



# Public Space Resiliency in Dar es Salaam

Investigating the qualities of public space resiliency in central Dar es Salaam to inform the strategic design of the Lower Msimbazi Redevelopment masterplan.

*Author:* Rakan Dajani

*Committee Members:*

Dr. Claudiu Forgaci – TU Delft

Dr. Jess Wreyford – Wageningen University & Research

# Public Space Resiliency in Dar es Salaam

Investigating the qualities of public space resiliency in central Dar es Salaam to inform the strategic design of the Lower Msimbazi Redevelopment masterplan.

**MSc Metropolitan Analysis, Design and Engineering**  
Master Thesis

## Author

Rakan Dajani

[rakan.dajani@wur.nl](mailto:rakan.dajani@wur.nl)

WUR Student nr. 1048929

TU Delft Student nr. 5437741

## Project Duration and Location

March 2022 - October 2022

Amsterdam, Netherlands

Dar es Salaam, Tanzania

## Supervisors

Dr. Claudiu Forgaci – TU Delft

Dr. Jess Wreyford – Wageningen University & Research

## External Supervisor

Remco Rolvink (DASUDA + VE-R)

## Institutions and Organisations

AMS Institute

TU Delft

Wageningen University

Dutch Alliance for Sustainable Urban Development in Africa (DASUDA)





# Abstract

A masterplan, commissioned by the Municipality of Dar es Salaam aims to redevelop the Lower Msimbazi River Basin with new urban development. In the context of rapid urbanisation and sustainable development, uncovering the relationship between public space and resiliency as mediated by urban form is essential to contribute to resilient master planning in developing environments and in this context, a more resilient public space in the redevelopment masterplan in Dar es Salaam. The research departs from an ongoing tension in master planning – how to assess and determine optimal qualities of urban form to enhance resiliency of public spaces. The research aims to define, spatially assess, and explore the relationships of factors influencing public space resiliency in central Dar es Salaam using a combination of a transdisciplinary literature review, geospatial quantitative analysis, ethnographic observations, and in-depth interviews. To inform a more resilient public space in the redevelopment masterplan, the research urges approaching resiliency in terms of ward-based identities and typologies. It recommends improving resiliency through the creation of space by enabling polycentricity, designing for wider conceptions of public space and strategically densifying through the creation of new urban forms. The research opens up possibilities for strategic interventions given further local investigation and site-specific acceptability by residents in Dar es Salaam.

## Contents

<b>List of Figures</b> .....	<b>8</b>
<b>List of Tables</b> .....	<b>9</b>
<b>Terms and Acronyms</b> .....	<b>10</b>
<b>1 Introduction</b> .....	<b>11</b>
1.1 Background .....	11
1.2 Research Aim & Objectives .....	14
1.3 Research Scope .....	15
<b>2 Literature Review</b> .....	<b>16</b>
2.1 Spatial Development and Master Planning in Dar es Salaam .....	16
2.2 Public Space .....	18
2.3 Spatial Resiliency.....	20
2.4 Resilient Urban Form .....	23
2.5 Research Gap: Public Space Resiliency .....	28
<b>3 Research Design and Structure</b> .....	<b>29</b>
3.1 Mixed Methods Approach .....	29
3.2 Research Design and Phasal Approach .....	29
3.2.1 Part A ‘Building an assessment framework for public space resilience’ .....	29
3.2.2 Part B ‘Geospatial analysis of public space resilience in Dar es Salaam’ .....	30
3.2.3 Part C ‘Qualitative analysis and ethnography in Dar es Salaam’ .....	30
3.3 Thesis Outline.....	31
<b>4 Part A: Assessment</b> .....	<b>32</b>
4.1 Public Space Resiliency Review .....	32
4.2 Framework Development .....	34
4.3 Public Space Resilience Framework .....	36
<b>5 Part B: Application – Geospatial Analysis</b> .....	<b>37</b>
5.1 Data Gathering and Generation.....	37
5.2 Geoprocessing.....	37
5.2.1 Normalisation and Units .....	39
5.2.2 Development of Fingerprint Typologies .....	41
5.3 Results.....	42
5.3.1 Kariakoo .....	43
5.3.2 Upanga .....	45
5.3.3 Magomeni .....	46

5.3.4	Tandale.....	47
5.3.5	Mikocheni.....	48
5.3.6	Comparative Ward Performace .....	49
<b>6</b>	<b>Part C: Application – Qualitative Analysis .....</b>	<b>50</b>
6.1	Methods.....	50
6.2	Results.....	51
6.2.1	Land Economy .....	54
6.2.2	Spatial Morphology and Integration.....	58
6.2.3	Governance and Communication .....	63
6.2.4	Public Space Usage.....	68
6.2.5	Urban Building Blocks .....	74
6.2.6	Environment.....	78
<b>7</b>	<b>Discussion &amp; Reflection .....</b>	<b>81</b>
7.1	Implications for Public Space Resiliency .....	82
7.2	Recommendations .....	85
7.3	<b>Putting Resiliency in a ‘Box’:</b> Reflections of Part A and Building an Assessment Framework .....	90
7.3.1	A Novel Approach to Assessment of Public Space and Resiliency.....	90
7.3.2	Scalability .....	90
7.3.3	Specificity .....	90
7.3.4	Thresholds and General Relations of Criteria .....	91
7.4	<b>Resiliency as a Fingerprint:</b> Reflections of Part B and the Process of Spatially Quantifying Resiliency into Typologies .....	91
7.4.1	Comparability of Resiliency Scores .....	91
7.4.2	Reproducibility and Interpretability.....	92
7.4.3	Proxy to Reality .....	93
7.5	<b>‘The Real Thing’:</b> Reflections of Part C and Synthesising the On-the-Ground Complexities of Resiliency in Dar es Salaam .....	95
7.5.1	The Generalisability of Interviews .....	95
7.5.2	Non-Spatial Factors.....	95
7.5.3	Underlying Ethical and Philosophical Perspectives.....	96
7.5.4	Scope of Intervention.....	96
7.5.5	Resiliency for Who? .....	96
7.6	Applicability & Impact.....	97
7.7	Research Limitations .....	97
<b>8</b>	<b>Conclusion.....</b>	<b>99</b>

8.1	Future Research .....	100
<b>9</b>	<b>Acknowledgements.....</b>	<b>101</b>
<b>10</b>	<b>References.....</b>	<b>102</b>
<b>11</b>	<b>Appendix .....</b>	<b>108</b>
11.1	Appendix 1: Full Criteria List for Assessment Framework (Unfiltered).....	108
11.2	Appendix 2: Space Syntax Integration and Connectivity Maps (DepthMapX).....	110
11.3	Appendix 3: Python Code for Resiliency Fingerprints.....	112
11.4	Appendix 3: Fingerprint Typologies .....	113
11.5	Appendix 4: Expert Interview Summaries.....	116
11.6	Appendix 5: Interviewee List.....	136
11.7	Appendix 6: Interview Guiding Questions .....	137

## List of Figures

All figures included are produced by the author unless otherwise specified.

Figure 1.1: Masterplan of The Lower Msimbazi Redevelopment Project showing city park and adjacent urban development. (DASUDA 2022).....	11
Figure 1.2: Project Boundary of Lower Msimbazi Redevelopment Project.....	11
Figure 1.3: Artistic Impression of Proposed City Park in Msimbazi Redevelopment Project .....	11
Figure 1.4: The Lower Msimbazi Redevelopment project as headlines news for The Citizen newspaper dated 6 October 2022. The project is described as a 'plan to tame flooding in Dar'. .....	12
Figure 2.1: Colonial Segregation in Dar es Salaam (Smiley 2012).....	16
Figure 2.2: 1930s Map of Dar es Salaam showing the racially divided urban morphologies taken from The Dar es Salaam Centre for Architectural Heritage (DARCH).....	17
Figure 2.3: Example of Detailed, Measurable and Technical Prescriptions of Public Space taken from UN Public Space Toolkit (2016).....	20
Figure 2.4: Classifications of Built Form (Stewart and Oke 2012) .....	24
Figure 2.5: Scales of Urban Morphologies (Feliciotti et al. 2016).....	26
Figure 4.1: Diagram of Public Space Resiliency Criteria Selection Process .....	35
Figure 5.1: Histogram showing skewed distribution of scores .....	39
Figure 5.2: Histogram showing logarithmic distribution of scores.....	39
Figure 5.3: Choropleth Map of Normalised Scores of Street Network Integration with Boundaries of Sub wards and Wards .....	40
Figure 5.4: Location of Kariakoo Ward .....	43
Figure 5.5: Figure-ground map of Kariakoo .....	43
Figure 5.6: Space Syntax Street Network Analysis for Integration .....	44
Figure 5.7: Integration Heat Map .....	44
Figure 5.8: Location of Upanga Ward.....	45
Figure 5.9: Figure-ground map of Upanga.....	45
Figure 5.10: Location of Magomeni Ward .....	46
Figure 5.11: Figure-ground map of Magomeni.....	46
Figure 5.12: Location of Tandale Ward.....	47
Figure 5.13: Figure-ground map of Tandale .....	47
Figure 5.14: Figure-ground map of Mikocheni.....	48
Figure 5.15: Location of Mikocheni Ward.....	48
Figure 6.1: Word cloud based on summaries of qualitative data collected including interviews and ethnographic observations.....	52
Figure 6.2: Upanga's 'Self-Enclosed' New High-Rise Developments .....	55
Figure 6.3: Mwenge as a new 'node' or 'satellite centre'.....	59
Figure 6.4: Bus Rapid Transit Stop in Kisutu (City Centre).....	60
Figure 6.5: Market stall at Tandale market .....	60
Figure 6.6: Side street in Tandale featuring single storey houses .....	65
Figure 6.7: 'Congested' Congo Street in Kariakoo .....	69
Figure 6.8: Street Vendor in Kariakoo .....	69
Figure 6.9: Informal and intimate cafe on roadside.....	70
Figure 6.10: Residents in Mwananyamala using the street for communal cooking.....	70
Figure 6.11: Boda boda taxis using sidewalk as taxi rank.....	71
Figure 6.12: High rises in the city centre (Kisutu).....	74
Figure 6.13: Cross cutting benefits of urban agriculture in Namanga .....	79
Figure 7.1: Recommendation 1 'Priority of Interventions' .....	86
Figure 7.2: Recommendation 2 'The Polycentric Circus Tent' .....	87
Figure 7.3: Recommendation 3 'Densifying to New Urban Block' .....	88
Figure 7.4: Recommendation 4 'New Public Space' .....	89
Figure 7.5: Resiliency Fingerprints of Kinondoni with clockwise (left) and counter clockwise (right) orientation.....	93
Figure 7.6: Image of Mtambani B, Jangwani with flood prone land of Lower Msimbazi in the foreground .....	94
Figure 7.7: Resiliency Footprint of Jangwani.....	94

## List of Tables

<i>Table 1.1: Summary of Research Questions and Objectives</i> .....	14
<i>Table 2.1: Qualities of Resilient Systems (summarised and adapted from Ergün 2020 and City Resilience Framework – Rockefeller Foundation 2014)</i> .....	22
<i>Table 2.2: Summary of Dar es Salaam Urban Typologies (Number of storeys, land coverage and floor area ratios) (Lupala 2002)</i> .....	25
<i>Table 2.3: Key Terms and Concepts</i> .....	28
<i>Table 3.1: Thesis Outline</i> .....	31
<i>Table 4.1: Literature Synthesis of Qualities of Public Space Resiliency</i> .....	33
<i>Table 4.2: Public Space Resiliency Framework</i> .....	36
<i>Table 5.1: Public Space Resiliency Framework Geoprocessing Definitions and Steps</i> .....	38
<i>Table 5.2: Normalised Resiliency Scores per sub ward</i> .....	41
<i>Table 6.1: Qualitative Methods in Dar es Salaam</i> .....	50
<i>Table 6.2: Land Economy Summary Table</i> .....	56
<i>Table 7.1: Resiliency Insights</i> .....	82

## Terms and Acronyms

**Bajaj** – Motorised rickshaw vehicles with three wheels. Also colloquially known as a ‘Tuk Tuk’.

**Boda Boda** - Bicycles and motorcycle taxis commonly found in Tanzania.

**BRT** – Abbreviation for Bus Rapid Transit which is a bus based rapid public transportation system.

**DART** – Dar es Salaam Rapid Transit (DART) Agency. The organisation responsible for the bus rapid transit system and its maintenance.

**Machinga** – Swahili term for street hawkers or petty traders.

**Mtaas** – Denoting sub wards in Swahili, these units are the smallest administrative units in Dar es Salaam.

**Mzungo** – Swahili word for ‘wanderer’ often pertaining to foreigners or tourists.

**PO-RALG** – Abbreviation for ‘President’s Office, Regional Administration and Local Government Tanzania’

**Ramia Huria** – A Tanzanian mapping organisation which uses bottom-up methods of data collection, funded by the World Bank and implemented by Humanitarian OpenStreetMap Team (HOT).

# 1 Introduction

## 1.1 Background

The Municipality of Dar es Salaam has commissioned the Msimbazi Basin Development Project with the ultimate aim to “improve resilience, mobility and liveability’ in the Dar es Salaam metropolitan region (Msimbazi Report 2022). The project, in its current stage, is focussed on redeveloping the Lower Msimbazi River Basin which poses a threat to flood-prone communities living in informal settlements in the basin. The \$270 million USD project is funded by the World Bank and involves dredging the river to construct terraces designed to accommodate urban agriculture, a city park, and a new urban development as seen in the masterplan (Figure 1.1).



Figure 1.1: Masterplan of The Lower Msimbazi Redevelopment Project showing city park and adjacent urban development. (DASUDA 2022)



Figure 1.3: Artistic Impression of Proposed City Park in Msimbazi Redevelopment Project



Figure 1.2: Project Boundary of Lower Msimbazi Redevelopment Project

Flood resilience is a central driver behind the Msimbazi redevelopment plan, as exemplified in *The Citizen* newspaper headline, ‘Sh 600 bn boost for plan to tame flooding in Dar’, seen in Figure 1.4 (The Citizen 2022). However, the creation of a new urban fabric requires investigating and accounting for the multiple ways the built environment and its public spaces influence social, economic, and environmental experiences. As Clos (2016 cited in Cloete and Yusuf 2018) argues, public space including streets, connects ‘everything’ in the city including mobility, traffic circulation and service provisioning. In most African cities, the provision of public space is lacking, only constituting approximately 10 percent of urban areas on average. This contrasts with around 30 to 35 percent public space in well planned cities (ibid.). Additionally, Roji (2020) explains the importance of public space in urban planning given that it acts as a vital economic asset to the city. This consideration of public space as an economic factor is pivotal given that in most African cities over 85 percent of residents rely on the informal economy (ibid.). As iterated by Hillier and Netto (2002 p.181), ‘society is seen through the prism of space’ and in this context, the public space network of the new urban development will form a core part of the urban fabric of the city. Therefore, a holistic and resilient approach to the new urban development in the Lower Msimbazi Basin requires direct attention to public space. This is especially significant given how the physicality of the built environment is directly linked to human experience and as Roji (2020) articulates, the ‘spaces of publics’ need to be considered as much as physical public spaces. As such, the research departs from the point that the built environment and the spaces enabled through it, impact the everyday lives of residents and therefore, demands special attention.



Figure 1.4: The Lower Msimbazi Redevelopment project as headlines news for *The Citizen* newspaper dated 6 October 2022. The project is described as a ‘plan to tame flooding in Dar’.

The masterplan of the Lower Msimbazi Redevelopment Project, developed by urban planners and architects at the Dutch Alliance for Sustainable Urban Development in Africa (DASUDA), is an intervention of urban form. Kevin Lynch (1981 p.47) defines urban form as “the spatial pattern of the large, inert, permanent physical objects in a city” which is the essence of any urban development project. The top-down planning approach invites a deterministic approach in understanding how the built environment and its form influence social processes. In reality, the relationship is complex and dialectic – social and physical factors as co-influencers in urban space. However, as Hanson and Hiller (1987 p.252) assert, “if we are to understand the social nature of space, then we must also understand the spatial nature of human society.” In the context of the masterplan, the implication of urban design is that the form of the built environment is significant for its function. Following this point, streets are particularly significant components of urban form given that the urban street network is composed by public spaces (van Nes and Yamu 2021). Jacobs (1961) considers streets to be the main public spaces and ‘vital organs’ of a city and by extension, a core characteristic of urban form. Given its significance, direct attention to designing resilient streets and squares is key to the success of the Lower Msimbazi Redevelopment Plan.

The approach to designing resilient urban form and public spaces should be specific to its context, which in this research is Dar es Salaam. Numerous scholars have noted patterns of urban form to influence public space resiliency (Creutzig et al. 2016, Gleeson 2012) and have drawn certain conclusions regarding conditions for resiliency. For example, Dumreicher et al. (2000) point to diversity, compactness, and integration as preconditions for urban resiliency. Kellert (1995) emphasises the ecological component of public spaces, noting the need for landscape features such as plants and trees which can reduce heat stress (Coaffee 2013). Public spaces are at the intersection of environmental, social, and economic needs. Given this complexity of influences, said principles and research findings require a unique and context-specific application to render their insights useful, an argument extended by Roji (2020).

To accurately uncover the built environment’s influence on public space, a scalar approach is needed to reflect the different roles and characteristics of public space. As Hillier and Vaughan (2007) conceptualises, cities have a dual nature. Firstly, a larger ‘foreground’ city-wide scale. Secondly, a more localised ‘background’ street-based network. Taking the scalar approach further to reflect the influence of form onto function, the spaces in this study can be conceptualised as scale of context (city-wide relationships), focus (public space and urban form) and detail (the functional elements of public space).

This research is a critical exploration of central Dar es Salaam to determine strategies for public space resiliency. The challenge emerges in conceptually breaking down public space – in terms of scale and relationships – to investigate how it negotiates the environmental, social, and economic needs of the city. As complexity forms the backdrop of the fastest urbanising African city<sup>1</sup>, Dar es Salaam, the research responds to the need to integrate and analytically bring together facets of public space to inform the strategic design and redevelopment plan of the Lower Msimbazi Basin.

---

<sup>1</sup> The city’s total population rose from 83,844 in 1950 to more than 7 million people today in 2022 (World Population Review 2022)

## 1.2 Research Aim & Objectives

This thesis aims to address an ongoing tension in master planning, how to assess and determine optimal qualities of urban form to enhance resiliency of public spaces. The relative benefits and impacts of top-down planning with urban development policy when compared to organic growth are debated in wider academic literature. Given the growing environmental, social, and economic pressures on the city of Dar es Salaam, the role and ability for public space to respond to these needs requires attention. The research adopts a general urban resilience approach which emphasises the future-proofness of a city’s social, economic, and environmental systems (Thornbush et al. 2013). This attention requires uncovering resiliency, with all its tensions, linkages, and scales, in a context-specific manner to Dar es Salaam. This attention to context is essential to synthesise a practical approach to optimising the masterplan of the Lower Msimbazi Basin.

The research aims to understand, assess, and enhance public space resiliency in central Dar es Salaam. The scale of the urban intervention requires a holistic approach to urban development and hence, designing a master plan with public spaces that account for the future social, economic, and environmental conditions of the city. It is with this backdrop that this research aims to uncover the relationship of public space resiliency and urban form, with the eventual intention to inform a more resilient public space in the redevelopment masterplan in Dar es Salaam. The research is led with the following research (sub)questions (RQ) and (sub)objectives which are found in Table 1.1. The main **research question** aims to uncover the approaches and measures to assess and hence, improve public space resiliency around the Lower Msimbazi development project. **Sub-question 1** focuses on developing a methodology to assess public space resiliency. **Sub-question 2** uses the methodology to assess the existing resiliency of public spaces in Dar es Salaam. **Sub-question 3** contextualises the findings of SQ1 and SQ2 in terms of qualifying the most important factors and their relationships to improve the resiliency of public spaces, specifically in Dar es Salaam.

Research Question	
What approaches and measures can help assess and improve the resiliency of public spaces around the Lower Msimbazi redevelopment project in central Dar es Salaam?	
Sub-Question	Objectives
SQ1: What methodology can be used to assess public space resiliency?	Objective 1.1: Review literature and identify properties of public space resiliency.
	Objective 1.2: Build an assessment framework for public space resiliency.
	Objective 1.3: Define indicators and obtain data for assessment.
SQ2: What is the existing resiliency of public spaces in central Dar es Salaam?	Objective 2.1: Geoprocess and visualise the results of assessment for public space resiliency.
	Objective 2.2: Identify 'fingerprint' typologies of resiliency.
SQ3: What are the main factors influencing public space resiliency performance?	Objective 3.1: Contextualise and validate findings of the public space resiliency assessment with qualitative data including non-spatial criteria.

Table 1.1: Summary of Research Questions and Objectives

### 1.3 Research Scope

This research, conducted over a seven month period, specifically focuses on central Dar es Salaam, investigating its present context to inform potential ways to improve the future resiliency of public spaces. The scope of research is confined to exploring public space, as understood by its urban form and how that can improve or reduce the resiliency of the city. Public space resiliency is understood through specific criteria, as defined in Section 4, Part A: Assessment. This research recognises the complexity of resiliency, especially in the rapidly urbanising context of Dar es Salaam. There are many other factors such as tenure laws which influence urban resiliency yet extend beyond the confines of this research. However, it is not the intention nor aim of the research to mislead nor exaggerate the ability of urban form to determine the city's functionality and resiliency. On the contrary, the research, in its focused consideration of resiliency factors, aims to explore specific factors which may contribute to or diminish resiliency in the city, particularly in the centre of Dar es Salaam around the Lower Msimbazi Basin.

## 2 Literature Review

### 2.1 Spatial Development and Master Planning in Dar es Salaam

Dar es Salaam's present city structure is heavily influenced by its history of spatial developments which reflect changing political and economic interests. By and large, Dar es Salaam's urban growth after the 19<sup>th</sup> century was set out by the state and championed by the presiding imperial rule (Brennan et al. 2007). German colonialisation in 1891 involved a tripartite racial segregation of building development codes extending to Asians (Arabs and Indians), Africans and Europeans (Armstrong 1987). Additionally, German rule solidified and extended the radial road network of the city which persists in Dar es Salaam's present road infrastructure (ibid.).

In 1916, post World War I, German East Africa was taken over by British rule and mandated as 'Tanganika Territory' retaining Dar es Salaam as its capital city. Residential segregation of the city was legalised, and the city was spatially demarcated into zones according to race as seen in Figure 2.1 (Nguluma 2003). These zones included present day Oyster Bay for the Europeans, Kariakoo and Ilala for the Africans and Upanga and Kisutu for the Indian residents of the city. These colonial divisions extended beyond spatial demarcations into influencing the urban form of the areas. Namely, administrative, and European areas in the East and alongside the harbour can be recognised by their broad streets and large plots of residences. Adjacently, the Asian district featured a more commercial and hence densified urban form. Inland and more westerly in Kariakoo and naturally bounded by the Msimbazi River, Africans were excluded from the central areas of the city as seen in Figure 2.2 (Nguluma, 2003).

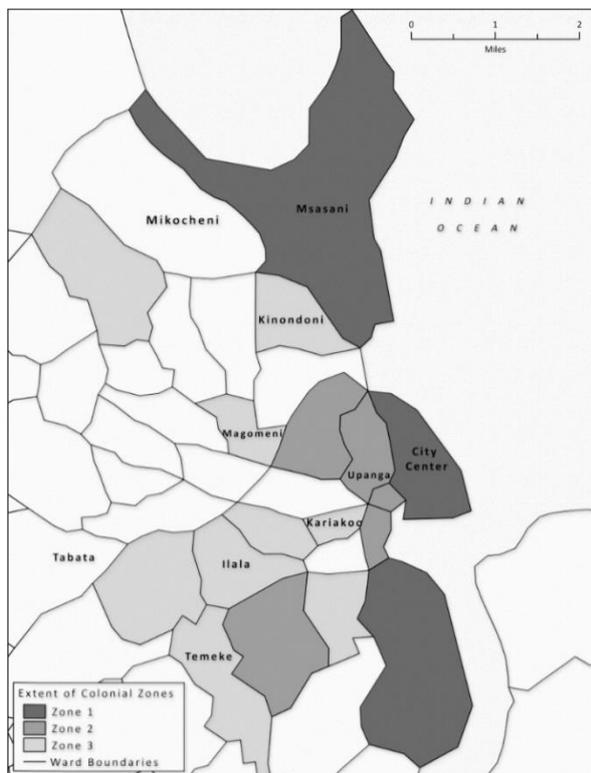


Figure 2.1: Colonial Segregation in Dar es Salaam (Smiley 2012)

Figure 2.1 outlines the zonal building ordinance plan of the British in 1923. The Zones explicitly reflect the racial zoning during German rule. This contradicted the League of Nations mandate which expressly prohibited racial discrimination (Smiley 2012). Even in the current context, Smiley (2007) finds that these zones seem to persist racially: 98 percent of expatriates 'complete some of their everyday life activities' on the Msasani Peninsula (former Zone 1 area), 100 percent of Asians in the City Center (parts of which were the Zone 2 commercial district), and 78 percent of Africans in Kariakoo (formerly Zone 3 area).



Figure 2.2: 1930s Map of Dar es Salaam showing the racially divided urban morphologies taken from *The Dar es Salaam Centre for Architectural Heritage (DARCH)*

Independence in 1961 marked the start of Dar es Salaam’s postcolonial development which abolished race-informed urban governance. Residents were allowed to freely move and reside across all administrative zones of the city (Hossain et al. 2018). Brennan et al. (2007) argue that in spite of independence transitioning the city away from the urban influences of the colonial period, both unplanned and planned development continued to be reminiscent of colonial urban development plans. Namely, the arterial roads constructed in the 1950s – Morogoro road in the West and Bagamoyo road to the North – defined the direction of further development (Hossain et al. 2015). In this way, it can be argued that the physicality of urban form has an inherent identity which links it to its colonial past and interests. Post-colonial development, in some regards, struggled to overcome the inequalities of the status quo. As Fanon (1995) argues, post-independence marks a moment whereby the similar unequal power relationships that persisted during colonial periods continue under economic precedents. The political economy, since 1967, was an African version of socialism called Ujamaa (Nyerere 1967). However contrary to the political context, specifically within Dar es Salaam, spatial inequalities still resonated former colonial divisions across the city which implies the limitation of urban governance to radically redefine the structure of the city under economic pressures.

Dar es Salaam’s rapid economic growth, responsible for the 40 percent of the country’s GDP (The Heritage Foundation 2018) intensified pressures in terms of urban development – namely, in terms of housing and infrastructure. Urban governance since 1961 was placed at the intersection of promoting economic growth and translating the growth into improving the livelihoods of the majority of residents. However, the present context perpetuates former racial segregation as territorialisation is

mainly determined by income groups (Hossain et al. 2015). This pattern is reinforced by Fanon's (1995) critique of post-colonial growth as reinforcing similar power relations of colonialism under the guise of a new political and economic order. The failure of urban planning to respond to the growing needs of the city resulted in the expansion of an informal land economy and informal settlements. Presently, over 70 percent of urban areas in Dar es Salaam consist of informal settlements (Sheuya 2007). These informal developments clearly reflect the former designated hinterlands for Africans in the colonial period. Settlement types that display the urban morphology of a garden city and chess-board neighbourhoods continue in former European areas. Informal settlements, which have spread along the arterial roads and on former farmlands, extend from the former hinterland designated for local Africans. Urban development in the Lower Msimbazi Basin is a clear example of this unplanned growth which present new challenges such as flood-risks. This pattern of growth continues as Dar es Salaam is set to become one of Africa's future 'megacities' (Wolff, Kuch and Chipman 2018).

Administratively, Dar es Salaam consists of five municipalities: Kinondoni, Ilala, Temeke, Kigamboni and Ubungu. Within these municipalities exist wards and sub-wards, also known as 'Mtaas' which have full mandate to govern and manage land use plans in their areas, since 1982 under the Local Government District Authorities Act 7 (Hossain et al. 2018). Presently, PO-RALG is following a masterplan strategy for the city up to 2036 for controlled growth, under which the redevelopment plan of the Lower Msimbazi supports. However, the issues and challenges of Dar es Salaam persist and the dissonance between planning and strategy with the practical challenges such as lack of funding and uncontrolled growth continue to remain.

## 2.2 Public Space

As Dar es Salaam's historical spatial development has proven, space is a significant political instrument which has the ability to shape social, economic and political relations of the city. Lefebvre (1991) emphasises the importance of space as both a product of social relations as well as the means of production of these relations. This implies a degree of agency of space to actively shape society. In other words, as Hillier (2007) explains it, space is where all these relationships manifest and are also reinforced, society can be seen via the 'prism of space' (Hillier and Netto 2002). The agency of space can also manifest across multiple scales of a city. It is by logical extension that such a significant concept, which signifies complex relations, that the term 'public space' is contested.

In simple terms and as defined by the UN Charter for Public Space, public spaces are "places that are publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive" (UN Habitat 2018). This definition clearly reinforces the egalitarian quality of public space as a public good outside of economic motives. Mitchell and Staeheli (2009) reiterate a similar definition of public space as 'property open to public use' with unrestricted access. However, academics such as Sendi and Marušić (2012) add an element of intended use – that public spaces are for group or individual activities which hold functional and symbolic purposes. These purposes can even be 'presence', as Arendt (1958 cited in Zhang and He 2020) identifies it as a 'place of appearance' where people participate and are 'seen' in the public domain. It is widely acknowledged in literature to expand definitions of public space to a wider range of 'heterogenous social areas' (Low and Smith 2013) and everyday spaces. For example, Lehtinen (2015) explores informal, semi-private and in-between spaces which are not traditionally conceived as public spaces such as parks or gardens. As such, public space is a term loosely delineated as a space of use and accessible by people (the public) whose activities are outside the confines of individual control or property.

Free access is core to public space. Carmona (2021) adopts a definition which relates parts of the natural and built environment whereby the public have free access. For example, this includes streets, squares, open spaces, parks and 'public/private' spaces with unrestricted access (ibid.). Harvey (2013) considers accessibility as the most important feature of public space as it actively promotes social integration. Or, as a reverse effect, any space which is accessible will then, by extension, become public (Madanipur 2013 cited in Carmona et al 2008).

The benefits of public spaces are widely explored within urban academic literature. Porada (2013) treats public space as a civic area whereby residents find common ground and can momentarily, escape economic stresses of the city. In Nairobi, public spaces are considered the entry point for holistic urban redevelopment and actively contribute to the competitiveness of cities (UN Habitat 2015). UN Habitat (2016) frequently report the benefits of public spaces to promote inclusion, urban safety, public health, and improve environmental sustainability. This points to a wide range of urban design literature which, on the scale of the public space, argue for various guidelines to improve public space.

Van Kamp et al. (2003) argue that urban design literature which outline best practices for public space development are relatively broad in conception. For example, the Charter of Public Space (UN Habitat 2018) outlines the need for 'social inclusion', 'integrated' and 'environmentally sustainable' spaces. Jan Gehl (1987), a leading thinker on public space, develops concepts such as accessibility, activities, and comfort into more tangible and measurable factors such as presence of trees and street furniture. Other thinkers such as Olsson (2000 cited in Iqbal 2020), argue that openness and attractiveness can be created by the presence of other people in the space. Mehta (2014) proposes five aspects that render spaces as public – namely, inclusivity, pleasurability, meaningful activities, safety and comfort. These concepts can be categorised in terms of factors that relate to the environment (e.g. street furniture) or relate to the individual (e.g. activities) and temporally, in terms of the future sustainability or in terms of the present, such as the current environmental quality (Kamp et al. 2003). It is clear that within literature, there is an ongoing tension between inclusive and conceptual perspectives of public space with more prescriptive and programmatic understandings of public use. The former has the advantage of capturing a range of public space typologies and uses whilst the latter takes a more practical approach to the remits of scale-of-detail interventions as seen in Figure 2.3.

Indicators	Supply	Quality	Distribution
Street Crossings	Street connectivity is between 80-120 intersections per square kilometre	Number of intersections per square kilometre  Crossing/wheelchair accesses, number over total city area  Streetlight sound alerts, number over total city area	Crossing/wheelchair accesses, number per square kilometre over city area indicator
Trees	Numbers of trees per kilometre of road/street		Number of trees per km. of road/street, selected city quadrant and quadrant/city ratio
Parks and Gardens	Surface over total city population  Proportion of population farther away than 200 - 300 metres from an open green area or a city park	Park maintenance budget per inhabitant	Surface over population of selected city quadrants City quadrant/total city ratio  Proportion of population farther away than 200 - 300 metres from a city park, selected city quadrants, and as city quadrant/total city ratio
Playgrounds	Total number per 1000 inhabitants		Total number per 1000 inhabitants, selected city quadrants  City quadrant/total city ratio
Public Sports Facilities	Total number per 1000 inhabitants, city-wide	Free access, availability and status of maintenance	Total number per 1000 inhabitants, selected city quadrants



Global Public Space Toolkit  
From Global Principles to  
Local Policies and Practice

UN HABITAT  
FOR A BETTER URBAN FUTURE

Figure 2.3: Example of Detailed, Measurable and Technical Prescriptions of Public Space taken from UN Public Space Toolkit (2016)

Public space research is increasingly expanding its focus towards more developing contexts (Mitchell 2009). For example, dynamic uses of public spaces in Tanzania include vending spots or religious meeting places (Sanga and Mbisso 2020). It is noted that in Dar es Salaam, the provision of public spaces should follow from the socio-cultural everyday experiences of residents (ibid). This is reiterated by post-development thinkers such as Roji (2020) who urge a context-specific conception of public space. Linguistically, Roji (2020) even suggests a reframing of public space as a ‘space of publics’ to emphasize the social components of these spaces. In this sense, streets as a vital economic asset for informal vending should be considered given that over 76 percent of residents in Dar es Salaam work in the informal economy (Oxford Business Group 2018). The street is, arguably, the most significant public space and as Jacobs (1961) describes, streets are the city’s most ‘vital organs’ – a metaphor which neatly extends to Dar es Salaam’s streets as a source for economic vitality.

Beyond their economic significance, Deore and Lathia (2019) claim streets are the most *public* of urban spaces. Streets deserve special attention given their ability to cultivate social capital (Hernbäck 2012) with the presence of commerce, general liveliness, and a variety of cultural activities. The social capital, understood as the personal network of residents, is especially significant as a form of capital in informal settlements (where other forms of capital are lacking) (AbdulHakim Ismail et al. 2010, Tunas 2008), which is important considering informal settlements form most of Dar es Salaam’s built environment (Sheuya 2007). In this sense, the public spaces of streets – freely accessible and in turn, also enable accessibility to the city – are at the core of enabling the benefits of public spaces and the urban development of Dar es Salaam.

## 2.3 Spatial Resiliency

Recently, in the past decade, sustainable urban development discourse has increasingly engaged with the concept of resiliency. In its original conception, resiliency, was theorised as an ecological term to describe the way ecosystems cope and retain structure when faced with adverse conditions (Sharifi

2019). Broadly, resiliency approaches can be grouped into engineering, ecological and evolutionary resiliency (Sharifi and Yamagata 2016).

Sharifi (2019) describes engineering resiliency to focus on the resistance and stability of a system to deal with a shock or stressor and return to its equilibrium state. It is a conventional approach and in an urban planning context, works from the assumption that said stressors are relatively predictable (Allan et al. 2013). Ecological resilience is applied to understand the amount of disturbance a system can absorb before shifting to a new equilibrium state (Holling 1996 cited in Forgaci and Van Timmerman 2014). Most recently, evolutionary understandings of resiliency adopt a non-linear perspective to a system. It places resiliency as an ability for a system to consistently undergo transformation to deal with and recover optimally to deal with future shocks.

Resiliency as a systemic concept can be applied to multiple factors besides space. For example, social resiliency which focuses on qualities of empowerment to withstand political turmoil and poverty; economic resiliency which qualifies factors of growth and productivity to withstand economic shocks and lastly, environmental resiliency which is used to understand how the carrying capacity of an ecosystem can deal with climate change (Siavash 2016). Beyond various dimensions of resiliency, the term, in all its applications, explores the persistence of relationships within a system and how it deals with or absorbs interference (Holling 1973, Wardekker et al. 2010). In urban applications, resilience is the city's capacity to absorb and deal with shocks and hence either return to its normal state or restructure the city structure. Meerow et al. (2016) offer a more intuitive definition and claim resilience is what allows a system to adapt or respond to a change. However, the concept of resiliency can be nebulous without a clear understanding of resilience 'of what', 'to what' and 'for what' (Sharifi 2019).

In terms of resilience 'of what' and 'to what', there is a growing call to strengthen the link between urban form with resilience (Felicetti et al. 2018). Marcus and Colding (2014) explore urban spatial patterns of the built environment to determine how urban form impacts resilience. Density, land use, and street networks are growing areas of interest within literature (Godschalk 2003, Berke et al. 2009). Sharifi (2019) claims street networks are the 'backbones of cities' and are a vital part of spatial resilience impacting dimensions of social vibrancy, environmental impact and economic growth. The aforementioned dimensions of resiliency are growing areas of interest to examine stressors in the city such as congestion, economic activity, and environmental disasters. For example, spatial heat resilience indicates the ability for the built environment to support activities during periods of heat stress (Sharifi and Boland 2017). Therefore, the seemingly innate and passive public spaces of cities, as a direct result of urban form, have an immense capacity to influence how able a city can cope with various disturbances from environmentally related to socio-economic. Urban resilience is a growing area of research which defines and explores characteristics of resilient cities.

The characteristics of resiliency describe the 'for what' elements of resilient cities – in other words, it answers the question, 'what makes a system resilient?'. The characteristics of resiliency vary within literature depending on the system being researched. For example, Gharai et al. (2018) values 'diversity' as a characteristic of resiliency in cities particularly when investigating economic and social vitality of streets. In this example, spatial 'diversity' of land uses and users in the space indicate a degree of resiliency. Academic terminology around resiliency qualities vary across research focuses. For example, certain authors such as Walker et al. (2004) use the term transformability to refer to a system's ability and capacity to radically change its structure and learn from past events. This differs slightly from 'adaptability' which Folke et al. (2002) uses to understand how a system can learn and incrementally respond to new changes and circumstances. Table 2.1 outlines the core qualities of resilient systems.

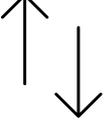
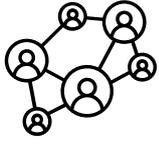
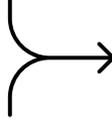
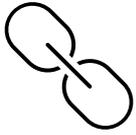
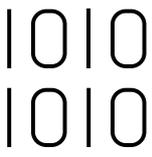
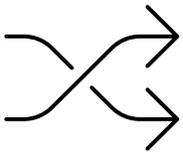
Quality	Icon	Description	Intersection
<b>Reflective</b>		Reflective systems continuously evolve and modify based on new circumstances. They use past evidence to inform future changes to optimise resiliency.	Learning from past events and decisions to enhance the system during a time of crisis. It refers to the way a system can act during a time of crisis.  These qualities refer to effective governance and leadership to align strategies and resources in an equitable and efficient manner.  Robustness, redundancy and flexibility describe qualities which conceive assets and systems that can withstand disruptions and where needed, use alternative ways to cope.
<b>Resourceful</b>		Resourcefulness implies a degree of a system to mobilise resources during times of stress or crisis. It is key to restoring basic functionality of system in constrained environments.	
<b>Inclusive</b>		Inclusive systems prioritise a broad engagement of stakeholders and communities. It contributes to a shared vision of a resilient city.	
<b>Integrated</b>		Integration values consistency and collaboration of efforts across city systems. It emphasises that resource allocation and efforts are mutually supportive of different systems and across scales of the city.	
<b>Robust</b>		Robust systems describe well-managed and conceived physical assets which can withstand stressors and hazards (without significant loss of function).	
<b>Redundant</b>		Redundancy describes the availability of alternative resources, components or pathways that perform a same or similar function, and this enhances the ability to adapt to or absorb shocks and to ensure that the entire system can continue when a component fails (Anderies 2014).	
<b>Flexible</b>		Flexibility implies a degree of a system able to adapt, change and evolve with changes in circumstances. Modular and decentralised approaches are key to infrastructure management.	

Table 2.1: Qualities of Resilient Systems (summarised and adapted from Ergün 2020 and City Resilience Framework – Rockefeller Foundation 2014)

Within urban resiliency studies, and especially relating to public space, diversity, connectivity, and redundancy are often most cited (Ergün 2020). Diversity can refer to spatial diversity of the built environment as well as functional diversity (Ergün 2020). In addition, there is a distinction between response diversity which provides many solutions to the same problem (such as several technologies to store rainwater to prevent floods) and functional diversity which has solutions that can address several problems (street furniture that can be used during emergency floods as well as heat stress events) (Carpenter 2012 cited in Forgaci 2018). Connectivity refers to the city's network – such as the street and mobility network – and its ability to connect and allow ease of circulation (Gharai et al. 2018). Connectivity increases accessibility and can also be understood as urban permeability – it links people and various urban elements (Bentley et al. 1995). Redundancy constitutes a degree of insurance against disturbances or increased demand by valuing spare capacity for the system to cope. It relates to diversity in how it refers to multiple means to achieve a similar function (Rockefeller Foundation 2014). In spite of redundancy and diversity's similarities, the quality of diversity involves 'a variety of urban elements' while the quality of redundancy refers to a 'multiplicity of a specific type of urban element' (Gharai et al. 2018). These qualities summarise the facets of resilience which most directly apply to public space and resilient urban environments.

Qualities of resiliency, including diversity, connectivity, and redundancy, specifically apply to urban form and public spaces. For example, the physical form of streets can influence greater urban resilience by impacting urban microclimate, energy usage, social capital, and economic activities (Sharifi 2019). The public spaces of urban environments can be decisive in affecting the ability of urban systems to develop and survive when faced with disruptions (Godschalk 2003). A further dive into academic literature reveals that public space can support or impede the aforementioned resiliency qualities in numerous ways.

## 2.4 Resilient Urban Form

Urban form is one of the significant determinants of public space resiliency in cities. Urban form can signify factors of the built environment in terms of population size, heterogeneity and density and so, by extension, it signifies the 'urban personality' of different areas of the city (Wirth 1938 cited in Jacobs 1961). Jabareen's (2006) research focuses on urban form as it can directly impact factors such as urban ecosystems, land consumption, travel behaviours, availability of open space and noise pollution. Urban form can be simply understood as the "spatial pattern of the large, inert, permanent physical objects in a city" (Lynch 1981 p.47). In this sense, urban form is a concept which takes interest in urban patterns (Lozano 1990). These patterns can exhibit similar characteristics of street layout, block size, block height, street design and layout of public spaces. Sharifi (2019) understands urban form in terms of scale – a macro scale which explores the overall city structure and distribution patterns, a meso scale which examines the neighbourhood layout and street pattern, and lastly, a micro scale which is more granular in interest, investigating positions of buildings in relation to the street and open spaces (Sharifi and Yamagata 2018). Academic literature on urban form is segmented in terms of its theoretical understanding of city spaces. For example, Puckett (2009) examines urban form in terms of street patterns however, Wheeler (2002) urges a holistic analysis of urban form given the way social segregation, income levels and congestion can not only be explained solely by the physical layout of the city. Within urban form discourse, it is partly the disagreements regarding the most sustainable qualities of urban form which render its study so important. As such, these disagreements strengthen the argument that the most rigorous way to explore urban form is in application to a specific city

context. Otherwise, there is a risk of generalisation and an over-emphasis of form as a determinant of city functionality. Conceptually, there are categories of urban form which allow for an initial understanding and definition of a particular built area.

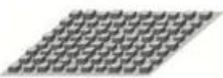
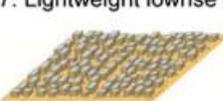
Built types	Definition
 <p>1. Compact highrise</p>	Dense mix of tall buildings to tens of stories. Few or no trees. Land cover mostly paved. Concrete, steel, stone, and glass construction materials.
 <p>2. Compact midrise</p>	Dense mix of midrise buildings (3–9 stories). Few or no trees. Land cover mostly paved. Stone, brick, tile, and concrete construction materials.
 <p>3. Compact lowrise</p>	Dense mix of lowrise buildings (1–3 stories). Few or no trees. Land cover mostly paved. Stone, brick, tile, and concrete construction materials.
 <p>4. Open highrise</p>	Open arrangement of tall buildings to tens of stories. Abundance of pervious land cover (low plants, scattered trees). Concrete, steel, stone, and glass construction materials.
 <p>5. Open midrise</p>	Open arrangement of midrise buildings (3–9 stories). Abundance of pervious land cover (low plants, scattered trees). Concrete, steel, stone, and glass construction materials.
 <p>6. Open lowrise</p>	Open arrangement of lowrise buildings (1–3 stories). Abundance of pervious land cover (low plants, scattered trees). Wood, brick, stone, tile, and concrete construction materials.
 <p>7. Lightweight lowrise</p>	Dense mix of single-story buildings. Few or no trees. Land cover mostly hard-packed. Lightweight construction materials (e.g., wood, thatch, corrugated metal).
 <p>8. Large lowrise</p>	Open arrangement of large lowrise buildings (1–3 stories). Few or no trees. Land cover mostly paved. Steel, concrete, metal, and stone construction materials.
 <p>9. Sparsely built</p>	Sparse arrangement of small or medium-sized buildings in a natural setting. Abundance of pervious land cover (low plants, scattered trees).
 <p>10. Heavy industry</p>	Lowrise and midrise industrial structures (towers, tanks, stacks). Few or no trees. Land cover mostly paved or hard-packed. Metal, steel, and concrete construction materials.

Figure 2.4: Classifications of Built Form (Stewart and Oke 2012)

Built typologies is a highly significant descriptor of urban form. It conceptualises the spatial distribution and density of the built area. For example, as previously noted, Dar es Salaam’s primary type of development are informal settlements. As built forms, these are commonly composed of ‘Swahili style’ single storey houses with six rooms (Lupala 2002). In the central business district (CBD), compact mid-rise (three to nine storeys) built types are most common. Ndetto and Matzarakis (2014) expand upon the spatial implications of the CBD type of built form which leave limited space for greenery, contain mainly paved surfaces and mostly suit the purposes of commercial activities. Figure 2.4 as produced by Stewart and Oke (2012), provide a simple classification of built typologies and forms. In Dar es Salaam, Lupala (2002) neatly classifies built types in terms of land coverage, storey height, and floor area ratio as described in Table 2.2.

The street network plays a vital role in urban form alongside built type. Puckett (2009) states that the layout of street networks impacts how residents navigate and orientate themselves in cities (cited in Van Nes and Yamu 2021). Dempsey et al. (2010 p.25) builds on this point by arguing that “the configuration of the street network, in terms of its urban block sizes, their overall location within the city, pedestrian and vehicular connectivity can affect the functioning of a city by, for example, influencing the location and intensity of activities.” Social capital and networks can be enhanced by the physical layout of streets in line with how Jacobs (1961) argued that walkability improves the ‘urban life’ of streets. On a more operational

level, street network configurations that feature shorter segments and frequent intersections are considered more flexible and resilient to adverse stressors (Sharifi 2019). In addition, street connectivity increases urban permeability which by extension, improves walkability. This factor is important to consider in resilient public space design as LSE Cities et al. (2013) argues, permeability

and accessibility from ‘near and far places’ is key to resiliency. Space syntax studies as developed by Hillier et al. (2007) and advocated by Van Nes and Yamu (2021), quantify and measure the ability of a street network to facilitate permeability, accessibility, and walkability. For example, an angular segment analysis which measures the angular changes in direction whilst moving through a space is used as a good predictor of movement. People prefer to adjust their routes to move between different streets and junctions with angles close to 90° or 180° (Van Nes and Yamu 2021). Hillier et al. (2007) reinforces the scalar approach to understanding networks and states that cities have a foreground network (which connects the city as a whole) and a background network (the local street network). Sharifi (2019) takes a particular focus on investigating the resiliency capacities, such as redundancy, of street networks. Dendritic hierarchy of streets (tree-like structure), despite promoting efficiency, may adversely impact resiliency as it increases the dependence of smaller blocks on streets ‘high on the scale’ of integration (ibid). This limits modularity and hence, reduces redundancy capabilities of street networks, in terms of availability of different routes. Despite extensive research which investigates the resiliencies of street configurations, there is no consensus on the optimal street network as it is entirely context dependent. Depending on the stressors and socio-economic drivers of the space, different qualities of street networks may perform differently in terms of resiliency.

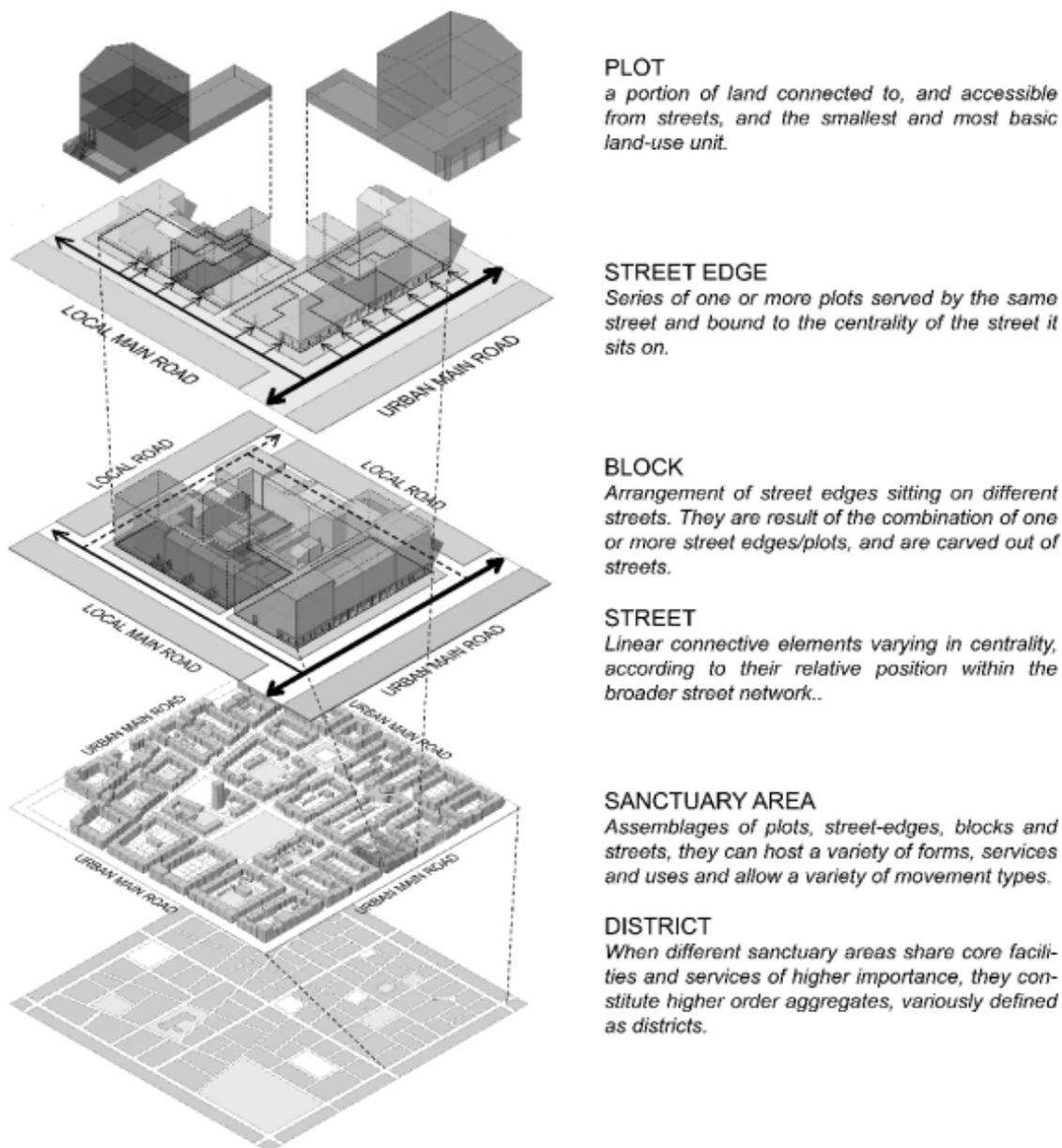
Urban Type		Number of storeys	Lot (Land) Coverage (%)	Floor Area Ratio (FAR)
1a	The Administrative / Institutional area	3-12	35.2	1.8
1b	The Commercial residential area The Commercial residential area	3-5	44.1	2.2
1c	The Institutional (former European residential) area	1-2	10.2	0.19
2	Medium density, moderate height residential	2-4	19.9.	0.44
3	Mixed density commercial / residential	1-7	40	1.5
4	Low density, low coverage residential	1-4	7.9	0.16
5a	Small detached quarters	1	6.9	0.07
5b	Semi-detached residential quarters	1	18.7	0.19
5c	Row housing residential quarters	1	22.1	0.22
6	High-density, low-rise, Swahili house residential	1	36.6	0.37
7	Consolidated high density, low-rise informal settlements	1	41.5	0.41
8	High density high-rise residential	5	10.8	0.54
9	Medium density, low-rise sites and services residential	1	36.2	0.36
10	Low density, low-rise consolidating informal residential	1	25.5	0.26

Table 2.2: Summary of Dar es Salaam Urban Typologies (Number of storeys, land coverage and floor area ratios) (Lupala 2002)

On a smaller scale, literature on public space defines and debates what qualities of urban form render a public space successful. Iqbal (2020) argues that accessibility, openness, and attractiveness are essential prerequisites for a thriving public space. Mehta (2014) extends the criteria to elements of safety, comfort, inclusiveness, and meaningful activities. UN Habitat (2020), in their report ‘Public Spaces for All’, consider public spaces at their highest potential when they foster integration between a variety of socio-economic groups, an extension of inclusivity. Whyte (1980) considers people as the essential ingredient to develop the aforementioned qualities of public spaces. Presence of people, combined with access to seating, food, and street furniture, generates perceived safety, and social interaction (ibid.). There is a tension within public space discourse between overprescribing the essential properties to include in public spaces and allowing for more conceptual interpretations of placemaking. For example, UN Habitat (2020) developed a public space assessment framework which

defines criteria as detailed as number of free parking spaces as a quality of accessibility. Whereas Relph (1976) is a proponent of placemaking which requires inhabitants to appropriate and define the space themselves. Jacobs (1961) reiterates the sense of personal belonging in public space and integrating a neighbourhood identity within it. Jacobs (ibid) describes the conditions for successful spaces as being multi-use, crowded with 'eyes on the street', and walkable. In present academic discourse, accessibility, inclusivity, safety, diversity, and personal connection to the space are recurring attributes of thriving urban public spaces. However, approaches within social sciences and urban literature to achieve these qualities vary depending on the specific context and scale of intervention.

Figure 2.5: Scales of Urban Morphologies (Feliciotti et al. 2016)



As shown in Figure 2.5, public space and urban forms relate to each other on a variety of scales of analysis. Extending beyond specific prescriptions on public space, literature on urban form steps up a scale to consider the factors beyond the immediate extent of public space which lead to successful

spaces – essentially, what elements at higher scales (block, street and district) create the right conditions for successful public spaces. There is a lack of agreement on the most sustainable or resilient urban form within urban literature. However, the concept of urban compactness or density is widely heralded as a means to enhance connectivity and resiliency. Compactness enhances social interactions, reduces greenhouse emissions by minimising the necessary distances of travel, and improves quality of life through readily accessible goods and services (Jabareen 2006). Dumreicher et al. (2000) emphasises that sustainable urban forms are dense, compact, integrated, and diverse. Compactness and density promote efficient land use, sustainable modes of transport, and supports economic activities (Elkin et al. 1991, Duncan and Hartman 1996). Mixed land use and diversity of built forms prevent monotonous urban areas (Elkin et al. 1991). Diversity of built forms and mixing land use promotes integration of socio-economic groups, reduces commuting distances, and more subjectively provides an interesting space for living (Wheeler 2002). Bramley et al. (2006) caveat criteria of resilient urban forms by including factors of flexibility of open spaces and adaptability. Montgomery (1998) similarly argues, given unpredictability in economic conditions or culture, mixed and adaptable built forms are resilient for their ability to change with evolving conditions. On a more tangible basis, wider pavements, as an example, are a quality of adaptable urban form. The wide pavements are adaptable as they create space for multiple uses (such as street vending, cafes, markets) as well retain potential to incorporate other modes of transport in the future (Sharifi 2019). Academics such as Jones and Mac Donald (2004) bring in more economic perspectives to the debate. Property value as linked with tenure policies can create resiliency through sustaining value during recessions (ibid.). LSE Cities et al. (2013) neatly conceptualise built form into physical, environmental, social and economic dimensions which provides a conceptual grounding to examine urban form in a holistic manner.

In spite of relative consensus within urban form and resiliency discourse, there is an ongoing debate around the operationalisation of concepts. For example, density is almost ubiquitously regarded as a positive quality, however, authors disagree on how far to densify and what type of density. Jacobs (1961) argues for population density, specifically, 200 dwelling units per acre. Whereas, for Gehl (1987) density should be considered in terms of pedestrian movement, specifically 10 to 15 pedestrians per minute per meter. In contrast, LSE Cities et al. (2013) argue for ‘sufficient density’ in terms of what the local infrastructure and capacity of space can offer. Other scholars dismiss an unequivocal acceptance of compactness as positive. They argue for ‘decentralised concentration’ of the city based around different neighbourhoods (Breheny 1992) which raises a debate on where to densify. Additionally, there are contradictions in literature regarding the resiliency of certain urban forms such as informal settlements. Montgomery (1988) argues for, at least, five to six storey buildings as a resilient built form. On the other side, Dovey (2012) considers informal settlements as resilient given their high density, low energy use, flexibility, and vitality. Therefore, concepts and qualities of successful urban forms ought to be applied contextually in terms of the types of resiliency and stressors being considered.

Heat stress and the microclimates of different urban forms is a growing area of research. As explained by Ellena et al. (2020), the probability of extreme heat stress is over a hundred times more likely than a century ago. Heat stress is of particular interest to urban research given its adverse impact on urban settings. Urban environments, characterised by compactness, paved surfaces and lack of vegetation, are disproportionately impacted by heat (Rosenzweig et al. 2011). In Dar es Salaam, December to February are the warmest months and the Physical Equivalent Temperature values are often above 35 degrees Celcius (Ndetto and Matzarakis 2013). The way heat impacts the urban environment is mediated by urban form. Spatial configurations influence the thermal comfort of public spaces and determine urban microclimates (Sharifi and Boland 2017). The connection between urban form and heat stress is validated by researchers who developed measurable indices such as the Spatial Heat

Resilience Index to understand how the built environment is capable to cope with heat stress (ibid.). For instance, Jänicke et al. (2019) found that in Seoul, traditional higher density, inner-city built forms performed worse than newly developed high rises in terms of heat-related deaths, despite sharing the same population density. McMichael et al. (2008) point to informal settlements as the least heat resilient of urban forms. In terms of solutions, discourse largely centres around urban greenery as a significant factor to improve urban microclimates. In contrast, Zhou et al. (2011) claim percentage of building land cover is a more significant factor to reduce heat stress. However, urban greenery has the added benefit of improving social resilience by promoting outdoor interaction (Shashua-Bar et al. 2009), benefit health, and improve beautification of the city (Ulrich 1999). Heat stress is an often-overlooked environmental stressor due to its 'invisibility' unlike flooding, however, it deserves further attention, especially in terms of how urban form can improve heat resiliency.

## 2.5 Research Gap: Public Space Resiliency

This research aims to apply the growing area of urban resiliency research, which is mostly applied to climate emergencies and 'shocks' to the city, with a perspective of public space and urban form in terms of its long-term ability to create conditions for a well-functioning urban environment. The conditions of what constitutes a successful public space aims to coalesce, often divergent, treatments of public space performance under the same conceptual umbrella of public space resiliency – in terms of its environmental, socio-economic and efficiency characteristics. As such, the research attempts to connect public space – across its spatial scales and thematic qualities – under a framework of resiliency as an attempt to provide a practical and long-term way to address resiliency with specific application to Dar es Salaam – which, in reality, is characterised by its complex interactions and multiple factors manifesting in space. Key terms, as explored in the literature review are explained in Table 2.3.

Table 2.3: Key Terms and Concepts

Theory	Definitions	Source
Spatial/Urban Morphology	Spatial morphology "combines the qualitative study of individual urban forms, such as streets, squares, and buildings typical for urban morphology [...] and the quantitative approach of spatial analysis that rather look at cities as spatial systems [...]"  "Urban morphology is the study of the form and shape of settlements."	Erixon Aalto et al. 2018 p.6 (cited in Forgaci 2018)  Carmona 2003 p.61
Urban Form	Urban form is a composite of characteristics related to land use patterns, transportation system, and urban design  Urban form as "the spatial pattern of the large, inert, permanent physical objects in a city."	Handy 1996 p.152-53  Kevin Lynch 1981 p.47
Spatial Resiliency	Spatial resiliency is an ability for the urban system to consistently undergo transformation to deal with and recover optimally to deal with future shocks.  This study focuses on diversity, connectivity and redundancy qualities of a resilient system.	Sharifi 2019
Public Space	Parts of the natural and built environment whereby the public have free access. For example, this includes streets, squares, open spaces, parks and 'public/private' spaces with unrestricted access.	Carmona (2021)

## 3 Research Design and Structure

### 3.1 Mixed Methods Approach

This research uses a mixed methods approach to leverage the unique strengths of various methodologies (Resch and Szell 2019). Using a combination of a transdisciplinary literature review, geospatial quantitative analysis, ethnography observations and in-depth interviews, this research aims to holistically address the central task of assessing and determining strategies to enhance the public space resiliency of Dar es Salaam. Given the complexity of the urban system, particularly in Dar es Salaam, it is appropriate to adopt a plural understanding of the context – as illuminated by different methods. This is a pragmatic approach of research which is “not committed to any one system or reality” (Creswell 2014 p.11 cited in Forgaci 2018). In this sense, employing mixed methods research can expose and reveal relationships which are normally overseen by singular methodologies (and hence, epistemologies). The methodologies employed will be explored within each section of the report.

### 3.2 Research Design and Phasal Approach

This sub-section outlines the research design of the thesis and by extension, the parts and phases of research separated by methodological approach.

#### 3.2.1 Part A ‘Building an assessment framework for public space resilience’

Sub-Question	Objectives
SQ1: What methodology can be used to assess public space resiliency?	Objective 1.1: Review literature and identify properties of public space resiliency.
	Objective 1.2: Build an assessment framework for public space resiliency.
	Objective 1.3: Define indicators and data sources for assessment.

Part A addresses Sub-question 1, “What methodology can be used to assess public space resiliency?”. To analyse public space resiliency in Dar es Salaam, a conceptual framework is developed to understand the qualities of public space resiliency to eventually, assess how different spaces perform in terms of resiliency. Using a transdisciplinary literature review, the framework conceptualises criteria to assess public space resilience. The criteria for the framework are selected in terms of resiliency as qualified by diversity, connectivity, and redundancy dimensions. The multiple dimensions of public space relating to the environment, network, built form, and socio-economic factors emerging from literature are included to capture resiliency in a holistic sense. Following the identification of criteria along dimensions of public space resiliency, indicators to measure them (using obtainable and open-source data) are developed in the framework. The outcome of Part A is a Public Space Resiliency Framework which defines the criteria and measurable indicators which relate to the principles of resilient public space.

### 3.2.2 Part B ‘Geospatial analysis of public space resilience in Dar es Salaam’

Sub-Question	Objectives
SQ2: What is the existing resiliency of public spaces in central Dar es Salaam?	Objective 2.1: Geoprocess and visualise the results of assessment for public space resiliency.
	Objective 2.2: Identify ‘fingerprint’ typologies of resiliency

Part B addresses Sub-question 2 “What is the existing resiliency of public spaces in central Dar es Salaam?”. Using the public space resiliency framework emerging from Part A, data is obtained for each of the criteria of the framework. The data is processed or, where needed, generated from a variety of sources including Google Earth Engine for satellite imagery, Tanzanian municipal geospatial databases, and produced from software including DepthmapX for space syntax analysis. Once obtained, all datasets are geo-processed in ArcGIS Pro to the spatial extent of central Dar es Salaam. Calculations are conducted for all Mtaas or sub wards of Dar es Salaam per criteria resulting in indicator scores for every spatial unit. Following scoring resiliency indicators, the data is exported into Python and code is developed to assess patterns of resiliency by creating radar charts of resiliency per sub-ward. The output of Part B are resiliency fingerprints – precisely, radar charts based on the framework criteria – which outline qualities of resiliency performance. These resiliency charts are subsequently analysed in terms of the common patterns emerging between different urban forms and resiliency performances.

### 3.2.3 Part C ‘Qualitative analysis and ethnography in Dar es Salaam’

Sub-Question	Objectives
SQ3: What are the main factors influencing public space resiliency performance?	Objective 3.1: Contextualise and validate findings of the public space resiliency assessment with qualitative data.

Part C addresses Sub-question 3, “What are the main factors influencing public space resiliency performance?”. This phase continues from Part B, it aims to contextualise and validate the resiliency patterns of different typologies of public spaces in Dar es Salaam. Using expert and localised knowledge from civil engineers, academics, urban planners, municipal decision makers, and academics, the objective of Part C is to draw insights regarding the main factors influencing the relationship between urban form and public space resilience in central Dar es Salaam. Analysis of interview summaries aims to synthesise other factors at play when considering public space resiliency. To supplement the expert insights, interviews with local residents as well as ethnographic site observations further contextualises the main weak spots of resiliency and henceforth, informs future possibilities for improvement. The qualitative insights from Part C offer a rich and varied insight to compliment the geospatial analysis from Part B. When combined, it offers a complete understanding of public space resiliency as found in different urban form typologies in central Dar es Salaam.

### 3.3 Thesis Outline

As presented in Table 3.1, the thesis is mainly structured in three sections: Assessment Framework, Geospatial Analysis and Qualitative Analysis. The thesis sections follow the phase-based approach of the study as described in the Research Design section.

The research outline tackles the research question by addressing sub-questions and completing objectives required to answer said sub-questions. **Part A: Assessment Framework** builds an assessment framework for public space resiliency based on reviewed literature. **Part B: Geospatial Analysis** applies the public space resiliency assessment framework through geoprocessing and visualising the results of resiliency performance on a ward level of Dar es Salaam. In its data visualisation, ‘fingerprint typologies’ and patterns of resiliency are explored. **Part C: Qualitative Analysis** gathers on-the-ground insights to contextualise and validate insights gathered from the geospatial analysis. Using interviews and ethnographic methods, the resiliency of different wards of central Dar es Salaam are analysed based upon expert and local insight – it also considers factors influencing resiliency beyond specific criteria defined in the assessment framework. The **Discussion** chapter critiques the insights and tensions gathered from the research as well as reflects upon the reliability and applicability of its results. It also includes **Design Recommendations** which synthesises the findings of the geospatial and qualitative analysis to formulate design recommendations to improve the future resiliency of the new urban development in the Lower Msimbazi Basin as well as principles which apply to central Dar es Salaam. Within **Parts A, B and C**, the methodologies and results of each sub-question are explored within the section. The **Conclusion** draws the findings of the research to a close and proposes areas for further research.

Table 3.1: Thesis Outline

Introduction		
Literature Review		
Research Design		
Report Part	Sub-Question	Objectives
Part A: Assessment Framework	SQ1: What methodology can be used to assess public space resiliency?	Objective 1.1: Review literature and identify properties of public space resiliency.
		Objective 1.2: Build an assessment framework for public space resiliency.
		Objective 1.3: Define indicators and obtain data for assessment.
Part B: Geospatial Analysis	SQ2: What is the existing resiliency of public spaces in central Dar es Salaam?	Objective 2.1: Geoprocess and visualise the results of assessment for public space resiliency.
		Objective 2.2: Identify ‘fingerprint’ typologies of resiliency
Part C: Qualitative Analysis	SQ3: What are the main factors influencing public space resiliency performance?	Objective 3.1: Contextualise and validate findings of the public space resiliency assessment with qualitative data.
Discussion and Reflection		
Conclusion		

## 4 Part A: Assessment

Part A: Assessment Framework	SQ1: What methodology can be used to assess public space resiliency?	Objective 1.1: Review literature and identify properties of public space resiliency.
		Objective 1.2: Build an assessment framework for public space resiliency.
		Objective 1.3: Define indicators and obtain data for assessment.

### 4.1 Public Space Resiliency Review

Based upon existing literature which explores discourses on public space, urban form, and resilient design – as more extensively summarised in the literature review – the main qualities regarding what constitutes resilient public space are denoted in Table 4.1. The purpose of reviewing literature on public space is to uncover recurring principles and commonalities of resilient public spaces.

The qualities and principles summarised in Table 4.1 are purposefully described more conceptually rather than prescriptively. The reason being that more conceptual understandings of resilient public space can be compared between different academic disciplines and discourses, allowing, as an example, public space guidelines to relate more explicitly to street network resiliency research. This results in foregoing a degree of contextual detail in the qualities of resilient public space. For example, Jacobs (1961) argues that the ideal density of an urban environment should be between 125-200 dwelling units per acre. However, to minimise potentially imposing urban design principles conceived in other urban contexts onto Dar es Salaam, only the overarching principle of ‘population density’ is adopted as a guiding criterion in the literature summary. Additionally, the caveats and qualifications of principles – for example, the degree of density before it becomes congestion and hence, a negative influence on space – are noted beyond the framework development and explained in Section 5.

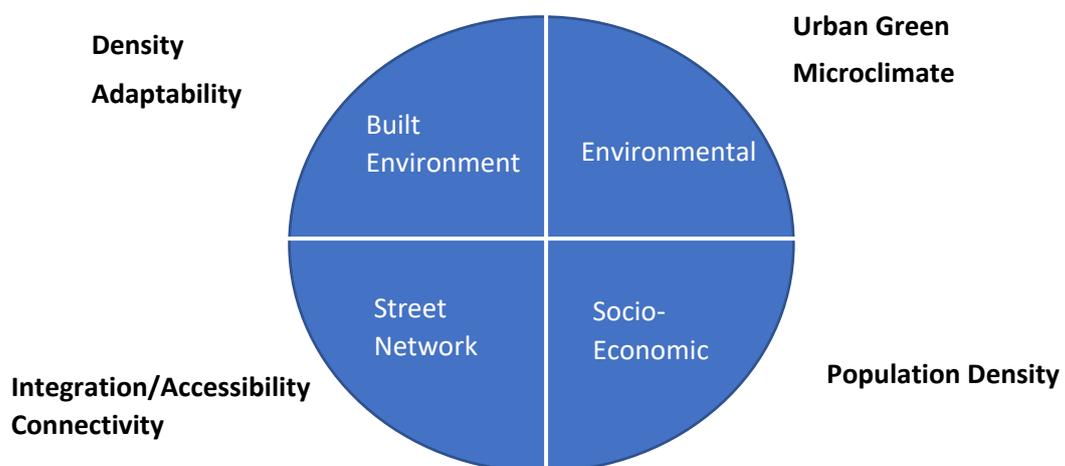
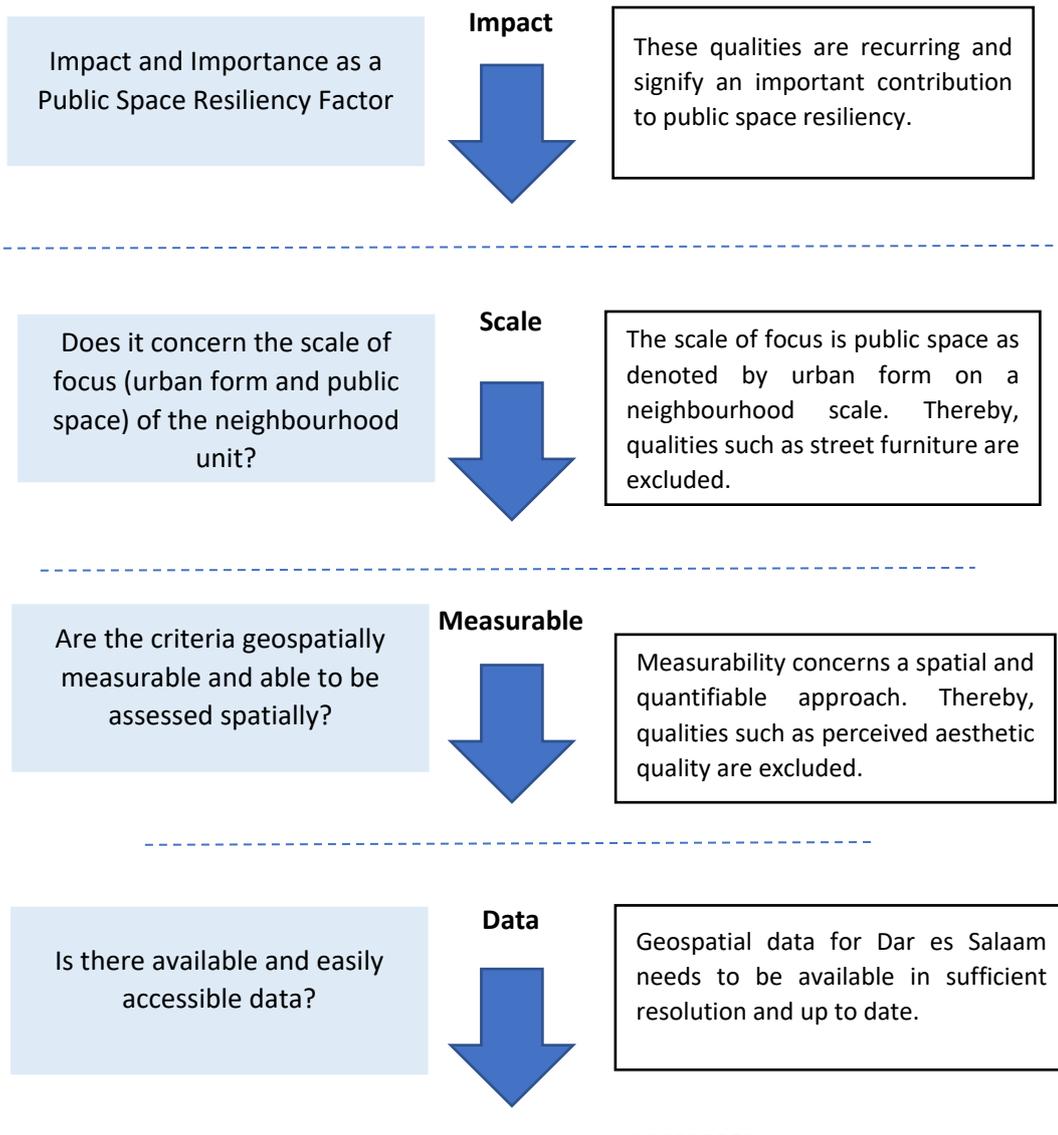
Table 4.1: Literature Synthesis of Qualities of Public Space Resiliency

Author (s)	Study Focus	Qualities of Resilient Public Spaces	Research Area
Marcus and Legeby 2012	<i>Space Syntax and Spatial Form</i>	Connectivity on a local walkable scale (co-presence and creation of social capital)	Public Space Design
Keeton and Nijhuis 2019	<i>African New Towns</i>	Flexibility of programming in urban design to respond to changing needs	Urban Planning Principles
Jabareen 2006, 2013	<i>Sustainable Urban Forms</i>	Compactness, Density, Diverse + Mixed Land Use, Integrated, Walkable, Connected Street Layout, Diversity of Built Forms, Greening	Urban Forms
Johansson et al. 2018	<i>Microclimate Public Spaces</i>	Building Height (High Rises), Vegetation, Compact Urban Morphologies, Ventilation	Public Space Design
Sharifi 2019a	<i>Resilient Urban Forms</i>	Street Connectivity, Microclimate, Building Diversity, Compact Development, Population Density	Urban Forms (Macro Scale)
LSE Cities et al. 2013	<i>Resilient Urban Form</i>	Population Density (population rather than dwelling units), Built Area Density, Accessibility, Adaptability of Street Layout, Green Space, Land Use Diversity, Property Land Values, Wide Streets (Bryant and Allen 2011), Public Transport Accessibility + Integration	Urban Forms + Resiliency
Ellena et al. 2020	<i>Heat Stress + Urban Form (Lit Review)</i>	Building Volume per unit area, (Kim et al. 2014) Open Space (Harlan et al. 2006), Building Types (Taylor et al. 2015), Enhanced Vegetation Index (Chen et al. 2018)	Urban Forms
Cavan et al. 2014	<i>Microclimate and Morphology</i>	Land cover, Presence of Vegetation, Green and Open Spaces Space	Public Space Design
Iqbal 2021	<i>Resilient Public Space</i>	Safety, inclusivity, integration, Accessible. Presence of People, Street furniture	Public Space Design
UN Habitat (2020)	<i>Public Space Toolkit and Assessment</i>	Walkable, Socially Inclusive, Integrated, Environmentally Sustainable, Safety, Thermal Comfort, Multi-Functional, Street Furniture, Aesthetic Quality	Public Space Design (Micro)
Commission for Architecture and the Built Environment (2004)	<i>Public Space Guide</i>	Accessibility, Presence of People, Inclusive, Aesthetics, Safety, Diversity	Public Space Design
Jacobs 1961	<i>Community Activism + Vibrant Streets (USA)</i>	Presence Of People, Density, Diversity, Separation Public/Private Spaces, Presence of Commercial Activity i.e. Retailers, Diversity of Use, Safety, Small Blocks, Mixed Use	Street and Neighbourhood Design
Sanga and Mbisso 2020	<i>Place-making in Dar es Salaam</i>	Accessibility and Integration, Greenery, Diverse Uses and Activities, Commercial Activities	Urban Open Spaces
Gehl 1987	<i>Urban Design Principles</i>	Walkable 400-500m basis, Diversity of Street Layout, Open spaces	Urban Design
Ergun 2020	<i>Urban Public Space Resiliency (Ankara)</i>	Accessibility, Safety, Diversity, Mixed Use, Connectivity, Urban Permeability, Comfort	Urban Form + Resiliency
Mehta 2014	<i>Public Space Evaluation</i>	Inclusiveness, Pleasurability, Safety, Comfort, Meaningful Activities	Public Space Design
Hernbäck 2012	<i>Urban Form + Co-Presence in Public Space (Pune, India)</i>	Small Blocks, Permeable Street network, Integration, Commercial Activity	Space Syntax, Urban Form and Morphology
Sharifi 2019b	<i>Street Networks</i>	Connectivity, Centrality Measures, Permeability, Grid Layouts Heterogeneity of The Urban Form, Building Type Diversity, Adaptability, Hierarchical Street Networks, Density, Mixed Use	Street Morphology, Resiliency
Lu et al. 2020	<i>Urban Spatial Resiliency</i>	Scale of City, Functional Complexity, Polycentricity, Density and Compact Development, Small and Medium Sized Blocks, Connectivity, Accessibility, Mixed Land Use, Open Spaces, Walkability of Street Layout	Spatial Resiliency
Forgaci 2018	<i>Urban Form Resilience</i>	Density (population and built form), Adaptability (streets and building types), Open Spaces, Accessibility, Permeability, Green Space Coverage, Diversity of Land Use, Property Values	Socio-Ecological Resilience
Jacobs and Appleyard 1987	<i>Public Space Guidelines</i>	Density of Built Environment, Intensity of Land Use, Mixed Use, Integrated Commercial and Residential, Buildings Defining and Enclosing Public Space, Multiple Separate and Distinct Buildings with Complex Spatial Arrangements	Urban Design
Carmona 2008, 2021	<i>Public Space</i>	Accessibility, (Visual) Permeability, Smaller Blocks and Grids, Density, Mixed Use, Pedestrian Friendly, Safety	Urban Design

## 4.2 Framework Development

The qualities of resilient public space, outlined in Table 4.1, uncover commonalities and patterns of resilient public spaces. To develop an assessment framework, certain qualities and criteria were selected based upon a series of questions relating to **significance and relevance**, **scale of focus**, **measurability** and lastly, **data availability** of criteria. As demonstrated by current discourse on urban form and resiliency, a holistic assessment framework needs to consider a multitude of factors which can be broadly separated into thematic areas of built environment, street network, environment and lastly, socio-economic qualities. The full list of qualities and criteria are listed in **Section 11.1, Appendix 1**. The first stage of criteria selection involves extracting qualities that are recurring in literature and considered important in their contribution to resiliency. Secondly, these qualities are filtered based upon their scale of focus – whether they directly consider urban form and public space at a neighbourhood scale. Thirdly, the qualities need to be geospatially analysed and hence, measurable. To exemplify this point, qualities such as community orientation or sense of place are excluded. Lastly, the qualities and criteria are assessed in terms of whether there is available data – which is significant in selecting criteria given the general lack of geospatial data for Dar es Salaam. Figure 4.1 outlines the framework criteria selection process.

Figure 4.1: Diagram of Public Space Resiliency Criteria Selection Process



### 4.3 Public Space Resilience Framework

The public space resilience framework aims to grasp the resilience qualities of different neighbourhoods in Dar es Salaam rather than define or prescribe any typology of urban form or public space qualities. Given the intangibility of urban form and spatial factors which contribute to resiliency, the framework aims to provide a means to uncover the spatial qualities of the sub ward and its resiliency performance.

The spatial resilience criteria selected for the framework need to be operationalised and translated into indicators. Table 4.2 displays the full public space resilience framework, the spatial resilience criteria is described, the qualities and themes of resiliency it aims to proxy are outlined and lastly, the specific indicator used to measure the presence of the spatial resilience dimension is described.

Table 4.2: Public Space Resiliency Framework

Built Environment			
Spatial Resilience Component	Themes	Indicator	Data Source
Density	Floors/Area, Built Up Area, Building Volume	Building Footprint Floors <b>(BE1)</b>	World Settlement Footprint 3D 2019 + Resiliency Academy Building Heights <a href="#">Link</a>
Adaptability/Diversity	Building Mix, Types of Buildings, Adaptable Uses, Open Spaces	Degree Variability of Building Type <b>(BE2)</b>	World Settlement Footprint 3D 2019 + Resiliency Academy Building Heights <a href="#">Link</a>
Street Network			
Spatial Resilience Component	Themes	Indicator	Data Source
Integration/Accessibility	Diversity, Permeability, Locational Advantage, Integration	Space Syntax Integration Global (n) <b>(SN1)</b>	Road Network Open Street Map Space Syntax (DepthMapX)
Connectivity	Urban Contiguity, Centrality/Choice/ Through Movement, Co-presence	Space Syntax Metric Choice/Angular Betweenness 800m <b>(SN2)</b>	Road Network Open Street Map Space Syntax (DepthMapX)
Environmental			
Spatial Resilience Component	Themes	Indicator	Data Source
<i>Urban Green</i>	Thermal Comfort, Heat stress, NDVI	Enhanced vegetation Index (EVI) <b>(E1)</b>	MOD13Q1.061 Terra Vegetation Indices 16-Day Global 250m extracted using Google Earth Engine 15 Day (10-06-22 _15_06_22) <a href="#">Link</a>
<i>Microclimate</i>	Urban Heat Island Effect, Thermal Comfort	Summertime mean surface temperature <b>(E2)</b>	Google Earth Engine Daytime Surface UHI Intensity 2018 (Derived from a combination of MODIS TERRA and AQUA Land Surface Temperature (LST)) <a href="#">Link</a>
Socio-Economic			
Spatial Resilience Component	Themes	Indicator	Data Source
<i>Population Density</i>	Co-presence, Urban vitality, 'Eyes on the Street'	People/Hectare <b>(SE1)</b>	National Bureau of Statistics (Higher Resolution) via Ardhi University <a href="#">Link</a> (1 km <sup>2</sup> )

## 5 Part B: Application – Geospatial Analysis

Part B: Geospatial Analysis	SQ2: What is the existing resiliency of public spaces in central Dar es Salaam?	Objective 2.1: Geoprocess and visualise the results of assessment for public space resiliency.
		Objective 2.2: Identify 'fingerprint' typologies of resiliency

### 5.1 Data Gathering and Generation

Data sources range from satellite imagery from the MODIS Terra database to local Dar es Salaam geospatial databases such as the Resiliency Academy Climate Risk Database. The full list of final sources, selected based upon quality of data (resolution, time collected, detail and usage permission) is found in **Error! Reference source not found.**

Most criteria were obtainable using geodatabases and satellite imagery however, for the street network analysis, data on integration and connectivity was generated using space syntax software. The street network was created using a combination of OpenStreetMap and DASUDA's maps from the Lower Msimbazi Basin Redevelopment Project. The masterplan for the redevelopment is integrated into the road network. Using AutoCAD, the street network is combined and reformatted to simplify the road network and eliminate duplications of roads. Using the QGIS plugin 'Geo simplification' and the Douglas-Peucker simplification algorithm, the road network was reconstructed and prepared for the space syntax analysis. The space syntax analysis was generated using the open-source, DepthMapX software. A global integration (n) and an angular segment metric choice analysis at 800 meters (walkable distance) was generated using DepthMapX. The results were exported as a DXF file into ArcGIS Pro to be integrated with all data layers for the geospatial analysis. Further maps of space syntax analysis can be found in Section 11.2, Appendix 2.

### 5.2 Geoprocessing

Table 5.1 describes the geoprocessing definitions and steps for the geospatial datasets within the ArcGIS Pro environment.

Built Environment					
Spatial Resilience Component	Themes	Indicator	Data Source	Geoprocessing Definition	Geoprocessing Steps
Density	Floors/Area, Built Up Area, Building Volume	Building Footprint Floors (BE1)	World Settlement Footprint 3D 2019 + Resiliency Academy Building Heights <a href="#">Link</a>	Sum of Built Floor Area per 90 x 90-meter spatial resolution (Area adjusted per sub-ward)	<ol style="list-style-type: none"> <li>1. Raster Data Building Heights</li> <li>2. Zonal Statistics Sum of Built Height per sub ward</li> <li>3. Join Field (Sub ward ID)</li> <li>4. Calculate Geometry of Sub wards</li> <li>5. Adjusted per Area of Sub ward -&gt; Sum of Building Height per km<sup>2</sup></li> <li>6. Logarithmic Transformation</li> <li>7. Min-Max Normalisation</li> </ol>
Adaptability/Diversity	Building Mix, Types of Buildings, Adaptable Uses, Open Spaces	Degree Variability of Building Type (BE2)	World Settlement Footprint 3D 2019 + Resiliency Academy Building Heights <a href="#">Link</a>	Standard Deviation of Building Heights	<ol style="list-style-type: none"> <li>1. Raster Data Building Heights</li> <li>2. Zonal Statistics Standard Deviation of Building Heights (Within each sub ward, calculate how widely distributed are the building heights)</li> <li>3. Join Field (Sub ward ID)</li> <li>4. Min-Max Normalisation</li> </ol>
Street Network					
Spatial Resilience Component	Themes	Indicator	Data Source	Geoprocessing Definition	Geoprocessing Steps
Integration/Accessibility	Diversity, Permeability, Locational Advantage, Integration	Space Syntax Integration Global (n) (SN1)	Road Network Open Street Map Space Syntax / Urban Land Nexus	Integration Score averaged	<ol style="list-style-type: none"> <li>1. OSM Tanzania Road Network</li> <li>2. Clipped to Study Area (Sub wards within 10km of Msimbazi Development Project)</li> <li>3. Converted to DXF &amp; Converted Multipart Polygons to Single parts</li> <li>4. PST QGIS Plugin Segment Map</li> <li>5. Space Syntax Toolkit Road Network Cleaner</li> <li>6. DepthmapX Segment Map Analysis of Integration (N)</li> <li>7. Reprojected Reference System to WGS 1984</li> <li>8. Summarise Within (mean score per sub ward)</li> <li>9. Validate Outliers and No Values (which skew normalisation)</li> <li>10. Join Field (Sub ward ID)</li> <li>11. Min-max Normalisation</li> </ol>
Connectivity	Urban Contiguity, Centrality/Choice/Through Movement, Co-presence	Space Syntax Metric Choice/Angular Betweenness 800m (SN2)	Road Network Open Street Map Space Syntax / Urban Land Nexus	Choice Score averaged	<ol style="list-style-type: none"> <li>1. Repeat Steps (SN1)</li> <li>2. Logarithmic Transformation</li> <li>3. Min Max Normalisation</li> <li>4. DepthmapX Segment Map Analysis Metric Choice 800m</li> </ol>
Environmental					
Spatial Resilience Component	Themes	Indicator	Data Source	Geoprocessing Definition	Geoprocessing Steps
Urban Green	Thermal Comfort, Heat stress, NDVI	Enhanced vegetation Index (EVI) (E1)	MOD13Q1.061 Terra Vegetation Indices 16-Day Global 250m extracted using Google Earth Engine 15 Day (10-06-22_15_06_22) <a href="#">Link</a>	Normalised Score	<ol style="list-style-type: none"> <li>1. Download Raster Data Google Earth Engine</li> <li>2. Clip Raster to Study Area</li> <li>3. Zonal Statistics EVI per sub ward</li> <li>4. Join Field (Sub ward ID)</li> <li>5. Min-Max Normalisation</li> </ol>
Microclimate	Urban Heat Island Effect, Thermal Comfort	Summertime mean surface temperature (E2)	Google Earth Engine Daytime Surface UHI Intensity 2018 (Derived from a combination of MODIS TERRA and AQUA Land Surface Temperature (LST)) <a href="#">Link</a>	Mean Surface temp.	<ol style="list-style-type: none"> <li>1. Download Raster Data Google Earth Engine</li> <li>2. Clip Raster to Study Area</li> <li>3. Converted to Higher Resolution than 90x90m (Resample Tool) using bilinear interpolation technique</li> <li>4. Replace Raster Value of -999 to average score on periphery (0.39) to prevent skewed normalised</li> <li>5. Zonal Statistics Mean of Surface Temperature per sub ward</li> <li>6. Join Field (Sub ward ID)</li> <li>7. Calculate Field * -1 (to inverse the results to indicate higher score as better microclimatic conditions)</li> <li>8. Min-Max Normalisation</li> </ol>
Socio-Economic					
Spatial Resilience Component	Themes	Indicator	Data Source	Geoprocessing Definition	Geoprocessing Steps
Population Density	Co-presence, Urban vitality, 'Eyes on the Street'	People/Hectare (SE1)	National Bureau of Statistics (Higher Resolution) via Ardhi University Worldpop.org (1 km <sup>2</sup> )	Mean of Population Density	<ol style="list-style-type: none"> <li>1. Import Raster Population Dataset</li> <li>2. Clip Raster to Study Area</li> <li>3. Converted to Higher Resolution than 1 km<sup>2</sup> (Resample Tool)</li> <li>4. Zonal Statistics Mean of Population Density</li> <li>5. Join Field (Sub ward ID)</li> <li>6. Min-Max Normalisation (Using Standardise Field Tool)</li> </ol>

Table 5.1: Public Space Resiliency Framework Geoprocessing Definitions and Steps

### 5.2.1 Normalisation and Units

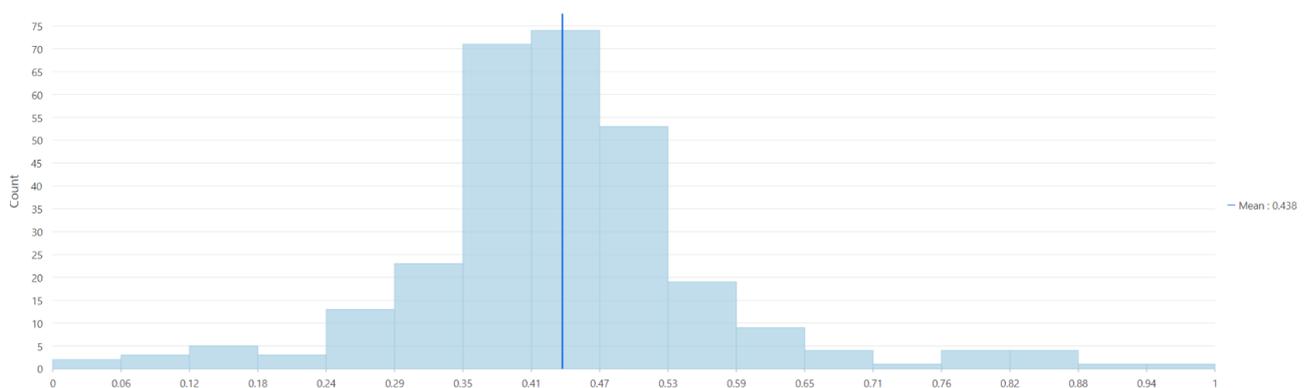
To be able to compare the performance of different public space resiliency criteria, the scales of the data need to be normalised. Therefore, criteria are normalised within ArcGIS using a min-max normalisation technique distributing the data along a scale of 0 to 1. This normalisation technique is preferable as it minimises the manipulation of numbers and retains a degree of interpretability (in terms of its original units). For consistency across criteria, higher numbers are considered more positive in terms of being more resilient. In the case of surface temperature (microclimate), the dataset was inverted before normalisation to qualify higher values as having a better contribution to resiliency, and so, in this case, higher temperatures are equated to lower resiliencies.

In certain cases, where data is skewed towards higher or lower values as in the case of built density shown in Figure 5.1, the data requires a logarithmic transformation to distribute the values more evenly. This requires assessing each datasets distribution and logarithmically normalising it where needed. Figure 5.2 shows the result of the logarithmic transformation where values are more evenly distributed. This allows for an easier comparison of criteria across neighbourhoods. However, logarithmic normalisation was conducted only where necessary as it potentially biases the data values towards average values and risks losing the original meaning of the measurement score (the score is less interpretable in its original measurement units such as temperature in degrees Celsius).

Figure 5.1: Histogram showing skewed distribution of scores

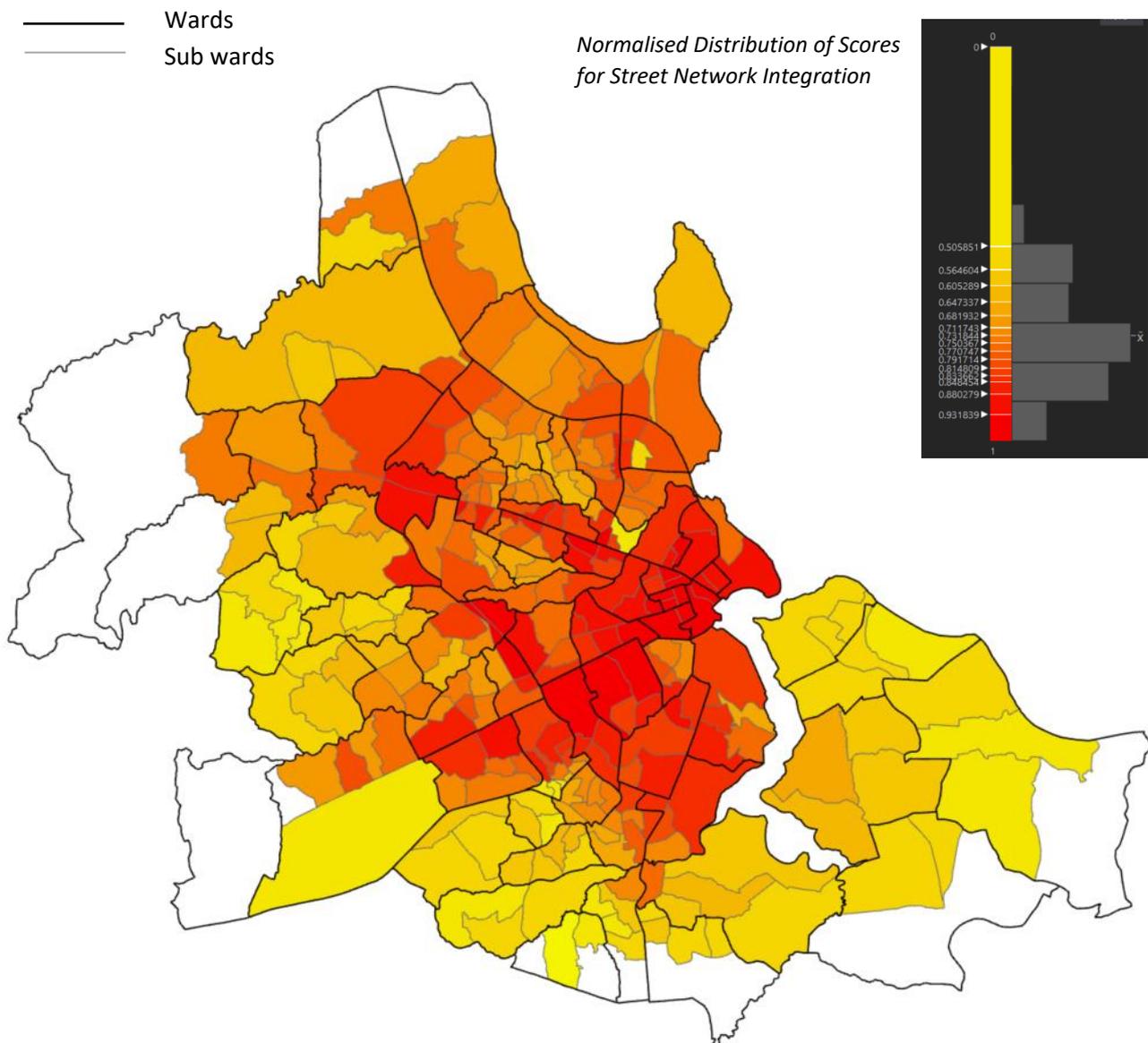


Figure 5.2: Histogram showing logarithmic distribution of scores



After data manipulation and normalisation, the scores of the raster and vector map layers are aggregated per sub ward or Mtaa. These calculations are made per km<sup>2</sup> to eliminate bias for area size – as sub wards vary in spatial size. Resiliency scores for seven criteria were obtained for 290 Mtaas in central Dar es Salaam. All sub wards (Mtaas) within a 11-kilometre radius of the Msimbazi project site were included in the analysis. The sub wards are shown in the Figure 5.3 within the boundaries of wards. To exemplify the normalisation process in a spatial manner, Figure 5.3 visualises the *normal* distribution of street network integration within central Dar es Salaam.

Figure 5.3: Choropleth Map of Normalised Scores of Street Network Integration with Boundaries of Sub wards and Wards



## 5.2.2 Development of Fingerprint Typologies

Upon obtaining normalised resiliency scores between 0 and 1 for seven criteria and 290 sub wards, a table (as shown in Table 5.2) is exported from the ArcGIS Pro environment.

Table 5.2: Normalised Resiliency Scores per sub ward

id	subward	ward	district	Building Diver	Population D	Microclimate	Heat Stress	Connectivity	Integration	Built Density
1	Kilimahew	Tandika	Temeke	0.12919015	0.82188541	0.06798837	0.15035123	0.68485857	0.5662965	0.34121388
2	Nyambwe	Tandika	Temeke	0.2688227	0.7711024	0.28802538	0.14539135	0.642627	0.45844204	0.4193388
3	Mabatini	Tandika	Temeke	0.18889398	0.69933803	0.16545599	0.12525242	0.53440758	0.48517733	0.39821422
4	Mangaya	Mbagala	Temeke	0.43424529	0.44606448	0.43700767	0.73343129	0.65698203	0.20911321	0.43790055
5	Maguruwe	Tandika	Temeke	0.29102525	0.65227082	0.15308485	0.12031466	0.60992788	0.55645413	0.47092698
6	Tamla	Tandika	Temeke	0.14383219	0.63624606	0.19135607	0.12166607	0.56587657	0.55547198	0.37459504
7	Tandika	Tandika	Temeke	0.23927542	0.67533554	0.10552472	0.12348662	0.50581225	0.58809655	0.46714753
8	Mbagala	Mbagala	Temeke	0.27755193	0.39639859	0.35860428	0.73343129	0.63935678	0.26078636	0.43660174
10	Bughudadi	Mbagala	Temeke	0.34710106	0.31402197	0.54430106	0.38238667	0.34784905	0.55098928	0.50035832
11	Kizinga	Mbagala	Temeke	0.36212357	0.38029348	0.42139396	0.41727102	0.58279253	0.33679867	0.45150259
12	Serenge	Mbagala	Temeke	0.42454667	0.32690249	0.67470262	0.50308619	0.49784906	0.18627781	0.35572486
14	Mbonde	Makangari	Temeke	0.25721188	0.64192938	0.13854084	0.20455303	0.69702902	0.39481505	0.35932589
16	Makangari	Makangari	Temeke	0.17816983	0.45073419	0.35773806	0.22413196	0.59930983	0.33182943	0.39050793
17	Uwazi	Makangari	Temeke	0.19515356	0.37158684	0.42720945	0.37175211	0.68328032	0.3614257	0.40053498
18	Yombo Do	Makangari	Temeke	0.2943365	0.62055192	0.31181602	0.27164553	0.76635389	0.41413426	0.45376307
19	Makuka K	Mbagala K	Temeke	0.21346213	0.41132754	0.42442506	0.73343129	0.63940817	0.28830987	0.49690144
21	Msakala	Makangari	Temeke	0.18792544	0.54293158	0.46365319	0.39804466	0.60197153	0.26495274	0.35279345
27	Makuka K	Mbagala K	Temeke	0.29478102	0.35678801	0.52053926	0.73343129	0.71027385	0.32403789	0.41142029

Radar charts are selected as the most appropriate form of data visualisation for its high interpretability. Multivariate criteria can be visualised and plotted into shapes allowing for an intuitive and visual comparison of resiliency performances of neighbourhoods. Identifying patterns and typologies are aided by radar charts as shapes and sizes allow for quicker comparison between Mtaas. 'Fingerprint Typologies' refer to the radar charts of each Mtaa, the label of 'fingerprints' refers to the shapes' uniqueness to each Mtaa and 'typologies' refers to the patterns emerging from wards with similar urban forms.

The *Plotly package* within the Python coding environment is used to develop code to visualise the resiliency radar charts. The full coding transcript is found in Section 11.3, Appendix 3.

### 5.3 Results

Prior to exploring the resiliency performances of different wards (and hence urban form typologies), there were certain patterns that traversed all ward performances. Wards, composed of several sub-wards, demonstrated to a high extent, that similar patterns of resiliency existed within the wards. In effect, this implies that there is not much variation of spatial configurations and urban form within the wards which exceed sizes of 7.5 km<sup>2</sup>. For example, as shown in Tandale's resiliency chart, the greatest variation that exists between sub wards' scores do not exceed 10 percent. As such, wards internally display homogenous resiliency components; however, between wards, there is a larger distinction of resiliencies pointing to the different typologies of urban development. Albeit obvious, it is clear that the overall resiliency of wards in Dar es Salaam, even bordering each other, vary significantly. Secondly, this variation correlates highly with the classification of different urban typologies which reinforces a link between resiliency and typology of urban development. Historical urban planning during the colonial era seems to persist in present resiliency scores. For example, areas such as Masaki, the former European quarters, remain low-rise, low density and relatively green. Despite these inequalities, there is no clear ward that is exceeding in resiliency across all factors and hence, different wards have various configurations of resiliency. For example, Tandale is highly walkable and dense yet lacks in greenery and has an uncomfortable microclimate. Whereas Upanga is well integrated into the street network with little heat stress yet lacks in walkability and population density. Certain criteria of resiliency such as integration and built density appear to have a positive correlation pointing to a confounding factor such as the land economy. Lastly, the wards around the project site all exhibit high integration values given the central location of the project site.

### 5.3.1 Kariakoo

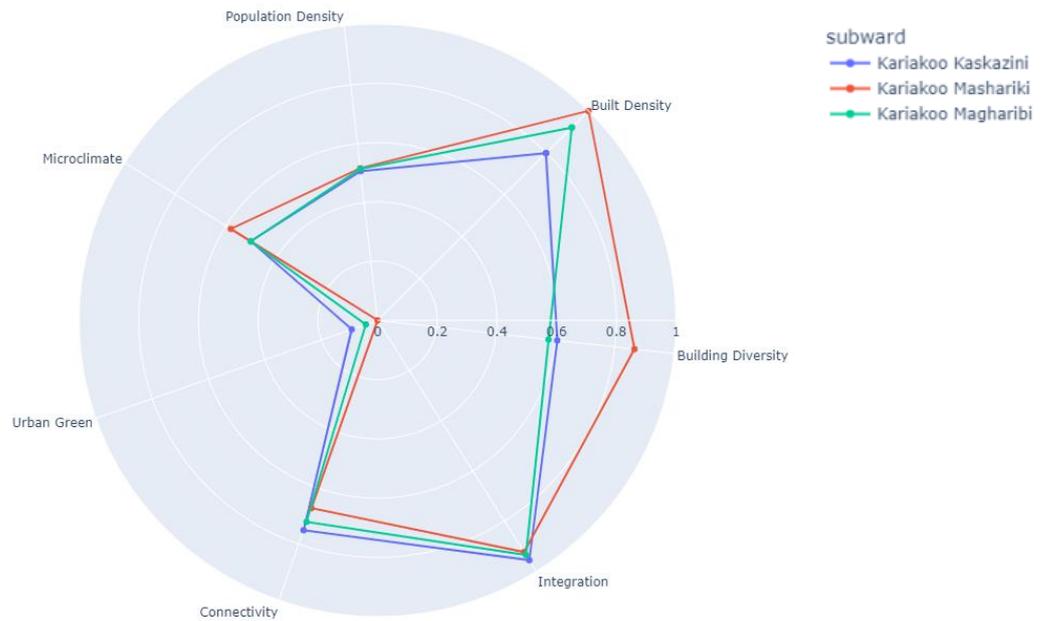


Figure 5.4: Location of Kariakoo Ward



Figure 5.5: Figure-ground map of Kariakoo

Kariakoo, as an old-planned area, performs highly in terms of resiliency except for the presence of greenery. Its gridded street network seems to enable connectivity whilst also being highly built up and densely developed. It is extremely well integrated as it is located in the centre of Dar es Salaam. The built density scores highest compared to other wards of Dar es Salaam which points to potential issues of congestion, especially when unmatched by other factors such as microclimate or infrastructural services. The morphology of Kariakoo, demonstrates the efficiency of the street network to enable movement around block sized developments. The building diversity is lacking, pointing towards the homogeneity of high-rise buildings in the ward. The relatively better performance of microclimate in spite of a lack of greenery is aided by the high rise-built form which limits direct radiation.

Figure 5.7: Integration Heat Map

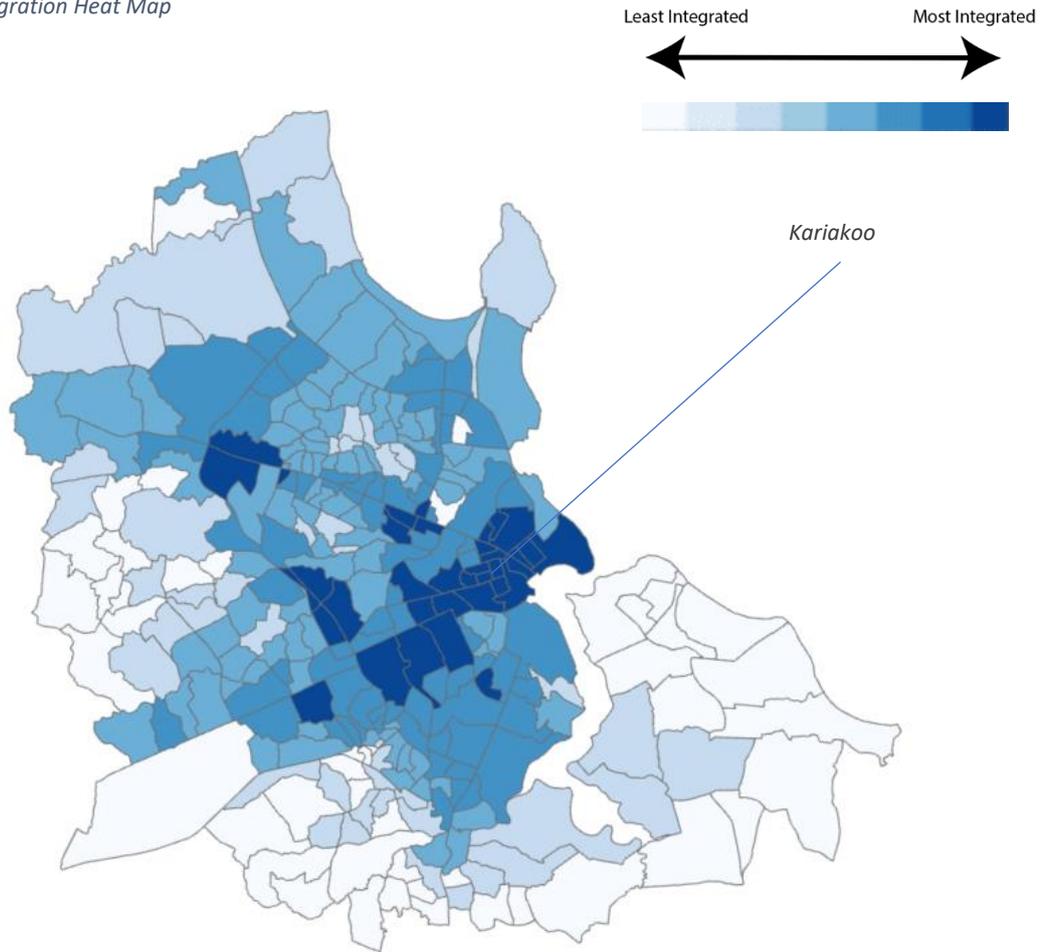
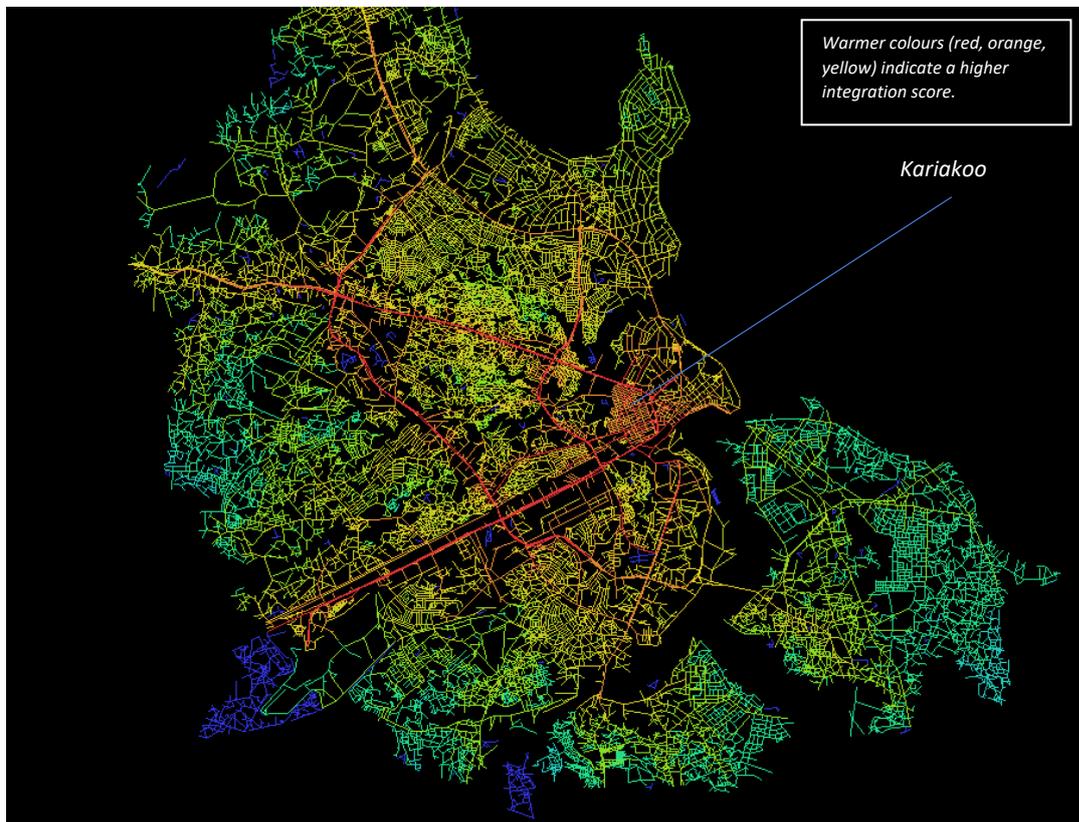


Figure 5.6: Space Syntax Street Network Analysis for Integration



### 5.3.2 Upanga

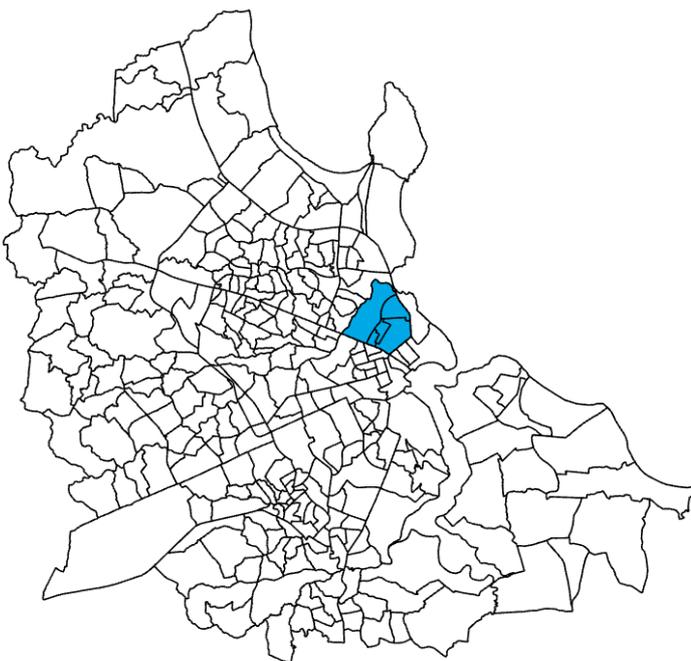
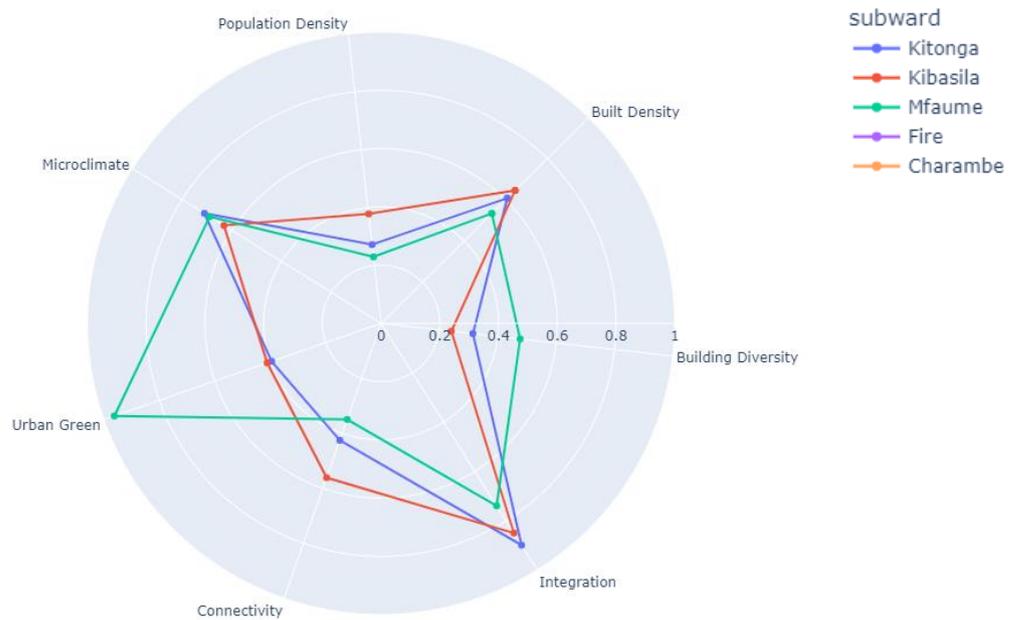


Figure 5.8: Location of Upanga Ward



Figure 5.9: Figure-ground map of Upanga

Upanga, formerly planned as the 'Indian' neighbourhood of Dar es Salaam during the colonial period, demonstrates a varied resilience. Exhibiting similar qualities to Kariakoo, in terms of high built density and high integration, Upanga exhibits a low population density and low building diversity. The presence of green is aided by its morphology with wider streets and less compact development. In another sense, high rises with slightly more space in the immediate vicinities. The sub ward of Charambe is an outlier in terms of microclimate and greenery, as it intersects the floodplain of the Lower Msimbazi Basin where development is discouraged by the municipality. The proximity to the green river basin helps maintain a relatively average microclimatic score, despite its densely built environment. The higher ratio of built density to population density implies that more buildings are dedicated for commercial purposes.

### 5.3.3 Magomeni

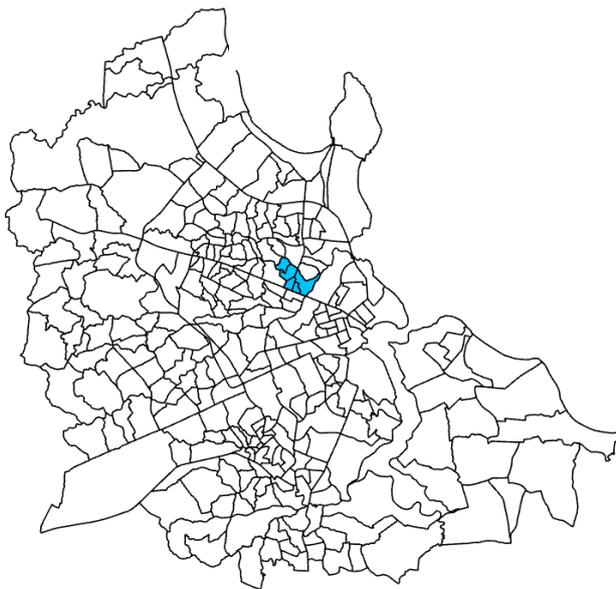


Figure 5.10: Location of Magomeni Ward



Figure 5.11: Figure-ground map of Magomeni

Magomeni, mainly developed before 1970, features a structured and gridded street network. Adjacent to the Lower Msimbazi Basin, the sub ward of Sunna is mainly uninhabited and hence has little to no population density in combination with the highest levels of greenery. The presence of an arterial road of Morogoro, heading towards Kariakoo, gives Magomeni its high integration value and explains the differences of sub wards' integration scores depending on whether it has direct access to the main road. Density in terms of population is neatly matched with built density, indicating that overcrowding is not as prevalent as other wards. Connectivity of sub wards in Magomeni varies, as certain sub wards contains informal settlements and hence organic type street networks which perform better in terms of walkability (connectivity).

### 5.3.4 Tandale

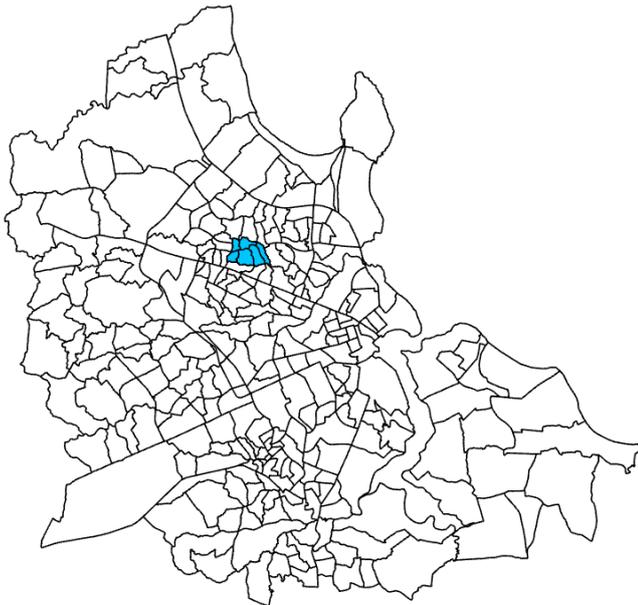
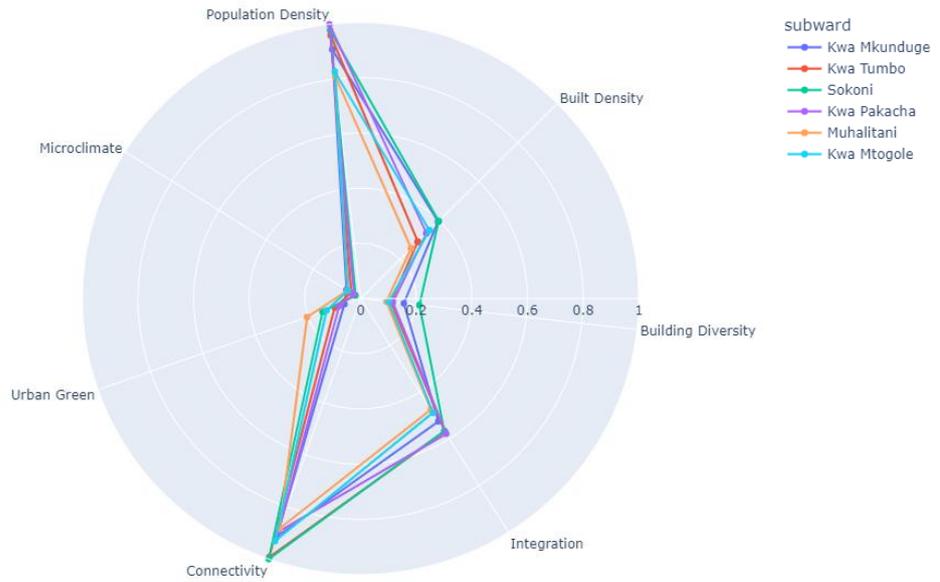


Figure 5.12: Location of Tandale Ward



Figure 5.13: Figure-ground map of Tandale

Tandale is an old informal settlement from the pre 1970s period. Its resiliency typology is characterised by extremely high connectivity and high population density matched with very low resiliency scores in microclimate, urban greenery, building density, and diversity. Overall, the informal typology seems to be the least resilient given the extremely low scores for most criteria. However, given its organic and irregular street network formation, it is very walkable and despite being low rise, one storey, 'Swahili type' housing, it has a very high population density implying overcrowding. This typology points to increasing building density and improving urban greenery within the already well-connected network to improve resiliency and housing standards.

### 5.3.5 Mikocheni

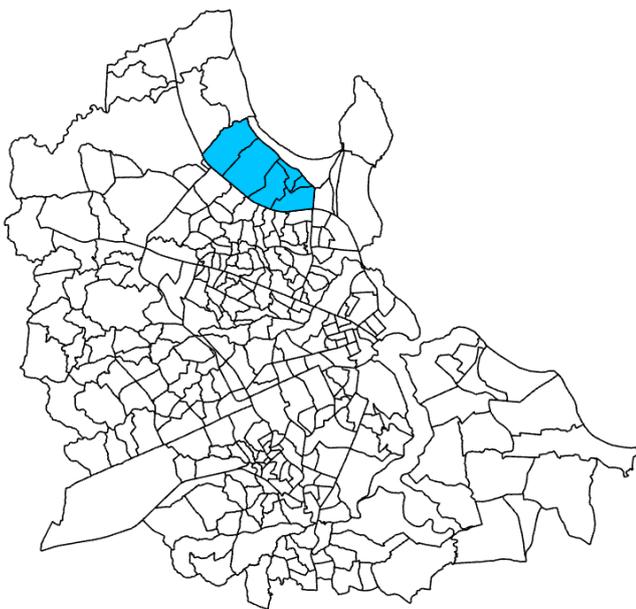


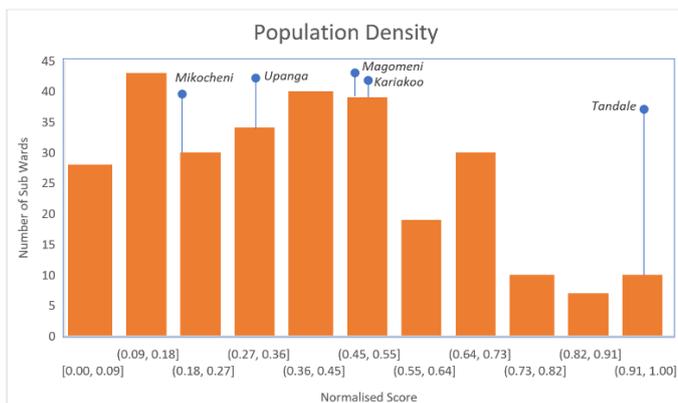
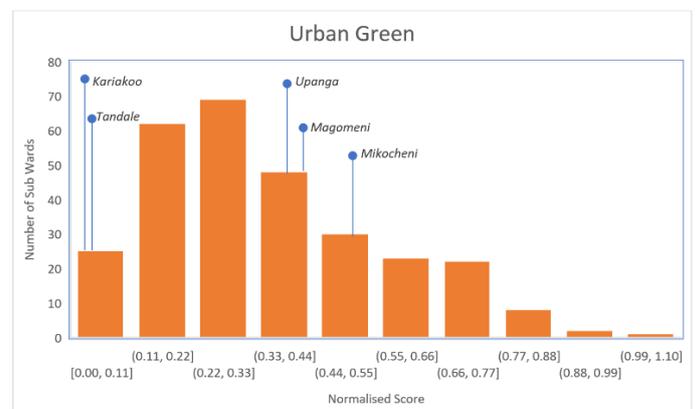
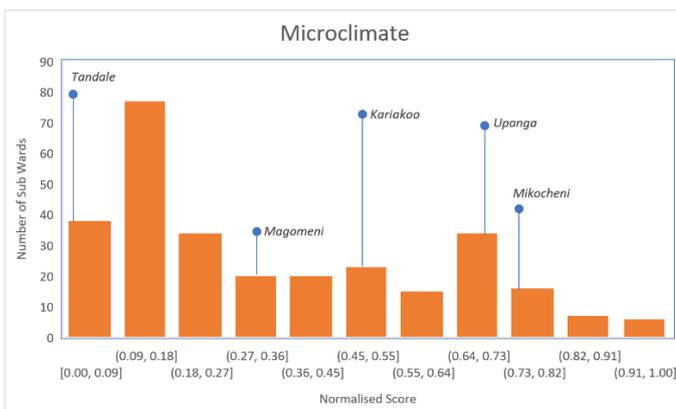
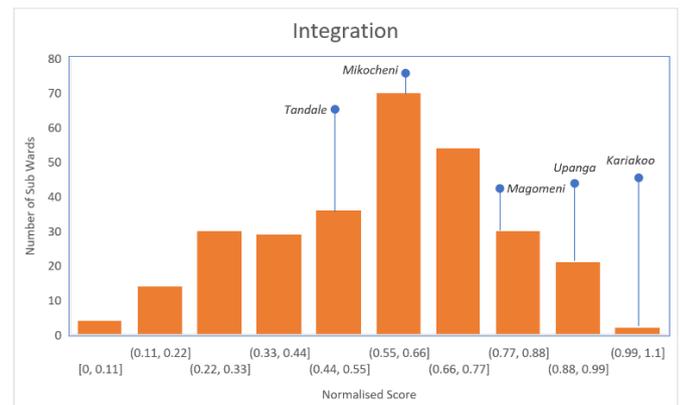
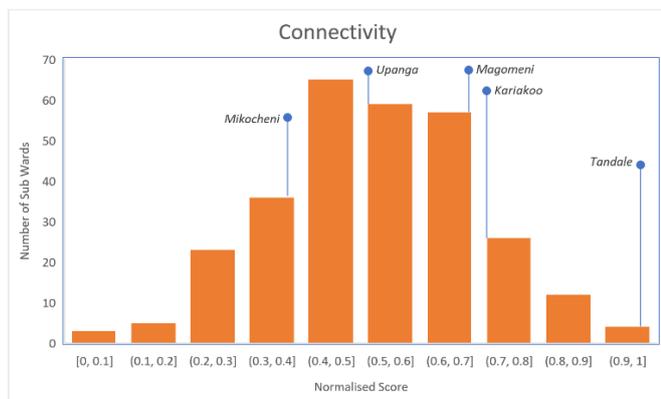
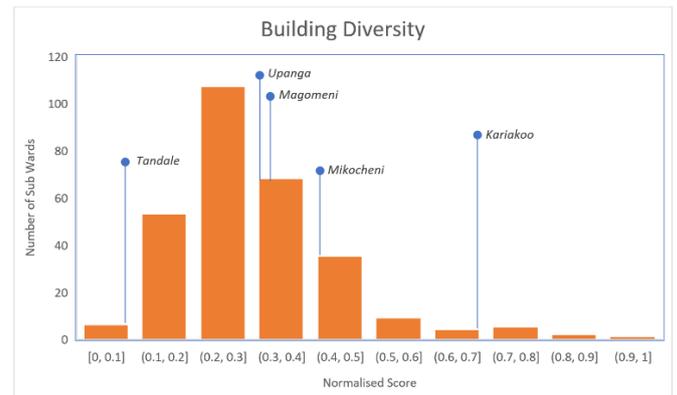
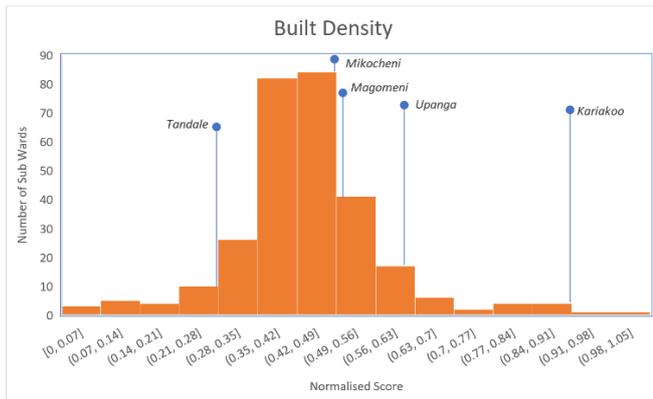
Figure 5.15: Location of Mikocheni Ward



Figure 5.14: Figure-ground map of Mikocheni

Mikocheni, a newly planned area, demonstrates a similar resilience typology to Upanga. Low population levels with relatively high built density implies a higher degree of housing standards. However, lower connectivity scores imply a lack of road infrastructure to service these areas extensively. Mikocheni has an average performance in terms of microclimate and urban greenery as well as a below average building diversity score. The similarity to Upanga in terms of resilience typology shows the impact of medium rise developments, often housing high income groups, to enable more space around developments at the expense of residential density.

### 5.3.6 Comparative Ward Performance



## 6 Part C: Application – Qualitative Analysis

Part C: Qualitative Analysis	SQ3: What are the main factors influencing public space resiliency performance?	Objective 3.1: Contextualise and validate findings of the public space resiliency assessment with qualitative data.
---------------------------------	---	---

### 6.1 Methods

**Part C: Qualitative Analysis** used a combination of ethnographic research methods and in-depth expert interviews over a five-week period in Dar es Salaam. The ethnographic component aimed to uncover the experiential factors of public space, for example, how congested or walkable is this neighbourhood? The ways in which different neighbourhoods demonstrated various criteria of resiliency were noted in a daily diary alongside photographs. Additionally, a record of observations in voice-note format were summarised daily in the diary to ensure complete and detailed accounts of observations. Informal interviews were conducted with residents regarding their perceptions of their neighbourhood and the identity of different areas of Dar es Salaam. For example, what type of demographic lives here and how residential or commercial do they consider this area to be? Insights garnered from informal conversations were complimented by recurring site visits to different wards in Dar es Salaam. There was a particular focus on the city centre area, Kariakoo, given its proximity to the redevelopment project of the Lower Msimbazi. Additionally, Kariakoo was considered important to investigate by urban experts given it is highly developed as an area. Interviews with urban experts were the main source of qualitative information given how it tapped into a host of experiences and contextual knowledge of Dar es Salaam. The interviews were the main source of information and were summarised individually alongside ethnographic records. The findings of the summaries were compared and analysed in Section 6.2. Interviews were not recorded, and hence not transcribed, as it was found early in the process that participants preferred not to be recorded for privacy reasons. The interviews are completely anonymised for the same privacy concerns.

Table 6.1: Qualitative Methods in Dar es Salaam

<b>In-Depth Expert Interviews</b>		<i>14 interviews with urban professionals specialised in Dar es Salaam including architects, master planners, academics, civil engineers, and social scientists. In-depth expert interviews were the main qualitative methodology for this research.</i>
<b>Site Observations (Ethnography)</b>		<i>Field notes including photos and voice recordings of different wards of Dar es Salaam and their various characteristics to be included in a daily field diary. This includes a 5-hour tour with Afriroots, an organization from the neighbourhoods of Tandale, Mwanamela, Sinza and Mikocheni.</i>
<b>Informal Interviews (Ethnography)</b>		<i>Interviews ranged from one to ten minutes and involves quick commentary regarding perceptions of different wards of Dar es Salaam. This included 9 informal interviews in Kariakoo with a translator.</i>
<b>Participant Observation (Ethnography)</b>		<i>Attendance of meetings regarding the Lower Msimbazi Redevelopment Project with government officials from PO-RALG. Additionally, it includes participation with the World Bank workshop on urban development and greening in Dar es Salaam. This brought exposure to common practices and perceptions of decision makers in the urban field.</i>

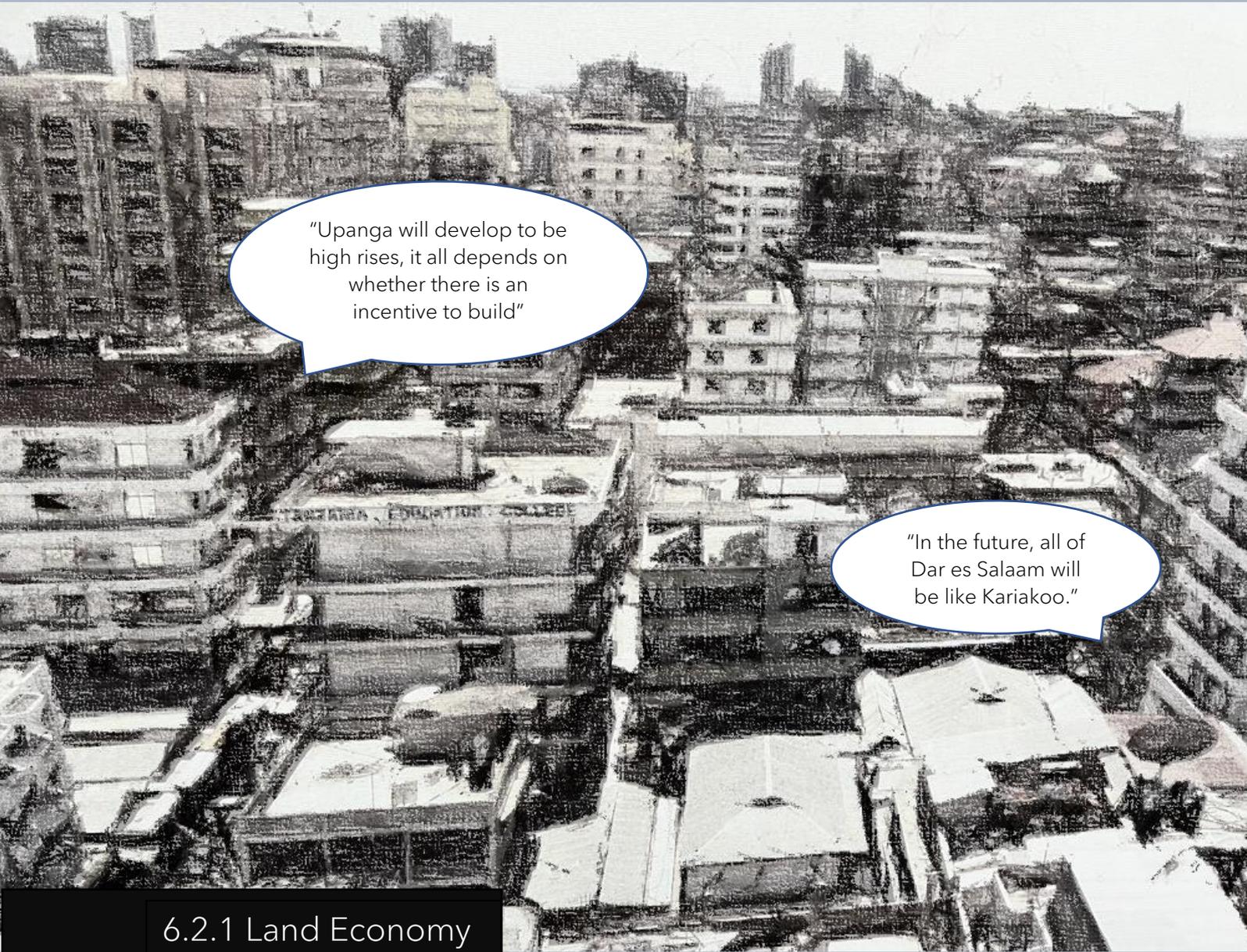
## 6.2 Results

Respondents, including residents, urban designer, and land policy advisors, thoroughly engaged with the topic of public space resiliency. Semi-structured interviews led into discussing a variety of issues that are highly relevant to consider for public space resiliency, albeit not explicitly discussing 'resiliency' as a technical concept. After twelve interviews and four weeks of ethnographic research, patterns begun to emerge based on recurring points mentioned by respondents on how to improve and consider public space resiliency in Dar es Salaam.

The results of the qualitative research are grouped within thematic sections of land economy, spatial morphology and integration, governance and communication, public space usage, urban building blocks, and environmental concerns. These themes were captured after reviewing interviews and observations summaries and subsequently noting down recurring terms and subtopics. Figure 6.1, a word cloud based on the summaries of the interviews, shows the recurring terms and themes which emerged around the topic of public space resiliency. The results are grouped by these themes, as briefly explained below, based on their significance to public space resiliency. The complete interviews are summarized in Appendix 4 in Section 11.5.

- **Land Economy**
  - The land economy theme explores the ways that the unregulated housing market and hence, changing land values influence and determine urban forms of different wards in Dar es Salaam.
- **Spatial Morphology and Integration**
  - The spatial morphology and integration theme synthesises the ways in which accessibility and street network connectivity influences resiliency both within and between wards.
- **Governance and Communication**
  - The governance and integration theme tackles the issues and pitfalls of ineffective land policies, lack of an urban development and growth strategy as well as disregard for bottom-up decision making by Dar es Salaam municipalities.
- **Public Space Usage**
  - The public space usage theme covers insights relating to how residents of Dar es Salaam use and value public space. This relates to the blend between public and private spaces as well as retaining economic spaces in the city.
- **Urban Building Blocks**
  - The urban building blocks theme summarises and discusses the limitations of current land use policies and small plot size developments. It explores potential ways to strategically densify with block type developments.
- **Environment**
  - The environment section reveals the issues of heat stress, flooding, and pollution. It summarises how environmental issues spatially intersect different urban forms and wards.





"Upanga will develop to be high rises, it all depends on whether there is an incentive to build"

"In the future, all of Dar es Salaam will be like Kariakoo."

6.2.1 Land Economy

### 6.2.1 Land Economy

Land value was considered by over eight interviewees to be the largest determinant of urban form and public space. It was considered as an '*internal determinant*' of urban development as compared to external determinants such as building codes or masterplans. Due to the lack of regulation and ability to enforce a masterplan in Dar es Salaam, which was unanimously agreed upon by all interviewees, the internal determinant of land value becomes an even more significant consideration of resilience. **Integration and distance** from the central business district was referenced as the largest factor determining the value of land. Hence, wards closer to the city centre, namely Kariakoo, Upanga and Magomeni were developing to be denser, especially with high rise buildings. However, the impact of these types of developments is negative on the quality of the street as can be observed in Figure 6.2. The plots of land are fenced from the street and **self-enclosed**. Additionally, linked to one respondent's points, **densification seems to correlate with gentrification** as seen in Kariakoo. This leads to residents selling plots of land to move further outside of the city thereby reinforcing the trend of **urban sprawl**. Property developers are also taking advantage of the lack of building permits and **speculating land value** increases thereby further increasing pressure on green spaces around the fringes of the city such as the Pugu Hills. As one respondent mentioned, the typology of housing can be linked to incentives related to land value. For example, the Jenga Uza housing typology (see Section 11.5, Interview 14) evolved based on expectations of economic value. The trend of land value questions the role capital can play in improving resiliency. One respondent pointed out that **income is the largest determinant of resiliency**. On the one hand, respondents point to the vulnerability of low-income residents living in informal settlements within flood prone areas. However, on the other, the increase in income can be met with gentrification and risk **destabilising local and residential communities**.



Figure 6.2: Upanga's 'Self-Enclosed' New High-Rise Developments

**Affordability of housing** for low-income earners is key to **reduce urban sprawl** according to two urban development specialists. Additionally, the **retention of existing networks** is key to resilience building. Networks that exist within informal settlements, as explained, and demonstrated during a tour of Tandale, act as insurance systems for residents and develop a strong sense of place. As respondents explained, gentrification or relocation risks compromising these networks despite better land use efficiency. As such, interests to develop informal settlements such as Tandale may be incentivised by stakeholders who aim to benefit from the inevitable land value increases, especially given an unregulated housing market.

#### Relating to Public Space Resiliency

- Resiliency requires questioning resiliency for who – property developers, new middle-class inhabitants or residents pressured to the fringes?
- This involves separating the resiliency of people versus the resiliency of spaces.

The **lack of regulation** of the housing and building developments leads to **development beyond the capacity of available services** to the area. For example, one resident remarked that Kariakoo is congested and lacks urban services such as streetlights and frequent waste collection. Therefore, it seems to be in agreement between respondents that there is a particular **balance between densification and providing services** to the area. One respondent remarked that **Kariakoo's services are 'overstretched'**, and it is *"why I see a short-lived neighbourhood"*. Therefore, even highly developed areas are met with the same lack of services as the 60-70 percent informal settlements in the city. Service provision is lacking behind the rapid growth of the city – both from within the centre of the city and along its fringes.

To ensure the resiliency of urban public spaces in Dar es Salaam, communities and the networks already existing within informal settlements should be maintained. Design should account for their income streams and everyday activities. Therefore, further **regulation of the housing market** would help avoid rapid and sudden changes to the land economy which risks pricing residents out and compromise existing communities and their connection to neighbourhoods of the city. It poses a risk to their **income streams which are directly linked to their networks**.

Additionally, one respondent criticised the tendency to construct buildings and allow infrastructure and services to follow. They explained that the **provision of services or amenities such as schools or hospitals should be the deciding factor to the urban form**. For example, high rises in neighbourhoods with poor road infrastructure will rapidly reduce resiliency.

#### Service Provision Before Development

- According to one respondent, the provision of services or amenities such as schools or hospitals should be the deciding factor to the type of urban form.

One urban planner remarked, resiliency of urban areas would be enhanced by **medium density typologies of urban forms around four storey high buildings**. The four-storey building typology increases the density of the city – thus improving access to the city centre and availability of affordable housing. High rises above five storeys may counterintuitively trigger gentrification given their higher cost per

unit area – in this sense, as one respondent remarked *'these buildings are not worth it'*. It is not economically efficient to ubiquitously build high rises to achieve higher densities.

**Transport connections directly impact land values** and so, the transport infrastructure can be used to strategically allow residents to benefit from rising land values. Four respondents suggested rechanneling development funds away from the centre of the city towards residential areas. One respondent involved in the 2036 master plan, proposes a **joint private public investment partnership** as an innovative tool in the real estate market. Regulation can require that **developers invest with local residents** thereby allowing residents to benefit from land value increases without needing to relocate and hence, not compromise the sense of community or link with place. They describe the proposal as defining Dar es Salaam for *“its people”* to create a *“common wealth city”*. As such, respondents broadly agreed upon the significance of land value to influence the city’s development however, ideas on how to intervene varied based upon their perspective of whether increasing land values benefitted the city or compromised intangible yet vital networks of communities.

Table 6.2: Land Economy Summary Table

Land Economy	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>• Land value increases trigger development and gentrification</li> <li>• Lack of affordable housing in an unregulated housing market has contributed to gentrification and low-income residents being driven out of the city centre</li> <li>• Land values increase based on levels of street network integration to the city centre</li> </ul>	<ul style="list-style-type: none"> <li>• Use transport connections to influence integration and hence steer urban development growth (via value increases)</li> <li>• Encourage densification up to carrying capacity of the ward (in terms of existing service provision)</li> <li>• Typology of affordable housing of four storey high residences optimise affordability and counteract gentrification</li> <li>• Private-public investment partnerships as a real-estate tool may enhance community feeling and allow residents to benefit from the land economy</li> </ul>

Four residents argued for more organisation, signage, and zoning of market goods to reduce congestion of the area. Two residents suggested skywalks between buildings as a solution to connectivity.



"There is nothing you cannot find in Kariakoo, everyone knows Kariakoo, so it is difficult to convince people there are better markets elsewhere!"

"But, Kariakoo has very bad infrastructure and it's not very connected. It is not easy to get around once you are here. Congo street is the worst congested."

"It is so easy to reach Kariakoo because of the bus system"

## 6.2.2 Spatial Morphology and Integration

## 6.2.2 Spatial Morphology and Integration

Dar es Salaam's spatial morphology is denoted by its **urban spawl** and unprecedented growth. Six respondents pointed towards the fact that the rapid growth and **overdevelopment** of areas (as **triggered by land value increases**) negatively impacts the provision of services, drainage, sewage, and waste. The key to controlling the service provision of the city is **to control the growth of the city**. The road infrastructure of Dar es Salaam shapes its spatial morphology. The urban spawl occurs from North to South along the most integrated highways. This type of development was described by three respondents as **'finger type development'** whereby urbanised areas concentrate around the road connections towards the centre. One respondent described that the city lacks ring roads leaving *'open pockets'* in less integrated areas. This is linked using infrastructure, especially the road network, to stir urban development through speculative land value increases.

The spatial morphology of Dar es Salaam is **monocentric**. One resident expressed concern that *'as a city, we are too reliant on Kariakoo'*. The city is not well-connected which points to **integration** as a way forward for the city. Dar es Salaam's street network means that *'everything has to pass through the centre to access the rest of the city'* according to one respondent. Morogoro, Nelson Mandela, and Bagamoyo roads are the main roads which help counteract the monocentricity of the road network. However, for Dar es Salaam's size, it needs

---

*"As a city, we are too reliant on Kariakoo!"*  
**Resident of Upanga**

---

**more arterial roads** not directed towards the centre. The dependence upon Kariakoo relates to its role in the economy. One respondent claimed that Kariakoo's importance increases the city's vulnerability. They described that *"if there is a disaster in Kariakoo, it would be a tragedy for the whole country... as everyone is one step removed from Kariakoo"*. Two respondents quoted that almost 50 percent of the population commuted to the city centre everyday leading to congestion in the centre during the morning, empty streets at night and congestion in the suburbs during the afternoon. The **transport cost of commuting** is highly important to consider as it can form a large portion of daily earnings. If commuting costs are sufficiently high, it leads to family disconnection as the *'earner of the family'* stays in the centre to work and then sends money back to their family in the suburbs. It was unanimously agreed that there is a greater need for more centres in the city and especially, more multifunctional areas that combine businesses and residents. In its present situation, one respondent pointed to the inefficient structure of Dar es Salaam whereby Magomeni (close to the centre) is residential however, as one travels out, it returns to being industrial before returning to residential areas in the distant suburbs. More centres, apart from Kariakoo, would minimise commuting costs as

### Redundancy in more nodes

- The alleviation of pressure on Kariakoo creates resilience by **reducing dependency on a single area** of the city as well as create space for Kariakoo to become greener and provide essential services.

well as alleviate pressure and congestion from the centre. Eight respondents mentioned **'satellite cities'** and **'nodes'** to distribute many centres around the city. Mwenge was most mentioned as a key example of a future node – efficiently located at the cross section of the major roads of Bagamoyo and Sam Nujoma as seen in Figure 6.3.



Figure 6.3: Mwenge as a new 'node' or 'satellite centre'

The potential shift from monocentric spatial morphology towards **polycentric spatial morphology** is dependent on an efficient transport system. Respondents varied in their response to the most effective modes of transport for the city. Five respondents mentioned upgrading and investing further in **Bus-Rapid Transit** system (Figure 6.4), and other respondents mentioned **mass cheap transit** in an underground network, tram, or light rail to allow for people to **affordably and efficiently access** different areas of the city. The latter respondents referenced the tackling the inefficiency of the road network as a solution to future mobility. In Makumbusho, a ward in the Kinondoni District, a shopkeeper explained his business relies on buying cheap goods from the Tandale market (Figure 6.5) and reselling it in Makumbusho, a middle-class neighbourhood. He explained that accessibility by bus is what allows him to access these new buyers and markets. These investments in transport infrastructure can serve to connect informal settlements on the *'outskirts of the city'* with other centres of Dar es Salaam which can rapidly improve economic opportunity.



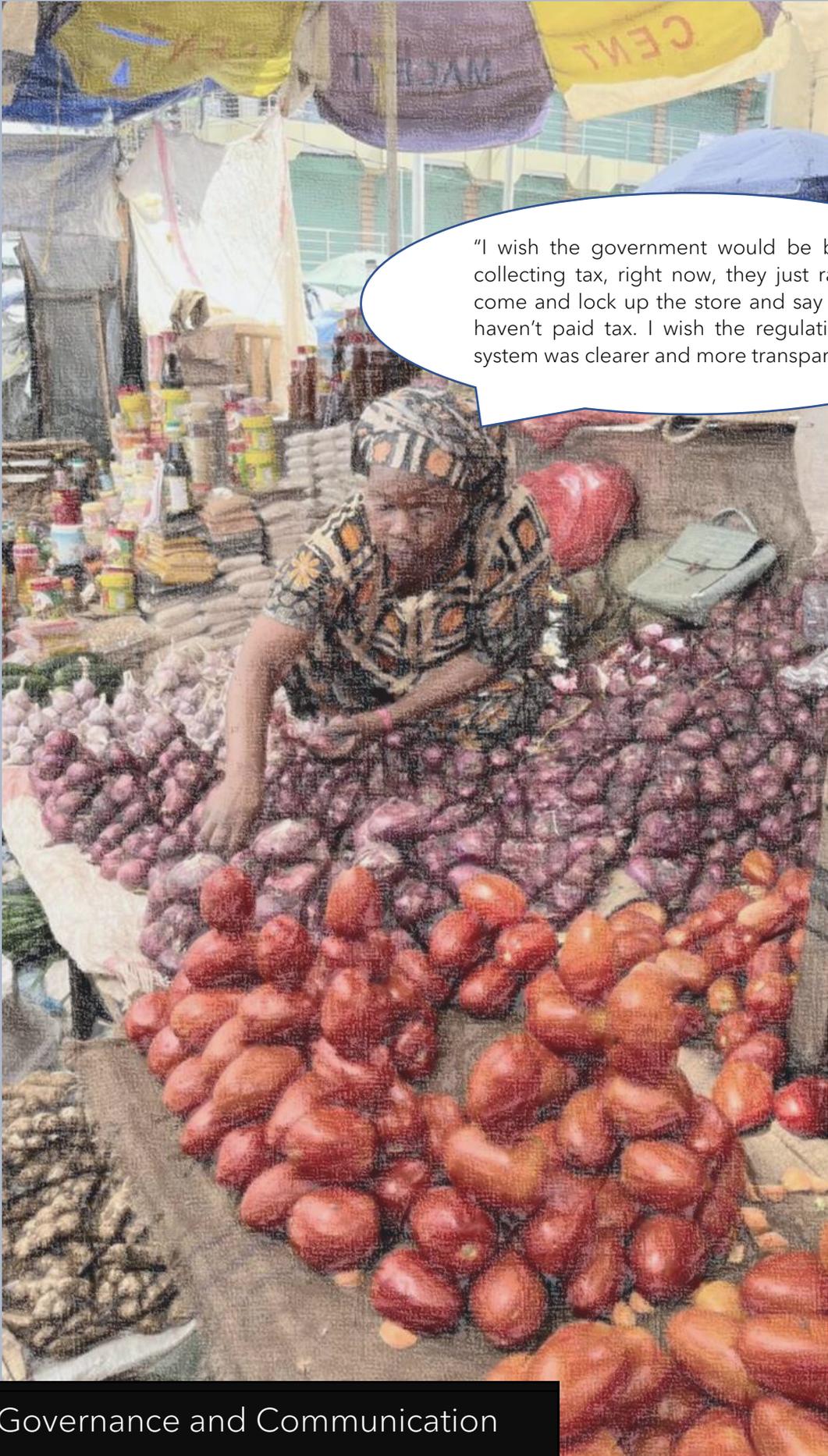
Figure 6.4: Bus Rapid Transit Stop in Kisumu (City Centre)



Figure 6.5: Market stall at Tandale market

One respondent criticised the government’s prioritisation of development funds to the centre of the city. Instead, other centres and potential nodes should be invested in. The resilient spatial morphology should be **densified along nodes and existing ‘fingers of development’** as denoted by the transport network. These satellite cities such as Mwenge should feature a mixed use of residential and commercial functions. These **nodes or satellite cities are mini centres** which are densely built however, gradually decrease in density further from its centre in line with **‘decentralised concentration’** based around different neighbourhoods in a city (Breheny 1992). Two residents of Kariakoo explained their idea for several centres in the future of Dar es Salaam, *‘there should be some places like Kariakoo, and then around it is quieter and then you reach more crowded places’* (\*translated from Swahili). The underlying drive of changing Dar es Salaam’s spatial morphology is to develop resilience by **distributing the reliance for economic opportunity in Kariakoo into more satellite centres** (which also serves to alleviate congestion and reduce commuting costs).

Spatial Morphology and Integration	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>Overdevelopment and ‘unmanaged growth’ of urban sprawl has led to stretching of services</li> <li>Monocentric morphology of Dar es Salaam leads to dependence on the centre as well as an expensive and inefficient transport system</li> </ul>	<ul style="list-style-type: none"> <li>A shift is needed toward polycentricity of the city with many centres or ‘nodes’</li> <li>Mass public transport should be invested in, namely, the Bus Rapid Transit Network</li> <li>A ring road should be constructed to alleviate pressure on the centre of the city, Kariakoo</li> <li>Funding and investment should be steered away from the centre of the city towards the outskirts</li> <li>Satellite cities should be dense ‘mini-cities’ and form the centres of different municipalities of Dar es Salaam</li> </ul>



"I wish the government would be better at collecting tax, right now, they just randomly come and lock up the store and say that you haven't paid tax. I wish the regulations and system was clearer and more transparent!"

### 6.2.3 Governance and Communication

### 6.2.3 Governance and Communication

Respondents unanimously agreed that there needs to be an **improvement of urban governance to improve resiliency**. One respondent explained urban governance strategies to control development and growth is essential otherwise Dar es Salaam will be *'chaotic, inefficient and lead to land use conflicts'*. Governance around land use planning, allocation and infrastructural development should be centred on a process of **accountability** and **transparency**. Another respondent claimed transparency needs to be further incorporated, *'you cannot get resilience if there is corruption'*. This was re-emphasised by a resident of Kariakoo who expressed confusion at where city tax expenditures are being invested. Therefore, amongst respondents, the importance of laws and regulations informed through stakeholder buy-in and **community involvement** is essential. Good governance is *'an eye beaming at what you want to look at'* and serves to guide and regulate development. Master planning in Dar es Salaam has been unsuccessful in the past because of its top-down formation and some respondents pointed to the fact that *'making a plan is one thing, implementing it is another'*. Urban governance requires a legal framework and coordination amongst several authorities in Dar es Salaam to implement plans.

There is a wider call for bottom-up planning decisions informed through the consultation of residents. *'Plans come first and then people are told to*

*follow, that is the problem'* pointed out one respondent. This **bottom-up approach** needs to incorporate **inclusivity, flexibility, and transparency**. Another respondent working as an urban planner claimed *'we are part of the problem at times, we make plans, put it in the cabinet and they are not flexible. We need inclusive, transparent, and flexible plans.'* For example, the government has encouraged street markets in middle to upper class neighbourhoods where residents are more accustomed to supermarket shopping, claimed one respondent. This exemplifies the **lack of effective communication with residents**. However, bottom-up consultation can be difficult given the

---

*'We are part of the problem at times, we make plans, put it in the cabinet and they are not flexible. We need inclusive, transparent, and flexible plans!'*

**Respondent 7**

---

---

*"Spaces of informal settlements are invisible cities, and the main issue of planning is not considering neighbourhoods as cities in themselves. Therefore, we should ... make invisible cities visible again"*

**Respondent 11**

---

divergences in lifestyles and interests in the city. **Local preferences are not homogenous**. A respondent urged focussing attention to the **neighbourhood unit**. This is in agreement with another respondent who claimed that in the neighbourhood, the network is essential to promote effective income flows and hence, **planning should help facilitate the everyday** activities of residents.

As another example, the urban governance barrier to promote city greening was cited by three respondents. Currently, there is an **educational and cultural barrier with greening** the city. Historically, these respondents claimed that urban green was considered counterintuitive to urban development. The maintenance and presence of green is considered an extra cost and nuisance to municipalities. Governance is key to unlocking the potential behind urban greening in Dar es Salaam

through both communication and strategizing where and how to green the city. Strategically, two respondents urged separating **urban spaces into legally private and public spaces**. Public space is easier to green especially because residents do not have an incentive to green private spaces. Another respondent urged that climate resilience to be promoted through **small scale interventions on a large scale**, such as requiring all Dar es Salaam residents to green their private properties to limit flooding. These proposals contradicted in their consideration of the role of the local resident. The former proposal to green public space was informed by a ‘hierarchy of needs’ whereby lower income communities rarely can consider climate resilience except for when it *‘impacts their income’*. The latter, which proposed local involvement in city-wide climate resilience initiatives, assumed the cost-benefit analysis of investment to resilience was already known. In both cases, the need for broader alignment of government activities with the needs of the community is essential. More efficient governance strategies are needed to enact bottom-up incentives with **community buy-in**.

#### How to consider the role of the local resident in resiliency building?

- Disagreements emerged regarding whether to consider the local resident as directly responsible for resiliency building or for the State to tackle hazards which impact the public (such as heat stress or flooding).

Increasingly, **data is bridging the gap between local knowledge and political decision making**. Four respondents pointed to various initiatives such as Ramani Huria or the Resiliency Academy which use community-based mapping techniques to support risk-based decision making. For example, it informs how to improve flood resilience in line with the community’s priorities and awareness of their neighbourhood. Oftentimes, this alleviates the vulnerability of the most at-risk communities of Dar es Salaam. *‘The best knowledge comes from the community itself... they have the best grasp of the data and the issues faced’* remarked one respondent. To develop the **national infrastructure for data collection and sharing**, this requires combining different stakeholders in the urban resiliency space in Dar Es Salaam. For example, one respondent pointed to the organisation of Bus Rapid Transit, DART, as responsible for roadside greening and hence, essential to the strategy of greening the city. Lack of communication and overall strategy has meant that greenery planted by DART often perish due to lack of maintenance. This speaks to a larger motive to improve the public-private partnerships of the city, in terms of collaboration between residents and the municipality as well as private organisations and state actors. This supports integration and inclusive qualities of resiliency,

Communication efforts are needed to overcome **cultural attitudes** to housing. Six respondents pointed to the issue of densification of informal settlements which is impeded by preference of living on land. One respondent claimed, *‘people like to have a plot of land and put their house on it’*. Another respondent, living in Tandale (Figure 6.6), an informal settlement, commented, *‘people want to own land’*. In this sense, the idea of living in multi-storey buildings is not appealing to a large proportion of residents. Another respondent said, *‘people want to own the land and not the building, and so,*

---

*“People want to own the land and not the building, and so, communication is key to educate people.”*

**Respondent 11**

---

*communication is key to educate people’*. This pattern extends towards respondents claiming that residents of informal settlements being reluctant to move to formal planned areas due to the high living costs due to tax and utility bills. This has contributed to the horizontal urban sprawl rather than the vertical growth of the city as more land is needed to satisfy housing

preferences. The law is helping support the change in attitude and the **Unique Titles Act** was cited as the most significant advancement in legal governance. The Unique Titles Act recognises the ownership of an apartment and extends multiple land deeds for the same plot of land. In line with legal changes and government communication, another respondent urged **affordability** as a significant factor in reducing sprawl. They pointed towards the mortgage facilities available to people with lower incomes, which currently do not exist. This would require a **formalisation of informal businesses** to record incomes and allow access to mortgages. In this sense, **urban governance should consider cultural communication, legal instruments as well as economic systems to stimulate resilient urban development.**

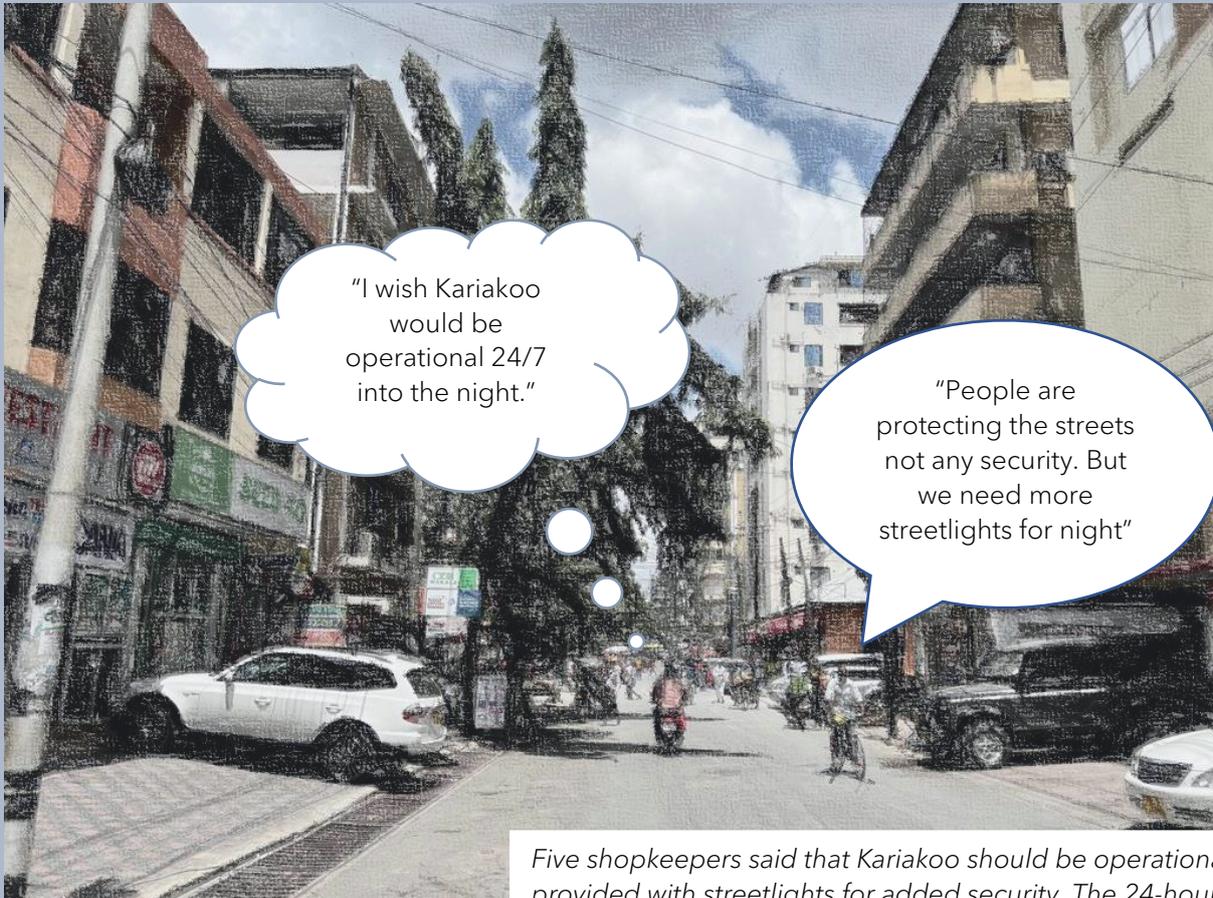
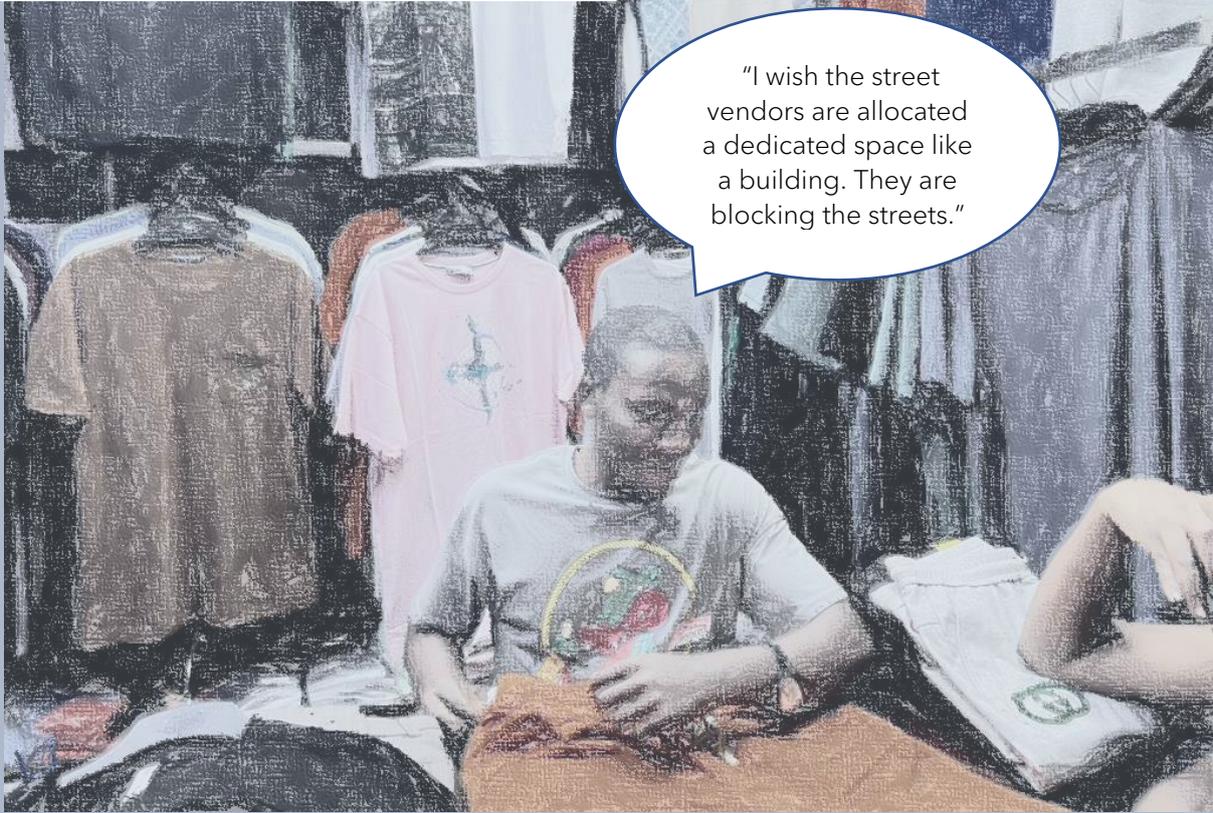


Figure 6.6: Side street in Tandale featuring single storey houses

Alongside the aforementioned legal, communication and economic drivers, there needs to be a well-defined strategy for the city. One respondent asked, *'we need to ask ourselves, what is the city we want and who is the city for?'*. For example, Dar es Salaam can strategize its growth as a tourist hub, services centre, transport hub or a port city. Understanding and **defining Dar es Salaam's identity** can serve to channel investments and efforts more effectively. Certain respondents pointed to the lack of development of the historic centre of Dar es Salaam as well as the coastline as a missed opportunity for urban tourism. Urban governance, therefore, is a vital tool to offer incentives and steer growth of the city. In terms of resiliency, one respondent who focused on risk analysis and planning, commented that a shift is needed away from event-focused responses to a **systems approach of resiliency**. The current political system is geared to respond to crises rather than **long-term planning**. Another respondent urged an even-more progressive approach, to shift resilience away from *'bouncing-back'* towards *'bouncing forwards'* to rebuild the city to be even more resilient after crisis events such as flooding. Governance, with its economic incentives, legal power, strategic authority, and nation-wide communications, has a large ability to **align stakeholders**, from developers to local residents, and steer the development of Dar es Salaam to serve its residents.

Governance and Communication	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>• Lack of transparency, accountability, and strategy in current urban governance</li> <li>• Lack of communication which has meant initiatives such as urban greening has no community buy-in</li> <li>• Cultural attitudes influence potential urban development patterns such as preference to live on land rather than apartments</li> </ul>	<ul style="list-style-type: none"> <li>• Bottom-up planning decisions with consistent community involvement is essential for inclusive planning</li> <li>• Focus on the neighbourhood unit for consensus on development strategies</li> <li>• Increase data collection via community engagement to inform planning and risk decision making</li> <li>• Legal and economic instruments in combination with communication can help influence cultural attitudes</li> <li>• Develop and define a city-wide strategy of development and enforce regulation</li> </ul>

Nine shopkeepers expressed concern for allocating dedicated spaces for street vendors to reduce waste and congestion.



Five shopkeepers said that Kariakoo should be operational 24/7 and so, provided with streetlights for added security. The 24-hour system, they said, would reduce congestion through spreading working hours.

### 6.2.4 Public Space

#### 6.2.4 Public Space Usage

**Informal vending**, according to respondents and observation notes, dominates the use of public space in Dar es Salaam. As seen in Figure 6.8, street vendors depend on the street as an **economic space** to conduct business. One respondent commented on the importance of viewing the street as a site of economic activity, *'it all happens in the street'*. However, over seven respondents referred to informal vending as an issue that needs to be addressed due to its negative spill-over effects of *'blocking the street'* and *'making waste'*. In Kariakoo, business-owners operating within buildings unanimously commented on the need to organise and formalise street vending. In the current arrangement, street vendors are said to **block movement and connectivity within Kariakoo**, especially around Congo Street (Figure 6.7). Another respondent, working on urban policy, commented that street vending currently does not generate any income for the city despite generating a lot of **waste** and **congestion**. Respondents pointed towards the need to allocate **dedicated spaces** for informal vendors with licences which require the users to maintain and clean the space. A positive feedback loop can be generated when earnings of informal vendors are formalised, government education on financial planning is given and then, taxes are invested into the public space of the ward. A respondent emphasised, it is essential for people to see the benefit of their taxes, *'if you pay your taxes, you will get your roads'*. This concern for formalising the informal economy contradicts with another respondent's comment that *'the formal is informalizing and the informal is formalising'*. Kariakoo, Mikocheni, and Sinza are being informalized, for example restaurants are being replaced by street food vendors. In Mwanamala, and Tandale, there is a process of formalisation whereby the space is getting more programmed and organised. In spite of the informalisation process *'causing chaos'*, one respondent says *'there is something quite nice about informal'* uses of space. Informal uses of public space are positive contributions to the city however, most respondents urged a degree of **organisation to minimise the negative effects**.



Figure 6.7: 'Congested' Congo Street in Kariakoo



Figure 6.8: Street Vendor in Kariakoo

There is a need to broaden conceptualisations of public space beyond solely open, government-owned land. One respondent used the term, *'public usable space'* to refer to spaces whereby residents participate in the public realm. This includes **blend of private and public property** and especially in informal settlements, observations noted many *'in-between spaces'* or left-over spaces which were widely used as seen in Figure 6.9. In Tandale, residents ran informal businesses or cooked in front of their residences as seen in Figure 6.10. One resident commented, *'it helps with taking care of children'* as the adults can work closely to their homes. Greenery and trees facilitated the use of these spaces for cooking and vending purposes. The **street can be treated as a public space**, despite uses of the street that were not intended in its original design, for example, sidewalks as boda-boda stations as seen in Figure 6.11. One respondent, who conducted extensive research on public spaces in informal settlements, urged consideration of the meaning of the spaces by residents. They pointed to the street as an extension of their homes like a *'collective living room'* and urged urban design to consider spaces inclusive of its residents' needs. An interviewee of their research analogised the use of public space, *'that tree is our castle, we discuss everything here'*. Residents in Tandale expressed their desire for diverse, mixed commercial and recreational spaces **close to their areas of work and living**. Informal settlements, despite very high densities and low service provision, demonstrate effective use of public spaces which centre around community.



Figure 6.9: Informal and intimate cafe on roadside



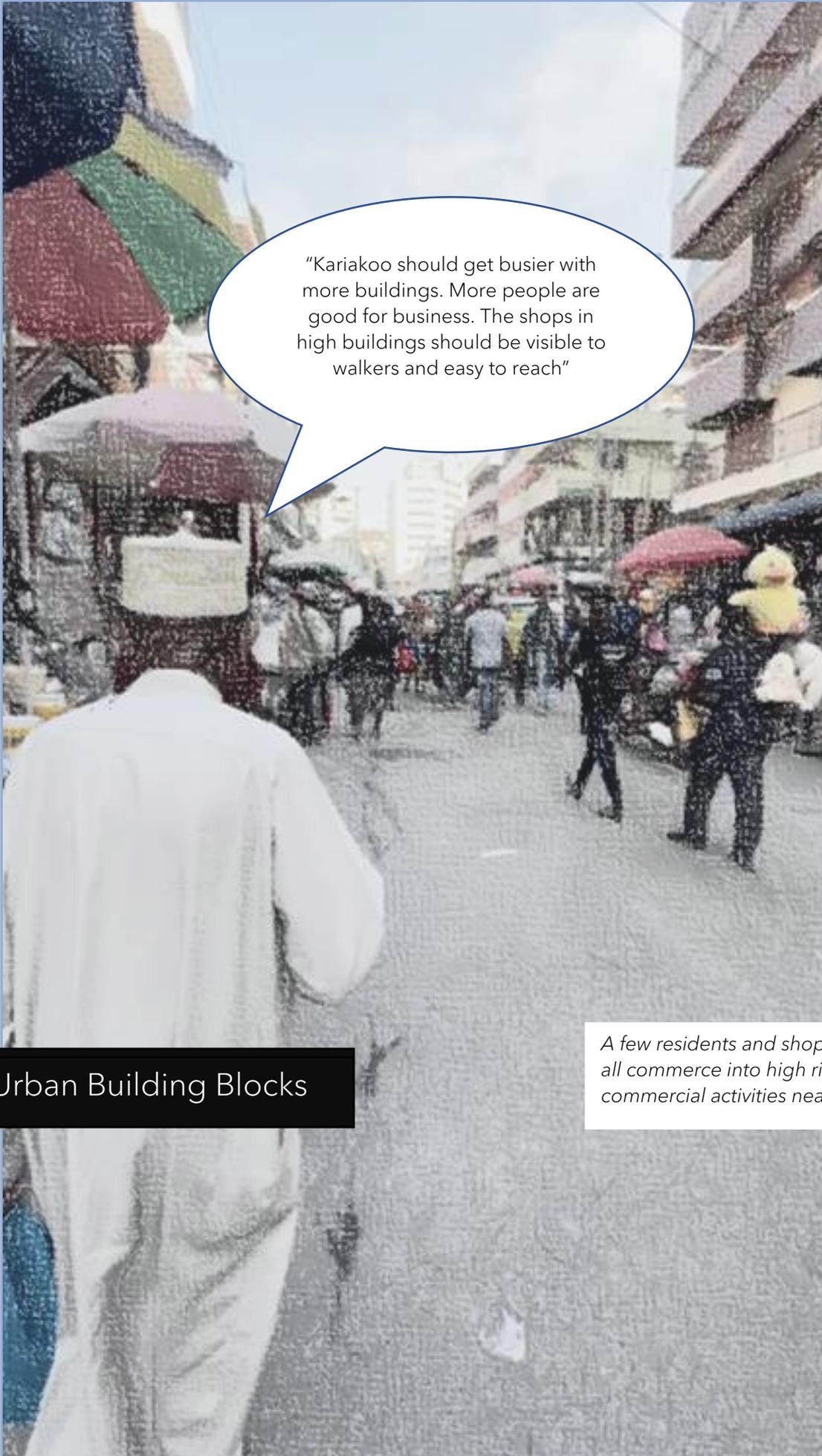
Figure 6.10: Residents in Mwananyamala using the street for communal cooking



Figure 6.11: Boda boda taxis using sidewalk as taxi rank

For future consideration of public space, respondents urged **adaptability** and incorporating informal uses of public space such as areas for children to play. Two respondents specifically pointed towards the need for public space to be in **immediate vicinities of residences, smaller and more ubiquitous rather than fewer and larger open spaces**, and lastly, to **support economic activities** of nearby residents. However, a tension emerges between respondents who urge for adaptability in public space design versus respondents who promoted programming of public spaces. One respondent explained that many open spaces exist in the city however, they are **not maintained nor programmed** hence, not contributing to the city's urban renewal. Other respondents explained that all spaces are used, and people adapt to make '*spaces work for them*'. Based upon observations, informal uses such as sites for families to eat or religious meeting points to congregate before going to Church or the Mosque are common in Dar es Salaam. In Kariakoo, a resident implicitly urged for more public spaces in the neighbourhood by asking '*where do the kids play?*'. The issue reveals itself as two-fold, firstly ensuring **availability of public space** and secondly, promoting **effective use of that space based on resident's preferences**. Two urban designers claimed that the roads need to be more conducive for walking and cycling and in certain areas, **pedestrianisation** of the street, even on a temporal basis such as weekends, will maximise public space use. They followed up by explaining, eating on the street is very common and so design should embrace such existing uses of public space. In terms of urban development, the **density** of the area as well as the building **diversity** are the most important criteria to consider as they enclose and effectively create the public space. Public space, in essence, requires a consideration of public needs in conjunction for ensuring that spaces exist in the city for the public to use.

Public Space	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>• Public spaces are economic and living spaces</li> <li>• Informal vending, albeit beneficial for residents, have negative spill over effects such as waste and congestion</li> <li>• Private and public spaces blend, especially in informal settlements.</li> <li>• The street is the most significant and used public space</li> <li>• Informalisation of formal planned areas and vice versa is occurring in Dar es Salaam</li> </ul>	<ul style="list-style-type: none"> <li>• Informal uses of streets should be included in plans using adaptable/flexible design however, more regulation and control is needed to mutually benefit vendors, residents, and the municipality whilst minimising traffic and waste</li> <li>• Pedestrianisation as well as promoting multiple uses of streets (including cycling) would improve public space availability (and promote local uses such as communal eating and religious gatherings)</li> <li>• Increase availability of smaller public spaces in closer vicinity to households</li> </ul>



"Kariakoo should get busier with more buildings. More people are good for business. The shops in high buildings should be visible to walkers and easy to reach"

Urban Building Blocks

*A few residents and shopkeepers suggested moving all commerce into high rise buildings with more commercial activities near the ground floor.*

## 6.2.5 Urban Building Blocks

The majority of respondents acknowledged the need for **strategic densification** of Dar es Salaam to **reduce urban sprawl**, preserve natural areas such as Pugu Hills and improve the functioning of the city. As one urban planner summarised, densification is needed to be *‘more efficient, more cost effective and lead to better service provision in terms of cheapness and ease’*. Densification was commented to support liveability through encouraging **walking** as well as improving public presence on streets. Currently, the main impediment to resilient urban forms are the sizes of the plots of land which are a significant determinant of the building typology. **Plots of 20 meters squared** are the current spatial demarcations of development in most wards of Dar es Salaam. Three respondents explained that this size of plot is too small to manage in a coherent manner. However, another respondent claimed that the small plot sizes increased affordability and lowered the financial barrier to land ownership. In congested areas such as the city centre and Kariakoo, this has led to a pattern of **overdevelopment of high rises on small plots** which inadvertently leads to a **lack of public space** and parking. The degree of densification, according to different wards of Dar es Salaam, varies depending on the **identity of the area as commercial, residential, or recreational**. However, there was an agreement amongst respondents to change the **plot size regulation** to shape more resilient urban forms.

---

*“Densification is needed to be ‘more efficient, more cost effective and lead to better service provision in terms of cheapness and ease.’”*

*Respondent 9*

---



Figure 6.12: High rises in the city centre (Kisutu)

In terms of densification, building standards varied by the area and topography. For example, coastal developments are limited in height to preserve sightlines of the sea. On the contrary, central areas such as Kariakoo are required to be high rise as advised by planners. One respondent advised limiting the development of high rises, despite their ability to improve densification, given that high rise buildings can feel too *'anonymous', 'artificial'*, and ineffective due to power cuts. The balance between densification and walkable neighbourhoods with public space can be more economically achieved by promoting **medium rise, high density social housing with less than four or five storeys**. Additionally, three respondents commented on the cost of high-rise developments which makes them counteractive to improve housing and living standards for the majority of residents in Dar es Salaam. To escape the main tension between densifying and the negative impacts of congestion and lack of public space, respondents urged **combining sets of two or three plots whereby densification can also be met with more area for green and public space**. In effect, the economies of scale can be achieved by building more intensely (and higher) on smaller areas of land thus leaving more room for public space.

#### Proposing a new urban form.

- The balance between densification and walkable neighbourhoods with public space can be more economically achieved by promoting **medium rise, high density social housing with less than four or five storeys**.

In Kariakoo and the city centre, densification is at its **carrying capacity** due to building developments being constructed even beyond their allocated plot sizes. This has impeded the efficiency of service provision and come at a cost of availability of public space. One respondent urged optimisation of spatial use in Kariakoo through redeveloping on existing plots of land. More tangibly, they recommended enacting a building code which requires **building on only 50 percent of the plot** leaving the rest for more street space for traffic circulation, economic activities, urban green, and public recreational use. The risk of Kariakoo, Upanga, and the CBD of becoming a *'concrete jungle'* should be mitigated by **limiting building heights to six storeys**. In addition, the historic city centre should be protected by a clear **conservation** policy. Regardless, the central part of Dar es Salaam should retain a degree of high-rise developments as it is the central part of the city and as one respondent commented *'it will continue to represent Dar es Salaam's centre'*. Therefore, development in Kariakoo has exceptional and specific conditions of development as the city's economic and commercial hub. Two respondents suggested the implementation of **skywalks**, which resonate with existing internal passages between buildings, as a remedy to over congestion in Kariakoo. Development in Kariakoo *'sets the tone for the rest of the city'* and according to a couple of residents, they explained *"in the future, all of Dar es Salaam will be like Kariakoo"*. Two respondents recommended combining plots in the centre to be **500m<sup>2</sup>** to form a city block. Due to the 99-year lease system, the government ultimately owns the land and hence, has the ability to enforce combining plots into single block developments. It also serves to force collaboration between the different plot owners to set an agenda

#### Space as a precondition of resiliency.

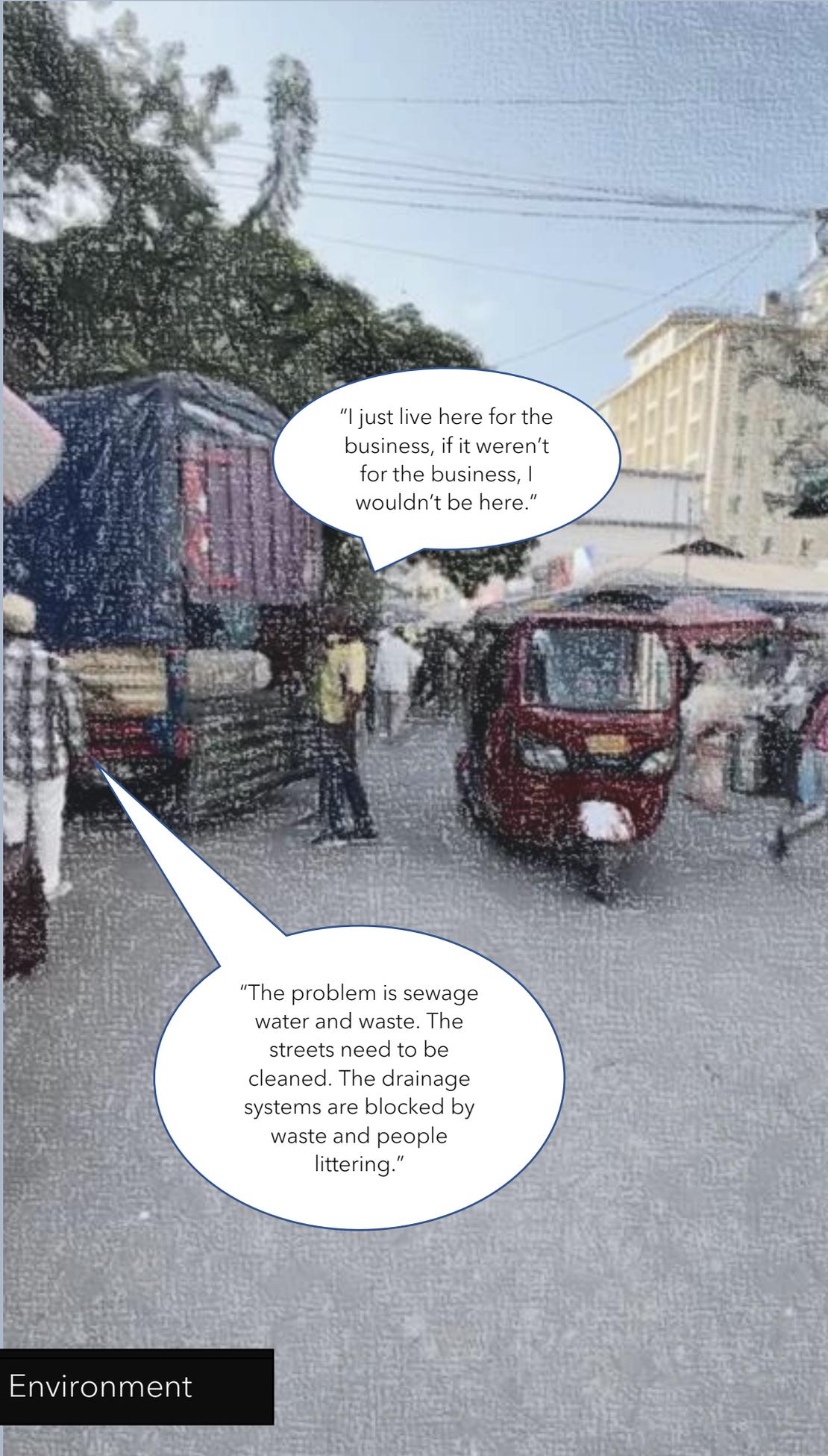
- The availability of space is a precondition for resiliency in terms of diversity, redundancy, and connectivity.
- It is also essential for flexible and adaptive planning.

for a new urban block. These blocks should accommodate more residences and retain **the lower three floors for commercial use**, one respondent described these future blocks as *'high rises with culture'* or *'vertical villages'*. The blocks should **vary in building diversity and heights** to maximise sunlight, ventilation and create a diverse built environment. The block-type development

helps resilience through **making space** which is the ultimate **precondition for resiliency in terms of diversity, redundancy, and connectivity**.

Resiliency is limited by the lack of space in highly developed areas of Dar es Salaam. In stress events, as one respondent listed potential hazards of *'a fire, flood, terrorist attack or heat stress period'*, there is no public space for emergency services, green infrastructure, or even, wide-enough passages for mass mobilisation of residents. The proposal to promote block type developments by combining land plots and limiting the built area within it aims to improve the **availability of public space and accessibility**. The availability of space, in terms of resiliency, is needed **for flexible and adaptable planning**.

Urban Building Blocks	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>• 20 meter squared sized plots have been influential in determining the urban form (in a negative way)</li> <li>• Small plot sizes have led to overdevelopment as well as a lack of public space</li> <li>• Densification is needed for better liveability as well as more efficiency, cost effectiveness and cheaper service provision</li> </ul>	<ul style="list-style-type: none"> <li>• Block-type developments, made by combining smaller plots to be around 400 - 500m<sup>2</sup> meters, will promote densification as well as more public space for urban greening and public use</li> <li>• Enact building codes to construct only on 50 percent of land plots</li> <li>• Limit development of city centre and Kariakoo to be maximum 6 storeys high</li> <li>• Medium rise, high density social housing, with maximum five storeys is optimal building typology for most of Dar es Salaam</li> </ul>



"I just live here for the business, if it weren't for the business, I wouldn't be here."

"The problem is sewage water and waste. The streets need to be cleaned. The drainage systems are blocked by waste and people littering."

## 6.2.6 Environment

Environmentally, seven respondents pointed to **heat stress, pollution and waste, loss of green and flooding** as the main climate stressors for Dar es Salaam in the future. **Drainage, sewage disposal, and polluted groundwater** were pointed out by two respondents as urgent matters which particularly impact the neighbourhood of Sinza. A resiliency approach should be motivated by a '*social and environmental justice*' approach, as one respondent articulated it. This is particularly true given that it was unanimous amongst respondents that informal settlements and **low-income neighbourhoods are the most vulnerable** to environmental hazards especially, heat stress. In the city centre and higher income areas such as Masaki, options to protect against heat stress are prevalent such as cooled indoor spaces with air conditioning. Greenery, efficient drainage systems and limited congestion are specifically found in higher income areas such as Oyster Bay. In addition, the way **heat stress impacts the city is inverted**, as one respondent pointed out that as one leaves the city centre, there is more heat stress. This is due to a lack of green, congested housing, and iron corrugated roofs in more residential informal neighbourhoods. One respondent, who specialises in urban green initiatives in Dar es Salaam, pointed to the need to **increase greenspace density to at least 9m<sup>2</sup> per city dweller** and ideally, 20m<sup>2</sup>. As such, there is a specific lack of green space and vegetation in Dar es Salaam.

Three respondents urged the priority of resilient design to be given to interventions that are '*cost effective and have cross cutting benefits*'. Nature-based solutions should be considered as a water resilient infrastructure as it supports sustainable drainage systems, helps harvest water, and supports cooling the city. Additionally, '*greening the city is cheap and effective*' indicating high value use of investments in resiliency building. One respondent commented that the importance of

### **Nature-based solutions are functionally diverse.**

- Urban greenery is appealing for its ability to support economic activities (cooling markets), enhance residential wellbeing, reduce heat stress as well as limit flooding.
- These 'cross cutting benefits' increase the functional diversity in terms of resilience.

urban greening should be linked to recharging the city aquifer which 30 to 40 percent of residents in Dar es Salaam depend upon. Ultimately, most respondents promoted a bottom-up approach to environmental resilience given that **lower income residents are the most negatively impacted**. Interventions at the **smallest scale are highly effective**. One example given by a respondent, included requiring residents to 'green' or include vegetation at least on 50 percent of their plots such as in Figure 6.13, as part of a building permit or law (which the respondent indicated will be passed by 2030). Additionally, decision-making tools can align strategies of private and public actors such as real estate developers and municipalities to jointly support the greening of the city.



Figure 6.13: Cross cutting benefits of urban agriculture in Namanga

Respondents shared specific conditions for strategic greening including where to green in the larger scope of the city and the right species to maintain biodiversity. For example, one respondent specified the use of **Chrysopogon zizanioides grass species** for the erosion control of road embankments. Additionally, there are technical specifications regarding the distances of planting in proximity to infrastructures of roads, building foundations and sewage pipes. Additionally, overhead infrastructure services such as power lines should be controlled as they infringe with tree and vegetation growth. Two respondents mentioned Sinza's high water table as a barrier to include any nature-based solutions in the neighbourhood as pollution is highly susceptible to spreading during heavy rainfall. In terms of spatial morphology, one respondent recommended prioritising **green along corridors bordering 'fingers of development'**, referring to the main arterial roads and surrounding urban development that led into the city centre. Greening is a low risk and cost-efficient solution which is particularly suited to Dar es Salaam's **subtropical** climate. In terms of the existing morphologies, the location and type of vegetation should be contingent on the space available, air pollution levels, and maintenance budget. Trees in street canyons are effective for pollution uptake, however, counteractively reduce air circulation. In more open and spacious morphologies, the vegetation should be high and thick enough for large deposition in the space whilst still maintaining porosity to allow airflow. Additionally, Dar es Salaam should prioritise greening areas whereby heat stress overlaps with other issues such as air pollution, for example, around bus terminals. **Cross cutting solutions** improve the microclimate whilst simultaneously enhance societal wellbeing. Most importantly, it gives city officials evidence-based rationale for spatial allocation which increases accountability and credibility.

Environment	
Insights	Potential Interventions
<ul style="list-style-type: none"> <li>• Informal settlements are the most vulnerable to climate stress and especially, heat stress</li> <li>• Greening is a cost effective and cross beneficial solution to environmental hazards of flooding and heat stress</li> <li>• High buildings are just as effective as trees in providing shade</li> <li>• Inversed heat stress means that the urban heat island effect worsens further from the centre</li> </ul>	<ul style="list-style-type: none"> <li>• The 'what' and 'where' of urban vegetation should be allocated depending on characteristics of species, presences of issues such as pollution, and ability to maintain the vegetation</li> <li>• Employing small scale greening interventions for the whole city is highly effective (40 percent of land plots to be green) for climate resilience (flooding and heat stress)</li> <li>• 10-20 m<sup>2</sup> greenspace density per city dweller is needed</li> </ul>

## 7 Discussion & Reflection

The **Discussion and Reflection** section includes a set of recommendations based on the insights of the results, lessons learnt during the research process as well as the applicability of the research. It broadly follows the parts of assessment building (Section 4.0), geospatial analysis (Section 5.0) and qualitative analysis (Section 6.0) and within each section, it discusses findings and reflects upon the sub-research questions.

The **Discussion** chapter is grouped by the following subsections. **Implications for Public Space Resiliency** (Section 7.1) builds upon the results to draw certain insights regarding public space resiliency as related to the research questions. **Recommendations for Dar es Salaam** (Section 7.2) is a set of recommendations, in infographic style, for the redevelopment site of the Lower Msimbazi based on results and insights of Parts A, B, and C. **Putting Resiliency in a 'Box' and Assessment Building** (Section 7.3) reflects upon the complications of building a framework to assess public space resiliency and critically assesses the method of selecting criteria to include as part of the framework. **Resiliency as a Fingerprint: Spatially Quantifying Resiliency into Typologies** (Section 7.4) reflects upon the caveats of quantifying and building typologies of public space resiliency. It specially aims to address how the resiliency measurements relate to the real-world circumstances in Dar es Salaam. **'The Real Thing': The Realities of Resiliency in Dar es Salaam** (Section 7.5) reflects upon the methodology of qualitative research as well as the various 'extra' considerations needed to assess resiliency whilst on site in Dar es Salaam. It draws attention to the limitations of used methods, unforeseen resiliency factors, different philosophical treatments of resiliency, and lastly, the potential scopes of intervention. **Applicability & Impact** (Section 7.6) outlines the applicability of the research's methods and results to help urban professionals working on resiliency in Dar es Salaam. **Research Limitations** (Section 7.7) reflects upon the role of subjectivities within research and the process of conducting research in an unfamiliar context.

## 7.1 Implications for Public Space Resiliency

The results from geospatial analysis, expert interviews, and site observations indicated a broad range of insights and potential interventions. In addition, the insights gathered led to a variety of new insights for public space resiliency. **Table 7.1: Resiliency Insights** includes summaries from the main themes from the interview-based research (already included at the end of thematic sections) and builds upon them with the implications of public space resiliency, and hence the original research question.

Table 7.1: Resiliency Insights

Theme	Insights	Potential Interventions	Relationship to Resiliency
<b>Land Economy</b>	<ul style="list-style-type: none"> <li>Land value increases triggers development and gentrification</li> <li>Land values increase based on levels of street network integration to the city centre</li> <li>Lack of affordable housing in an unregulated housing market has contributed to gentrification and low-income residents being driven out of the city centre</li> </ul>	<ul style="list-style-type: none"> <li>Use transport connections to influence integration and hence steer urban development growth (via value increases)</li> <li>Encourage densification up to carrying capacity of the ward in terms of existing service provision, infrastructure and space can offer</li> <li>Typology of affordable housing of four storey high residences optimise affordability and counteract gentrification</li> <li>Private-public investment partnerships as a real-estate tool may enhance community feeling and allow residents to benefit from land economy</li> </ul>	<ul style="list-style-type: none"> <li>The personal networks of communities are a contributor to resiliency as social capital (not just physical space)</li> <li>Affordability is key to maintain communities and retain income streams</li> <li>Integration values can steer other factors which contribute to resiliency such as population density or microclimate</li> <li>There is a threshold of 'sufficient density' before density starts to have reverse and non-linear impact on resiliency</li> </ul>
<b>Spatial Morphology and Integration</b>	<ul style="list-style-type: none"> <li>Overdevelopment and 'unmanaged growth' of urban sprawl has led to stretching of services</li> <li>Monocentric morphology of Dar es Salaam leads to a dependence on the centre as well as an expensive and inefficient transport system</li> </ul>	<ul style="list-style-type: none"> <li>A shift is needed toward polycentricity of the city with many centres or 'nodes'</li> <li>Mass public transport should be invested in, namely, the Bus Rapid Transit Network</li> <li>A ring road should be constructed to alleviate pressure on the centre of the city, Kariakoo</li> <li>Funding and investment should be steered away from the centre of the city towards the outskirts</li> <li>Satellite cities should be dense 'mini-cities' and form the centres of different municipalities of Dar es Salaam</li> </ul>	<ul style="list-style-type: none"> <li>More economic centres increase redundancy (and by extension, resiliency)</li> <li>Transport systems and integration are limited by affordability (physical infrastructure needs to be met with economic access)</li> <li>Resiliency of the city as a whole system varies from resiliency of a ward on its own</li> </ul>

<p><b>Governance and Communication</b></p>	<ul style="list-style-type: none"> <li>• Lack of transparency, accountability, strategy in current urban governance</li> <li>• Lack of communication has meant initiatives such as urban greening have no community buy-in</li> <li>• Cultural attitudes influence potential urban development patterns such as preference to live on land rather than apartment</li> </ul>	<ul style="list-style-type: none"> <li>• Bottom-up planning decisions with consistent community involvement is essential for inclusive planning</li> <li>• Focus on the neighbourhood unit for consensus on development strategies</li> <li>• Increase data collection via community engagement to inform planning and risk decision making</li> <li>• Legal and economic instruments in combination with communication can help influence cultural attitudes</li> <li>• Develop and define a city-wide strategy of development and enforce regulation</li> </ul>	<ul style="list-style-type: none"> <li>• There is a hierarchy of resiliency factors to residents (accessibility is more important than microclimates)</li> <li>• Cultural factors influence spatial resiliency factors such as densification (cannot be abstracted from the cultural context)</li> <li>• Resiliency should be defined alongside the strategy of the city (Defining what kind of city Dar es Salaam is informs the type of resiliency criteria prioritised)</li> <li>• Inclusive and Integrated resiliency qualities can be a limiting factor to other spatial resiliency criteria</li> </ul>
<p><b>Public Space</b></p>	<ul style="list-style-type: none"> <li>• Public spaces are economic and living spaces</li> <li>• Informal vending, albeit beneficial for residents, have negative spill over effects such as waste and congestion</li> <li>• Private and public spaces blend, especially in informal settlements.</li> <li>• The street is the most significant and used public space</li> <li>• Informalisation of formal planned areas and vice versa is occurring in Dar es Salaam</li> </ul>	<ul style="list-style-type: none"> <li>• Informal uses of streets should be included in plans using adaptable/flexible design however, more regulation and control is needed to mutually benefit vendors, residents, and the municipality whilst minimising traffic and waste</li> <li>• Pedestrianisation as well as promoting multiple uses of streets (including cycling) would improve public space availability (and promote local uses such as communal eating and religious gathering)</li> <li>• Increase availability of smaller public spaces in closer vicinity to households</li> </ul>	<ul style="list-style-type: none"> <li>• Resiliency factors can contradict each other (such as economic activity with accessibility in the case of street vending and congestion)</li> <li>• Connectivity is essential to walkability and promoting access to public spaces in proximity to places of work/living</li> <li>• Building density and diversity define the public spaces available in an area</li> </ul>

<b>Urban Building Blocks</b>	<ul style="list-style-type: none"> <li>• 20m squared sized plots are key to determining the urban form (in a negative way)</li> <li>• Small plot sizes have led to overdevelopment as well as a lack of public space</li> <li>• Densification is needed for better liveability as well as more efficient, cost effective, and cheaper service provision</li> </ul>	<ul style="list-style-type: none"> <li>• Block-type developments, made by combining smaller plots to be around 400-500m<sup>2</sup> meters, will promote densification as well as more public space for urban greening and public use</li> <li>• Enact building codes to construct only on 50 percent of land plots</li> <li>• Limit development of city centre and Kariakoo to be maximum 6 storey high</li> <li>• Medium rise, high density social housing, with maximum five storeys is optimal building typology for most of Dar es Salaam</li> </ul>	<ul style="list-style-type: none"> <li>• Density is a contributor of public space resiliency until issues of congestion arise (Kariakoo)</li> <li>• Land use policies indirectly set the tone for urban form, in this case, small plot sizes</li> <li>• Availability of space is a precondition for any criteria of public space resiliency as well as ensuring space for adaptability in the future</li> </ul>
<b>Environmental</b>	<ul style="list-style-type: none"> <li>• Informal settlements are the most vulnerable to climate stress and especially, heat stress</li> <li>• Greening is a cost effective and cross beneficial solution to environmental hazards of flooding and heat stress</li> <li>• Inversed heat stress means that the urban heat island effect worsens further from the centre</li> </ul>	<ul style="list-style-type: none"> <li>• The 'what' and 'where' of urban vegetation should be allocated depending on characteristics of species, presences of issues such as pollution and ability to maintain the vegetation</li> <li>• Employ small scale greening interventions for the whole city is highly effective (40 percent of land plots to be green)</li> <li>• 10-20m<sup>2</sup> greenspace density per city dweller is needed</li> </ul>	<ul style="list-style-type: none"> <li>• Urban green is functionally diverse given its ability to mitigate several environmental hazards</li> <li>• Urban green can impede the positive microclimate (ventilation) if placed in specific urban environments</li> </ul>

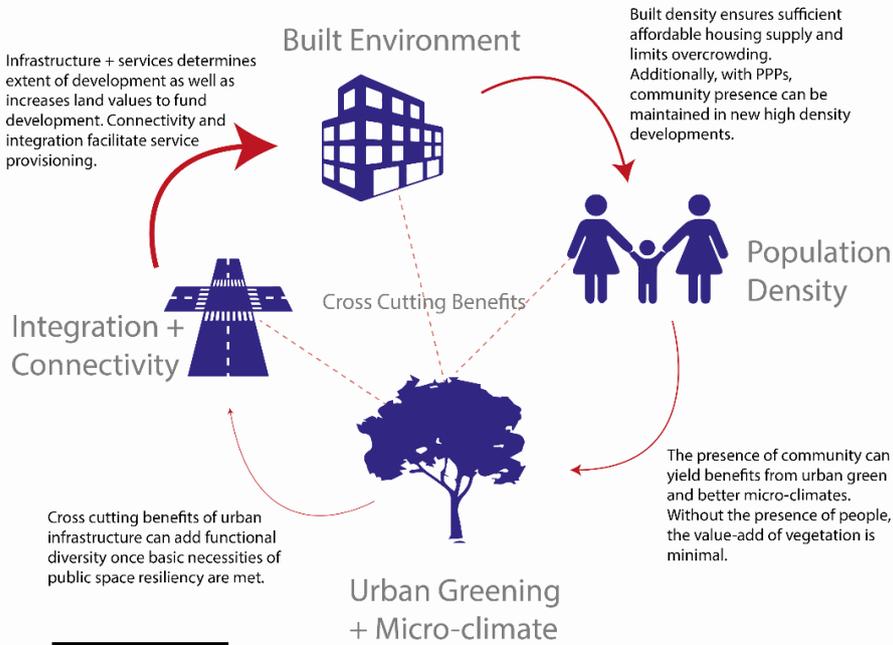
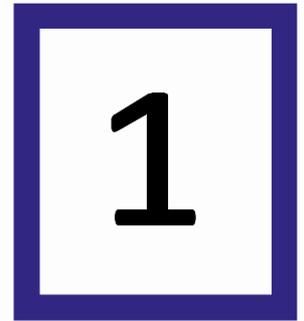
## 7.2 Recommendations

The recommendations are outlined and illustrated in infographics as seen in Figure 7.1, Figure 7.2, Figure 7.3 and Figure 7.4.

Figure 7.1 explores the recommendation to adopt a particular priority of interventions given the relationships between different resiliency factors. Figure 7.2 outlines the morphological changes needed for improved resiliency and proposes a polycentric 'circus tent' type of decentralised distribution of density. Figure 7.3 explores the development of a new type of urban block in the Lower Msimbazi Redevelopment Plan which serves to improve public space resiliency with medium rise, high density, and mixed-use buildings. Figure 7.4 proposes a hierarchy of mobilities in line with the creation of new public spaces.

# Recommendations

## Priority of Interventions

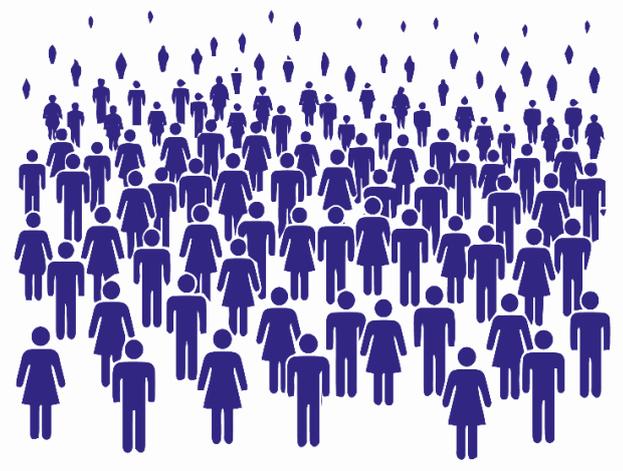


### What?

In terms of spatial criteria, the relationship between various factors of resiliency need to be accounted for to avoid over stretching services, congestion, lack of affordable housing and hence gentrification. Ideally, all interventions will be enacted at the same time however, in a context of incremental change and limited resources, certain factors such as transport infrastructure (which supports service provision and economic mobility) as well as built density (for affordable housing) can be prioritised.

### Why?

Certain spatial changes are very difficult to enact if not in order. For example, building drainage infrastructure in a very densely built area can be expensive and cost-inefficient. More importantly, resiliency is heavily influenced by people's networks and not just space. And so, efforts to retain affordable housing and avoid relocation is essential to maintain community networks. Additionally, functionally diverse interventions such as urban greening are cost effective and hence, should be considered as a fast way to improve resiliency. .



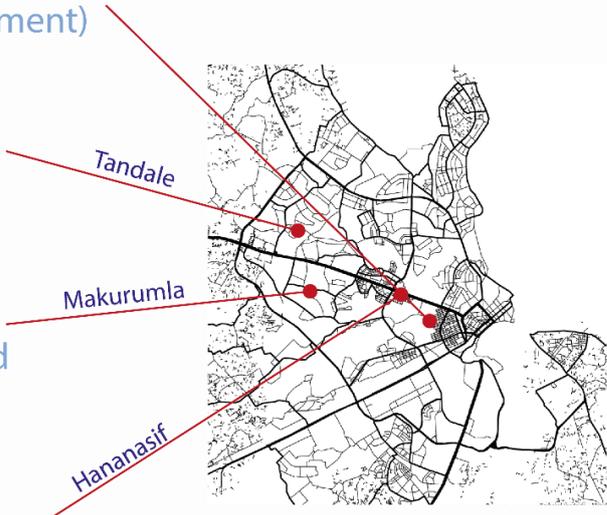
### Where?

New Developments (Lower Msimbazi Redevelopment)

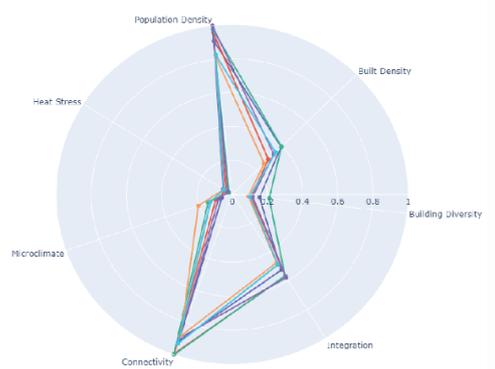
Informal Settlements

High Population in combination with Low Built Volume and Integration

Historic Communities



Typology of Low Integration, High Population with Low Built Density

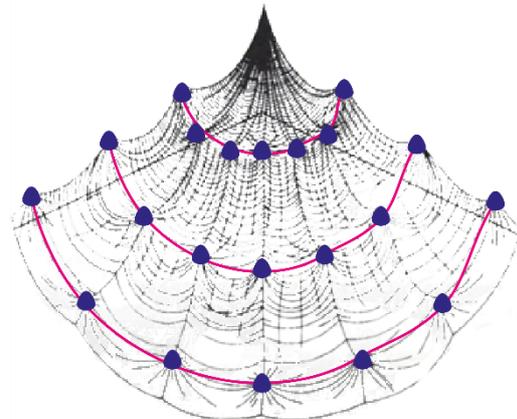


# 2

## Recommendations The Polycentric Circus Tent

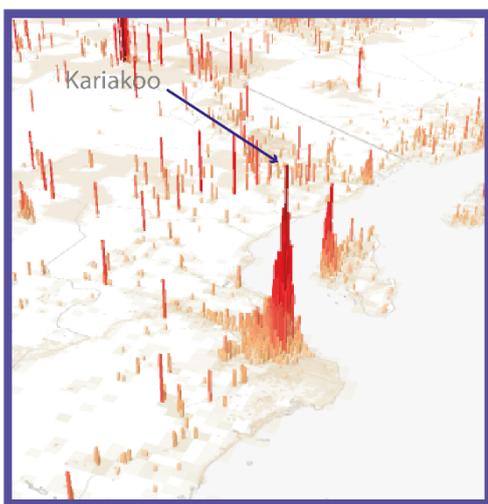
### What?

Shift urban development away from the centre, namely Kariakoo, to satellite cities or 'nodes'. Polycentricity can be achieved by reinforcing and enhancing ring roads and building more arterial roads linking centres between themselves (infrastructure triggers land development). Density, in terms of built volume as well as population, should be distributed as a circus tent model, increasing closer to centres and subsiding further from nodes.



Circus Tent of Density with Ring Roads

Dar es Salaam's Monocentric Population in 3D



### Why?

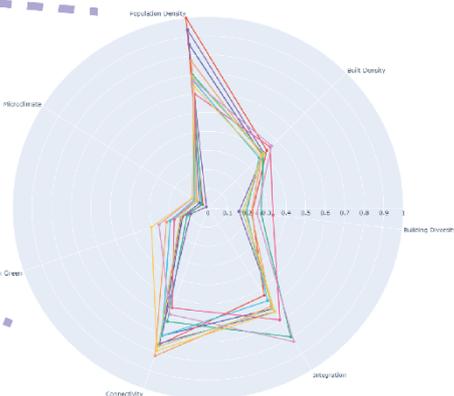
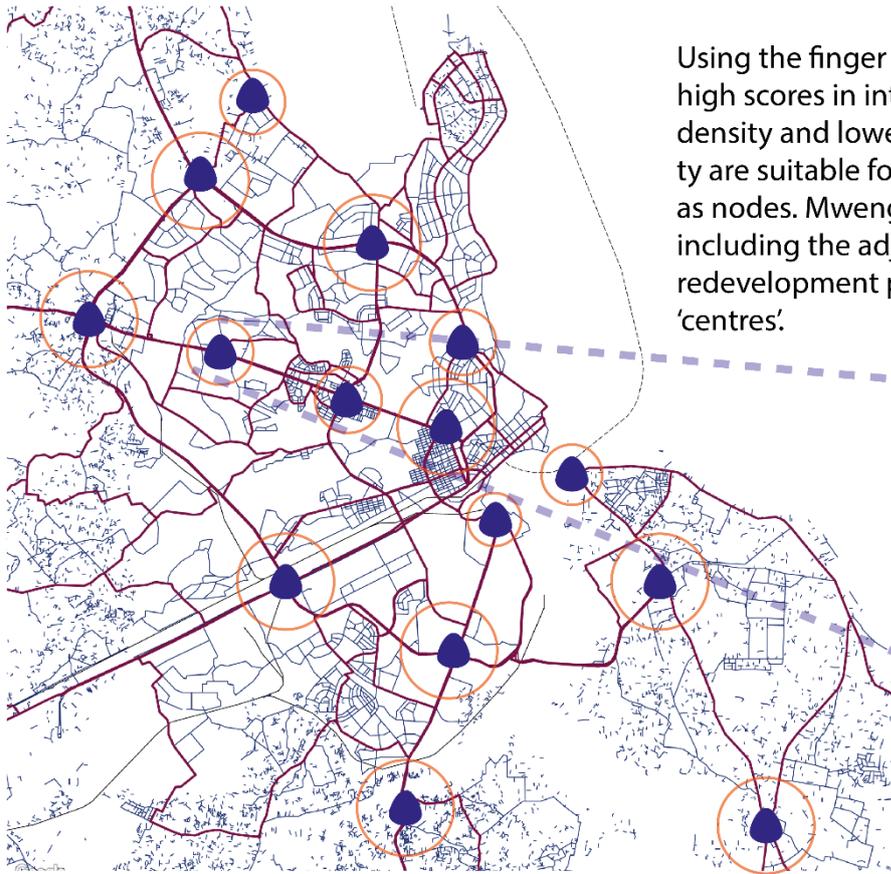
More populated and commercial centres increase diversity, redundancy and by extension, resiliency. Public infrastructure improves access to already existing arterial connections in an affordable way. The resiliency should be approached from a city wide, not just sub ward, scale.

Network Redundancy 

Reliance on Kariakoo 

Using the finger print typologies, with high scores in integration, population density and lower scores in built density are suitable for further development as nodes. Mwenge, Upungu, Kariakoo including the adjacent Lower Msimbazi redevelopment project are suitable 'centres'.

### Where?



Resiliency Fingerprint of Manzese

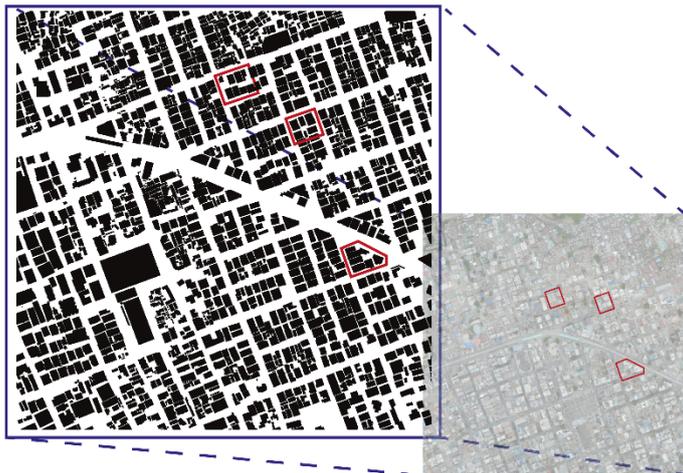
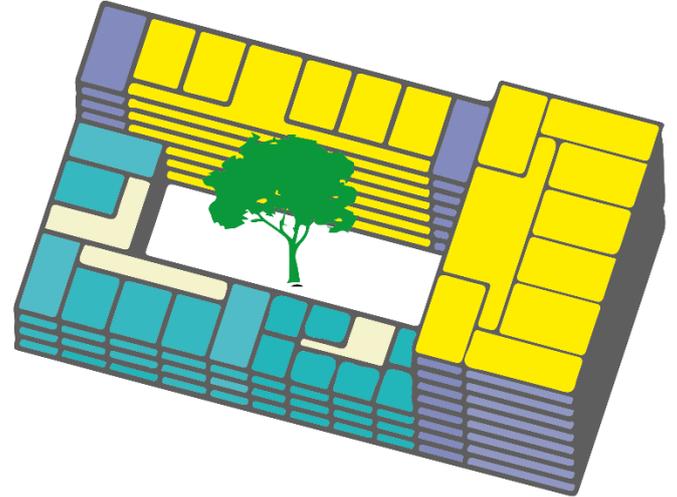
# Recommendations

## Densifying to New Urban Block



### What?

Block-type developments, especially in the Lower Msimbazi redevelopment plan, made by combining smaller plots to be around 500 m<sup>2</sup> meters, will promote densification as well as more public space for urban greening and public use. These new blocks are mixed use developments which densify whilst promoting availability of public space.



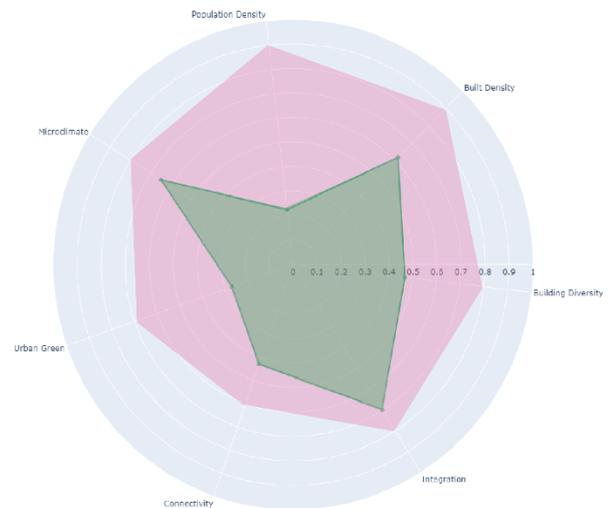
Combining existing plots of land into blocks.

### Where?

Medium rise, high density social housing, with maximum five storeys is an optimal building typology for most of Dar es Salaam. The development of the city centre and Kariakoo should be a maximum of 6 storeys high in line with available service provision.

### Why?

The New Urban Block tackles the criteria of resiliency by improving availability of space, a precondition for flexible and adaptive planning for most factors. Additionally, built area would occupy only less than 60 percent of the plot of land. Blocks can mimic the community or neighbourhood unit, especially if combined with innovative public-private partnerships to develop land in collaboration with local landowners.



The New Urban Block (red) improves the resiliency potential of neighbourhoods in Dar es Salaam.

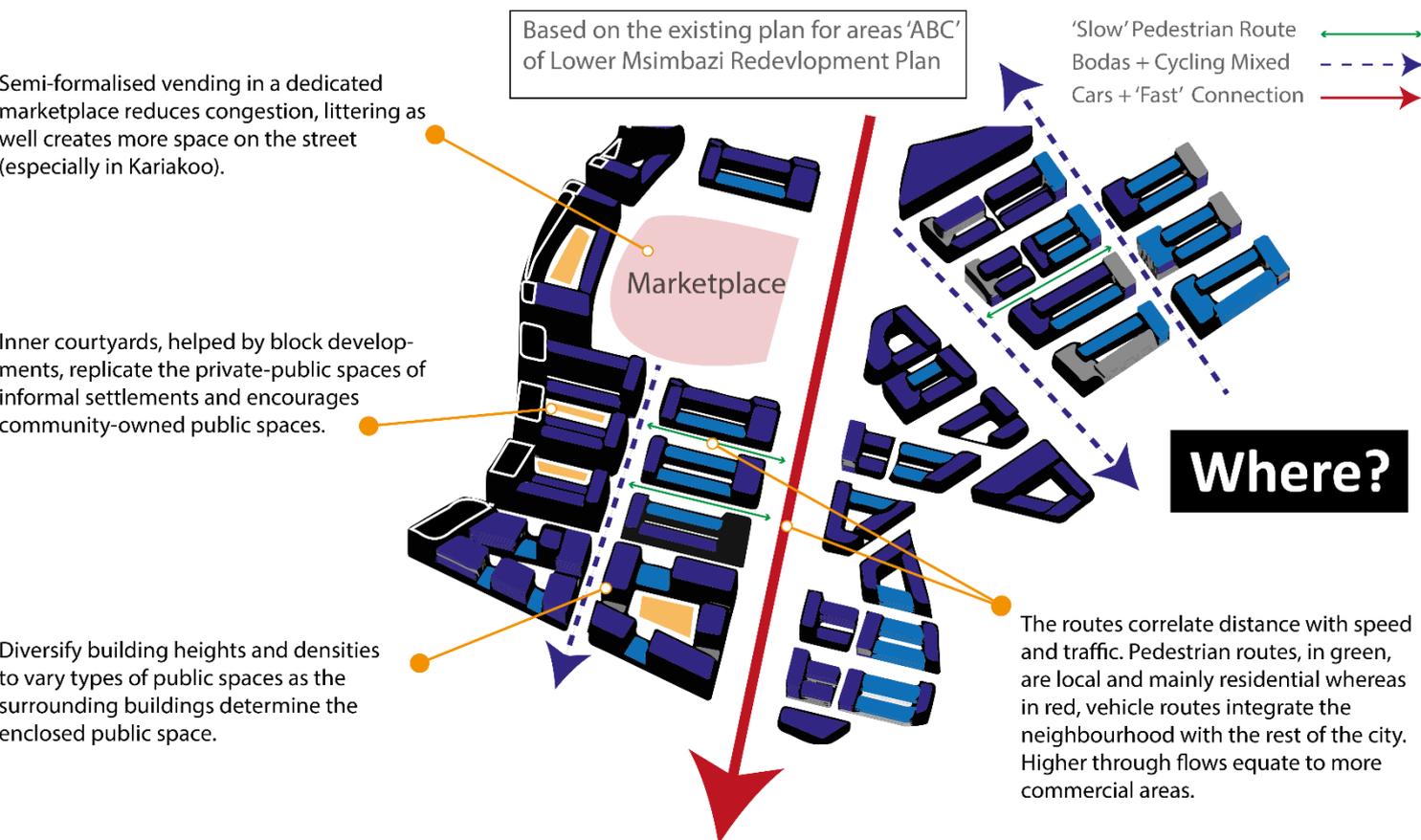
# Recommendations

## New Public Space



### What?

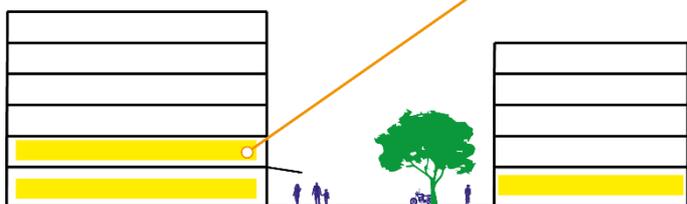
Public spaces, namely streets, in the new urban areas of the Lower Msimbazi redevelopment project should resemble places that are flexible, spacious and wide, pedestrian friendly for community feeling, yet integrated with the wider street network of Dar es Salaam. Added space on streets improves adaptability and potential for greening. Additionally, for improved resilience, public spaces should be ubiquitous favouring many smaller spaces rather than few, larger public spaces. Informal vending ought to be given dedicated spaces both to limit overcrowding, waste disposal as well as formalise the informal sector to give access to capital and mortgages. Lastly, the diversity of the population is essential to promote societal integration and hence, developments ought to mix affordable and high end housing in close proximity for a resilient public space.



### Where?

### Why?

Commercial ground and first floors help contribute to the mixed type of developments which help residents 'live close to work'.



More space in wider streets allow for functionally diverse and cross cutting benefits of urban green on the streets.

After 'making space', the aim is to retain community ownership over public spaces and avoid over programming their uses. The networks of residential communities should be enhanced by the built form and actively contribute to the street life. In this case, the layers of networks within the immediate neighbourhood, larger ward and the city is related in different mobility routes: slow, medium and fast which both improves resiliency through internal connectivity as well as higher scale integration.

## 7.3 Putting Resiliency in a 'Box': Reflections of Part A and Building an Assessment Framework

To answer Sub-question 1 (“What methodology can be used to assess public space resiliency?”), a framework was built to conceptualise public space resiliency in a spatial, quantifiable, and holistic manner.

### 7.3.1 A Novel Approach to Assessment of Public Space and Resiliency

As compared to other industry-standard urban resiliency frameworks such as Rockefeller and Arup’s City Resilience Framework (The Rockefeller Foundation 2014), the public space resiliency framework (PSRF) specifically focuses on criteria which directly contribute to creating healthy and vibrant public spaces. In this sense, it adopts a resiliency framework that can be applied to the scale of the neighbourhood rather than city-wide assessments of resiliency. In addition, it focuses on factors which contribute to resiliency of public space rather than general criteria which contribute to the general functioning of a city such as housing affordability which are beyond the spatial scope of public spaces such as streets. In addition, it translates factors which contribute to resiliency such as connectivity, diversity, and redundancy, to criteria that contributes to resilient public spaces. The PSRF is specifically a framework for resilience rather than a generic public space framework. Lastly, it takes an extra step in ensuring the measurability of spatial criteria which gives it an applicable quality. As such, it uses methods similar to Forgaci (2018) to translate more conceptual qualities into concrete and measurable criteria that can be spatially assessed in Dar es Salaam. Despite the concise approach to measurability of criteria, it still retains a holistic approach to resiliency including factors such as environmental comfort under the same framework as street network integration. In this way, it conceptually opens up to assess potentially unlikely relationships with other types of data such as demographic records with microclimatic records. Authors such as Ergün (2020) have similarly developed holistic frameworks to integrate different dimensions of public space. However, the PSRF further develops it by integrating space syntax methods with other measurements when mostly in broader literature, space syntax as an approach is seldom integrated with other types of data (especially in terms of resiliency).

### 7.3.2 Scalability

The framework is weaker in terms of small-scale, specific applications of public space assessment. Given its spatial data application, it lends itself to large scale applications and comparisons. In this case, it is helpful to measure over 300 sub wards of Dar es Salaam. However, if one were interested in investigating a specific public space or street, the data is not as valuable as on-site assessment of the area. In this sense, it is resource efficient to quickly analyse many different spaces and perform a comparative analysis. However, in terms of specific applications on a smaller scale (a particular street), better and higher resolution data may be obtained on site.

### 7.3.3 Specificity

The framework risks overbiasing certain high density urban developments given that a few criteria are already correlated. For example, in most cases, built density correlates with population density. However, in this case, informal settlements countered this relationship with low built volume and high-density areas. In addition, the process of building the PSRF required compiling and synthesising different academic understandings under more general umbrella themes. For example, there is extensive and specific considerations of accessibility within cities in terms of street design, income-levels, and disabled access to name a few. The process of capturing significant, literature-based, qualities of public space resiliency required removing such concepts from their original research

context and grouping them broadly with similar themes. At points, the terms can be relatively nebulous leaving a degree of linguistic interpretation, for example, being ‘connected’ versus ‘accessibility’. This risks overgeneralising concepts to the extent that their rigour and meaning is lost. The slight benefit of an approach of broad consultation is the different academic discourses from a variety of disciplines influence the framework criteria. The difficulty of using a spatial framework is that the spatial factors, which are always mediated by other forces in the city, are proxy criteria which means the relationship between the indicator and original interest is less direct. For example, population density is used as a proxy for social vibrancy. However, this relationship is mediated by other factors such as safety or presence of amenities which are not included in the framework. Given that measurability was a criterion of selection, unmeasurable yet significant factors such as perceived safety are missed. Additionally, certain drivers of spatial resiliency can be not spatial such as land policy which are missed in this analysis. The PSRF captures criteria ‘late’ in the process of urban transformation, once they are spatially manifested. This questions at what stage of urban transformation does the framework inform; planning, design, or transforming existing urban environments. However, since geospatial criteria are central to the framework, the PSRF may be more relevant for urban transformation of existing urban fabrics.

#### 7.3.4 Thresholds and General Relations of Criteria

Lastly, there is a linear relationship implied between resiliency factors and their influence on public space. As seen in Kariakoo, built density is important for public space resiliency up to a certain extent until services are overstretched. On the one hand, using specific levels of density prescribed in literature such as ‘225 people per hectare’ (Jacobs 1961), may serve as a useful caveat to the implied linear and positive relationship. However, there is an even greater risk attached to using specific thresholds that are defined in other urban contexts. For example, the optimal density of 225 households per hectare, was not conceived in a context whereby basic service provision such as waste collection and drainage systems are lacking, as they are in Dar es Salaam. The dependent relationships of certain criteria are not accounted in the PSRF. For example, connectivity is only a positive contribution to resiliency if an area has a high perceived safety, This positively contributes to a more flexible application of the framework to the Dar es Salaam context however, it risks over or under exaggerating the presence of resiliency in specific neighbourhoods. Therefore, local validation and qualitative research is essential to assess these relationships and dependencies which may not have been captured in the framework.

### 7.4 Resiliency as a Fingerprint: Reflections of Part B and the Process of Spatially Quantifying Resiliency into Typologies

To answer Sub-question 2 (“**What is the existing resiliency of public spaces in central Dar es Salaam?**”), geospatial analysis using ArcGIS software as well as Python was used to measure, geo-process and visualise the public space resiliency framework. The ‘resiliency fingerprint’ is a reference to the resiliency radar **charts** which act as a quick identifier to a ward’s overall qualities of resilience. The aim was to gather, on a ward-by-ward basis, how various public space resiliency criteria are performing and to assess a pattern or typology of resiliency.

#### 7.4.1 Comparability of Resiliency Scores

In terms of resiliency criteria, the normalisation of values is useful to compare different criteria. For example, Magomeni, on average, scores 0.6 for population density which is similar to its score of 0.5 for building density. This allows for a comparison of scores between wards; for example, Magomeni is

average in its building density compared to other wards in Dar es Salaam. It also allows for a comparison of different criteria such as its building density is similar to its population density score. However, criteria are always more accurately compared to the same criteria. For example, comparing the scores of connectivity across different wards. Given the thematic nature of the resiliency framework, comparing scores between very different factors such as the microclimate and road network integration is not rendered very useful in terms of the original meaning of the scores. In another sense, comparing the scores are only useful to understand how resilient the performance is within its own criteria's dataset. For example, it has an above average population density and connectivity score. Logarithmic transformations, applied to skewed data, additionally manipulates the original values of data which make it less interpretable in terms of its original measurements, for example, it changes how a score of 0.2 of microclimate relates to surface temperature in centigrade. The reliability of a resiliency score is weakened by the lack of other dependent factors. For example, Upanga performs in the top 10 percentile of integration to the rest of the city street network however, there is a factor of affordability to indicate whether the street infrastructure, albeit good, is extensively used. There is a lack of geospatial datasets such as household income and access to healthcare, as also pointed out by several respondents. Therefore, resiliency scores should always consider other potentially 'invisible' factors that would be significant. On this note, the calculation of resiliency scores does not account for relationships between various criteria. Therefore, it may give a false impression that interventions to improve certain criteria do not come at the adverse expense of reducing the resiliency scores of other criteria. For example, highly developed areas such as Sinza experience higher levels of heat stress, perhaps due to its built density and presence of corrugated roofs in informal areas. However, tackling the poor performance of microclimate does not account for potential indirect impacts on reducing spaces for the local economy and impeding connectivity. The worthwhile trade-offs between various criteria require deeper qualitative knowledge of the specific ward before recommending any resiliency interventions.

#### 7.4.2 Reproducibility and Interpretability

On a more practical level, the geospatial analysis and processing was conducted using proprietary software, ArcGIS Pro. This is a limitation in terms of reproducibility as it requires a paid version of ArcGIS. However, geoprocessing steps are recorded and described in detail in Table 5.1 which can be reproduced using free software such as QGIS with only minor adjustments in tools. The added advantage of ArcGIS Pro is the speed of analysis and ease of use of the software when dealing with large datasets. For Python visualisations of the radar charts, also referred in this research as 'fingerprints', the code is accessible as a public repository in GitHub and found in Section 11.3, Appendix 3. The visualisation of resiliency in radar charts is highly interpretable and intuitive to grasp the distribution of resiliency criteria on a ward basis. In addition, it allows to identify patterns more easily as shapes and sizes are more in line with visual interpretation than comparing ratios or numerical scores. In this way, the radar charts are highly effective at performing their task, providing a quick interpretation and an easily identifiable 'fingerprint' of resiliency. However, it should be noted that the orientation of criteria greatly shifts the shape of the radar chart which is shown in Figure 7.5. Interpretations of typologies of resiliency should consider the variability, and be aware of the shapes as only a tool for interpretation rather than carrying any intrinsic meaning to resiliency.

Figure 7.5: Resiliency Fingerprints of Kinondoni with clockwise (left) and counter clockwise (right) orientation



### 7.4.3 Proxy to Reality

The quantitative analysis is foremost a representation of reality and aid to understand the factors that influence the public space of a particular area. For application to the real-world, the resiliency measurements and scores, in terms of thresholds or weights, should be calibrated to the specific context of application based upon on-site evidence. The resiliency measurements, in this research, is especially strong for a city-wide scale analysis of resiliency (denoting ‘fingerprints’ for all wards of central Dar es Salaam). However, it is at the expense of high resolution, up-to-date and ward specific data validated by local knowledge. The resiliency performances require a qualitative step of spatial validation. For example, as seen in Figure 7.7 showing the resiliency fingerprint of Jangwani including the sub ward of Mtambani B’ which excels in urban green. This may suggest spatial interventions in other sub wards in Jangwani to follow in its example. However, the high greenery score does not show the flood-prone land of Lower Msimbazi upon which it is risky to develop any urban area as seen in Figure 7.6. Additionally, the identity and local knowledge of a ward is pivotal to contextualise the typology of resiliency fingerprints. For example, a purposefully zoned industrial area performs completely differently in terms of its resiliency criteria (often very poorly) however, its identity and role as an industrial zone are to fulfil a specific purpose. This relates to the appropriate scale to measure resiliency – as a whole city or within a ward. As demonstrated, each ward may play a specific role within the larger network of the city, similar to how the majority of Dar es Salaam relies heavily upon Kariakoo for its commercial activities. The relationships between the wards and their identities are essential pieces of qualitative information which can render the resiliency fingerprints more useful and take resiliency beyond just the sum of its individual parts or criteria.

Figure 7.7: Resiliency Footprint of Jangwani

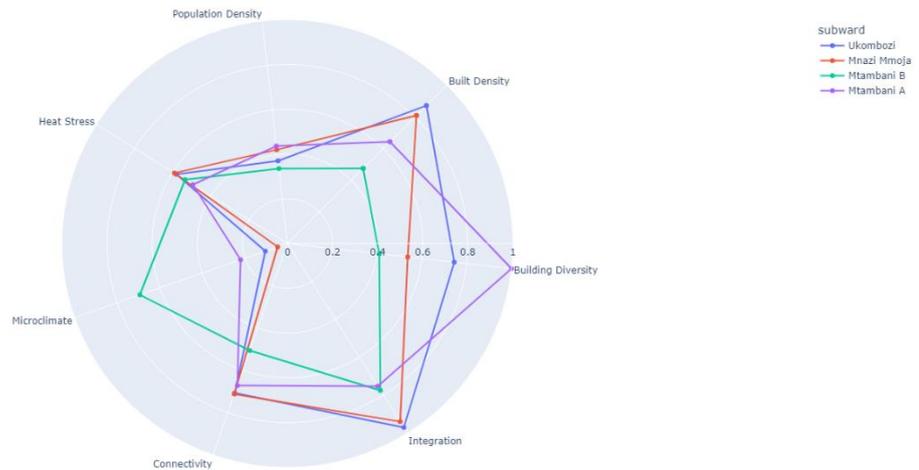


Figure 7.6: Image of Mtambani B, Jangwani with flood prone land of Lower Msimbazi in the foreground



Reverting to Sub-question 2, “What is the existing resiliency of public spaces in central Dar es Salaam?”, the resiliency fingerprints were effective in identifying typologies especially within wards. The performances of resiliency did reflect the ‘real-life’ case, as was validated with Tandale in its high density, low built volume, and high connectivity network. The fingerprints, albeit a slight abstraction of resiliency, provide an intuitive and easily interpretable way to understand a ward’s relationship to public space resiliency and hence, potential areas for improvement. However, the limits of its use are important to consider as there are relationships outside of the scope of the research which are deeply influential to the resiliency performances such as land use policy. There are correlations and relationships between various criteria, mediated by certain non-tangible factors, which are important to understand. Therefore, the quantitative resiliency assessment effectively answers the *ways* in which various wards’ public spaces are resilient however, it falls short of answering the *extent* of the resilience. The latter requires a deeper, qualitative, and contextual understanding of resiliency in all its complications and caveats.

## 7.5 'The Real Thing': Reflections of Part C and Synthesising the On-the-Ground Complexities of Resiliency in Dar es Salaam

To answer Sub-question 3 (“**What are the main factors influencing public space resiliency performance?**”), ethnographic research combined with in-depth interviews with professionals in the urban development sector were conducted. The aim of the expert interviews and ethnographic research, including neighbourhood tours and photo-voice observations, was to gather a holistic picture of public space resiliency in Dar es Salaam including other factors not included in the original framework.

### 7.5.1 The Generalisability of Interviews

Expert interviews have the added advantage of building upon and synthesising a whole host of experiences including interviewees’ past research. In a sense, it culminates the most urgent and significant points of interviewees’ experiences and perspectives, which itself, is based upon empirical evidence or past research. However, the disadvantage of this approach is a potential abstraction of resiliency. Many points of interviewees were ‘easier said than done’ especially relating to governance, for example, the ‘government needs a stronger strategy’ or ‘bottom-up approaches are needed for community buy-in’. These points are inevitably true and insightful; however, the level of detail was limited and did not always include a practical approach to public space resiliency. This is with exception to discussion of land policy and the creation of new urban building blocks which were the most tangible considerations of resiliency. Given the limited time in Dar es Salaam (five weeks), this approach built upon expert experiences and their local insights rather than attempting to gather a representative sample of residents in Dar es Salaam. Attempting to ‘integrate’ myself to understand the nuances of the local context would have been less effective and may have presented more issues given my position as an external researcher and a resident abroad. The qualitative insights are potentially biased based on the professional background or field of expertise of interviewees, who are by and large, urban development academics and practitioners from middle to upper class socio-economic backgrounds. This reduces the generalisability of the insights gathered on ‘local attitudes’. There is no ‘local’ in such a diverse and large population in Dar es Salaam and the homogeneity implied by ‘local’ can be misleading. Lastly, many casual discussions with residents, especially during neighbourhood walks, did not explore resiliency explicitly. As a result, the relationship to resiliency, based upon gathered insights and evidence, is inferred by me as a researcher. This risks ‘over-interpreting’ interviews in terms of how they relate to public space resiliency.

### 7.5.2 Non-Spatial Factors

Numerous factors, not originally included in the resiliency framework, were found to be especially significant to consider. This effectively addresses the original sub research question 2, indicating that there are several non-spatial factors such as the land economy and urban governance which play an important role in resiliency. For example, the political dimension of resiliency was clear upon observing a discussion of Tanzanian government officials who discussed the political risk and damage to the reputation of the residing political party for a particular urban development. These non-spatial insights are extremely helpful to contextualise the decision-making process surrounding resiliency. However, it is difficult to link certain non-spatial factors such as political communication or land policy to the spatial remit of the PSRF. Within the context of this study, it is helpful to consider these criteria as significant factors but on a more practical basis, it was difficult to include them fully in the analysis.

### 7.5.3 Underlying Ethical and Philosophical Perspectives

An underlying philosophical approach to resiliency is essential to uncover pivotal questions relating to the resiliency of public space in Dar es Salaam. On one level, what temporal context do urban professionals and academics look to improve the resiliency of an environment – for the current needs or the future needs of residents? In Dar es Salaam, as many respondents mentioned, housing is unaffordable and access to basic services such as clean water and waste collection is lacking, especially in informal settlements. It raises the question, when approaching resiliency, of whether to prioritise resources to maximise benefits for residents' needs currently or develop an urban environment that has less essential yet higher quality standards in the future such as green public spaces (which are presently not essential). It is important to reflect upon these ethical questions as it directs the priority of interventions depending on their intended impact of resiliency, and for when. Additionally, when considering the interventions to improve resiliency, respondents considered different political and economic systems to operate within. For example, one respondent suggested strategic ways to work within the limitations of the unregulated housing market whilst others implied a more utopic context whereby regulation and governance was extremely effective. Political alignments influenced respondents' perspectives on resiliency. A few respondents inferred the omnipotence of municipalities to enact whatever plan in a top-down manner whilst others, pointed more towards free-market interventions such as market-based incentives to green private land. Understanding and defining an ethical approach to resiliency is important to also define a hierarchy of resiliency criteria. There are limited resources in urban development and hence a need to prioritise areas of impact. Additionally, there are contradictions between resiliency criteria. For example, one respondent pointed to a contradiction between wide streets for accessibility yet more narrow streets for better microclimates. To add on, high rise buildings seem to have more impact, according to some respondents, on heat stress than greening. Yet, these tensions and contradictions need to be decided upon based upon the value of each criterion and their area of impact. In another sense, decision makers should be able to say, as an example, accessibility is a priority to general urban resilience as it brings the highest impact to increasing income levels of residents. Resiliency is an incredibly complex and rich field of interest due to these tensions and contradictions and so, developing an ethical undertone of resiliency will shape a more solid basis to deal with inevitable decisions.

### 7.5.4 Scope of Intervention

The scope of intervention heavily determines which factors of resiliency to consider and hence, what are the potential ways to improve public space. Respondents pointed to different tools of interventions ranging from design to policy. However, adding to the difficulty to define a scope of intervention, defining the scale of resiliency is just as important. For example, improving the resiliency of Sinza as a ward is remarkably different to improving the resiliency of the city as a whole. In the case of Kariakoo, whereby the ward plays a role as a commercial hub in the wider city, it becomes even more pivotal to define. To complicate matters further, the approach to resiliency is different for new developments as compared to existing areas. As one respondent mentioned, the 'cost of our mistakes are permanent' referring to the influence of past planning mistakes. Addressing the scope, scale and space of resiliency is essential to contextualise the findings of this research and future research on resiliency.

### 7.5.5 Resiliency for Who?

Upon discussing the social insurance networks within informal settlements, it was revealed that resiliency as a spatial factor differs from the resiliency of communities and networks of residents. The relationship between spatial and community resiliency coalesces in many ways and should be further researched. However, appreciating the role of community resiliency, in terms of social capital (Abdul-

Hakim 2010), is highly significant to any spatial resiliency discussion. In Dar es Salaam, a city with high social and spatial inequality, addressing the ‘resiliency of where and for who?’ is essential to adopt a social and spatial justice approach.

As demonstrated, the richness of qualitative research is clear in the space of resiliency. Especially given the importance of local context, expert interviews and ethnography grants many nuances and caveats to resiliency. These should be embraced by researchers to expand resiliency as beyond just an abstraction and quantifiable entity to an all-encompassing concept that is grounded in its context.

## 7.6 Applicability & Impact

This research, in spite of its specific focus on Dar es Salaam, proposes a methodology of resiliency assessment which can be applied to other rapidly urbanising cities in Sub-Saharan Africa. In this sense, it makes an extremely modest contribution to research relating to resiliency in developing urban contexts.

In terms of impact, the research is inspired by the Lower Msimbazi Redevelopment Project initiated by PO-RALG. As the current design and masterplan is iterated and developed by DASUDA, insights gathered from the public space conditions of surrounding wards to the project site can inspire new perspectives on the detailed urban design of the newly built area.

Additionally, the geospatial analysis on a Mtaa and ward level may serve as a useful tool for researchers in Ardhi University and by extension, municipal decision-making. It makes a humble contribution to the data-gap of geospatial information of Dar es Salaam – an issue frequently mentioned by professionals in the city.

As an open-source and publicly available piece of research, it will be shared with professionals in the urban development space of Dar es Salaam and may add to, in a miniscule way, current thinking on the city, which in its rapid development requires updated research insights.

## 7.7 Research Limitations

This research departs from a point of interest in urban space. The assessment and analysis of public space resiliency centres its focus on spatial issues and interventions. However, as Kempen and Marcuse (1997) explain, ‘spatial change is both a consequence and a cause of changes’ for city residents however, those changes cannot be completely captured solely through spatial patterns. Therefore, as the research revealed, there was always a tension between rigour in research through maintaining focus on the public space resiliency domain and opening up to the complexities with non-spatial issues which are just as significant. The former risks extracting resiliency from its unique and often, messy context. The issue of solving non-spatial problems with spatial design re-emerges and must be caveated by outlining the limitations of spatial design. In addition, qualitative data collection provided a more meaningful insight into public space resiliency. Qualitative research methods provided a holistic and arguably, more locally informed picture of public space resiliency in Dar es Salaam as compared with quantitative geospatial analysis, which was extremely time intensive.

As an outsider to Dar es Salaam and Tanzania, unable to speak Swahili, the interview process was influenced by potential bias. Interviews are a co-productive exercise and respondents were likely to

converse differently with a foreigner. This also applies to my role as a researcher, whereby, my own bias may have influenced the direction of research. For example, upon touring the informal settlement of Tandale and witnessing the gross negligence of these communities by the government, my personal opinion shifted to prioritising housing and basic services as a prerequisite for resiliency. It was only after many more interviews and time spent in these settlements that I allowed my own experiences to fall to the background of local insights. The risk of over-analysing insights, that are obvious and intuitive to locals, applies to all external researchers conducting fieldwork in new environments. This poses a difficulty especially with a relatively conceptual topic of public space resiliency. As the researcher, I am required to be the lynchpin of the research and shape the direction of the fieldwork. In this case, whereby the risk of bias was clearly present, it may have further influenced the results as I adopted the role of guiding the conversations rather than being a passive interpreter.

It demonstrates the importance of long-term relationships and trust building in an unfamiliar context, a difficult and intensive process yet worthy use of time. Unfortunately, due to time and funding constraints, this was out of the scope of this research. Given limited resources and time in Dar es Salaam, insights gathered are not based upon extensive local consultations with residents and hence, recommendations are not necessarily informed by local acceptability. The contents of the research should be treated as insights which shed light on qualities of urban form and public space in Dar es Salaam. Any serious consideration of recommendations or applicability of insights gathered from the research requires extensive further consultation to understand other factors of influence.

## 8 Conclusion

In Dar es Salaam, Tanzania, the Lower Msimbazi Redevelopment Plan sets out to create a new urban development with the aim to ‘improve resilience, mobility and liveability’. Against this backdrop of resilient urban design, this thesis research aimed to uncover the relationship between public space and resiliency as mediated by urban form. The main research question was: “**What approaches and measures can help assess and improve the resiliency of public spaces around the Lower Msimbazi redevelopment project in central Dar es Salaam?**” To understand, assess and enhance public space resiliency, the research adopted a mixed methods approach, using a combination of a transdisciplinary literature review, geospatial quantitative analysis, ethnographic observations, and in-depth interviews. The research was composed in three parts – Assessment (Part A), Geospatial Analysis (Part B), Qualitative Analysis (Part C). Each part was led by specific sub-questions and research objectives as summarised in Section 1.2.

**Part A** focused on developing a methodology, the PSRF framework, to assess public space resiliency in a holistic, quantifiable, and spatial manner in line with redundancy, diversity, and connectivity dimensions of resiliency. **Part B** used geospatial analysis, based upon the PSRF, to assess the existing resiliency performances of wards in central Dar es Salaam. It found patterns between resiliency performances and urban typologies are prevalent, especially within wards. **Part C**, based upon in-depth expert interviews and ethnographic observations in Dar es Salaam, qualified the most significant factors influencing public space resiliency and contextualised the findings of Parts A and B with non-spatial criteria. It found that public space resiliency is significantly influenced by the land economy, governance strategies, centralised spatial morphologies, lack of service provision, and types of building developments. These insights indicated that notions of resiliency should expand to networks of people, communities and then consider the question, resiliency for who? The scale in which resiliency is considered, across a city or within a ward, radically shifts the system of analysis and influences governance approaches to resiliency. Based upon these insights, **recommendations** were proposed in Section 7.2 to improve resiliency. The recommendations were tailored for the Lower Msimbazi Redevelopment Plan as well as for wards across central Dar es Salaam. On a higher scale of a city-wide system, public space resiliency should be implemented with a specific **priority of interventions**, namely, infrastructural development ahead of housing and population density. It is recommended to adopt a **decentralised spatial morphology** to enable redundancy type resiliency with strategic densification along satellite nodes of Dar es Salaam. More specifically in the Lower Msimbazi Basin, a **new optimal building typology** of five to six storey mixed-use urban blocks increases affordable housing stock, retains community ownership of public spaces, and enhances service provisioning. In conjunction, **new public spaces** in the masterplan should dedicate spaces for informal vending, develop a hierarchy of mobility routes and develop more flexible and adaptable programming of public spaces. In terms of other applications, this research takes a step forward in qualifying public space resiliency and setting out a replicable methodology to measure, assess and subsequently, improve the general resiliency of a city’s spaces in a locally informed manner.

This research has found that public space resiliency is deeply embedded in its local context. The criteria and interventions to create a resilient space in a city is dependent on its networks and relationships to other factors. It follows that the intricate balance of resiliency criteria is plural – there are many typologies of resilient systems – and each one is unique to the identities of the systems of wards and cities alike. This research has demonstrated the significance of the built environment and its urban forms to influence dimensions of social vibrancy, environmental impact, and economic growth. And so, given the temporal longevity of our built environments, planners and developers have a shared

responsibility to deeply understand and assess the right conditions for public space resiliency in line with the local identity of the place. As rapid urbanisation continues in East Africa, the importance of public spaces, in particular streets, as the lynchpin to a resident's ability to function, thrive, and adapt in city life cannot be underestimated.

## 8.1 Future Research

Further research is necessary to determine local acceptability and community informed responses to resiliency criteria as defined in this research. Additionally, further research should consider the ways in which the resiliency of residents and their networks, outside of spatial domains, can be quantitatively determined and applied at scale for strategic urban governance and resiliency building. On a more conceptual level, there is a need to develop public space resiliency discourse and conceptually combine factors of resiliency that are spatial and non-spatial under the same framework of understanding and assessment.

## 9 Acknowledgements

First and foremost, I owe my deepest thanks to my supervisors, Dr. Claudiu Forgaci and Dr. Jess Wreyford. Claudiu patiently supported me from the start to pursue my passion for resilient urban planning and I took a lot of inspiration from his research approach to urban resiliency. He helped guide me in structuring my thoughts and maintain a research focus which was essential in a complex research context. Jess pushed me to reflect upon my research process. I am grateful for Jess' rigorous approach to research instilled to me during this process, all with complete support and encouragement. With their passionate approach to urban design and planning, I have learnt the diligence and intrigue required to be a researcher. In addition, I owe a special thank you to Dr. Steffen Nijhuis who helped me conceive and jump-start my initial interest in urban development and urged me to adopt a holistic approach to understanding resilient systems.

I would like to thank the whole team at DASUDA and VE-R who welcomed me into their team and office with the most warmth and interest in my research. I will miss the camaraderie over many spinazie-feta boreks at lunch. I am especially grateful for Remco Rolvink and Josje Hoefsloot who encouraged me from the start to pursue my interest in the Msimbazi project and journeyed with me through all its twists and turns. Most of all, I am especially thankful for their encouragement to apply the research on the ground, in Dar es Salaam. It has been an incredible learning process and their mentorship has been the foundation supporting my passion in this topic.

I owe the deepest gratitude to the participants and interviewees of this research. It goes without saying that they are the life of the research. A special thank you to Dr. Alphonse Kyessi, Dr. Camilus Thomas Lekule, Linda Heiss, and Beatrice Mhagama for going above and beyond in supporting this research and connecting me with their networks in Dar es Salaam. Their dedication to education and research is inspirational.

And I will continue to feel indebted to the residents of Dar es Salaam for welcoming me into their city so warmly. Asante sana!

Lastly, thank you to TU Delft FAST Fund and TU Delft Global Student Initiative for funding this research.

## 10 References

- Abdul-Hakim, R., Abdul-Razak, N. A., & Ismail, R. (2010). Does social capital reduce poverty? A case study of rural households in Terengganu, Malaysia. *European journal of social sciences*, 14(4), 556-566.
- Allan Jacobs & Donald Appleyard (1987) Toward an Urban Design Manifesto, *Journal of the American Planning Association*, 53:1, 112-120.
- Allan, P., Bryant, M., Wirsching, C., Garcia, D., & Teresa Rodriguez, M. (2013). The influence of urban morphology on the resilience of cities following an earthquake. *Journal of Urban Design*, 18(2), 242-262.
- Andersson, C, Martinuzzi, C., Lahoud, C., & United Nations Human Settlements Programme. (2020). Public space site-specific assessment: Guidelines to achieve quality public spaces at neighbourhood level. In *UN Habitat*. UN Habitat. Retrieved August 4, 2022, [https://unhabitat.org/sites/default/files/2020/07/final\\_pssa\\_v.1\\_reviewed\\_compressed.pdf](https://unhabitat.org/sites/default/files/2020/07/final_pssa_v.1_reviewed_compressed.pdf)
- Andersson, C., Analo, P., UN Habitat, NCCG, & SNI. (2020). Nairobi Public Space Inventory and Assessment: Reclaiming the Green City in the Sun. In *UN Habitat*. United Nations Human Settlements Programme. Retrieved September 4, 2022, [https://unhabitat.org/sites/default/files/2020/08/nairobi\\_inventory\\_2020.pdf](https://unhabitat.org/sites/default/files/2020/08/nairobi_inventory_2020.pdf)
- Armstrong, A. M. (1987). Master plans for Dar-es-Salaam, Tanzania: The shaping of an African city. *Habitat International*, 11(2), 133-145.
- Bentley, I. (1985). *Responsive environments: A manual for designers*: Routledge.
- Berke, P. R., Song, Y., & Stevens, M. (2009). Integrating hazard mitigation into new urban and conventional developments. *Journal of Planning Education and Research*, 28(4), 441-455.
- Bramley, G., Dempsey, N., Power, S., & Brown, C. (2006). *What is 'social sustainability', and how do our existing urban forms perform in nurturing it*. Paper presented at the Sustainable Communities and Green Futures' Conference, Bartlett School of Planning, University College London, London.
- Breheny, M. (1992). The compact city: an introduction. *Built Environment*, 18(4), 241.
- Brennan, J., & Burton, A. (2007). The emerging metropolis: A short history of Dar es Salaam, circa 1862-2005.
- Carmona, M. (2021). *Public places urban spaces: The dimensions of urban design*: Routledge.
- Carmona, M., De Magalhaes, C., & Hammond, L. (2008). *Public space: the management dimension*: Routledge.
- Carpenter, S. R., Arrow, K. J., Barrett, S., Biggs, R., Brock, W. A., Crépin, A.-S., . . . Kautsky, N. (2012). General resilience to cope with extreme events. *Sustainability*, 4(12), 3248-3259.
- Cavan, G., Lindley, S., Jalayer, F., Yeshitela, K., Pauleit, S., Renner, F., Woldegerima, T. (2014). Urban morphological determinants of temperature regulating ecosystem services in two African cities. *Ecological indicators*, 42, 43-57.
- Cloete, M., & Yusuf, S. (2018). Conceptual commentary of public spaces in Durban, South Africa. *Town and Regional Planning*, 73, 35-45.
- CLOS, J. (2016). We have lost the science of building cities. Interview in *The Guardian*, 18 April 2016. [online]. Available at: <<https://www.theguardian.com/cities/2016/apr/18/lost-science-building-cities-joan-clos-un-habitat>> [Accessed: 2 November 2018].
- Coaffee, J. (2013). Towards next-generation urban resilience in planning practice: From securitization to integrated place making. *Planning Practice & Research*, 28(3), 323-339.

- Commission for Architecture and the Built Environment & Greater London Authority. (2009). Open space strategies. In C.A.B.E. Commission for Architecture and the Built Environment. Retrieved April 4, 2022, from <https://www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/open-space-strategies.pdf>
- Creutzig, F., Agoston, P., Minx, J. C., Canadell, J. G., Andrew, R. M., Quéré, C. L., . . . Dhakal, S. (2016). Urban infrastructure choices structure climate solutions. *Nature Climate Change*, 6(12), 1054-1056.
- Dempsey, N., Brown, C., Raman, S., Porta, S., Jenks, M., Jones, C., & Bramley, G. (2010). Elements of urban form. In *Dimensions of the sustainable city* (pp. 21-51): Springer.
- Deore, P., & Lathia, S. (2019). Streets as public spaces: Lessons from street vending in Ahmedabad, India. *Urban Planning*, 4(2), 138-153.
- Dovey, K., & King, R. (2012). Informal urbanism and the taste for slums. *Tourism Geographies*, 14(2), 275-293.
- Dumreicher, H., Levine, R. S., & Yanarella, E. J. (2000). The appropriate scale for "low energy": Theory and practice at the Westbahnhof. *Architecture, city, environment, proceedings of PLEA*, 359-363.
- Duncan, B., & Hartman, J. (1996). *Sustainable urban transportation initiatives in Canada*. Paper presented at the Paper submitted to the APEC Forum on Urban Transportation, Seoul, South Korea, November.
- Elkin, T. (1991). *Reviving the city: Towards sustainable urban development*: Friends of the Earth with Policy Studies Institute.
- Ellena, M., Breil, M., & Soriani, S. (2020). The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics. *Urban Climate*, 34, 100676.
- Feliciotti, A. (2018). *Resilience And Urban Design*. University of Strathclyde,
- Feliciotti, A., Romice, O., & Porta, S. (2016). Design for change: five proxies for resilience in the urban form. *Open House International*.
- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. *AMBIO: A journal of the human environment*, 31(5), 437-440.
- Forgaci, C. (2018). Integrated Urban River Corridors: Spatial design for social-ecological resilience in Bucharest and beyond. *A+ BE| Architecture and the Built Environment*(31), 1-382.
- Forgaci, C., & Van Timmeren, A. (2014). *Urban form and fitness: Towards a space-morphological approach to general urban resilience*. Paper presented at the ISDRC 2014: 20th Annual International Sustainable Development Research Conference "Resilience—The New Research Frontier", Trondheim, Norway, 18-20 June 2014; Authors version.
- Frantz, F. (1995). *Wretched of the Earth*. In: Penguin Books.
- Gehl, J. (1987). *Life between buildings* (Vol. 23): New York: Van Nostrand Reinhold.
- Gharai, F., Masnavi, M. R., & Hajibandeh, M. (2018). Urban local-spatial resilience: developing the key indicators and measures, a brief review of literature. *Bagh-e Nazar*, 14(57), 19-32.
- Gleeson, B. (2012). 'Make no little plans': anatomy of planning ambition and prospect. *Geographical research*, 50(3), 242-255.
- Godschalk, D. R. (2003). Urban hazard mitigation: Creating resilient cities. *Natural hazards review*, 4(3), 136-143.
- Harvey, D. (2013). The political economy of public space. In *The politics of public space* (pp. 23-188): Routledge.
- Hernbäck, J. (2012). *Influence of Urban Form on Co-presence in Public Space: A Space Syntax Analysis of Informal Settlements in Pune, India*.

- Hiller, B., Hanson, J., & Graham, H. (1987). Ideas are in things: An application of space syntax method to discovering housing genotypes. *Environment and Planning D: Planning and Design*, 14, 363-385.
- Hillier, B. (2007). *Space is the machine: a configurational theory of architecture*: Space Syntax.
- Hillier, B., & Netto, V. (2002). Society seen through the prism of space: outline of a theory of society and space. *Urban Design International*, 7(3), 181-203.
- Hillier, B., & Vaughan, L. (2007). The city as one thing. *Progress in planning*, 67(3), 205-230.
- Hossain, S., Scholz, W., & Baumgart, S. (2015). Translation of urban planning models: Planning principles, procedural elements and institutional settings. *Habitat International*, 48, 140-148.
- Hossain, S., Scholz, W., & Baumgart, S. (2018). Territorialisation, urban planning and spatial dis/order in Dar es Salaam. In *Spatial Practices* (pp. 190-210): Brill.
- Iqbal, A. (2021). Inclusive, Safe and Resilient Public Spaces: Gateway to Sustainable Cities?
- Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. *Cities*, 31, 220-229.
- Jabareen, Y. R. (2006). Sustainable urban forms: Their typologies, models, and concepts. *Journal of Planning Education and Research*, 26(1), 38-52.
- Jacobs J. (1961). *The Death and Life of Great American Cities*. New York. Random House.
- Jacobs, J. (1961). Jane Jacobs. *The Death and Life of Great American Cities*, 21(1), 13-25.
- Jänicke, B., Holtmann, A., Kim, K. R., Kang, M., Fehrenbach, U., & Scherer, D. (2019). Quantification and evaluation of intra-urban heat-stress variability in Seoul, Korea. *International journal of biometeorology*, 63(1), 1-12.
- Johansson, E., Yahia, M. W., Arroyo, I., & Bengs, C. (2018). Outdoor thermal comfort in public space in warm-humid Guayaquil, Ecuador. *International journal of biometeorology*, 62(3), 387-399.
- Jones, C., & MacDonald, C. (2004). *Sustainable urban form and real estate markets*. Paper presented at the Proceedings of the Annual European Real Estate Conference, Milan, Italy.
- Keeton, R., & Nijhuis, S. (2019). Spatial challenges in contemporary African New Towns and potentials for alternative planning strategies. *International Planning Studies*, 24(3-4), 218-234.
- Stephen R. Kellert, & Edward O. Wilson. (1993). The biophilia hypothesis. *Island Press*.
- Kempen, R. V., & Marcuse, P. (1997). A New Spatial Order in Cities? *American Behavioral Scientist*, 41(3), 285-298. doi:10.1177/0002764297041003002
- Lefebvre, H. (1991). *The Production of Space* (translated by Nicholson-Smith, D.) Blackwell Publishing: Oxford.
- Lehtinen, S. (2015). Excursions into Everyday Spaces: Mapping Aesthetic Potentiality of Urban Environments through Preaesthetic Sensitivities.
- Low, S., & Smith, N. (2013). *The politics of public space*: Routledge.
- Lozano-Perez, T. (1990). Spatial planning: A configuration space approach. In *Autonomous robot vehicles* (pp. 259-271): Springer.
- LSE Cities, Smith, N., & Davis, J. (2013). EVOLVING CITIES: Exploring the relations between urban form resilience and the governance of urban form. In *LSE Cities*. London School of Economics and Political Science. <https://www.lse.ac.uk/cities/publications/research-reports/Evolving-Cities>
- Lupala, J. M. (2002). *Urban types in rapidly urbanising cities*. Infrastruktur,
- Lynch, K. (1984). *Good city form*: MIT press.

- Marcus, L., & Colding, J. (2014). Toward an integrated theory of spatial morphology and resilient urban systems. *Ecology and Society*, 19(4).
- Marcus, L., & Legeby, A. (2012). *The need for co-presence in urban complexity: Measuring social capital using space syntax*. Paper presented at the Eighth International Space Syntax Symposium.
- McMichael, A. J., Wilkinson, P., Kovats, R. S., Pattenden, S., Hajat, S., Armstrong, B., . . . Kingkeow, C. (2008). International study of temperature, heat and urban mortality: the 'ISOTHURM' project. *International journal of epidemiology*, 37(5), 1121-1131.
- Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and urban planning*, 147, 38-49.
- Mehta, V. (2014). Evaluating public space. *Journal of Urban Design*, 19(1), 53-88.
- Mitchell, D., Staeheli, L. A., & Thrift, N. (2009). Public Space. In *International Encyclopaedia of Human Geography* (1st ed., Vol. 1, pp. 511–536). Elsevier. <https://doi.org/10.1016/B978-008044910-4.00990-1>
- Montgomery, J. (1998). Making a city: Urbanity, vitality and urban design. *Journal of Urban Design*, 3(1), 93-116.
- Ndetto, E. L., & Matzarakis, A. (2013). Basic analysis of climate and urban bioclimate of Dar es Salaam, Tanzania. *Theoretical and Applied Climatology*, 114(1), 213-226.
- Ndetto, E. L., & Matzarakis, A. (2015). Urban atmospheric environment and human biometeorological studies in Dar es Salaam, Tanzania. *Air Quality, Atmosphere & Health*, 8(2), 175-191.
- Nguluma, H. (2003). *Housing themselves: Transformations, modernisation and spatial qualities in informal settlements in Dar es Salaam, Tanzania*. Infrastruktur,
- Nyerere, J. K. (1967). Socialism and rural development. *Mbioni: The Monthly Newsletter of Kivukoni College*, 4(4), 2-46.
- Oxford Business Group. (2018). *Tanzania seeks to quantify the informal economy*. Retrieved September 8, 2022, from [https://oxfordbusinessgroup.com/analysis/easy-does-it-measured-approach-formalisation-getting-positive-results#report\\_launcher](https://oxfordbusinessgroup.com/analysis/easy-does-it-measured-approach-formalisation-getting-positive-results#report_launcher)
- Population Mountains. (2022). The Pudding. Retrieved October 12, 2022, from <https://pudding.cool/2018/12/3d-cities-story/>
- Porada, B. (2013). Ten ways to transform cities through placemaking and public spaces. *ArchDaily* [online]. Available at: [Accessed: 8 May 2022].
- Puckett, R. R. (2009). Multi-agent crowd behaviour simulation for tsunami evacuation. *Comput. Sci.*
- Relph, E. (1976). *Place and placelessness* (Vol. 67): Pion London.
- Roji, A. (2020). *Towards Pan-African Spaces of Publics*. Urbanet. Retrieved September 1, 2022, from <https://www.urbanet.info/towards-pan-african-spaces-of-public/>
- Rosenzweig, C., Solecki, W. D., Hammer, S. A., & Mehrotra, S. (2011). *Climate change and cities: First assessment report of the urban climate change research network*: Cambridge University Press.
- Sanga, E. E., & Mbisso, D. A. (2020). Sense of Place and Placelessness of Urban Open Spaces in Dar es Salaam. *Journal of Sustainable Development*, 13(4), 1913-9071.
- Sendi, R. & Goličnik Marušić, B. (2012). Neighbourhood design: Public Spaces. In *International Encyclopaedia of Housing and Home*. (Vol. 5, pp. 21-28). Elsevier, vol 5: 21-28.
- Sharifi, A. (2019). Resilient urban forms: A macro-scale analysis. *Cities*, 85, 1-14.

- Sharifi, A., & Yamagata, Y. (2016). Urban resilience assessment: Multiple dimensions, criteria, and indicators. In *Urban resilience* (pp. 259-276): Springer.
- Sharifi, E., & Boland, J. (2017). Heat resilience in public space and its applications in healthy and low carbon cities. *Procedia engineering*, 180, 944-954.
- Shashua-Bar, L., Pearlmutter, D., & Erell, E. (2009). The cooling efficiency of urban landscape strategies in a hot dry climate. *Landscape and urban planning*, 92(3-4), 179-186.
- Sheuya, S. A. (2007). Reconceptualizing housing finance in informal settlements: the case of Dar es Salaam, Tanzania. *Environment and urbanization*, 19(2), 441-456.
- Siavash, Y. S. (2016). *Achieving Urban Resilience: Through Urban Design and Planning Principles*. Oxford University Press.
- Smiley, S. L. (2007). *Patterns of urban life and urban segregation in Dar es Salaam, Tanzania*: University of Kansas.
- Smiley, S. L. (2013). Mental maps, segregation, and everyday life in Dar es Salaam, Tanzania. *Journal of Cultural Geography*, 30(2), 215-244.
- Staeheli, L. A., Mitchell, D., & Nagel, C. R. (2009). Making publics: Immigrants, regimes of publicity and entry to 'the public'. *Environment and planning D: Society and Space*, 27(4), 633-648.
- Stewart, I. D., & Oke, T. R. (2012). Local climate zones for urban temperature studies. *Bulletin of the American Meteorological Society*, 93(12), 1879-1900.
- The Citizen. (2022, October 6). Dar anti-floods plan gets Sh600bn. *The Citizen*, Dar es Salaam Edition. 2.
- The Heritage Foundation. (2018). 2018 index of Economic Freedom. Tanzania.
- The Rockefeller Foundation & ARUP International Development. (2014). City Resilience Framework. In *The Rockefeller Foundation*. The Rockefeller Foundation. Retrieved June 9, 2022, from <https://www.rockefellerfoundation.org/report/city-resilience-framework/>
- Thornbush, M., Golubchikov, O., & Bouzarovski, S. (2013). Sustainable cities targeted by combined mitigation-adaptation efforts for future-proofing. *Sustainable Cities and Society*, 9, 1-9.
- Tümer Ergün, E. (2020). *A research on resilience of urban public spaces: the case of Güvenpark, Ankara* [M.S. - Master of Science]. Middle East Technical University.
- Tunas, D. (2008). *The spatial economy in the urban informal settlement*. PAPIROZ Publishing House.
- Ulrich, R. S. (1999). Effects of gardens on health outcomes: theory and research. Chapter in CC Marcus and M. Barnes (Eds.), *Healing Gardens: Therapeutic Benefits and Design Recommendations*. New York: John Wiley, 27, 86.
- UN Habitat (2018). SDG Indicator 11.7.1 Training Module: Public Space. United Nations Human Settlement Programme (UN-Habitat), Nairobi.
- UN Habitat. (2016). Urbanization and development: emerging futures. *World cities report*, 3(4), 4-51.
- UN Habitat. (2015). Global Public Space Toolkit From Global Principles to Local Policies and Practice. *Nairobi: United Nations Human Settlements Programme (UN-Habitat)*.
- Van Kamp, I., Leidelmeijer, K., Marsman, G., & De Hollander, A. (2003). Urban environmental quality and human well-being: Towards a conceptual framework and demarcation of concepts; a literature study. *Landscape and urban planning*, 65(1-2), 5-18.
- van Nes, A., & Yamu, C. (2021). *Introduction to space syntax in urban studies*: Springer Nature.
- van Nes, A., & Yamu, C. (2021). Private and Public Space: Analysing Spatial Relationships Between Buildings and Streets. In *Introduction to Space Syntax in Urban Studies* (pp. 113-131): Springer.

- Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and Society*, 9(2).
- Wardekker, J. A., de Jong, A., Knoop, J. M., & van der Sluijs, J. P. (2010). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting and Social Change*, 77(6), 987-998.
- Wheeler, S. M. (2002). Constructing sustainable development/safeguarding our common future: Rethinking sustainable development. *American Planning Association. Journal of the American Planning Association*, 68(1), 110.
- Whyte, W. H. (1980). *The social life of small urban spaces*. Conservation Foundation.
- Wirth, L. (1938). Urbanism as a Way of Life. *American journal of sociology*, 44(1), 1-24.
- Wolff, S., Kuch, A., & Chipman, J. (2018). Urban land governance in Dar es Salaam: actors, processes and ownership documentation. *International Growth Centre*.
- World Population Review. (2022). *Dar Es Salaam Population 2022 (Demographics, Maps, Graphs)*. Retrieved October 10, 2022, from <https://worldpopulationreview.com/world-cities/dar-es-salaam-population>
- Zhang, X., & He, Y. (2020). What makes public space public? The chaos of public space definitions and a new epistemological approach. *Administration & Society*, 52(5), 749-770.
- Zhou, W., Huang, G., & Cadenasso, M. L. (2011). Does spatial configuration matter? Understanding the effects of land cover pattern on land surface temperature in urban landscapes. *Landscape and urban planning*, 102(1), 54-63.

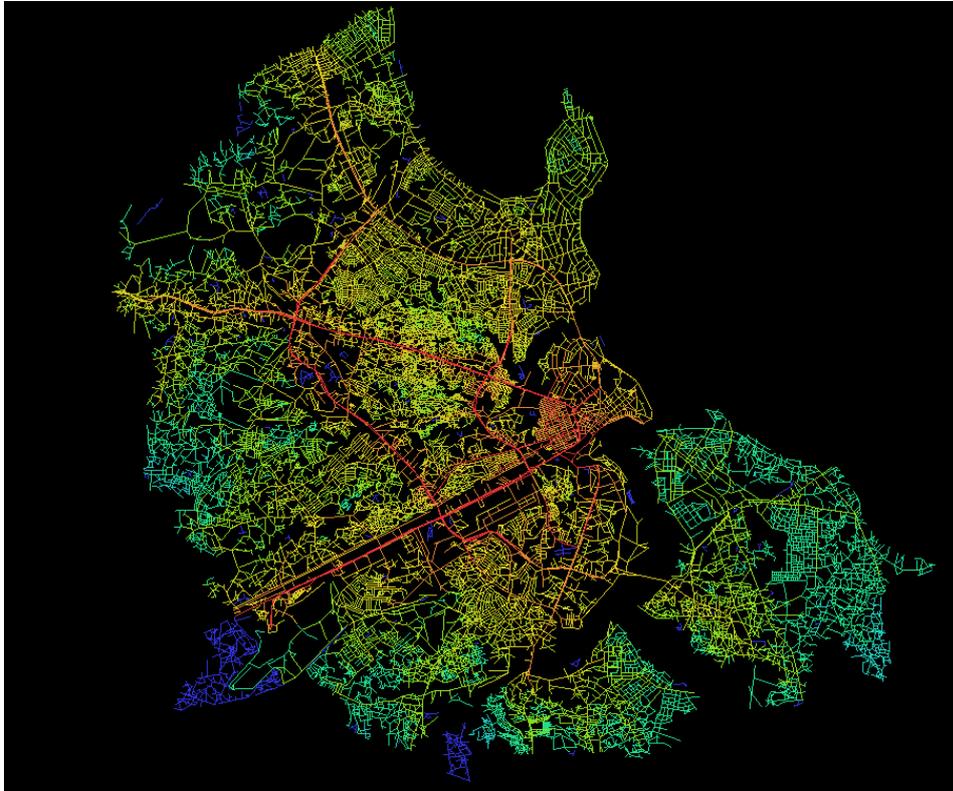
## 11 Appendix

### 11.1 Appendix 1: Full Criteria List for Assessment Framework (Unfiltered)

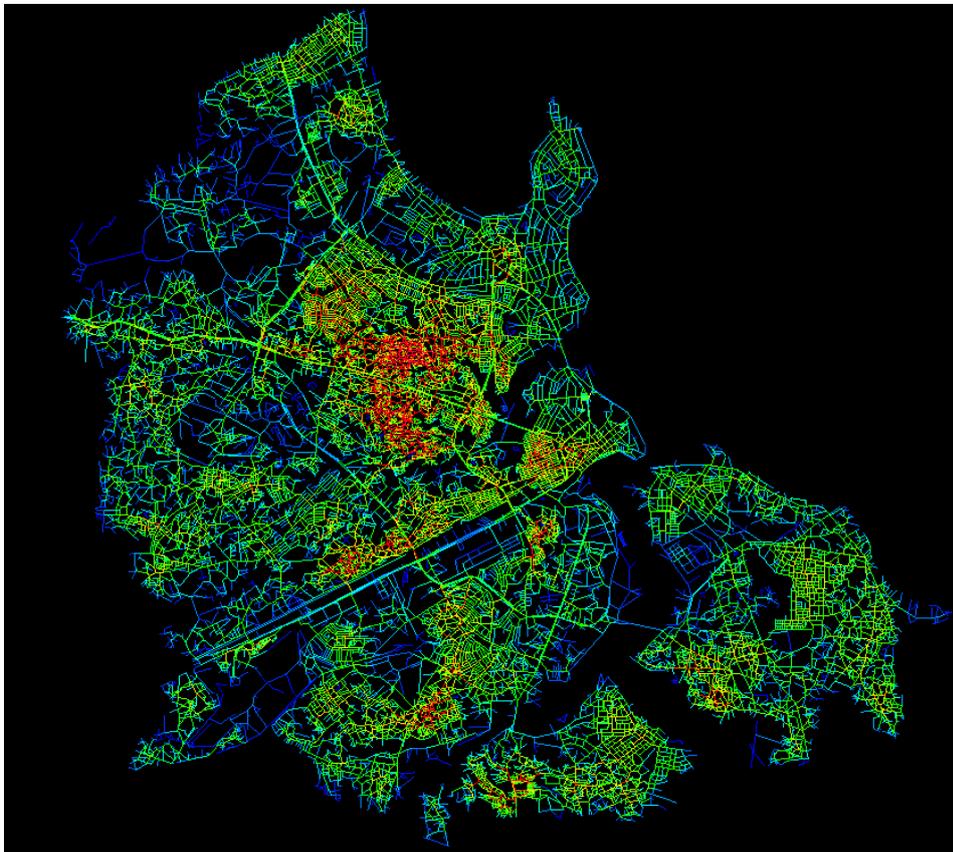
The following list demonstrates the working method of Part A: reviewing literature on public space, urban design, urban form and denoting every instance a quality or criteria that contributes to public space resiliency. The list contains repetition as multiple sources reiterate certain qualities.

- Co-presence (incl. social capital and complexity)
- Number of accessible people from local centre of neighbourhood
- % of people that are local vs % residents of other neighbourhoods 'visiting strangers'
- Compactness
- Urban contiguity and connectivity
- Dense
- Diverse
- Highly integrated
- Compact
- Sustainable Transport (urban Form)
- Pedestrian Friendly
- Mixed Use
- Compact
- Density
- Mixed Use
- Diversity
- Urban Microclimate (airflow, view of sun/sky, exposed surface area)
- Microclimate (street canyon)
- Vegetation and Green
- Lack traffic
- Greening
- Walkable
- Diverse
- Walkable
- Compact
- Accessibility
- Population Density (High)
- Street Connectivity through intersection density
- Compact
- Mix of high and low buildings (for microclimate)
- Social Control (from compact)
- Pop density 50-150 per ha
- Public transport modal share 50% plus
- Secure/Safe
- Green
- Compact
- Diversity of Building Types
- Dense
- Good infrastructure
- Flexible open spaces
- Density
- Green Space accessibility
- Economic property values
- Tenure diversity
- Public transport accessibility
- Adaptability of street layouts and building types
- Pop Density
- Density of Built Env (in relation to open level ground space)
- Dwelling units/acre
- 300-500 units per hectare
- Pop/hectare
- High land cover (but below 70%)
- 5-6 storey buildings
- Differently scaled open spaces
- Floor Area Ratio
- Mixed Use
- Adaptable Uses
- Wider Streets (more adaptable)
- Wide pavements
- Street Activities
- Integration
- Connectivity
- Public Transport Access
- Green Space
- Permeable and accessible from near and far places
- Shading
- Green space
- Land Use Diversity
- Tenure Diversity
- Intersecting rhythms of activity (ensure public presence in realm)
- Diverse land uses
- Urban Concentration
- Density
- Passive solar design
- Greening
- Heat Stress
- Green surfaces
- Building Density (for UHI)
- Vegetation index
- NDVI Green
- Safety

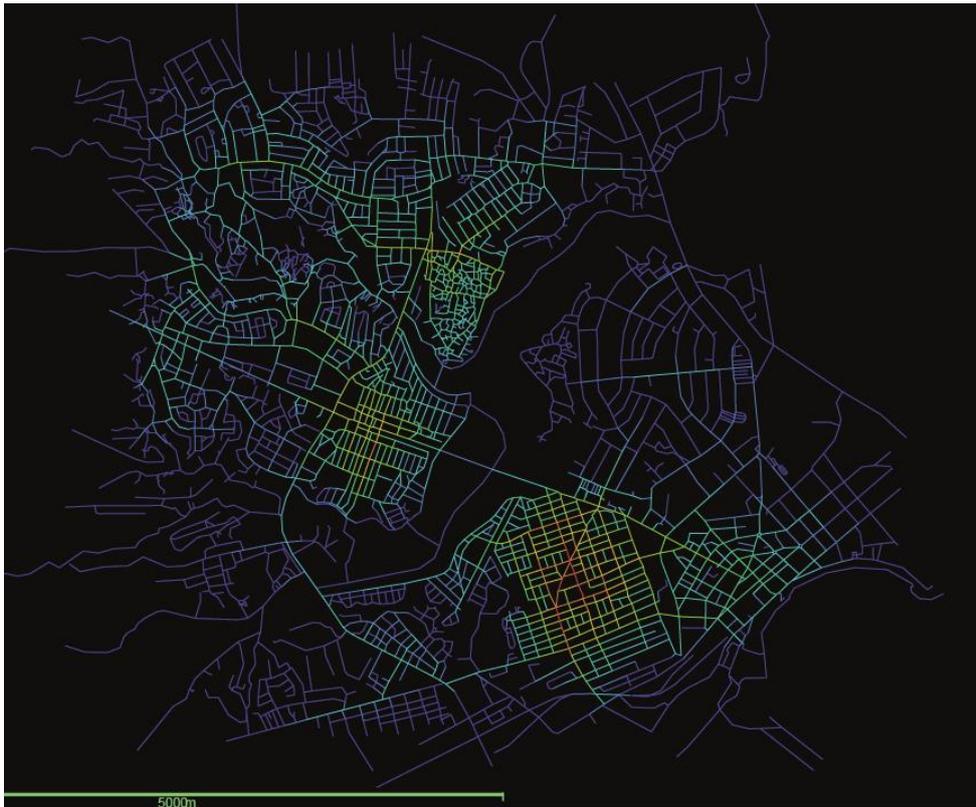
- Social Network
- Prospect Refuge Theory
- Open and attractive
- Street furniture
- Natural surveillance
- Socially inclusive
- Connectivity
- Biodiverse
- Safe
- Variety of users in public space
- Mixed use in frontage building
- Vacant unit in frontage building
- Presence of restriction rules
- Presence formal and informal economic activities
- Levels of traffic
- Quality public transport
- Lighting and streetlights
- Street furniture
- Amenities/public toilets
- Cleanliness
- Natural surveillance
- CCTV surveillance
- Air quality
- Green coverage
- Accessible
- Activities
- Comfortable
- Aesthetic Value
- Sidewalk/street ratio
- Trees per kilometre
- Playgrounds
- Benches
- Continuous presence of people
- Size of space
- Adaptable
- Security
- 10-15 pedestrians per minute per meter
- Spatial variation
- Inclusive/diverse
- Multifunctional
- Adequate lighting
- Accessible green space
- Locational advantage
- Accessibility
- Mix and concentration of
- mobility infrastructures
- Adaptable open and public and built-up spaces
- Porous street layouts
- Loose street hierarchy
- Wide streets
- Ventilation/Compactness
- Sky View Factor
- Wide Trees
- Street Typology (connectivity)
- Street canyon
- Street width
- Walkability
- Connectivity
- Intersection density
- Heterogeneity of open spaces
- Modularity of street network
- Permeable street edges
- Vibrant streets
- Dense
- Mixed use
- Centrality
- Bike Lanes



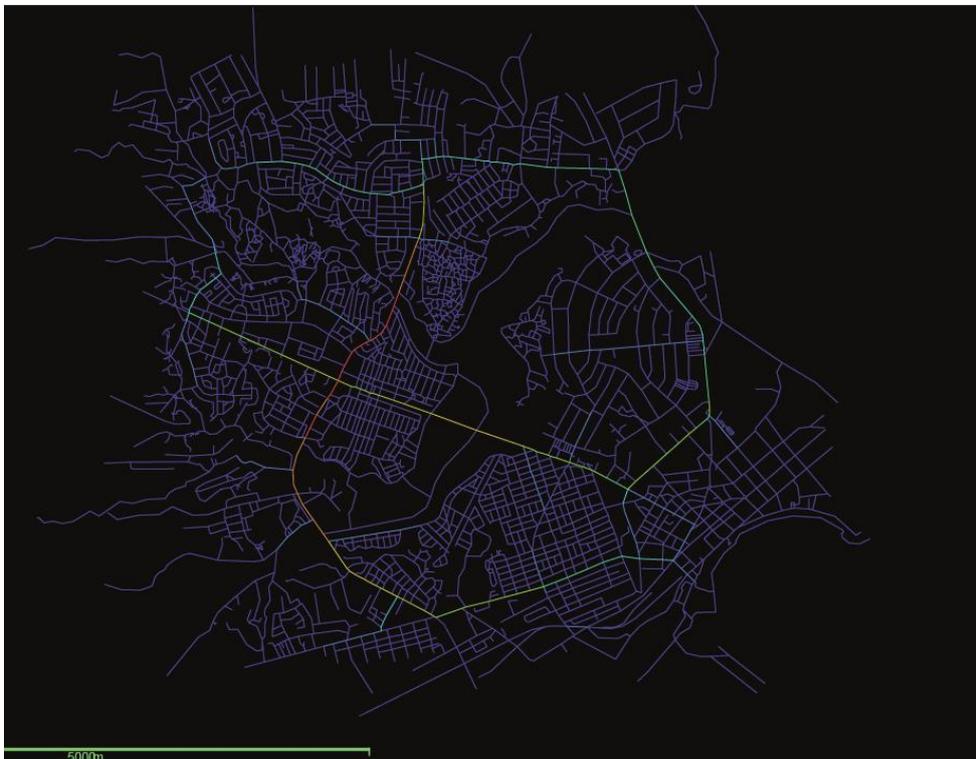
Global Integration Map



Connectivity Map  
(800m)



Integration 800m Lower  
Msimbazi



Choice Global Lower  
Msimbazi Plan

## 11.3 Appendix 3: Python Code for Resiliency Fingerprints

Open source and accessible (with resiliency scores of wards) at:

<https://github.com/rakandajani/ResiliencyFingerprints>

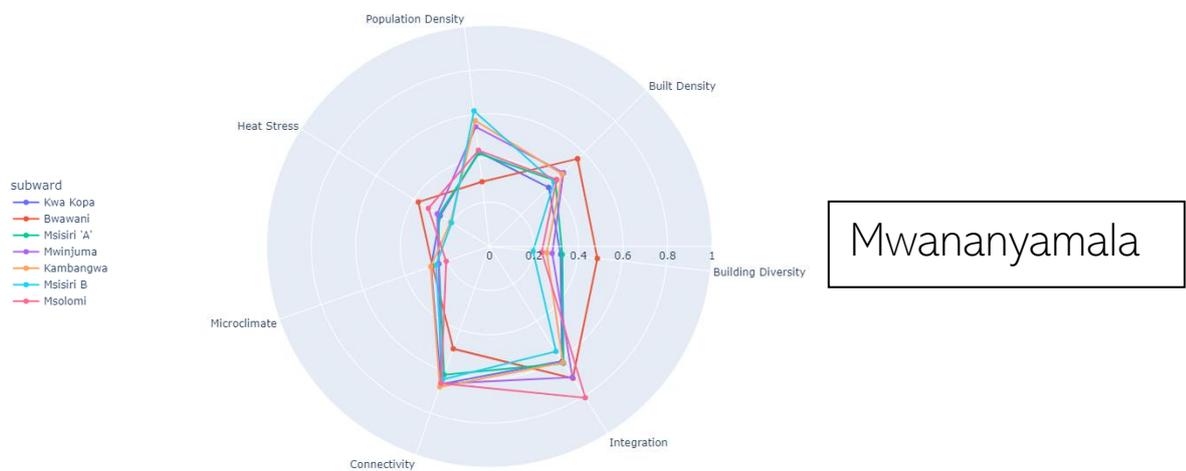
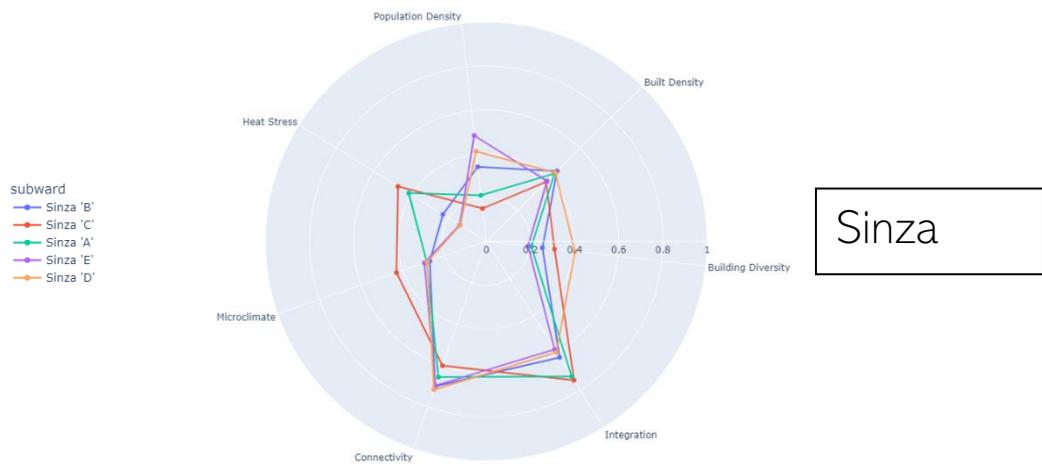
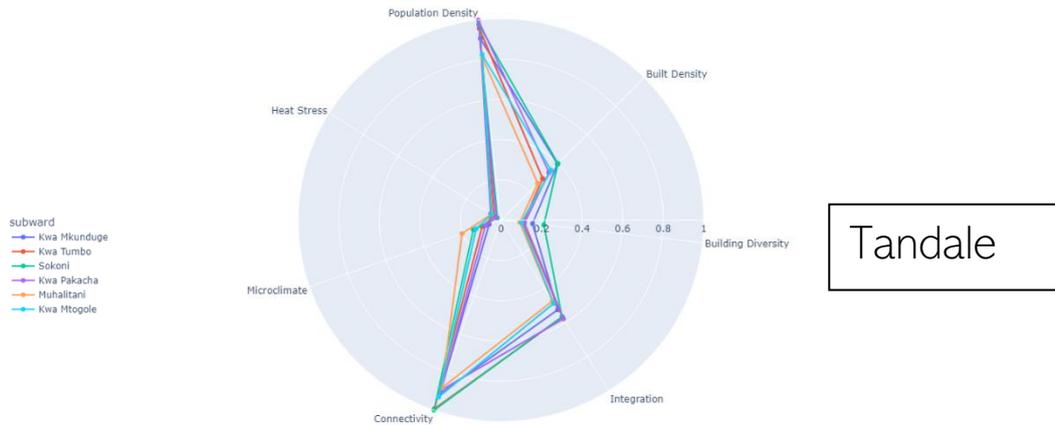
```
# Import Packages
import plotly.express as px
import pandas as pd

# Read Data
df = pd.read_csv(r'C:\Users\rakan\OneDrive\Documents\MSc MADE\Thesis\Phase
1 Framework Building\Spatial Data\Python Tables\Triald.csv')
print(df)
# Select Subward
df = df[df['ward'].isin(['Mikocheni'])]
print(df)

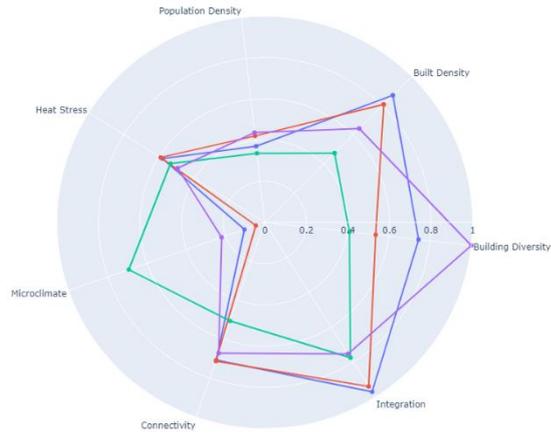
# Convert from wide data to long data to plot radar chart
df = pd.melt(df, id_vars=['subward'], var_name='category',
value_name='rating',
            value_vars=['Built Density', 'Building Diversity',
'Integration',
                        'Connectivity', 'Microclimate', 'Heat
Stress', 'Population Density'],
            )
print(df)

# Create Radar Chart
fig = px.line_polar(df, r='rating', theta='category', color='subward',
line_close=True,
                    line_shape='linear', # or spline
                    hover_name='subward',
                    hover_data={'subward':False},
                    markers=True,
                    # labels={'rating':'stars'},
                    # text='Hotelid',
                    range_r=[0,1],
                    direction='clockwise', # or counterclockwise
                    start_angle=45
                    )
#fig.update_traces(fill='toself')
fig.show()
```

# 11.4 Appendix 3: Fingerprint Typologies

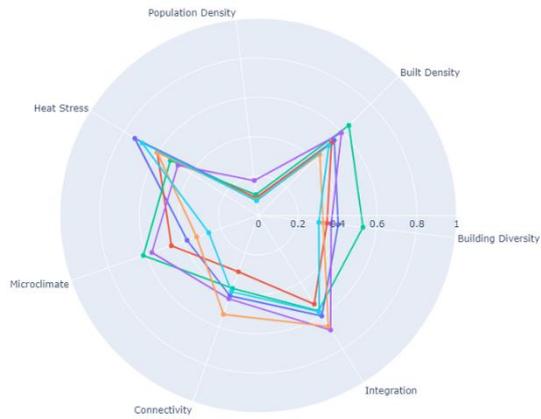


subward  
 - Ukombozi  
 - Mnazi Mmoja  
 - Mtambani B  
 - Mtambani A



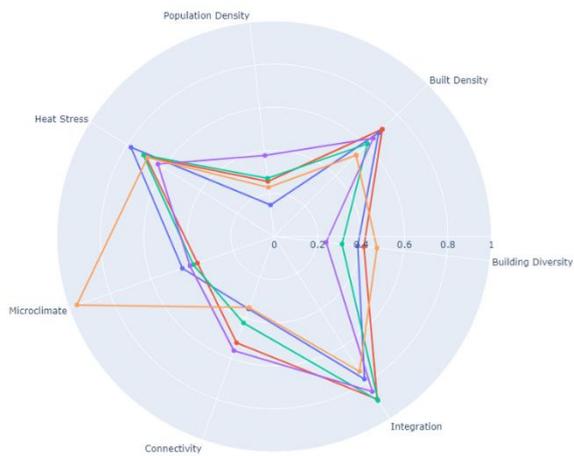
Jangwani

subward  
 - Mikocheni 'B'  
 - TPDC  
 - Ally Hassan Mwinyi  
 - Regent Estate  
 - Darajani  
 - Mikocheni 'A'



Mikocheni

subward  
 - Kitonga  
 - Kibasila  
 - Mfaume  
 - Fire  
 - Charambe



Upanga

- subward
- Masaki
- Oysterbay
- Makangira
- Bonde la Mpunga
- Mikoroshini



Msasani

- subward
- Ferry
- Tuamoyo
- Kigamboni



Kigamboni

- subward
- Idrisa
- Dossi
- Makuti 'A'
- Makuti 'B'
- Sunna



Magomeni

<b>Summary: Expert Interview 1</b>	
Interviewee	<b>1</b>
Expertise	<i>An urban specialist with expertise in urban sustainability, coastal management, climate change and applied GIS. Extensive experience in strategic planning for greening Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• Resiliency ought to shift away from event-focused to a more holistic systems approach. Political system in Dar es Salaam is geared to respond to crises and urgent needs rather than long term planning.</li> <li>• Resilient urban design requires consultation with range of experts, city officials, policymakers and communities. There is a dissonance that exists within urban planning regime and needs of community.</li> <li>• 60-70% of Dar es Salaam is organically grown and unplanned. This points to service delivery of basic services as a priority for resilient urban forms however, it should not neglect the less tangible and indirect benefits such as greening the city.</li> <li>• Greenspace density needs to urgently increase in Dar es Salaam. The international standard, recommended by the World Health Organisation (WHO) and the Food and Agricultural Organisation (FAO), is 9m<sup>2</sup> per city dweller which is the absolute minimum. Developed cities often have around 20m<sup>2</sup> greenspace per city resident.</li> <li>• Strategically, when greening Dar es Salaam, the location and structure of vegetation is important to consider alongside and relating to the urban morphology of the given area. <ul style="list-style-type: none"> <li>○ Trees in street canyons may be counterintuitive. Despite positive impact on pollution uptake, they are likely to reduce air circulation.</li> <li>○ In open areas and more ‘spacious’ morphologies, the green should be high and thick enough for large deposition in the space. Yet, it should be porous enough to allow for airflow.</li> </ul> </li> <li>• There is an educational and cultural barrier with greenery in the city. It is historically not been considered as positive and often, considered an antithesis to the built environment. Culturally, the greenery can be considered as an extra cost and a nuisance for municipalities and residents.</li> <li>• The priority of resilient design should be given to interventions that are cost effective and have cross cutting benefits. <ul style="list-style-type: none"> <li>○ Therefore, greening is appealing for its ability to support economic activities (cooling markets), enhance residential health and comfort (limiting heat stress), and limit flooding.</li> <li>○ Green infrastructure is the most cost-efficient solution to resiliency in Dar es Salaam and suits the sub-tropical climate which allows vegetation to easily grow and requires limited maintenance.</li> </ul> </li> <li>• Resilience should be imposed at the systemic level and through governance systems. Interventions are not enough, albeit helpful.</li> </ul>

Summary: Expert Interview 2	
Interviewee	2
Expertise	<i>Urbanist who conducted their research on public spaces in informal settlements with a focus on the Tandale informal settlement. They are closely affiliated with a local platform for re-imagining public spaces in Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• Research is focused on the site of Tandale using a combination of qualitative methods including participant ethnography, photo-voice recordings, unstructured interviews and observations.</li> <li>• Dar es Salaam’s public space is shaped by its planning (or lack of planning history). The approach to resilience should consider the informal settlements of Dar es Salaam which compose over 70% of the city. Informal settlements are most vulnerable to flood hazards and lack basic service delivery such as waste collection which can lead to disease outbreak.</li> <li>• Master planning is not necessarily effective to improve the quality of the built environment. For example, Kigamboni adopted a ‘copy and paste approach’ that culturally and climatically does not fit the context. Henceforth, resiliency can be achieved through being open and flexible and allowing for bottom-up designed spaces.</li> <li>• Reconceptualise public space as ‘public usable space’ as in the Tanzanian context, public space can blend inside and outside of public and private property. It is not as binary as European conceptions. For example, in informal settlements, there are a lot of ‘in-between or leftover spaces’ which are significant public spaces.</li> <li>• Resiliency can be achieved through allowing spaces which allow people to turn into something they need at the moment and has the ability to evolve with time and changing needs. Adaptability and flexibility are key to designing resilient spaces. This contradicts colonial legacy of public space in Dar es Salaam, for example, a ‘fenced off botanical garden.’</li> <li>• The street as a public space is key to informal economic activities – it ‘all happens in the street.’</li> <li>• Coco Beach is a successful example of resilient design in terms of facilitating a diverse range of uses in an inclusive and flexible manner. There are a lot of economic activities as well as flexible spaces. It is important not to ‘over-programme’ the spaces as it is common to see a dissonance between intended and actual use in designs and master plans.</li> <li>• Contrasting the different urban forms, in the city centre, economic activity can be mixed between the street and inside buildings. Whereas in Tandale, many more economic activities occur on the street. In high-rise urban typologies, people tend to commute outside in the evening and so temporally, the resiliency varies alongside the street life. Contrasted with Tandale, residents work in front of their house and blend public and private. Socially, the informal approach works as it can facilitate easy childcare and can remain close to homes in case of emergencies and so forth.</li> <li>• In terms of transportation, many informal settlements such as Hannassif are close to and well connected to the CBD. Settlements on the outskirts of the city can be serviced and rapidly transformed using the BRT system which can facilitate access to the rest of the city.</li> <li>• Design should work with informal settlements and existing context – these residents require public space in the immediate vicinity and rely on ‘day to day jobs’. Smaller and more ubiquitous public spaces are need rather than fewer larger spaces.</li> </ul>

### Summary: Expert Interview 3

Interviewee	<b>3</b>
Expertise	<i>Geomatician and an urban climate change expert. Specialised in spatial risk analysis of urban environments and have published several papers relating to risk in Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• Resiliency is mainly a question of risk management in Dar es Salaam. Flooding is a highly urgent issue hence, the respondent's focus on creating a Risk Management Index for 5 municipalities to mitigate climate risk. Additionally, the Disaster Risk Emergence Plan allows municipalities to prioritise risks and assets. Therefore, resiliency require strategic prioritisation – what is most important to address and prevent.</li> <li>• Urban governance is core to resiliency of public space. It requires a legal framework and coordination amongst several authorities in Dar es Salaam. Linking throughout should be a clear communication strategy between the municipal level and with urban residents.</li> <li>• In terms of resiliency of public space, different urban forms have their own capacity to deal with shocks. The CBD area and its community are resilient because of its density and their options to protect against heat stress with ACs in high concentration. Lower income activities such as machingas and bajjajis cannot escape the heat stress. Income is the largest determinant of ability to be resilient. This is most clearly seen in the way flooding impacts the city – in informal settlements, flooding frequently occurs due to the lack of drainage infrastructure and the density of how closely built homes are together. In planned areas, the water drains quickly and has limited impact on assets.</li> <li>• When considering resilient urban planning and master planning, the core to action is political will. Design should always account for the existing residents and their income streams and everyday activities. Their network is essential to facilitate their income flow.</li> <li>• Kigamboni, a top-down planned area, exemplifies the failures of master planning and lack of consultation with local residents.</li> <li>• Given the fact that the majority of Dar es Salaam is inhabited and is already built-up, there is a need to compromise and accommodate existing livelihoods of the areas. It is not a 'virgin land' and hence must account for the 'people living there'.</li> <li>• Strategically, resiliency should separate urban spaces which are legally public versus private. The former is easier to green and intervene whereas for private spaces, residents lack incentive or desire to green. It is about a 'hierarchy of needs' and economic income is more important. Lower income communities rarely 'care about climate resilience' – except for when it impacts their income.</li> </ul>

## Summary: Expert Interview 4

Interviewee	4
Expertise	<i>Their work is focused on mainstreaming nature-based benefits in urban environments through research and collaboration with city authorities on urban planning and project implementation.</i>
Summary	<ul style="list-style-type: none"> <li>• Decision making and urban governance is the key to unlocking spatial resiliency in Dar es Salaam. For example, the respondent investigated the spatial prioritisation of greenery in Dar es Salaam in a way that provides the maximum social benefit. Therefore, the tool developed helped decision makers draw upon social-ecological interaction as a rationale for greenery in particular spaces.             <ul style="list-style-type: none"> <li>○ For example, a city may increase tree planting in areas where extreme urban heat overlaps with areas of high air pollution, e.g. around bus terminals. This solution is optimal to reduce heat stress and improve societal well-being. Additionally, it gives city officials an evidence-based rationale for spatial allocation (hence increasing accountability and credibility).</li> </ul> </li> <li>• A decision-making tool should improve resiliency by showing where joint efforts can be made, and it can align the strategies of private and public actors. For example, DART BRT is responsible for road development and roadside greening which is an important stakeholder in the greening city conversation. However, due to lack of funding for maintenance, after a few years, greenery is neglected and often die. There is greater need for effective private and public partnership.</li> <li>• Greenery requires solid evidence-based approach and education on the right species for biodiversity and survival.</li> <li>• In terms of public space, the key stressors for the future of Dar es Salaam are heat and pollution. Heat stress impacts informal settlements disproportionately. Therefore a resiliency approach should adopt a social and environmental justice approach. Combating heat stress aligns neatly with improving access to greenspace.</li> </ul>

## Summary: Expert Interview 5

Interviewee	5
Expertise	<i>Member of a university partnership program focusing on skills and knowledge transfer on urban resilience. They manage a digital geospatial data repository that supports research, education, and disaster-risk management practices.</i>
Summary	<ul style="list-style-type: none"> <li>• It is important to develop the national infrastructure for data collection and sharing. This involves combining different actors in the urban resiliency space in Dar es Salaam. This should increase the availability of data and information on the most vulnerable communities of Dar es Salaam. Key to this process is involving communities in data collection. “The best knowledge comes from the community itself... they have the best grasp of the data and the issues faced.”</li> <li>• In terms of resilience, flooding is the main issue and stressor of the city. Original ideas of resilience were rooted in bouncing back however, we need to consider how we can “bounce forward” and rebuild infrastructure to be even better after events. In terms of flooding, this can be applied to drainage infrastructure however, it can also be applied to the urban heat issue.</li> <li>• Informal settlements should be prioritised in terms of resilience. These settlements lack planning and basic infrastructure – in summary, they are neglected by city officials. As a result, there is a lack of information of the issues faced and yet, these areas are rapidly growing. For flooding, these communities are at most risk. Lack of funding and interest also persist of these areas. Relocation is not suitable as firstly, their livelihoods depend on their location and secondly, it is not easy to relocate in such a dense city.</li> <li>• In terms of approaching resiliency, information and data are needed to know the issues first. Afterwards, the issues can be addressed.</li> <li>• The most resilient areas are generally higher income areas such as Oyster Bay and Masaki. Additionally, high rises are often protected for the effects of flooding. In the higher income areas, there is a lot of green, limited congestion, good drainage infrastructure and safety.</li> <li>• In terms of public space, the way space is used locally should be accounted for. Most free spaces in public are used for home activities such as cooking or commercial activities such as vending. Trees and greenery facilitate the use of these spaces for vending. People use the front of their houses, sidewalks, and businesses porches to hang out.</li> <li>• Reformulate public space as not the Eurocentric definition of a ‘public living room’ but rather, as an extension of a neighbourhood. Perhaps, public parks in more tranquil spaces – not in streets are most effective.</li> <li>• In terms of urban forms, planned, unplanned and new developments have different resiliency footprints. Oftentimes, new and commercial areas are only occupied in the daytime and at night, they are quiet as people commute out.</li> <li>• It is important to address the urban sprawl infringing on the natural green environments outside of the city.</li> </ul>

Summary: Expert Interview 6	
Interviewee	6
Expertise	<i>Urban planning and Disaster Risk Reduction specialist who has focused past research on informal settlements in Dar es Salaam, Tanzania.</i>
Summary	<ul style="list-style-type: none"> <li>• The respondent emphasised the importance of dealing with flooding. Due to the lack of infrastructure, or poorly maintained infrastructure, pluvial flooding due to depressions around the river basin leads to severe flooding</li> <li>• Informal settlements are most at risk. With flooding, other spill over effects are quite detrimental. For example, fecal waste in the water system arises as septic tanks are inundated and emptied (behavioural issue) due to groundwater infiltration.</li> <li>• Groundwater level is an often-neglected factor around the city. In Sinza, groundwater levels are very high and so, nature-based solutions so not make sense in those environments. These areas are also more susceptible to pollution spreading during rainwater event.</li> <li>• Master planning has been unsuccessful in Dar es Salaam and often, reinforces past attempts at organising the city during colonial times. For example, the UNDP formed a strategic plan which was quickly replaced.</li> <li>• There is an urgent need for community involvements and stakeholder buy-in.</li> <li>• In terms of morphology, Dar es Salaam is too monocentric given its size. All the main arterial roads focus and head towards the centre. Therefore, a ring road around the centre will help alleviate this pressure and congestion. Past attempts included building malls and shopping centres outside the city centre however, they were aimed at the middle class.</li> <li>• Density is optimal up until a certain point – its' carrying capacity. Provisions should be made to leave space for greening.</li> </ul>

Summary: Expert Interview 7	
Interviewee	7
Expertise	<i>Urban Planner and a Geographical Information System expert. Involved in the development of urban land management guidelines in Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• There needs to be greater consultation of people in the planning process. “Plans come first and then people told to follow, that is the problem.” There needs to be a shift towards bottom-up plans as well as incorporating inclusivity, transparency, and flexibility in the plans. “We are part of the problem, at times, we make plans, we put it in the cabinet, and they are not flexible. We need inclusive and flexible plans – make things visible. Transparency.” This requires constant and effective communication with people. For example, lots of markets are encourage in areas where people are middle to upper class and therefore used to using supermarkets – it also happens in reverse. “Plan with people, they like good environments”</li> <li>• In current work with the World Bank, the respondent advocates combining criteria and objectives to make decisions – asking questions of who, what, proximity to where, accessibility and functions of land. Developing a clearer understanding of locational advantage will help foster better decisions on land use guidelines.</li> <li>• Solving the issue in a bottom-up manner is important – there is master planning, neighbourhood planning and building level planning. Often, intervening at the smallest scale is most useful – for example requiring residents to green their plots (in building permits) to prevent flooding in the city. Greening the city is a cheap and effective strategy. There is a law soon to be enforced that requires 60% of land plots to be green. This would help as certain areas, such as the CBD is too congested to greenify.</li> <li>• Informal settlements are the least resilient specially to heat – streets are very narrow and roofs are iron corrugated. There is an unregulated housing market. These areas should be upgraded. However, it should be accounted for how these settlements are able to still make public spaces in spite of its high density. Generally, people aspire to mixed use areas and being close to their business.</li> <li>• Part of the solution requires informing and communicating with informal settlement residents on the benefits of living in planned areas. There is an impression that planned areas are expensive, involve more taxes, rent – and so, compared to their present living situation, does not offer any serious improvements.</li> <li>• Kariakoo faces uncomfortable microclimate and UHI. It needs greening and green roofs. Additionally, it is congested and vulnerable to health-related epidemics. It requires organising the street vending which is economically important for the city. <ul style="list-style-type: none"> <li>○ It is not resilient as when it floods, it is cut from Magomeni and rest of city.</li> </ul> </li> <li>• Densification and high rises are essential to limit urban sprawl and destructing natural areas such as Pugu hills – a green belt may be required. This requires regulation and strong politicians as well as collaboration across departments. Dar es Salaam needs to make streets liveable by encouraging walking which is more healthy and better than car.</li> <li>• Street furniture and beautifying the city are helpful but additional elements.</li> <li>• The city needs to move away from congesting the centre, it is too monocentric. It should be better integrated but not have one centre but rather more satelite cities.</li> </ul>

Summary: Expert Interview 8	
Interviewee	8
Expertise	<i>GIS and Urban Resilience Specialist. Involved in a university partnership program focusing on skills and knowledge transfer on urban resilience.</i>
Summary	<ul style="list-style-type: none"> <li>• Integration is essential to Dar es Salaam. Currently, the city is not well connected – look at Mbundo. Everything has to pass through the city centre to access rest of city. Morogoro, Bagamoyo, Nelson Mandela trunk roads connect the mini cities of Dar es Salaam. However, we need more ring roads to connect the city to different suburbs.</li> <li>• The city should densify. In Europe, development is initiated by the private sector as compared to Dar es Salaam whereby people build their own homes (it will continue to be the case). The planning of the city is not enforced.</li> <li>• Data is needed for decision making – this data needs to be collected and updated to help inform planning decisions.</li> <li>• The largest stressors to the city is urban heat and solid waste managements. Additionally, street vendors need to be regulated and given dedicated marketplaces as they currently block passages and increase congestion. Magomeni urgently needs to be improved, it is highly congested and lacks a good road network.</li> <li>• Informal settlements are the most vulnerable – often extremely dense and only one storey high.</li> <li>• Kariakoo is the CBD and will continue to be Dar es Salaam’s centre. High rises should dominate in this area. It is too congested and difficult to walk hence, skywalks are a solution.</li> <li>• Cultural gap in that locals are not used to high rises and prefer to live in low rise areas “you have your plot of land, and you have your house on it.” This may change in the future – move into apartments and use shared spaces. However, this is the reason the city is growing horizontally not vertically. People own land and develop on them directly. The law is catching up with this shift and the new law recognises that separate land titles can be attributed to same plot of land.</li> <li>• Public spaces are lacking and are needed – for sports and parking is an issue. In urban design, roads are not conducive for cycling or multiple users including pedestrians. Walking and cycling should be encouraged.</li> <li>• Basic infrastructure such as water infrastructure is needed in informal settlements – such as drainage in Sinza and Ubungo. Additionally, these settlements need to be integrated with road networks with rest of city.</li> <li>• Multifunctional areas are needed mixing businesses and people such as Mwenge. This area is like an exchange point, connecting different areas of the city. The city needs more centres – it is too monocentric.</li> </ul>

Summary: Expert Interview 9	
Interviewee	9
Expertise	<i>Architect and researcher specialized in urban design, sustainable cities, informal urbanism, architectural analysis, and urban transformation in Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• It is important to consider Kariakoo – as other parts of the city such as Sinza and Mwenge are following the tone and pattern of growth of Kariakoo.</li> <li>• In terms of resilience, the highest risk is flooding.</li> <li>• Urban sprawl and unprecedented growth is unpredictable. The growth negatively impacts availability of open space, transport system, overall quality of life. Provision of services, drainage, sewage, and waste cannot be managed without managing the growth of the city. Pollution from the economic activities and growth of the city is an issue. Additionally, food supply and management are under threat as it infringes on pockets of land where food is normally grown – leading to importing food which has a high environmental footprint.</li> <li>• In terms of a solution, depends on case-by-case basis whether to densify. The provision of services and amenities can be the deciding factor to decide where to build high or low. The building typology needs to follow the infrastructure (cannot built high rises where infrastructure is bad and lack of amenities such as schools and hospitals). Currently, it’s the opposite – buildings are constructed and then the infrastructure and services follow which is an issue.</li> <li>• Kariakoo – the speed of transformation matters, it cannot be too fast or else a bad quality of life, spaces and buildings will occur. The current buildings are substandard and there is a lack of services in the area. “I see a short-lived neighbourhood” The government will start demolishing the neighbourhood one after the other. They will then improve services and rebuild.</li> <li>• Kariakoo is at its highest in terms of densification, and so, the aim should be to improve quality of spaces by demolishing and rebuilding buildings. Currently, highly at risk to fire and hazards. The current built area is only built to sustain functionality for 20-30 years.</li> <li>• The quality of space needs to be improved or else, people will move out of the area, which reduces the land value and by extension, hinder its economic productivity and contribution to the city.</li> </ul>

Summary: Expert Interview 10	
Interviewee	<b>10</b>
Expertise	<i>Urban Resilience Specialist. Former senior member of municipal council in one of Dar es Salaam's largest municipalities.</i>
Summary	<ul style="list-style-type: none"> <li>• The history of Dar es Salaam influences the patterns of resiliency as seen through the geospatial charts.</li> <li>• People move to Dar es Salaam for the economic opportunities – when they arrive, they need to be accommodated. There is no law to restrict people coming to the city – all is welcome. When they arrive, they need shelter which they find through someone in their network however, eventually they need to move out – this is when the pressure on the land increases.</li> <li>• <b>Housing</b> is one of the main issues – people need to be housed safely.</li> <li>• <b>Economic activities</b> and increasing opportunities is the next big issue. There are many informal activities in Dar es Salaam and many opportunities to survive (machingas and so forth). However, a lot of the work is not productive – selling casavas for example. That energy could be spent elsewhere to something that produces economic benefit to the city as a whole. We need to produce more jobs and so need investment – to ensure the city remains economically productive.</li> <li>• <b>Pressure on land</b> is the next issue. Buildings are arising where they are not supposed to be built. People moving to Dar es Salaam consider factors such as commuting time to work. They buy cheap land in hazardous areas. It is difficult to enforce the law from the state as there is a lot of pressure from real estate developers and plot owners as well as customary ownership of land.</li> <li>• Dar es Salaam needs to define its identity to focus on how its strategizes its growth. Is it a services city, a transport hub, a tourist hub, an education city or port city? What are we? Once we know the identity, we can focus effort and investments.</li> <li>• If you continue building outside the city, there is a high transport cost into the city and most income generated ends up being spent on commuting. Additionally, family disconnection occurs because of cost – worker spends time in centre and family lives in the outskirts. And so, people must live central to make a living and the centre has jobs.</li> <li>• Create satellite towns to move pressure away from the centre – transport resilient development to facilitate mass cheap transit – invest in Bus Rapid Transit system – its essential and also important for the climate.</li> <li>• Invest in resiliency infrastructure – such as drainage and greening the city as nature bases solutions (harvest water, sustainable urban drainage systems) to become water resilient. At the moment, 30-40% of people depend on ground wells and so we should recharge the aquifer. NBS and public open spaces helps deal with heat stress.</li> <li>• Densification is important to reduce urban sprawl – use building codes to enact this densification. However, there is a cultural barrier, people are accustomed to owning plots themselves and living on the ground (not flats). Education and communication is important to convince people of lives in an apartment.</li> <li>• The Unique Titles Act legally is a good move to promote densification and allows people to own apartments. However, need affordable housing for low-income earners (who cannot previously afford flats). Affordability is key to reducing the sprawl. This requires improving the mortgage facility for people of lower incomes (which currently does not exist). Formalisation of informal</li> </ul>

businesses to access mortgages – so people have a record of earning and income generations are known.

- Formal planned areas are becoming informalized because there is a market and economic opportunities – people fill in the gap – all depends on economic activity.
- In terms of densification, there are building standards depending on the area. If you are by the sea, cannot build too high. If the area is commercial, like the area of the World Bank, it is not inhabitable – it depends on the intended function of the area. Kariakoo is required to be high as advised by planners. Densification is more efficient, more cost effective and better for service provision in terms of cheapness and ease.
- Upgrading and planning informal areas all depends on the economic situation.
- Keko – close to Kariakoo – the densification is too high leading to lack of safety and crime.
- Currently, due to the land market, informal residents are being bought out and moved to outskirts. People with middle income replace the poor in a natural process – so we must improve unplanned settlements and this replacement will occur.

Summary: Expert Interview 11	
Interviewee	<b>11</b>
Expertise	<i>Urban Planning Research Professor and Senior Member of the Tanzania Association of Planners and Honorary Secretary of the Tanzania Association of Consultants.</i>
Summary	<ul style="list-style-type: none"> <li>• The spatial morphology of Dar es Salaam is shaped by its infrastructure. Urban sprawl occurs from North to South where road network has been strongest. Transport connections impact land value. Dar es Salaam as a finger type development with no ring roads. As a result, open pockets occur along these ‘fingers.’ Water supply, electricity and transport infrastructure can stir urban development patterns.</li> <li>• Urban forms are influenced by topography. Kariakoo’s grid-iron pattern (which is good), introduced a while ago, is appropriate due to its flatness. Hill areas have different forms due to what is possible engineering-wise.</li> <li>• Master planning and high density should be cautious as it can replicate Kigamboni which is a “ghost town” and culturally detached from the rest of the city.</li> <li>• In terms of public space, there are a lot of open public spaces however, they are not programmed or taken care of. These spaces have economies and in terms of urban renewal, they should be planned and designed for these economies in line with other uses. Spaces in informal areas have informal uses i.e. children playing.</li> <li>• Urban tourism is lacking and is an obvious area of urban intervention. There should be more use of the river and coastline in terms of economies of tourism.</li> <li>• Land Value is the most important factor to consider – it determines the path of development and the resultant urban form. Hence, the coast and the CBD see increasing land values. When land value increases, people develop buildings differently and because of the location – the building types are also influenced (hence topography + land use).</li> <li>• Gentrification and density can sometimes align. Masaki is densifying and rapidly gentrifying as more people develop the area. A similar pattern is occurring in Kariakoo however, the plot sizes are very small with very high density – Kariakoo lacks space for people and parking.</li> <li>• Urban governance, which is lacking, is important to guide and regulate development. “You cannot get resilience if there is corruption.” It all follows from laws and regulations – “it is an eye beaming at what you want to want to look at.” Governance should be centred around accountability and transparency. Land use planning, allocation and development of infrastructure is essential.</li> <li>• Resiliency should be about inclusivity in terms of socio-economic, gender and disabilities. Economics is part and parcel of resiliency – generating income and employment.</li> <li>• Bid Rent Theory is an important theory to understand urban form of Dar es Salaam – distance from CBD is a factor that determines land values and by extension, morphology. In this sense, we can look at the city in terms of external (masterplan) and internal determinants (land value).</li> <li>• Informal residents do not want to move to formal planned areas.</li> <li>• Heat stress is inverse – as you leave city centre, it is warmer as more trees are cut in informal areas and corrugated iron roofs contribute to the heating.</li> <li>• Dar es Salaam’s structure is odd in that Magomeni (close to the centre) is residential, after Magomeni is industrial areas and then thereafter, it is residential again.</li> </ul>

- |  |  |
|--|--|
|  | <ul style="list-style-type: none"><li>• Based on experience in the city council, when one builds high rises, people are displaced as they cannot afford the are and hence, sell their plots.</li><li>• Resiliency can be achieved by addressing environmental conditions such as greenery and heat stress as well as imposing development control. If Dar es Salaam does not, it will be “chaotic, inefficient and lead to land use conflicts” as well as be economically inefficient.<ul style="list-style-type: none"><li>○ An efficient transport system, like an underground transport network, is needed to bring people to the CBD quickly and make the city commercially viable. The road transport system is not efficient.</li><li>○ Plots should be combined into two or three – and then densification can occur with high rises and space for more public space and green.</li></ul></li></ul> |
|--|--|

Summary: Expert Interview 12	
Interviewee	12
Expertise	<i>Landscape Architect and Consultant for public space development in Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• Built density and building diversity are the most important factors to consider as they enclose and effectively create the public space.</li> <li>• High rises are not effective given power cuts – as well as health and safety wise. It is too anonymous and artificial. We can achieve medium rise high density social housing – no more than 5 storeys but make it walkable and with public space.</li> <li>• In terms of spatial morphology, it is important to densify along ‘fingers’ of development and have green corridors in between. These should include satellite cities and then as move away from it – it gets less dense. ‘Circus tent’ type model. Ring roads will facilitate the creation of nodes and pockets of densification. Mwenge is a node. It takes pressure off Kariakoo to make it greener and more resilient. Mass cheap transit systems such as tram or light rail should help this.</li> <li>• Lack of strategic use of the ocean for transport and economic purposes – the whole economy of the waterfront and ocean needs to be developed.</li> <li>• The main resiliency stressors are traffic, waste, flooding (which is currently being addressed), loss of green/vegetation and unplanned urban sprawl. Localised sewage drainage is terrible and leads to sewage disposal which pollutes the aquifer below the city. In Sinza, the water table is very high and the water is polluted.</li> <li>• Urban Governance: need to be proactive in offering incentives and so forth to steer growth. Law persuasion and incentivise people combined with the political will to enforce.</li> <li>• The sprawl is being spurred by developers with money who are taking advantage of the land economy and not even paying building permits.</li> <li>• The plots of land being sold are essential to determine urban form. The plots of land 20x20m are too small to manage in a coherent manner. These plots originated as a money making scheme but its also affordable for everyone – it is subserviced and unregulated. These plots should be combined and made bigger into 500m squared to make a block.</li> <li>• There is a lack of urban design and no consideration of how buildings impact the street – the high rises have no regard for street design. This is despite “most of us spend our lives on the streets.”</li> <li>• Return to the basics of design and enforce using regulation and building permits – i.e. no exposed glass on the side of the sun. Part of the issue is that those approving building permits are not designers or care for the urban quality of an area.</li> <li>• Money needs to be pushed lower on the priority list.</li> <li>• Kariakoo – land tenure rights have 99 year leases and then it is technically owned by the government. The government should say there are 10 plots that make a block and allow one development per block so it forces collaboration. Block type development helps resilience as it makes space. Building diversity is important with varying building heights to get views and allow in ventilation.</li> <li>• Kariakoo is too important and central to the city – “if there is a disaster in Kairakoo, it would be a tragedy for the whole country”. Everyone is “one step removed from Kariakoo”. A fire,</li> </ul>

tsunami, flooding, terrorism makes it highly vulnerable. There is no place for emergency services and so block type development will bring back public spaces.

- The grid street network is efficient in terms of service delivery and its cheap – especially if streets are signposted, it makes it more legible for people to navigate the environment. There needs to be more parking space.
- There is a cultural consideration, Tanzanians do not want to live in high rises and many who come from villages prefer being on the ground. Additionally, they want to own the land and not the building – and so communication is key to educate people. But, at the end of the day, they want to live in a good place.
- The land value close to the city centre is getting higher, individuals who own land there are incentivised to sell it.
- Informal settlers develop a culture, and they move – and create a new culture. They are adaptable.
- There needs to be education to teach people how to live together in close proximity – requires enforcing legislation such as noise levels at 55 decibels.
- Street vending needs to be integrated and formalised so it can generate money for the city. Currently, the city is not financially benefitting from it yet forced to spend money cleaning after it. People should be given a licence to use a space – which they are responsible for cleaning and maintaining. Earnings should be formalised. Education is key to teach people about planning, financing, and so forth before given a space. People will see benefit of their taxes, “if you pay your taxes, you will get your roads”. On weekends, the streets can be pedestrianised and made into fully public space. It is very popular to eat on the street so let the city earn from it.
- The issue is people do not see where the value or tax is going – so the government need to make it explicit that the streets will be clean and kept safe.
- For new developments such as the Lower Msimbazi Basin, avoid overhead services such as power lines as it infringes with green and tree growth. Cheap solutions are expensive in the end. The Msimbazi development should be done in chunks to show people its usefulness.
- The Jangwani bridge and BRT has contributed to flooding as well as urban sprawl in the Pugu Hills. The BRT set the precedent that it is okay to build in the area.
- Masterplan lacks green in the city which is needed to tackle heat stress.

<b>Summary: Expert Interview 13</b>	
Interviewee	<b>13</b> (x 2 Interviews including a city tour)
Expertise	<i>Urban planning specialist. Involved in the executive team leading the design for the 2036 masterplan of Dar es Salaam.</i>
Summary	<ul style="list-style-type: none"> <li>• Urban public space is a vital part of the city, and we should pay attention to the meaning of the space. In informal settlements, everyone had different meanings for the same space (residents vs professionals) – space is not the same as place. Roads in informal areas are extensions of the home.</li> <li>• Design should enable freedom in everyday life. Space should be inclusive and is highly important to residents. “The space is their city, and the square is our town” and so we should reframe the street as a living room in informal settlements. Referring to a respondent in his research, “that tree is our castle, we discuss everything here”.</li> <li>• Spaces of informal settlements are invisible cities, and the main issue of planning is not considering neighbourhoods as cities in themselves. Therefore, we should connect cities (neighbourhoods) within themselves and make invisible cities visible again.</li> <li>• Dar es Salaam is a city with many cities within it. The formal and informal are emerging. In Kariakoo, the formal is being informalized – same with Oysterbay and Masaki. Mwanamala and Tandale are being formalised. The process of informalisation is faster than formalisation. The informal is disorganising and driving chaos in formal areas however, “there is something quite nice about the informal”.</li> <li>• Mikocheni and Mbezi see half of its area as informalized. Sinza used to be formal however became more informalized. Kariakoo at the city centre is being informalized as seen through street vending due to demand and disappearance of formal restaurants and cafes.</li> <li>• The Masterplan aims to connect the formal and informal – Dar es Salaam is caught between two paths of development, one of Singapore and the other of Stonetown. It must follow from the spirit of the people – a people centred city. Dar es Salaam is competing with Guangzhou and Mumbai.</li> <li>• In terms of flood resilience, in the Lower Msimbazi, the sea encroaches, and lagoon comes inwards. Inner city lakes should be created as social and environmental spaces which also reduce heat islands. The “whole city fails when the Msimbazi fails”.</li> <li>• Formal city is changing – a lot of high rises are being developed, a ‘Dubaisation’ and these buildings do not follow regulations such as in Kigaboni city.</li> <li>• In the Tanzanian constitution, it states “every person is entitled to own property” and land policy act states “Land is to be used productively” 1999 Land Act</li> <li>• Dar es Salaam needs to define who the city is for and explicitly invest with local people by using guidelines. Private and public investments need to become a norm in real estate – a joint partnership which see investments which improve the common good. A “common wealth city.”</li> <li>• The main issue of Dar es Salaam is the morphology as it is a monocentric city. There are five main roads including Bagamoyo, Morogoro, Kilwa roads. All development funds have been channelled into the centre of Upanga and Kariakoo. The monocentric nature means that congestion occurs in the morning and then, the suburbs are congested in the afternoon</li> </ul>

leaving the centre empty at night and Sunday. Almost 50% of the population enter the centre every day.

- Additionally, high rises and lack of regulation mean an overstretching of services – it is growing faster than service provision.
- Informal settlements are the next largest issue which have been going gradual upgrading development. The solution is to impose guidelines for redevelopment – do not demolish areas but rather look for investment to upgrade the area and redevelop in collaboration with local landowners to retain the sense of belonging and place.
- Do not resettle residents as that is ‘improved poverty’ – the value is in the community but its difficult because people want what they don’t have i.e. money.
- The money and investment should be rechannelled from the city centre to the residential area. It is not economically efficient to build high rises everywhere as it is more expensive compared to low rise. High rises are suitable for the centre however, four floors minimum is optimum for the rest of the city.
- Dar es Salaam should optimise spatial use and redevelop on existing plots of lands. 50% of plots should be built upon and the rest should be used for more green space and space on the street for circulation and economic activity.
- 400m<sup>2</sup> is the minimum plot size for this plan – alternatively a plot of 200m<sup>2</sup> with minimum of four stories with building only on 50% of the area. Currently in formal areas, people have built beyond the plot size and boundaries.
- In terms of the masterplan, the aim is to remove pressure from the centre by enhancing the ring roads. Mwenge, Upungu will become new nodes.
- The historical city centre needs to have a clear conservation policy and enact a maximum 6 floor height to limit development of high rises. CBD, Kariakoo, and Upanga will become a concrete jungle if not limited.
- For any redevelopment, the government should buy the land to use for urban space and limit new building growth and create public spaces. Redevelopments currently do not add benefit or value to the city.
- Increase pedestrian infrastructure which needs more space. Currently, people in Kariakoo are moving in between buildings using internal passages. Enhancing passages within buildings can reduce pressure on streets. Cycling is suitable as well as Dar es Salaam’s topography is flat.
- In terms of the buildings in Kariakoo, there should be more residential buildings. The first three stories should be connected to the ground floor to be used as a commercial podium. High rises with “culture”.
- It is a vertical redevelopment of buildings – pedestrian malls. Currently, they use the bottom floors and use the rest of the building for storage. More spaces in the street would be created to enjoy the nightlife and perform cultural activities (i.e. paying respects).
- Commuter expenditure should be reduced in the centre by increasing housing.
- Kariakoo’s main issue is congestion, stretched services, lack of circulation, heat stress and safety.
- In summary, use the existing network and enhance integration, limit built area on plots and increase density whilst improving access to spaces on the street.
- Images from excursion:



Upanga.

High rises emerging with little continuity to the existing urban fabric. They are not accessible from the street and built to maximise the plot size hence their proximity.

Upanga.

High rises emerging with little continuity to the existing urban fabric. They are not accessible from the street and built to maximise the plot size hence their proximity.



Between Magomeni and Tandale.

High rises are being developed on the fringes of large informal settlements close to the ring road.

Between Magomeni and Tandale.

High rises are being developed on the fringes of large informal settlements close to the ring road.



Between Magomeni and Tandale.

Many constructions are new and incentivised by rising land values and can be considered speculative investments. However, strategically, the density is not necessary in particular areas.

Between Magomeni and Tandale.

Many constructions are new and incentivised by rising land values and can be considered speculative investments. However, strategically, the density is not necessary in particular areas.

**Summary: Expert Interview 14**

Interviewee **14** (interview + attended academic presentation)

Expertise *Involved with a research platform in Dar es Salaam, Tanzania. Their research focuses on the intersection of housing and urban development policy.*

Summary

- All planning decisions reflect power interests. The masterplan sets a narrative and reflects the development agencies interests in the plan. There is no tool to implement the plan and there is an urgent need for zoning and community participation tools.
- Planner should understand what is happening on the ground and the interests involved – every transformation improves one set of lives yet may decrease quality of life for others. In Tandale, DART failed to consider the bottom-up approach of improving pedestrian infrastructure – accidental investment in walking paths and it was very successful.
- Many scales are invisible to the planner however, the neighbourhood unit is an important scale of focus. There needs to be deeper attention to the current actions of residents - what are they currently doing and why? Then the best way of intervening is creating a planning process for transformation of the neighbourhood.
- Current urban sprawl reflects the model of urban development and the top-down policy of the government. A lot of people intervening in the urban environment are not urbanists but rather economists that are keen to develop land and hoard value. In terms of power interests, to some stakeholders, they have an interest in formalising Tandale and upgrading it for land value improvements.
- Resilience is important for climate change as well as economic downturns – homelessness due to recessions and lack of affordable housing. Resilience is looking inwards and relying on local resources.
- The informal areas need to be broken apart – they are not homogenous. Informal housing typologies vary (as seen in Table A below)
- Different housing typologies reflect different values and interests of people (as seen in Table B below) – they end up displaying different morphological properties (Images A)



**Images A:**  
Satellite imagery of the morphologies of housing developments

MODALITIES OF SELF-BUILT HOUSING IN CHAMAZI				
Type	Main Agents	Resident's role in production	Funding source	Spatiality
Traditional/ Swahili Since 1960's	Residents, family members directly hiring small local contractors (fundis)	Builders and/ or direct contractors	Yearly savings, loans or help from family members	
Contemporary/ Jenga Uza 2000's	Local developers hiring a team of small local contractors (fundis)	"Clients"	Cash from: (i) compensation for forced removal, (ii) sale of properties in other areas of Dar es Salaam	
Cooperative based/ Federation 2009	Families, housing and water and sanitation NGOs	Advocates, facilitators and builders	Community-based daily saving schemes	

Table A:

Modalities of Self Built Housing in Informal Settlements

### Housing spatialities continued

#### Swahili

Plot size and density based on livelihood's needs



#### Jenga Uza

House size and layout based on expectations of economic value



#### Federation

Compact/ incremental development to enable cooperative model



Table B:

Images of housing typologies and incentives linked to housing development.

## 11.6 Appendix 5: Interviewee List

Interviewee no.	Date	Expertise
1	21/6/2022	An urban specialist with expertise in urban sustainability, coastal management, climate change and applied GIS. Extensive experience in strategic planning for greening Dar es Salaam.
2	22/6/2022	Urbanist who conducted their research on public spaces in informal settlements with a focus on the Tandale informal settlement. They are closely affiliated with a local platform for re-imagining public spaces in Dar es Salaam.
3	24/06/2022	Geomatician and an urban climate change expert. Specialised in spatial risk analysis of urban environments and have published several papers relating to risk in Dar es Salaam.
4	13/07/2022	Their work is focused on mainstreaming nature-based benefits in urban environments through research and collaboration with city authorities on urban planning and project implementation.
5	21/07/2022	Member of a university partnership program focusing on skills and knowledge transfer on urban resilience. They manage a digital geospatial data repository that supports research, education, and disaster-risk management practices.
6	09/08/2022	Urban planning and Disaster Risk Reduction specialist who has focused past research on informal settlements in Dar es Salaam, Tanzania.
7	18/08/2022	Urban Planner and a Geographical Information System expert. Involved in the development of urban land management guidelines in Dar es Salaam.
8	22/08/2022	GIS and Urban Resilience Specialist. Involved in a university partnership program focusing on skills and knowledge transfer on urban resilience.
9	23/08/2022	Architect and researcher specialized in urban design, sustainable cities, informal urbanism, architectural analysis, and urban transformation in Dar es Salaam.
10	24/08/2022	Urban Resilience Specialist. Former senior member of municipal council in one of Dar es Salaam's largest municipalities.
11	13/06/2022 22/08/2022	Urban Planning Research Professor and Senior Member of the Tanzania Association of Planners and Honorary Secretary of the Tanzania Association of Consultants.
12	02/09/2022	Landscape Architect and Consultant for public space development in Dar es Salaam.
13	23/08/2022 04/09/2022	Urban planning specialist. Involved in the executive team leading the design for the 2036 masterplan of Dar es Salaam.
14	31/08/2022	Involved with an research platform in Dar es Salaam, Tanzania. Their research focuses on the intersection of housing and urban development policy.

**Interviews adopted a semi-structured style and so, not all interviews followed the exact order and phrasing of questions depending on their focus area and interest.**

1. What is the primary use of public space in Dar es Salaam? (Informal vending, recreation, etc)
2. What is lacking in terms of public space in Dar es Salaam?
3. What should be prioritised in terms of creating better public spaces in Dar es Salaam?
4. (Follow Up) What are the largest barriers to do so?
5. In terms of the different types of urban form in Dar es Salaam (unplanned, planned, CBD, etc), how should they be tackled differently to create better functioning neighbourhoods – in terms of environmental and socio-economic conditions?
6. What criteria most important for you for successful urban area?
7. Could you describe the following areas of Dar es Salaam – in terms of the associations you make with them?
8. (Follow Up) What are the main functions of these areas?
9. What are the main shocks and stresses (social, environmental, etc.) that these neighbourhoods face?
10. How resilient are the neighbourhoods to those shocks and stresses?
11. What are your biggest concerns for these neighbourhoods in the future?
12. How do you envision the future of these neighbourhood at their highest potential?
13. What typologies of housing do residents aspire to? What type of urban form appropriate?
14. What are the most important criteria to think of for the future of Dar es Salaam?

[End]

# Public Space Resiliency in Dar es Salaam

Investigating the qualities of public space resiliency in central Dar es Salaam to inform the strategic design of the Lower Msimbazi Redevelopment masterplan.

**MSc Metropolitan Analysis, Design and Engineering**  
Master Thesis

## Author

Rakan Dajani

[rakan.dajani@wur.nl](mailto:rakan.dajani@wur.nl)

WUR Student nr. 1048929

TU Delft Student nr. 5437741

## Project Duration and Location

March 2022 - October 2022

Amsterdam, Netherlands

Dar es Salaam, Tanzania

## Supervisors

Dr. Claudiu Forgaci – TU Delft

Dr. Jess Wreyford – Wageningen University & Research

## External Supervisor

Remco Rolvink (DASUDA + VE-R)

## Institutions and Organisations

AMS Institute

TU Delft

Wageningen University

Dutch Alliance for Sustainable Urban Development in Africa (DASUDA)

