fruits:</i> eaten raw <i>Fruit sap:</i> ink <i>Leaves:</i> tea <i>Wood:</i> furniture and fence posts <i>Medicinal:</i> eye lotion, tonics for sore throat, lowers blood pressure, improves kidneys. 10m</p>	<p>Uses Brassica Carinata <i>Leaves, stalks, seeds:</i> cooked like spinach <i>Seeds:</i> spice for meat Biofuel: Its oil is used to make sustainable aviation fuel (SAF), reducing emissions by up to 68%. Animal feed: The protein-rich residue from oil extraction is used for livestock Soil health: Grown as a cover crop, it improves soil quality and water retention Industrial products: The oil is also used in bioplastics, lubricants, and cosmetics. <i>Medicinal:</i> gastritis, diabetes, anaemia 1m</p>	<p>Uses Amaranth <i>Leaves:</i> cooked as spinach or added to maize. <i>Seeds:</i> flour for baking <i>Medicinal:</i> diarrhoea and excessive menstruation 1.2m - 2m</p>	<p>Uses Sour fig Leaf juice: Astringent, antiseptic; treats diarrhoea, dysentery, stomach cramps, sore throats, and mouth infections. Topical use: Soothes burns, stings, bruises, cuts, sunburn, eczema, dermatitis, and skin conditions. Constipation: Fruits with brackish water act as a laxative; fruit syrup also has laxative properties. Traditional remedies: Used for TB, mosquito bites, pregnancy, and to strengthen newborns. Diabetes: Used to treat diabetes and diphtheria in the Eastern Cape. Cultural significance: Fruits eaten since ancient times, associated with Khoikhoi burial sites. Land use: Cultivated for dune stabilization, fire resistance, and as a water-wise plant.20cm</p>	<p>Uses wild pomegranate <i>Wood:</i> huts, agricultural implements, cattle yokes <i>Medicinal:</i> Roots for enenematic, Bark&roots for animal splints 8m</p>	<p>Uses african horned cucumber <i>Fruit:</i> flesh eaten raw or cooked, can be pickled <i>Leaves:</i> cooked as spinach or mixed with maize meal (khoisan) <i>Medicinal:</i> decoction of root for pain relief after childbirth(shona), boiled root for gonorrhoea cure 2-7cm</p>	<p>Fruits:Uses Wild plum <i>Fruits:</i> eaten raw or cooked, jams, chutney <i>Medicinal:</i> bark used for acne and eczema skin care, powdered burnt bark- to treat sprains and bone fractures 15m</p>	<p>Uses amadumbe <i>Tubers:</i> are eaten raw or peeled and boiled 2m</p>	<p>Natal Plum <i>Fruit:</i> Eaten raw or cooked. Made into jellies, pickles, syrups <i>Medicinal:</i> ward off cold&flu, as poultice for tooth ache. Root remedy for aches, malaria and inflammation 4m</p>	<p>Uses cloome Gynandra (spider wisp) <i>Leaves:</i> eaten as spinach or with porridge <i>Medicinal:</i> Treatment of scurvy, Leaves boiled and marinated in sour milk for 2-3 days then eaten as nutritional meal to improve eyesight, give energy, and cure marasmus. 26-60cm Uses wild pomegranate <i>Wood:</i> huts, agricultural implements, cattle yokes <i>Medicinal:</i> Roots for enenematic, Bark&roots for animal splints 8m</p>

-  Attracts birds
-  Attracts butterflies
-  Drought resistant
-  Edible plant
-  Medical plant
-  Useful plant
-  Feeds honeybees

CROPS

Repurposing and Recycling of Old Structures

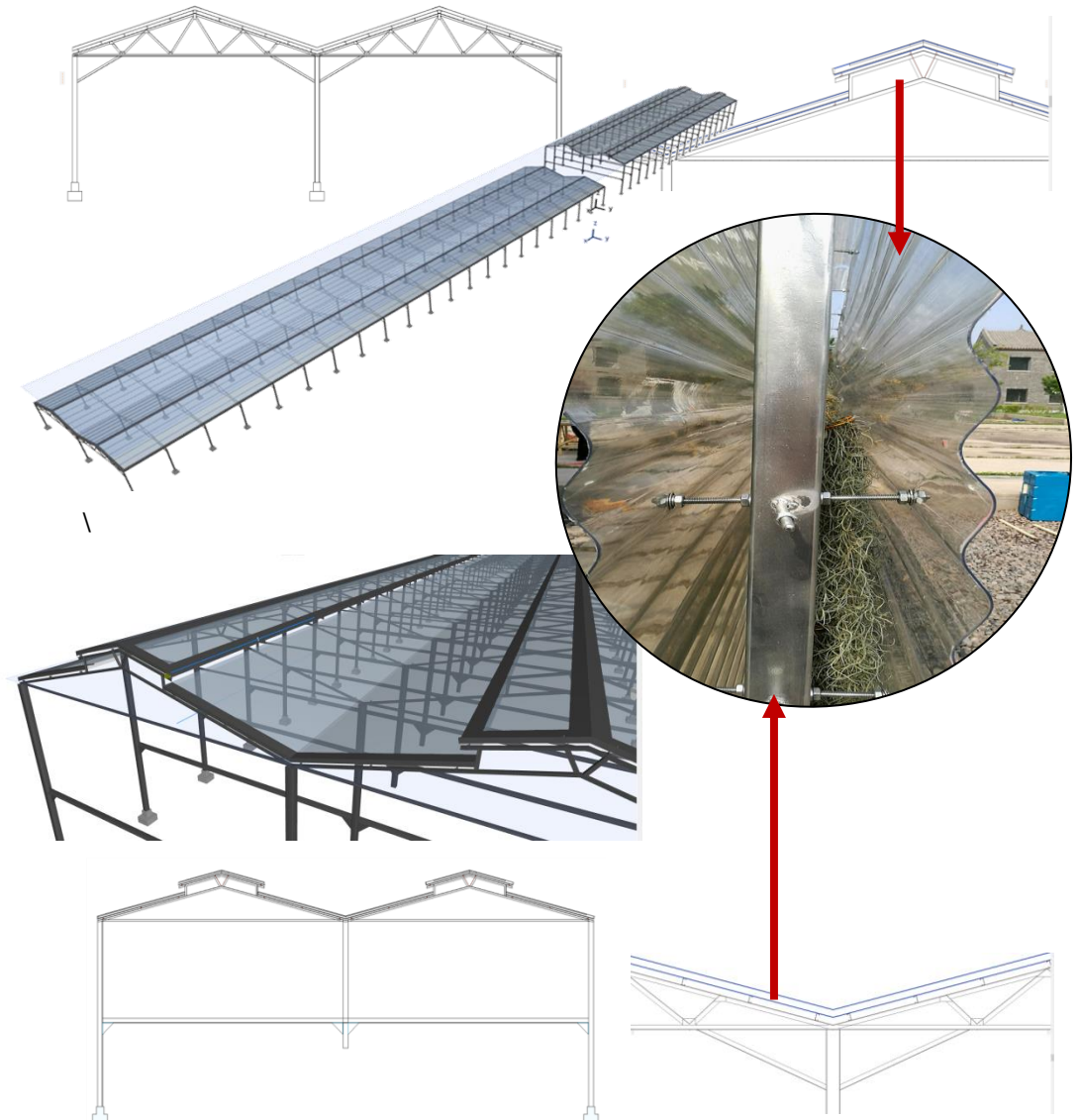
Sustainability in the Agro Hub extends to the adaptive reuse of old structures on the Site. Abandoned industrial buildings are repurposed as

- 1) A market space,
- 2) Multifunctional open space
- 3) Surface for planter beds
- 4) Concrete surfaces re-used to create gabion planters.
- 5) Pollinator garden education space with history of railway

Adaptive reuse conserves resources and energy, as demolishing and constructing new buildings would entail significant environmental costs. According to the Sustainable Sites Initiative (SITES, 2019), repurposing minimises resource use, reduces waste, and preserves the cultural character of the area. By preserving historical architecture, the Agro Hub minimises its carbon footprint while honouring Germiston's industrial background, harmonising past and present through deliberate landscape architecture (Friedman, 2007).

This adaptive reuse strategy corresponds with the UN's Sustainable Development Goals about responsible consumption and production, highlighting effective resource utilisation and the reduction of environmental impact. Repurposed structures also serve as educational examples, illustrating sustainable building practices and reinforcing the Agro Hub's role as a model of urban sustainability.

Images: Repurposing existing steel structures with 'Green roof'. (Author,2024)



Double Polycarbonate sheeting Roof, with 5m Climbers stemming from existing steel columns & existing steel columns in planter boxes to Extend nature into built fabric. This also creates natural shadow patterns day and night.

CRITICAL REFLECTION

The Germiston Agro Hub effectively addresses its primary goals of enhancing food security, stimulating economic growth, and building community resilience. By promoting the cultivation of Traditional African Crops (TACs), the project strengthens food security within Germiston by reducing dependency on external food sources and offering nutritious, locally sourced produce (Altieri, 2015). Landscape architectural techniques such as ecological zoning and multi-tiered vegetation contribute to a functional and visually appealing environment that promotes sustainable agricultural practices (Thompson & Sorvig, 2008). Features of water-sensitive urban design, including bioswales and rain gardens, improve the Hub's ability to adapt to climate fluctuations by effectively managing stormwater and lowering the likelihood of flooding, which is essential for ensuring a reliable food production system (SITES, 2019).

The project also contributes to economic growth by creating job opportunities in agriculture, maintenance, and education, benefiting residents. Repurposing old structures into facilities like a washing and packaging warehouse highlights sustainable landscape architecture principles, minimising waste and integrating cultural heritage into the modern landscape (Friedman, 2007). This adaptive reuse approach conserves resources and creates a visually cohesive site that respects Germiston's historical context (Van Niekerk et al., 2020).

While the project meets many goals, future improvements could focus on expanding educational initiatives and incorporating more community feedback. Boosting community-led workshops focused on sustainable practices would enhance local involvement, enabling the design to evolve in response to the changing needs of its users (IFLA, 2020). Furthermore, incorporating a greater variety of plant species could further support biodiversity, improving ecosystem services such as pest management and pollination, which are crucial for sustaining long-term food security and environmental well-being (Threlfall & Kendal, 2018).

Image: Diversity of discourses and concepts associated with Agroecology (Agroecology Info Pool, 2019).

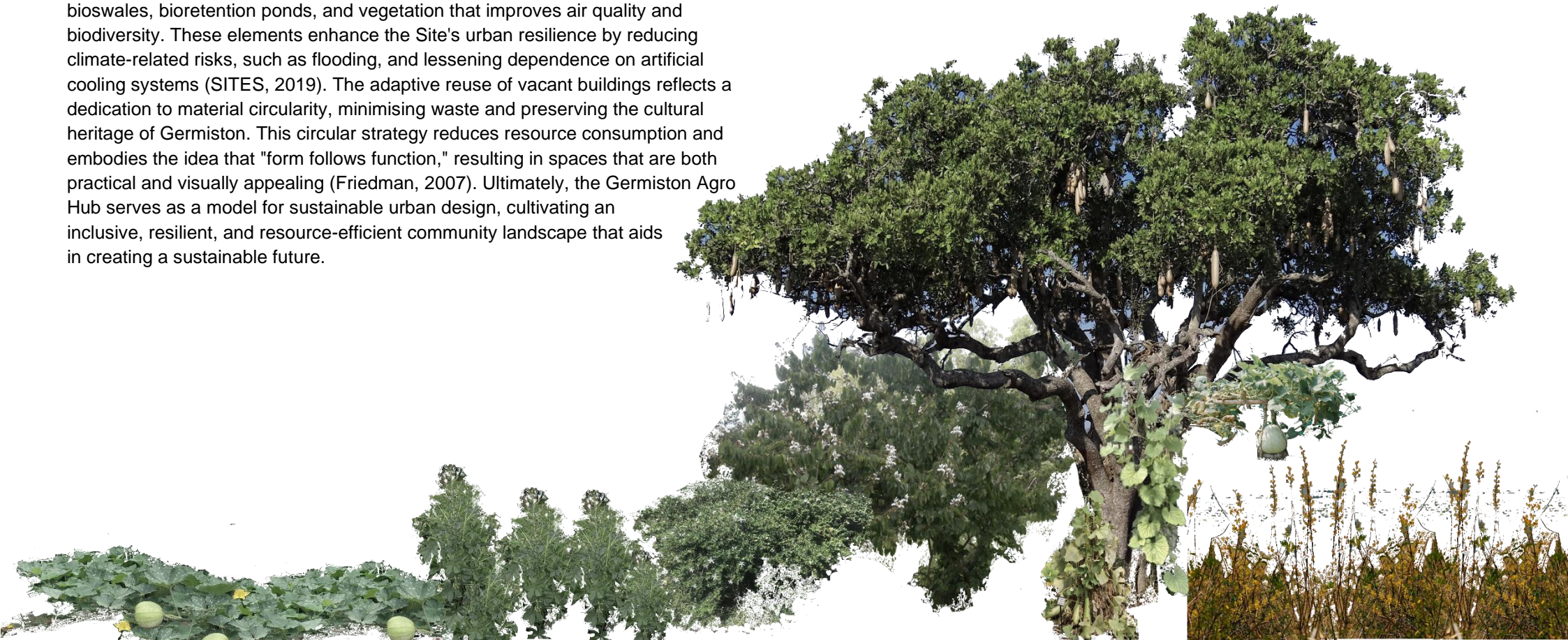


CONCLUSION

The Germiston Agro Hub exhibits a comprehensive approach to urban sustainability by unifying social, economic, and environmental advantages within a unified landscape design. The initiative enhances community resilience by creating inclusive spaces, including educational centres and an amphitheatre, where residents acquire sustainable farming skills and engage in cultural activities. This fortifies community connections and enhances ecological consciousness by sustainable development objectives (IFLA, 2020).

Economically, the Hub contributes to local growth by creating agriculture, maintenance, and education jobs, supporting the livelihoods of nearby informal settlements. The washing and packaging warehouse further supports the local economy by facilitating efficient, on-site processing of TACs, making fresh produce readily available to the community (Thompson & Sorvig, 2008).

Environmentally, the project emphasises sustainable water management by using bioswales, bioretention ponds, and vegetation that improves air quality and biodiversity. These elements enhance the Site's urban resilience by reducing climate-related risks, such as flooding, and lessening dependence on artificial cooling systems (SITES, 2019). The adaptive reuse of vacant buildings reflects a dedication to material circularity, minimising waste and preserving the cultural heritage of Germiston. This circular strategy reduces resource consumption and embodies the idea that "form follows function," resulting in spaces that are both practical and visually appealing (Friedman, 2007). Ultimately, the Germiston Agro Hub serves as a model for sustainable urban design, cultivating an inclusive, resilient, and resource-efficient community landscape that aids in creating a sustainable future.



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