

Changing public spaces and urban resilience in the City of Tshwane, South Africa

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ABSTRACT

The City of Tshwane has experienced significant political, socio-economic and spatial changes. The lives and daily use patterns of different people in the city, as well as public spaces changed. While some people have retreated to semi-privatised space, others are enjoying unrestricted use of space in more traditional parks and quality public spaces in former marginalised areas. This raises questions regarding the impact of these changes on urban resilience, especially in the context of the new Tshwane 2055 vision calling for a “liveable, inclusive and resilient city”. This study analyses six public spaces in three different neighbourhood types in Pretoria and highlights the emergence of three trends - degradation, adaptation and transformation. The paper argues that these trends have implications for urban resilience of both the public space and the immediate surroundings in terms of diversity, intensity, proximity and connectivity in and around these spaces. Limited diversity proximity, intensity and connectivity strain opportunities for adaptation, while radical intervention at a specific point in time can expedite the trajectory of change and bring about rapid transformation. This has implications for urban planning and design in terms of deciding the level, extent and nature of interventions in particular parts of cities.

KEYWORDS

word; urban resilience; urban system; change; public space; South Africa

Introduction

The rapid urban transformation has become an important focus area in recent years, with many discussions dwelling on how to deal with the complexity of these changes and the resilience thereof. Not only are cities changing, but public spaces within cities are also experiencing significant transformation, especially in African cities. The capital city of South Africa is no exception, where some spaces were neglected, and others privatised or revitalised (Landman 2019). Yet, the municipality is calling for a “liveable, inclusive and resilient city” in its new 2055 strategy. It is well established that quality public spaces can contribute to sustainable neighbourhoods and urban settlements (Talen 2000, 2008; Al-Hagla 2008; Carmona 2019).

Urban resilience is becoming a key factor towards sustainable urbanism (Leichenko 2011; Salat 2011; Chelleri and Olazabal 2012) and, consequently, there has been a growth

of plans and strategies to add it to the urban agenda (Coaffee and Lee 2016). Despite the increase of resilience plans seeking to understand and highlight institutional processes to adapt to the complexities of constant change (Ibid), there has been a neglect of the spatial impact and implications of resilience (Nel and Landman 2015; Peres, Du Plessis, and Landman 2017; Feliciotti, Romice, and Porta 2017; Masnavi, Gharai, and Hajibandeh 2019). Yet, Coaffee and Lee (2016, 263) argue that since there is now a greater consensus regarding the importance of urban resilience, planners need to start implementing resilience rather than just highlighting its merits. This raises questions regarding the impact of changing public space on urban resilience. This paper offers new insights on understanding change patterns at the local scale and the spatial implications for urban resilience.

As part of ongoing work on the resilience of aspirational African cities, we investigated the transformation of public spaces in different neighbourhood types in the City of Tshwane, the municipality that includes Pretoria, the capital city of South Africa. We have unpacked the spatial changes in the public spaces through form and function and then utilised four spatial directives, namely diversity, intensity, proximity and connectivity to explore the impact on and potential for urban resilience.

The paper argues that the presence of these spatial conditions helps mitigate unwanted system states while facilitating the creation of options and the generation of opportunities to improve the adaptive capacity and transformational potential of the urban system. The paper contributes to the existing debate on urban resilience by linking the transformation of public space to the potential for urban resilience and by identifying a set of spatial directives to understand and leverage this potential through urban planning and design.

Changing cities and public space and its relationship to urban resilience

We are living in a time of profound global change (Bhan, Srinivas, and Watson 2018), and often this is dramatically experienced in cities. Cities are facing several persistent challenges such as urban growth, changing family patterns, an increasing number of people in informal settlements or slums, as well as a lack of service provision in many parts of the world (UN-Habitat World Cities Report 2016). This is especially pronounced in countries of the Global South, where the highest numbers of people live in informal or unplanned areas without adequate services (UN-HABITAT 2008). However, amid rapid urbanisation and emerging issues such as climate change, inequality and insecurity, there is a role for public space to play in the development of more habitable cities.

The Sustainable Development Goals and more specifically, Goal eleven seeks to “make cities and human settlements inclusive, safe, resilient and sustainable”. One of the proposed targets set out by the above goal is the provision of “universal access to safe, inclusive and accessible, green public spaces particularly for women and children, older persons and persons with disabilities” (Habitat III Issue Paper on Public Space 2015). Besides, the New Urban Agenda (2017) highlights public space as a key lever towards transformed urban areas through “multifunctional areas for social interaction and inclusion, human health and well-being, economic exchange and cultural expression”.

However, as cities change, public space also alters in different ways, raising questions about how to deal with these rapid changes in a context of uncertainty and increasing

unpredictability. While many bemoan the “death of public space” due to increasing levels of privatisation (Banerjee, 1998; Low and Smith 2006), others see opportunities in the emergence of new forms of public space (Carmona 2015; Landman 2019). Yet, there is limited research related to public space that moves beyond ecological or socio-economic resilience to address the physical dimension (Masnavi, Gharai, and Hajibandeh 2019).

Resilience refers to the ability of a system to absorb disturbance and retain its basic function and structure. It, therefore, relates to concepts of sustainability and the challenge of servicing current service demands without eroding the potential to meet future needs (Walker and Salt 2006, 1–2). A resilience approach emerges from complex relationships among different actors and recognises that living entities sustain themselves through constant adaptation to their environments. Given this,

“Urban resilience refers to the ability of an urban system – and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales – to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity” (Meerow, Newell, and Stults 2016, 45).

Urban resilience has many dimensions, including the ecological, economic, social, institutional and physical dimension (Masnavi, Gharai, and Hajibandeh 2019). Considering the physical dimension, this raises questions about the role of spatial resilience and the ways to understand and analyse it in cities. In this regard, Salat and Bourdic (2012, 65) state that, “urban resilience can be understood as the robustness of urban structures and networks against random failures”. These failures may occur on a small scale – for example, disruptions to local transport networks or energy systems or at a large scale. However, the likelihood of these disruptions is also influenced by the urban form. While a few studies have started to investigate spatial resilience at a neighbourhood level (Nel and Landman 2015; Feliciotti, Romice, and Porta 2017; Davis 2018), or in terms of the relation of urban resilience to morphology at various scales (Marcus and Colding 2014; Feliciotti, Romice, and Porta 2016), little has been done on the urban resilience of public space. To do this, there is a need for directives to understand and investigate spatial resilience at a micro-level.

Following the studies conducted at the neighbourhood level or related to morphology at various levels, some proxies or principles for spatial or urban form resilience have been identified. In an attempt to unpack spatial resilience, Peres, Du Plessis, and Landman (2017), referred to the principles of diversity, redundancy and modularity. Investigating the resilience of gated communities in Pretoria, Nel and Landman (2015), utilised five principles, including, diversity, connectivity (which both contribute to complexity), proximity and intensity. In another study, exploring the resilience of a neighbourhood, The Gorbels, in Glasgow over time, Feliciotti, Romice, and Porta (2017) utilised five proxies for urban form resilience, including diversity, redundancy, modularity, connectivity and efficiency. The authors also maintained that these proxies can be applied at various scales, including that of the plot, street edges, the block, the streets, sanctuary areas and the district (Feliciotti, Romice, and Porta 2016). However, it is unclear whether public space would be considered at the plot level, street edge or blocks. One can argue that it would probably depend on the physical typology of the public space, for example, whether it is located in the middle of a block, on the edge of a block or surrounded by streets on all

sides, functioning more as a small urban block. This would imply that an investigation of the resilience of public space should be concerned with both the specific site, as well as its immediate environment.

From these studies, and to understand the resilience of public space in the City of Tshwane, the following directives (Table 1) were selected, namely diversity, proximity, intensity and connectivity; not only for their value in understanding resilience but also as a longstanding acknowledgement of normative principles for well-performing public spaces. While important for resilience, modularity and redundancy have been excluded from this study, as they have limited impact in terms of public space and would only have significance when studied within a larger context.

The diversity that accommodates a variety of activities and spreads the risk

Many authors have linked diversity to well-performing public spaces. Public spaces must offer access to different groups of people to a variety of activities (Madanipour 2010). Given this, diversity is an important element to facilitate intense social interaction and contribute to a sustainable district (Salat 2011, 400). To be more diverse, public spaces should accommodate different types of activities, namely those that are necessary, optional and social (Gehl 2011), a mix of land, allow for longer opening hours, different types of markets and entertainment facilities, include different types of vegetation and make provision for a range of properties (Montgomery 1998). Consequently, public space should avoid one-size-fits-all and not try to cater equally to every citizen or every occasion (Carmona 2019).

Diversity is also a core concept in resilience thinking, making the constituent elements and connections of systems more interchangeable (Coaffee and Lee 2016) and enabling them to implement multiple coping strategies (Marcus and Colding 2014). It is the conditioning attribute for building resilience in complex systems, by spreading the risks, working similar to insurance (Samuelson, Colding, and Barthel 2019). Diversity also enhances the complexity and adaptive capacity of the urban system through diversity

Table 1. Directives of resilience.

Directives	Description	Measurement
Diversity	The space distribution of different elements. Diversity helps to build complexity and redundancy by increasing the opportunities for interactions and providing more options.	Assess the variation in number and spatial distribution of urban factions at different spatial scales.
Proximity	Combined effect of good connectivity and high diversity improve proximity to opportunities and options. Good proximity reduces average distance between places and increases efficiency	The number and variety of importance facilities which are near and easily accessible.
Intensity	Intensity can be described as the quantity or concentration of something within an area at a given scale. Increased intensity of elements within an area improves access to opportunities and improve efficiency and more options are available closer.	Typically measured through density, for example, People/ha or Dwelling units/ha.
Connectivity	The ease of movement which is determined by the type, quality and configuration of the movement network. Good connectivity make movement easier while also providing more route options.	How connected an area is in terms of its road network or public transport and can be measured through various accessibility metrics.

among similar objects at the same scale, for example, a mix of population groups, income groups, land use and housing units in a given area, as well as the diversity of objects at different scales (Page 2011; Salat 2011), for example, the presence of certain large scale metropolitan facilities in a few places, including large hospitals or sport stadia. This links to what Feliciotti, Romice, and Porta (2017) refer to as efficiency, a phenomenon described by Salat and Bourdic (2012) as the inverse power law that accounts for the frequency of an element's appearance concerning its size. Increased diversity would also make provision for greater redundancy and increased capacity in terms of response diversity in the case of certain system failures and perturbations. Diversity can be further enhanced by spatial distribution, which refers to the concentration or dispersion of objects at a given scale in proportion to need and in a way that would be considered equitable, allowing people to access places to address their everyday needs, for example, the number of public buildings in a district (Salat 2011).

The proximity that facilitates access to opportunity and accommodates spatial distribution

The location of public space is important to facilitate greater convenience and ease of access to a variety of opportunities. The primary physical barrier to ease of access is the cost of overcoming distance and preferable, to gain access to the most necessary daily activities by foot (Dewar and Uytenbogaardt 1991). These opportunities are best released when the public spatial structure is positively made, focussed around places and space and movement channels.

“... the place is convenient; you can get almost everything you need within walking distance. The market operates from the main square where the taxis gather. Formal shops and small manufacturing and service industries surround it and extend along the main road: many of these enterprises have residential accommodation above them” (Dewar and Uytenbogaardt 1995, 12).

Therefore, concerning public space, Raymond Unwin noted that all districts, suburbs or wards should have a central place where major or minor public buildings are grouped, but also to focus common life of the community (cited in Salat 2011). However, these places should be able to evolve to accommodate new preferences and needs, which may be informal and taking into consideration the immediate context around the spaces (Carmona 2019; Landman 2019; Moroni and Conzolino 2019). Public space can be strategically provided in locations that are safe, convenient and inviting to use and avoid conflict, for example, between skateboarders and commercial interests or between revelers and residents (Carmona 2019).

Proximity is linked to diversity in terms of spatial distribution and connectivity at a broader scale. Proximity enhances the adaptive capacity of public space concerning its ability for urban generation and regeneration, not only on-site but also as an anchor for the concentration of key socio-economic opportunities clustered around. A city has to be able to change continuously and adapt to new needs, which imply a transformation of urban form and use where necessary. Successful urban developments are based on an intersection between urban planning and self-organisation (Salat and Bourdic 2012, 60). Both of these concepts, namely adaptive capacity and self-organisation, are considered as

critical in resilience theory (Resilience Alliance 2010). Proximity takes into account the average distance between two locations, for example, home and leisure activities or home and work. The aim is to minimise distance, thus reducing travel needs such as commuting (Salat 2011), as well as related costs of time and energy.

The intensity that supports economic activity and intense interactions

The size of the population should be large enough to support economic activity (Montgomery 1998). Every public space has its norm in terms of effective capacity. This depends on the time of the day, context, micro-climate, comfort and attractiveness. Besides, Whyte (1980) found that people have a tendency to cluster in public space and that more people sit where more people walk. The space for walking should be wide enough, but again this depends on the context (Gehl 2011). However, it is not just a matter of size and density that determines the number of people that will use the space, but also the quality of the space (Gehl 2010).

Intensity is also important in terms of resilience and is closely related to complexity and diversity. According to Dewar and Uytendogaardt (1991), the biggest chance for the generation of urban opportunity is through intense interactions and high levels of population support. This highlights the importance of intensity and the overlap of activities. It does not, however, mean ubiquitous levels of intensity, but rather a range of intensity and exposure from very intense to more private. "High-stimulus environments which promote learning are fine-grained and diverse" (Dewar and Uytendogaardt 1991, 20). Intensity, or density as it is often referred to, is used to measure the concentration of an object at a given scale and can, for example, describe the concentration of people or housing. Intensity implies the relationship between the result and the means employed.

Connectivity that facilitates greater access and ease of flow

There is a close connection between the activities taking place within a public place and the quality of the space (Gehl 2010). Where there is a better physical framework established through planning and design, the outdoor activities grow in number and duration. Public spaces should be accessible to the public at all times (Whyte 1980). Accessibility to parks is defined as one of the major factors influencing green space utilisation (Byrne, Wolch, and Zhang 2009). Given this, they should be connected and well-located within a city's movement pattern as this will allow people from different social groups to come together at different times (Hillier 1996). Connectivity is also enhanced through a good relationship to the street. To be accessible, public places need to be permeable (Madanipour 2010). This refers to visual and physical permeability to the outside, but also within the space (Gehl 2011).

Connectivity also relates to the ease of flow within and across systems (Felicetti, Romice, and Porta 2016). Therefore, connectivity encompasses the structure and strengths of interactions between systems. However, the relationship between connectivity and resilience is not straightforward. While connectivity can facilitate system reorganisation after a disturbance, it can also enable the spread of the disturbance. It requires a balance between over-connection and fragmentation (Samuelson, Colding, and Barthel 2019). An analysis of resilience needs to look at form, function and connectivity and of

these, the connections are the most fundamental element of creating a living and sustainable city. When these connections are destroyed, as happened in the last 30 years of city-building, a huge anti-urban product follows (Salat and Bourdic 2012). City plans offer valuable indicators of the type and level of connectivity, by looking at the role of the street and the intersections (Salat and Bourdic 2012; Cardillo et al. 2006). The resilience of a network can be understood through the level of fragmentation of the structure as related to the growing amount of fraction that occurs due to the removal of nodes (Buhl et al. 2004), which relates to the level of connectivity.

Study background and methods

This study focused on six public spaces in the City of Tshwane, which is located in the Gauteng Province in the north of the country – the most urbanised province and the economic powerhouse of South Africa. The City of Tshwane, as the municipal area is known, incorporates the older city of Pretoria and is the capital city of South Africa. The municipal area includes about 2, 9 million people spread out over a total land area of 6298 km² at a population density of 464 people/km². In 2018 the urban area of Tshwane covered roughly 731 Km² and grew by 245 Km² (37.7%) between 1990 and 2018, as shown in Figure 1 (land cover calculations derived from Department of Environmental Affairs (2018) South African National Land-Cover dataset). Although a large number of houses and significant services were provided for the poor, remaining challenges for the city are that 135645 households have no income and the unemployment rate is 24% (Tshwane 2055Strategy 2013, 42).

To investigate the resilience of public space in the City of Tshwane, six public spaces were selected in three settlement types: two in the inner city of Pretoria (Church Square and Burgers Park), two in typical older suburban areas (Springbok Park and Jimmy Aves Park) and two in former marginalised areas or so-called African townships (Solomon Mahlangu Square and Kalafong Fitness Park) (Figure 2). Due to data limitations, this paper only takes a snapshot of the spaces to compare the changes pre-and post-1994.

As part of a multi-year project on the transformation of public space in South Africa, the nature and use of various public spaces across the country were studied, making use of spatial analysis and site observation to determine the form, as well as semi-structured interviews with the users together with participant observation to investigate the function of these spaces.

The spatial analysis of the public spaces concerning their immediate surrounding environment made use of several different sources of data, these being: land parcel data (City of Tshwane 2015); population data at the Small Area Layer level (Statistics South Africa 2011 national census); OpenStreetMaps (OpenStreetMap contributors 2019) road network and land use data derived from StatsSA DwellingFrame 2015, which is a point-based building dataset which includes broad primary land use per building as well as estimates of the number of dwelling units per building.

Diversity, the first of the directives, was assessed for each public space in two ways. The first was a site-level assessment in terms of the amenities and uses on the site. The second method of assessing diversity was in terms of land use mix in the areas surrounding the site. Considering that different urban functions do not operate on the same spatial scale

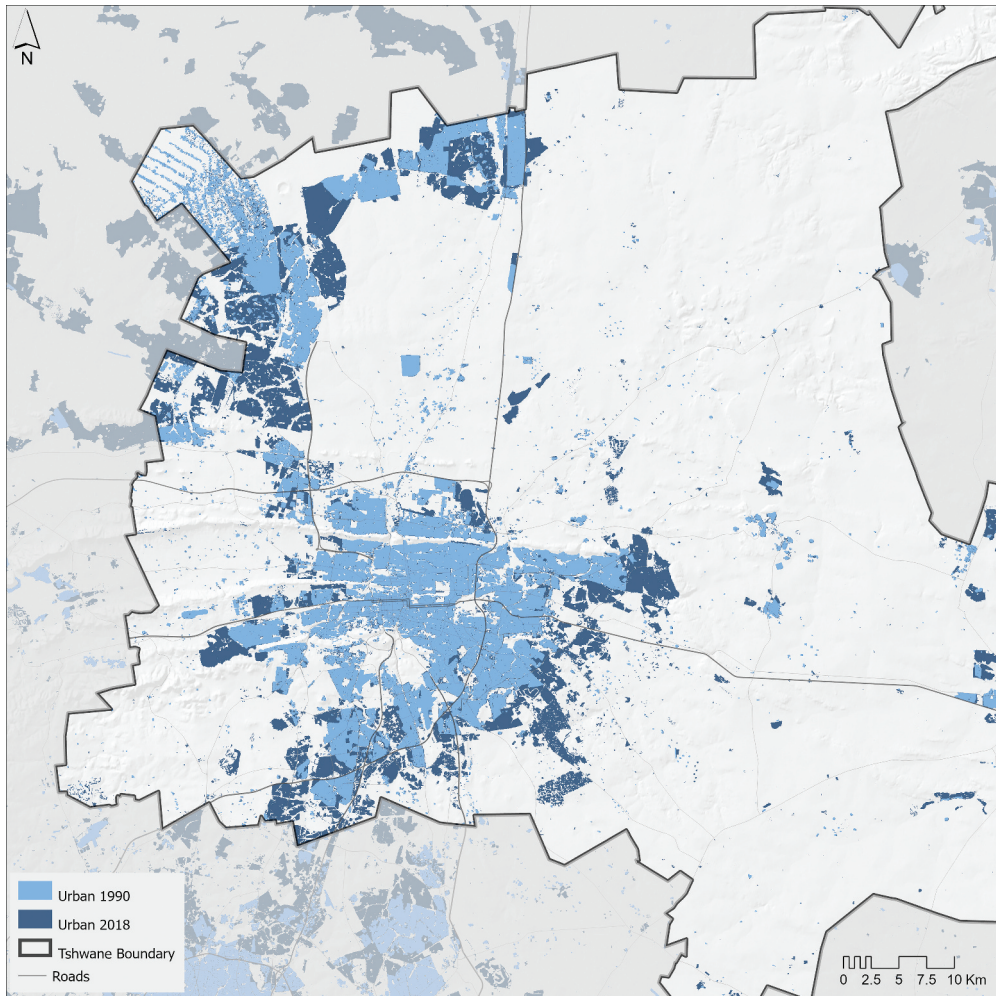


Figure 1. Change in urban land cover the City of Tshwane between 1990 and 2018.

(Dovey and Pafka 2017), land use diversity was assessed at multiple scales. For the multi-scale assessment, three buffers were created (0–500 m, 500–1000 m and 1000–2000 m) around each public space (see Figure 3 for example) and the number of different primary land uses (i.e. dwellings, business, recreation) within each buffer area were counted using the land use information derived from the Dwelling Frame. The land use counts were then used in a diversity index, using Shannon entropy (E_H) and normalised [0–1] (Equation (1)) to allow for comparison between scales and locations. Shannon entropy is often used in the assessment of land use balance as it allows for the assessment of the abundance of each of the land uses, as well as the evenness of the distribution of land uses (Zhang and Kukadia 2005).

$$E_H = \frac{-\sum_{i=1}^S p_i \cdot \ln p_i}{\ln S} \quad (1)$$

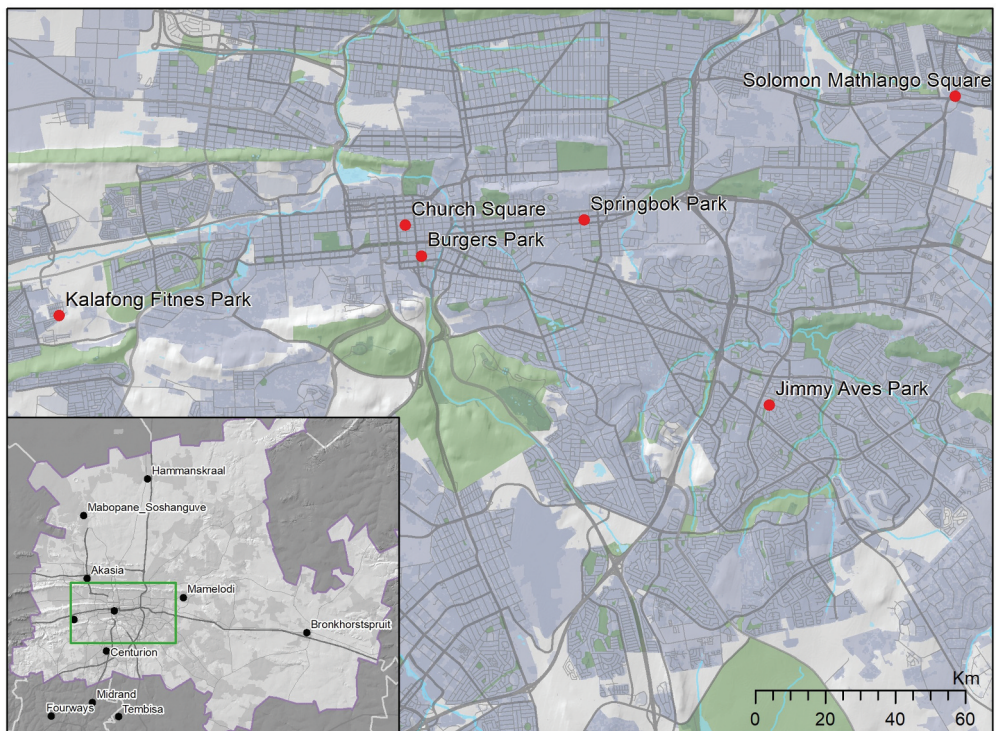


Figure 2. The location of the selected public spaces in the City of Tshwane.

Where S is the number of categories; i is the total number of elements; p_i is the proportion of elements within the i th group and \ln is the natural logarithm of p_i ; $\ln S$ is the natural logarithm of S .

Proximity considers the importance of the location of key urban functions and their ability to attract people (i.e. schools, community halls and hospitals), the proximity of public space to such facilities is important, in addition to proximity to people. Using a similar method to the assessment of diversity, the number of key public facilities were counted at multiple scales using buffers of 0–250, 250–500, 500–1000 and 1000–2000 metres around each public space. The additional buffer of 0–250 meters was included in an attempt to better capture the types of facilities in the immediate area surrounding the public space.

Intensity is strongly related to proximity; however, intensity considers the concentration of elements within an area, as such, measures of density are the most common methods of studying intensity. For this study, population density, as well as the density of dwelling units were used. To aggregate the data as well as to bypass issues relating to the “modifiable areal unit problem” or MAUP (Openshaw 1984), a kernel density estimation (KDE) method was used (Silverman 1986). KDE is a statistical method which transforms sample geographic point observations into a smooth continuous surface within a given search radius from each observation (Kloog, Haim, and Portnov 2009) and has been widely used in a variety of urban studies which require data to be aggregated and smoothed (Kloog, Haim, and Portnov 2009; Porta, Latora, and Strano 2010; Portnov, Dubnov, and

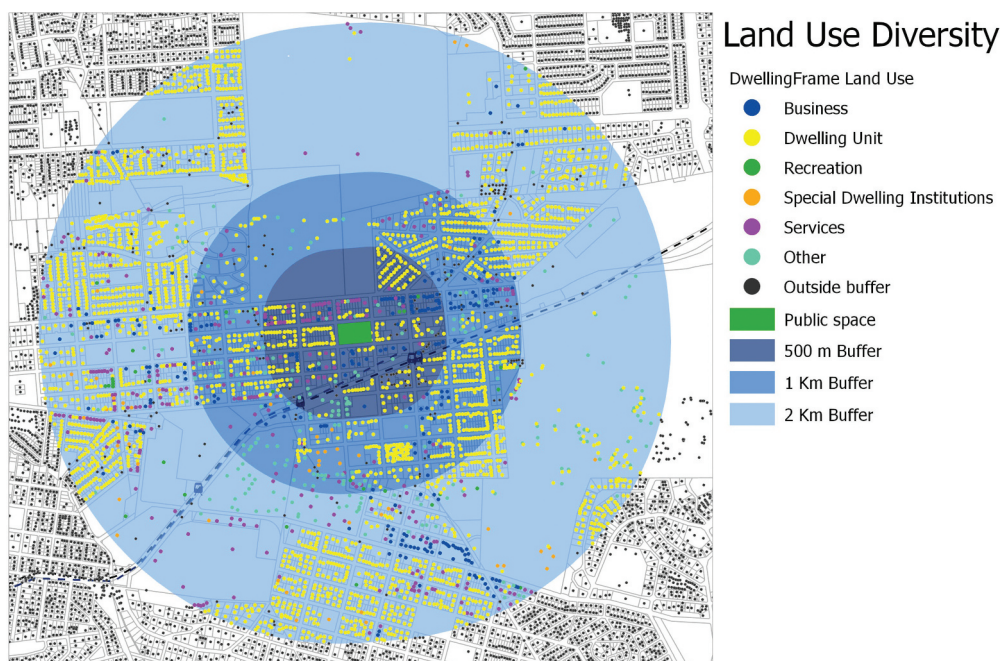


Figure 3. Example of three types of buffers created around the public spaces to determine land-use diversity.

Barchana 2009). Additional benefits of the KDE are that it allows for better visualisation of the data as well as identification of clusters (Kloog, Haim, and Portnov 2009).

For the population density, the 2011 national census data was used on the small area layer (SAL) level. The centroids of each SAL unit were used and a 500 m KDE was calculated and weighted by population. For the dwelling unit density, the 2015 StatsSA DwellingFrame was used and a 400 m KDE was calculated and weighted by the number of dwelling units per building. The results were two smooth surfaces which estimated the population and dwelling unit density for the City of Tshwane. The mean density within each buffer area was then calculated using ArcGIS's "Zonal Statistics as Table tool".

Connectivity can be measured in many different ways. Common measures include intersection density, road density or cyclomatic complexity (Salat 2011, 496; Sharifi 2018, 176). However, these measures are inadequate as they are limited to either describing the entire network or are bound within areal units, making it difficult to scale the analysis while being susceptible to the MAUP and the associated scale problem when data is aggregated into larger areal units (Harvey 1968). Sevtsuk (2010, 58) suggest that one method to overcome the MAUP problem and allow for scaling is to use accessibility measures at various network radii. In addition to allowing for scaling, access measures are a good indicator of the network connectivity, as they reflect the road and intersection density as well as the impact of the configuration of the network.

Connectivity was calculated with a gravity type access metric using Spatial Design Network Analysis (sDNA) method and tool (Cooper, Chiaradia, and Webster 2016) on an OpenStreetMaps pedestrian network. The gravity measure, called "Network quantity penalised by distance" (NQPD) in sDNA, is a type of access measure which "takes into

account both quantity and accessibility of network weight” (Cooper, Chiaradia, and Webster 2016) as well as placing a distance decay function into the distance (Equation (2)). Interested readers, please see Cooper, Chiaradia, and Webster (2016) for more details. For this study, network radii of 400 m, 800 m and 1500 m were selected for the multi-scale assessment. These radii were selected as they represent access, at an assumed speed of 5 Km/h for a 5, 10 and 20-minute walk respectively

$$NQPD(x) = \sum_{y \in R_x} \frac{(W(y)P(y))^1}{d_M(x, y)^1} \quad (2)$$

Where R_x denotes the set of polylines in the network radius from link x ; $P(y)$ is the proportion of any polyline y within the radius; $d_M(x, y)$ is the distance according to a metric M , along a geodesic defined by M , between an origin polyline x and a destination polyline y . Adapted from Cooper (2016).

The resilience of the six spaces was investigated at two levels, namely the site and the immediate surrounding environment. The directives of diversity and connectivity were applied at the site level, while all four directives discussed above were relevant to understanding the space within its immediate environment.

Changing public spaces and spatial resilience in Tshwane

Following the transition to democracy in 1994, the City of Tshwane experienced several political, socio-economic and spatial changes, which also contributed to the fluctuation within and around public spaces and the changing urban landscape. This section presents the six cases under consideration, followed by a discussion of the changes in the inner city, the suburbs and the township spaces, identifying key trends linked to the transition. Subsequently, the discussion considers the adaptive capacity of these public spaces, focussing on the resilience of both the specific space and its relation to the immediate surrounding environment.

Changing spaces in the City of Tshwane

The study analyses six public spaces in three different neighbourhood types. The context and characteristics of the six cases are summarised in [Table 2](#).

The inner city of Pretoria has dramatically changed from a white-dominated population to accommodate a diversity of users, including many poor and middle-class residents and workers of African descent. Church Square is one of the oldest open spaces in the city with four pathways leading to the statue of former president Paul Kruger in the centre. This improves the connectivity on the site. The square was recently upgraded to accommodate the Bus Rapid Transit system around the site, also improving connectivity. The square is surrounded by the Palace of Justice, Old Reserve Bank, General Post Office and the Capitol Theatre. It was observed that the space is well used for a variety of activities, ranging from those resting under the trees, or selling goods, to people utilising the free WiFi and listening to lay preachers. This contributes to the level of diversity on the site. It is also a popular venue for public protests. Burgers Park, a four-hectare Victorian park and Botanical garden, is located south of Church Square and is surrounded by various high-

Table 2. The context and characteristics of the six public spaces.

Church Square



Completion: 1855 (refurbished 2015–2018)

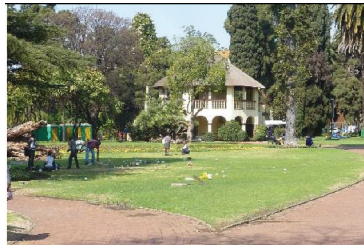
Size: 10936 m²

Form: Centralised square with walkways and statue, no equipment, some trees. The space is surrounded by older institutional buildings.

Function: Variety of activities – resting, Wi-Fi, lay preachers

Location: inner city

Burgers Park



Completion: 1874

Size: 47678 m²

Form: Victorian garden with 6 entrances, surrounded by a low fence. Includes band stand, statue, pavilion, floranium, play park, covered pergola, memorial, water ponds, trees & shrubs

Function: recreation, interaction

Location: inner city

(Continued)

Table 2. (Continued).

Springbok Park



Completion: 1930s
Size: 30569 m²
Form: Rectangular park surrounded by low wall with 6 entrances. Includes gazebo, stone stairs, small stream and restaurant to the side. Luscious vegetation and pond.
Function: recreation, events
Location: old suburb

Jimmy Aves Park



Completion: 1950s-1960s
Size: 58586 m²
Form: Not formal design, only a few footpaths across the grass. Play equipment for children and a stream to the south. There is a sports club next door.
Function: recreation, interaction, walking dogs, etc.
Location: modern suburb (1950s)

Kalafong Fitness Park



Completion: 2013
Size: 9961 m²
Form: Terraced park with amphitheatre, children's play area, outdoor gym, climbing wall, walkways and parking.
Function: Recreation, sporting activities and social interaction
Location: township (established in 1950s)

(Continued)

Table 2. (Continued).

Solomon Mahlangu Square



Completion: 1970s (refurbished 2015)

Size: 21,115 m²

Form: Square with nature of a park, statue, amphitheatre, wall of remembrance, vegetation, ablution facilities.

Function: Commemoration and special events

Location: township (established in 1950s)

rise apartment blocks. As observed and confirmed by the interviews, the park is extensively used for relaxation, reading, eating, playing ball, playing on the children's equipment and for general social interaction. In general, the form of these two public spaces has remained more or less the same until recently when Church Square was revitalised. However, interviews with the users of these spaces revealed concerns about the lack of maintenance. Yet, they are still extensively used. There is a presence of many "new" users of different cultures and backgrounds and new uses and opportunities, such as the presence of WiFi, informal traders, car washers and lay preachers. What stood out from interviews with users, was that now anyone is welcome to use these spaces. It, therefore, reflects a trend of adaptation.

Although not as visible as the transition in the city, many of the older suburbs have also experienced alterations, both physically and socially. These older suburbs are gradually densifying through greater numbers of apartment and townhouse complexes, and a wider range of commercial and business activities that are present in gated office parks and shopping centres. The population is also slowly changing to become more diverse in terms of race and income groups. Springbok Park is surrounded by low to the higher-rise office and apartment buildings with a range of income groups. The boundary is demarcated by a wall and includes several entrances that lead to curving walkways with brick paving, which improves the connectivity on site. The main attraction is the luscious vegetation and water features, including a larger and smaller pond connected to the stream. Users indicated that they often come to relax in the beautiful gardens or to take photographs on special occasions. Jimmy Aves Park is a more suburban park located further out in Garsfontein and is mostly surrounded by stand-alone houses. The park is fenced off, with a few entrances, which influences the level of connectivity. A few trees are scattered on the site. The park is utilised more during the weekends, with people walking their dogs, others relaxing under the trees or for church services on Sundays, showing more signs of diversity during this time. Both parks remained more or less the same, except for a lack of management and maintenance. While these spaces are still being used by people, to relax or walk their dogs, the users of the parks indicated that the fear of crime and homeless people staying in the parks have resulted in selective use or a retreat from the spaces. This reflects a general trend of degradation.

As a result of the Group Areas Act (1950), different population groups, including Whites, Coloureds and Blacks, were restricted to certain areas. Blacks or Africans, therefore, resided in what was commonly called African township areas or locations. After the abolishment of the Group Areas Act in 1990, people were free to stay across the city. Since the 1990s township areas have also changed dramatically to accommodate a wider range of income groups, much new housing and retail developments, as well as social facilities and amenities. The development of parks constituted a part of these redevelopment programmes. Kalefong Fitness Park is located in the middle-income area in Atteridgeville. All the attractions increase the diversity of activities and users, enhanced by the beautiful landscaping and continuous walkways, which improves the level of connectivity across the park. As observed and indicated in the interviews, people utilise the park for relaxation, children to play and exercise. Solomon Mahlangu Square (SMS) is located in the centre of Mamelodi. As

part of the upgrade, it was necessary to redesign the square to offer protection from the busy road, re-orientate the statue to face the park, provide lighting around the square for safety and ablution facilities. The space is fenced off and the entrance to the park is from the pedestrian walkway on the eastern side. Therefore, although the square has a formal design based on two paths leading from the statue to the entrance and amphitheatre and a curving walkway crisscrossing these, the single entrance restricts the level of connectivity. While the Kalafong Fitness Park is extensively used by young and old, the SMS, despite its major significance, is locked and only used for special events due to a fear of vandalism. Nevertheless, the upgrading of the parks reflects a trend of transformation.

The discussion indicates that public spaces in the city are changing in terms of their form and function, reflecting three trends, namely degradation, adaptation and transformation. Degradation is linked to deteriorating spaces and a lack of management and maintenance, as well as the presence of homeless people. The neglect of the spaces is linked to litter, graffiti, broken windows or lights and signs of unlawful behaviour such as urinating in the parks. However, despite some signs of neglect, some spaces adapted due to the presence of new uses, such as WiFi, informal trading, and special events, as well as the appropriation of the spaces by a new public. Yet, other spaces have completely transformed due to physical revitalisation and the creation of new opportunities in previously marginalised areas. In this way, they now open up the benefits of public space to communities in these areas. This raises questions regarding the impact of these changes on urban resilience and their adaptive capacity in the context of the new Tshwane 2055 vision calling for a “liveable, inclusive and resilient city”.

The resilience of public spaces and its contribution to urban resilience

The resilience of the spaces at the site level is influenced by two directives, namely diversity and connectivity. The nature of the physical space is influenced by opportunities for various uses. A diversity of facilities and amenities gives a range of options, for example, to relax and connect with nature, to play, to exercise, etc. However, these activities are hampered if the parks are not maintained or accessible. The diversity of uses in the public spaces also attract a diversity of users, who maintained that these spaces offer opportunities to meet other people. This, in turn, offers the possibility to mix and interact. In terms of connectivity, movement in the spaces is enhanced by well-defined paths and clear lines of sight, for example in Burgers Park, Church Square and Kalefong Fitness Park. However, movement along some paths can be restricted by a lack of clear sightlines due to overgrown vegetation, for example in Springbok Park, or at night, due to a lack of lighting in Kalefong Fitness Park. Connectivity is hindered by fencing. For example, Jimmy Aves Park is fenced around with access points at two sides that are always open, but SMS is locked with no access, except for special events that happen occasionally.

The resilience of the public spaces is also influenced by their immediate surrounding environment in terms of diversity, proximity, intensity and connectivity. The results of the multi-scale diversity assessment are indicated in [Figure 4](#). The figure

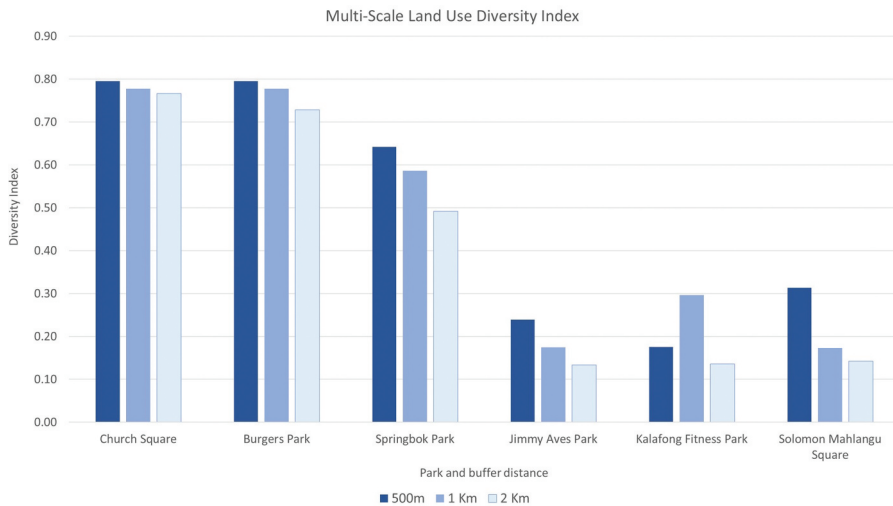


Figure 4. Multi-scale land-use diversity of the selected six spaces in Tshwane.

shows the relative diversity of land uses around each public space at increasing scales. Two structural characteristics can be seen. The first is that the parks in or nearer the inner city tend to have much higher land-use diversity when compared to parks in the newer areas and suburbs. This suggests a relationship with the age of an area and the land use diversity – something that can be explored further. The second observation is that, in general, the diversity around the parks decreases as the scale increases. This might indicate that parks play a role in generating local land-use diversity as they form attractors (Dewar and Uytendogaardt 1995). If this assumption is true, this also implies the overall resilience of cities, as parks might be useful generators of land diversity (improving the adaptive capacity of the area) in mono-functional areas.

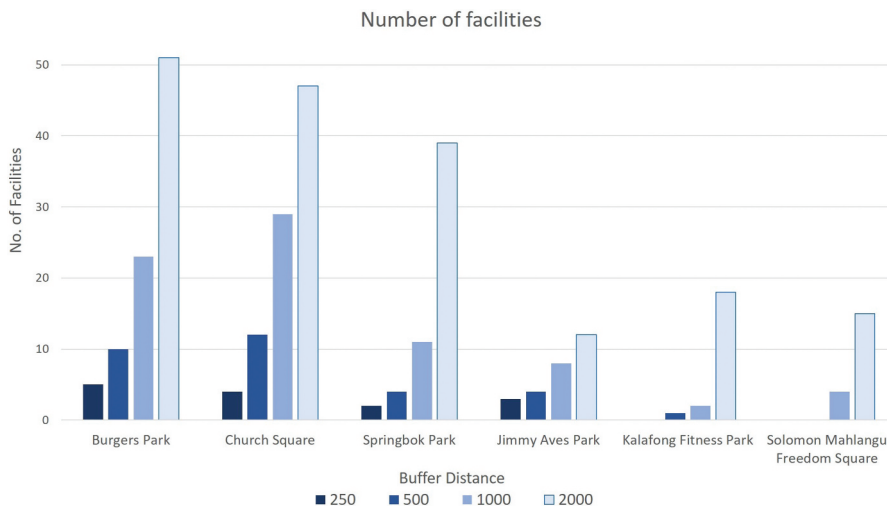


Figure 5. Number of facilities per buffer area around the selected six spaces in Tshwane.

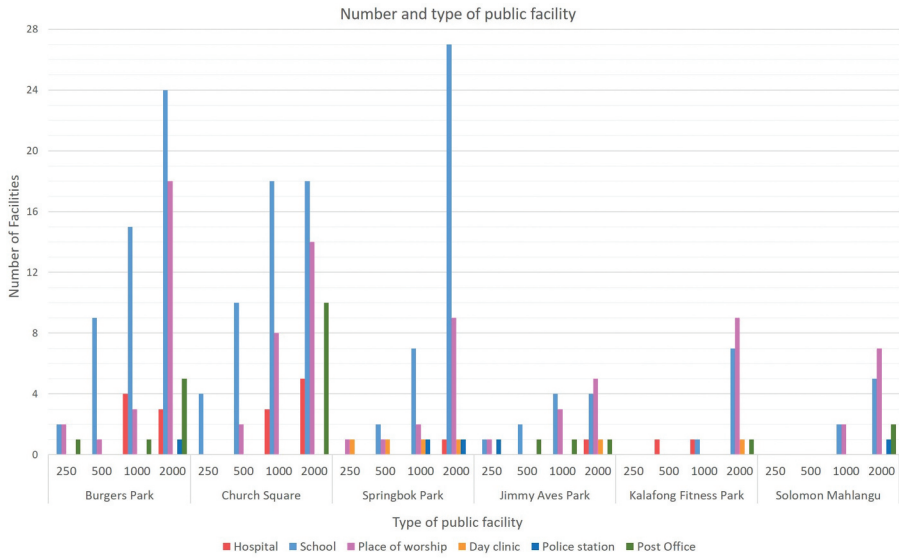


Figure 6. Number and type of facilities per buffer area around the selected six spaces in Tshwane.

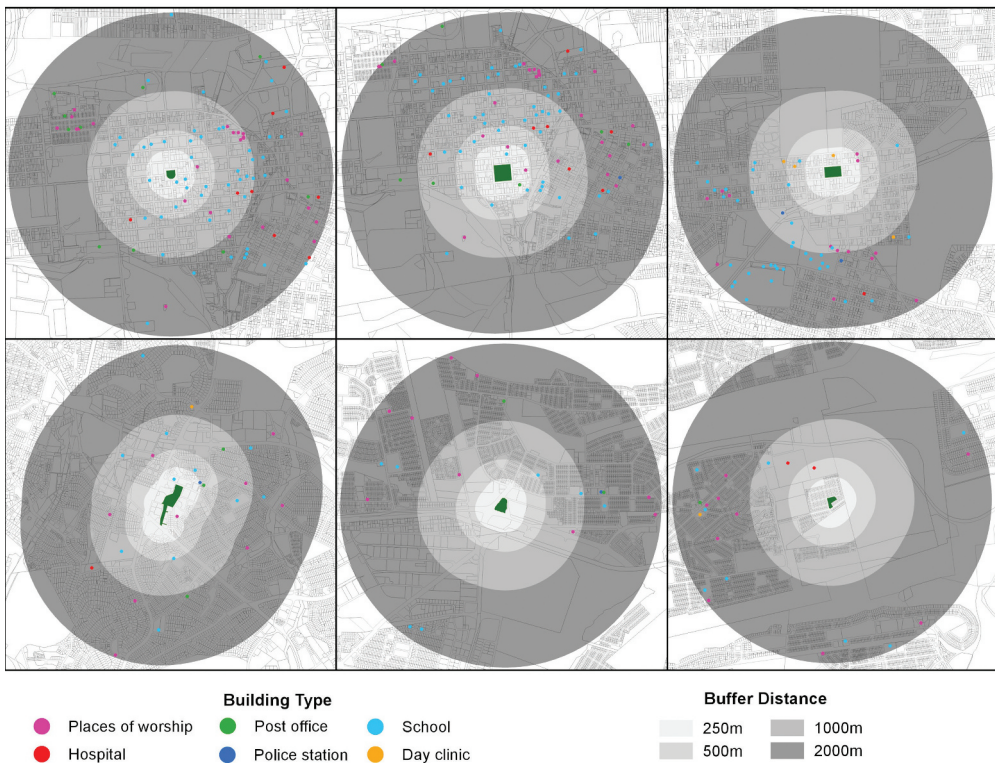


Figure 7. Proximity maps for the selected six spaces.

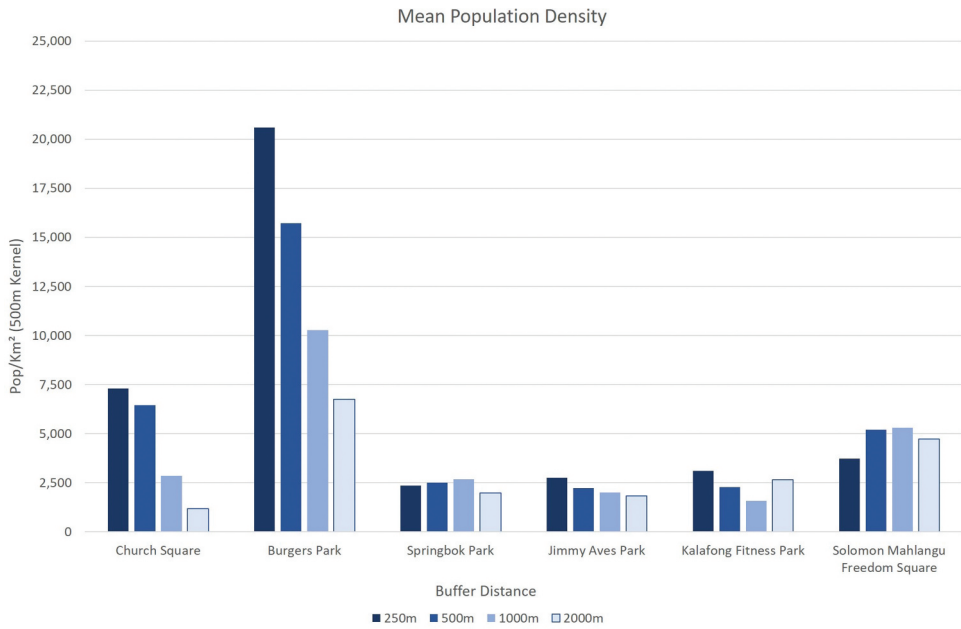


Figure 8. Mean population density around the selected six spaces in Tshwane.

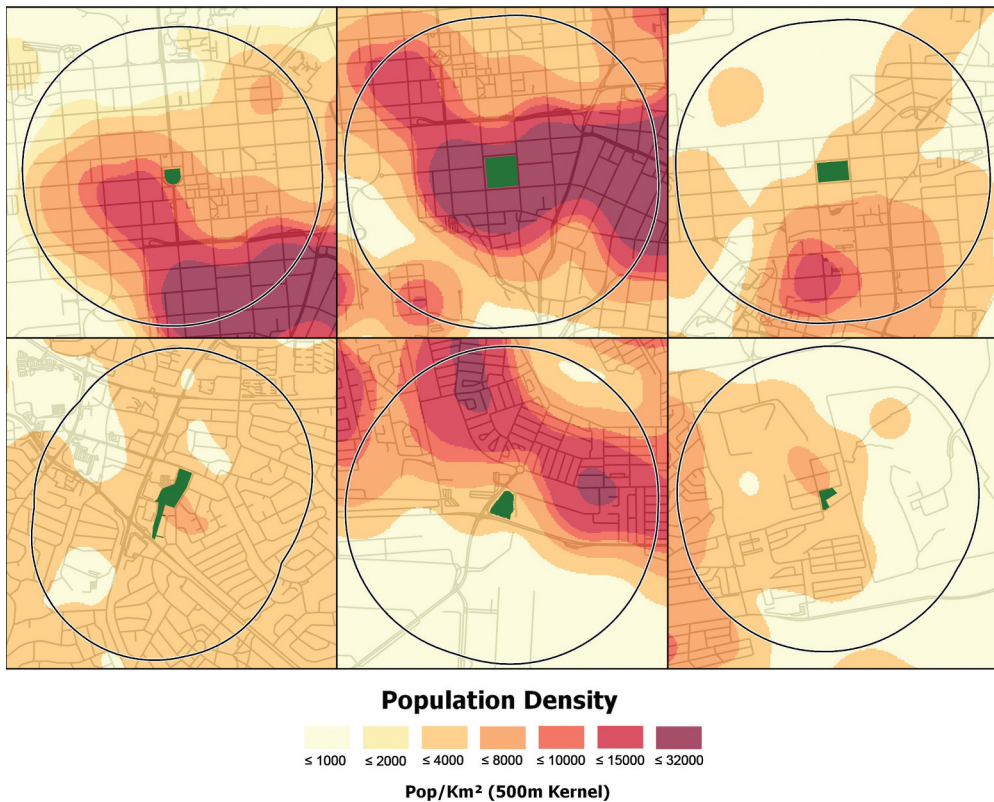


Figure 9. Variation of population density in space around the selected six spaces in Tshwane.

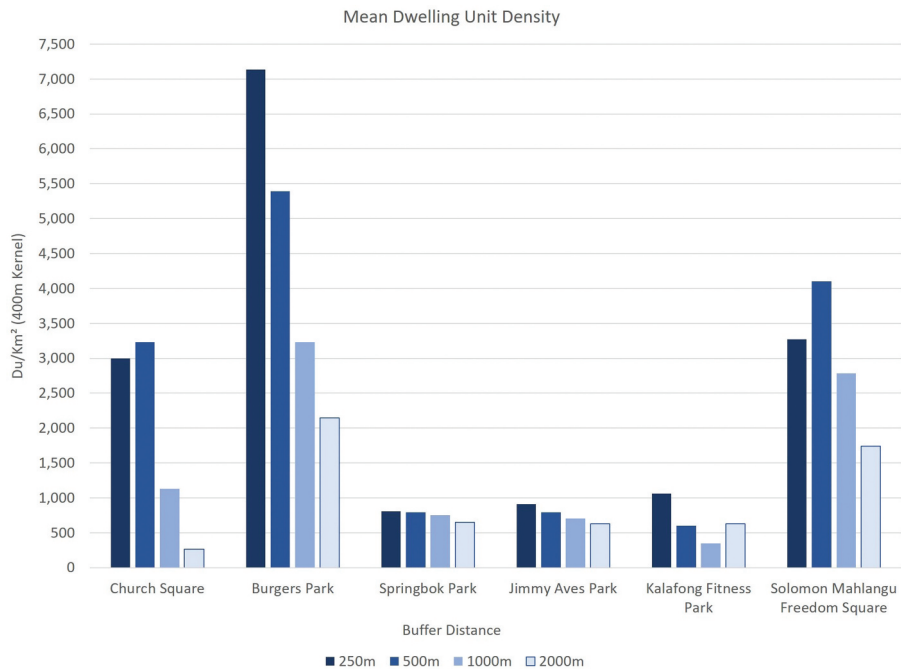


Figure 10. Mean dwelling unit density around the selected six spaces in Tshwane.

Considering the proximity of facilities around the parks, unsurprisingly, this increase with distance. As with the diversity, the inner city spaces (Church Square and Burgers Park) have a proportionally greater number of facilities closer to them (Figures 5 and 6). As shown in Figure 7, the inner city parks do not have any day clinics within proximity to them; however, this may be because they have better access to hospitals. A noteworthy observation is the number and distribution of schools and places of worship in proximity to public spaces, which are the two facilities, which stand out for all six spaces.

Studying intensity in terms of population density (Figures 8 and 9) and dwelling unit density (Figures 10 and 11) of the study areas, the density around the parks varies drastically depending on if the park is within the city centre, suburb or in the township area. The inner-city parks typically have higher densities of both population and dwelling units nearby, with the density decreasing as the distance from the parks increases. Alternatively, the density remains relatively constant for the non-inner city parks. When comparing the densities and distribution of densities (seen in the maps of Figures 10 and 11) of the townships with the suburbs, the townships generally have higher densities (especially true for SMS), yet the public spaces are located on the edges of the developments.

Being on the edge of the developments also have implications for access to the parks, as shown in Figures 12–14. The township parks tend to be in areas with much poorer access at all scales and which therefore decreases the likelihood of these areas being used. However, SMS has a few additional advantages over Kalefong Fitness Park, other than higher dwelling unit density. The first is that SMS is located at the intersection between two major roads (Maphalla Street & Tsamaya Ave) which connect Mamelodi to the larger

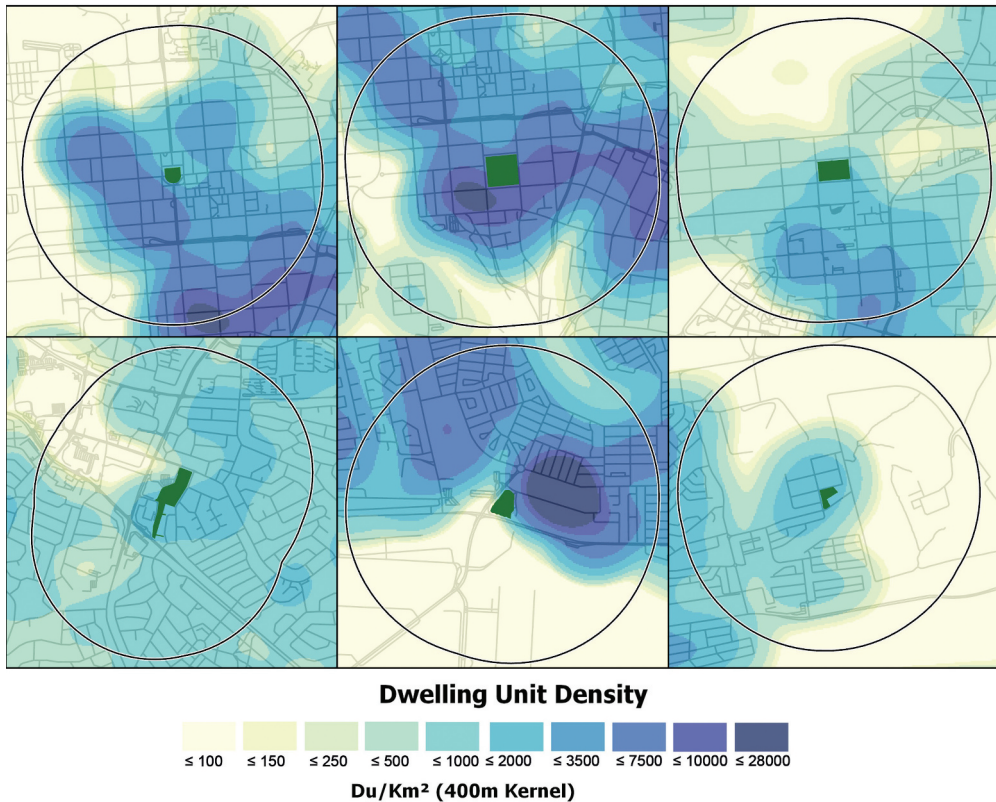


Figure 11. Variation of dwelling unit density in space around the selected six spaces in Tshwane.

city and therefore generate larger volumes of traffic. Secondly, and likely a result of the locations the two roads just mentioned, there is a shopping mall located across the street of the SMS, which is also likely able to attract more visitors to the park. Lastly, as the park is located opposite Denneboom Station (which has a shopping centre attached), it is also likely to have larger volumes of pedestrian traffic which pass by the park.

The impact of the configuration of the areas can be seen in terms of how accessible each public space is. The more open networks, typically grid networks, located within the city centres mean that the parks are accessible and within generally more walkable areas when compared to the spaces located in the suburbs and townships. The suburban and township areas typically have more closed networks that correspond to the modernist planning approaches which were popular from the 1960s and still impact how cities in South Africa are planned. The open networks are less vulnerable and more flexible as they can redirect traffic should there be an incident (Salat and Bourdic 2012). Alternatively, the closed networks have strict hierarchies with low permeability which force traffic through choke points. Should any of the choke points fail, the circulation in these areas fail and the system stands still.

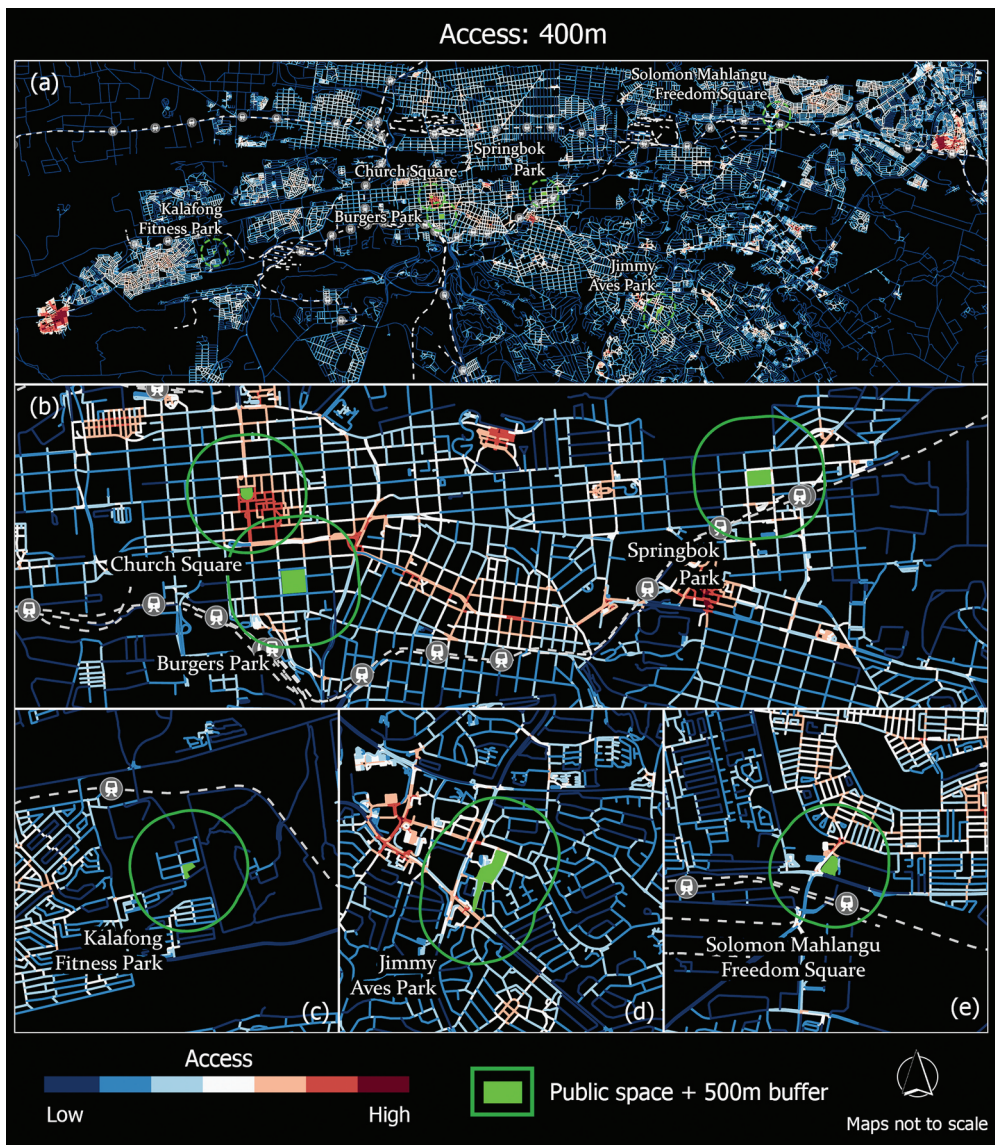


Figure 12. Access to the selected spaces within a 400 m radius buffer. Top panel (a) shows the variation in access scores and the location of all public spaces within the context of the city. While the middle and bottom panels show the access scores for streets around (b) Church Square, Burgers Park, Springbok Park, (c) Kalafong Fitness Park, (d) Jimmy Aves Park and (e) Solomon Mahlangu Square.

Discussion and conclusion

Public spaces in the City of Tshwane are fluctuating along with other changes in cities. The discussion indicated that these changes reflect trends of degradation, adaptation and transformation of public spaces, which starts to indicate the resilience of these spaces. According to Meerow, Newell, and Stults (2016), resilient urban systems require different degrees of alteration, whether transitional, incremental or transformational. In their

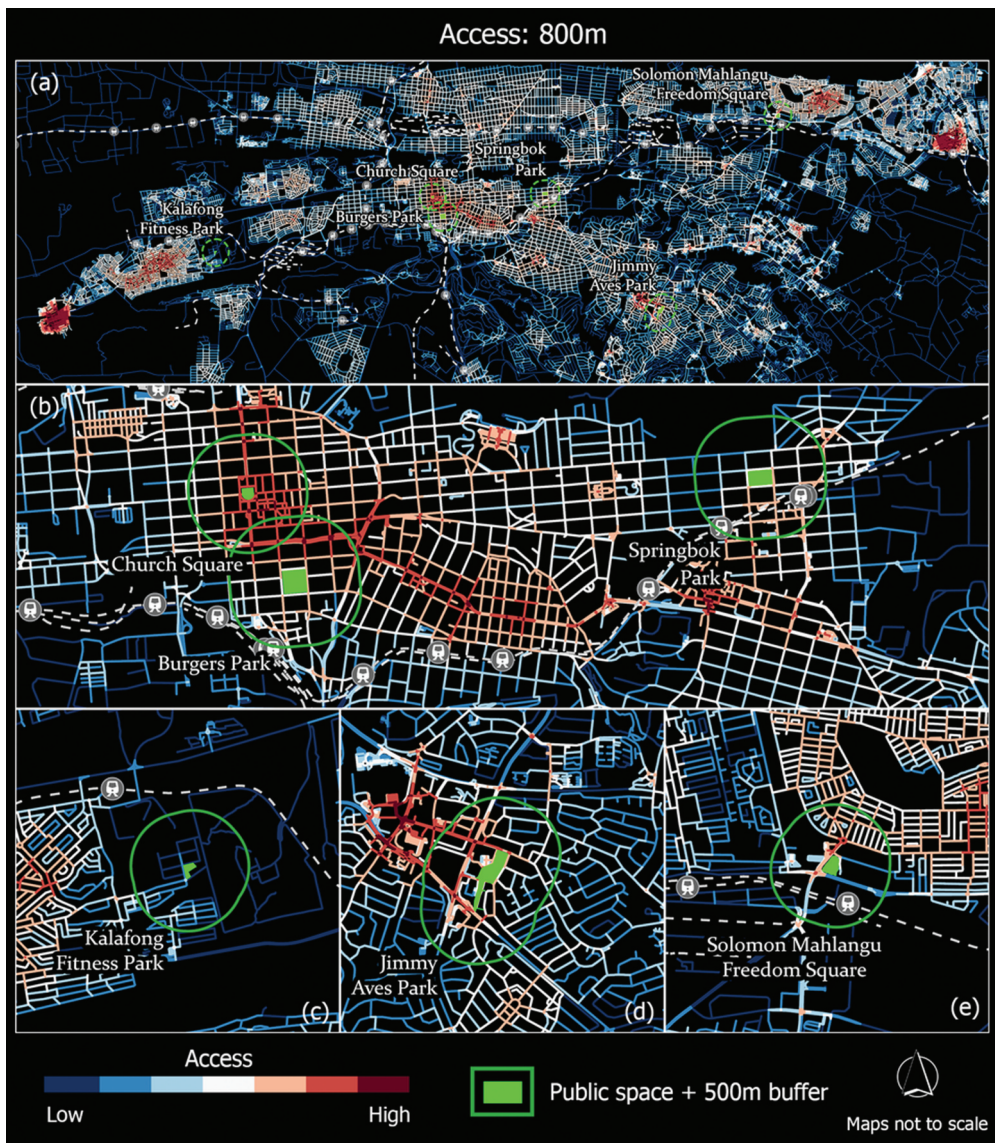


Figure 13. Access to the selected spaces within an 800 m radius buffer. Top panel (a) shows the variation in access scores and the location of all public spaces within the context of the city. While the middle and bottom panels show the access scores for streets around (b) Church Square, Burgers Park, Springbok Park, (c) Kalafong Fitness Park, (d) Jimmy Aves Park and (e) Solomon Mahlangu Square.

definition of resilience, cited earlier, they refer to a continuum of actions from resistance to change (i.e. persistence) to radical transformation. This is also evident in the spaces in Tshwane where those in the suburbs are generally resisting change or experiencing negative change, those in the inner city are adapting to new uses and users and those in the townships benefitting from urban renewal programmes, are reflecting a major transformation. Linking these trends to the directives for resilience, it is evident that limited diversity, proximity, intensity and connectivity strain opportunities for mitigation

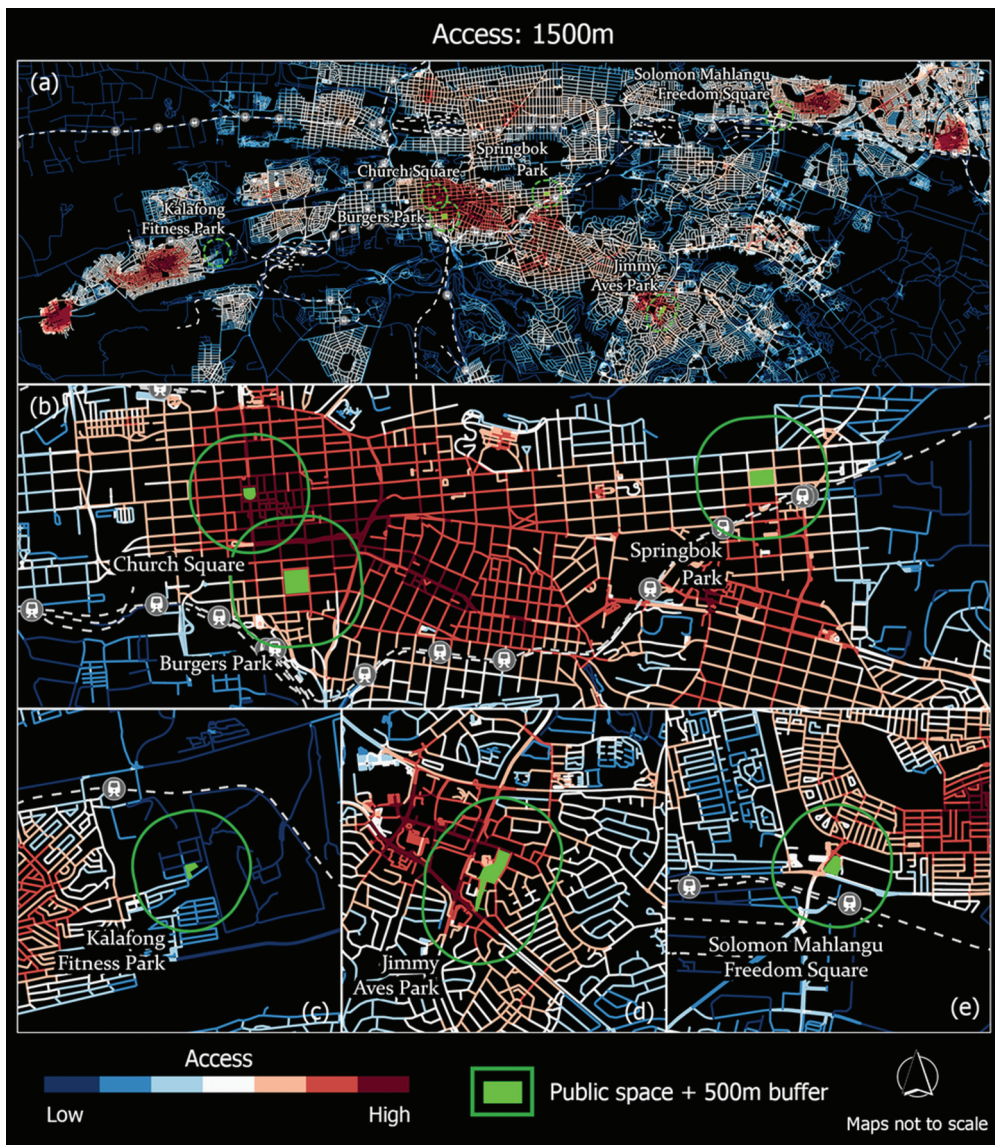


Figure 14. Access to the selected spaces within a 1500 m radius buffer. Top panel (a) shows the variation in access scores and the location of all public spaces within the context of the city. While the middle and bottom panels show the access scores for streets around (b) Church Square, Burgers Park, Springbok Park, (c) Kalafong Fitness Park, (d) Jimmy Aves Park and (e) Solomon Mahlangu Square.

and adaptation as it reduces options and the generation of opportunities for change. However, radical intervention at a specific point in time can move the trajectory of change and bring about rapid transformation.

The discussion also highlighted the value of the directives to understand spatial resilience and move towards sustainable urbanism, both in terms of their normative value and as proxies for urban resilience. Increased diversity, intensity, proximity and connectivity in and around public spaces can improve the resilience of parks by

responding to urban dynamics and changing needs, as well as the resilience of the neighbourhood and larger city through the ripple effects at a higher level. However, for the significance of these findings to have a meaningful impact in terms of future urban transformation, requires a more nuanced reading of public space in the broader context and the role of urban planning and urban/landscape design in ensuring the continued relevance of public space in changing cities. Firstly, there is a need to understand the importance of parks in urban planning and the changing vision thereof over time. In the past, the park or square was a central place and used as a gathering place, for example, Church Square, while in the suburban areas the public spaces tend to be more hidden away. However, those planning the township areas seemed to put parks in leftover places, more as an afterthought and not as a central point in the town plan, which reflects planning dominated by land use and not a physical structure. This, in turn, has implications in terms of who uses the park due to access (centre or periphery of the neighbourhood), the density of people around the park and the proximity of a range of facilities. Therefore, if one contemplates the ability of parks to adapt as being related to the people using them, the more people who use the parks, the more likely these spaces will be able to adapt and transform over time, as there will be more demand for the public spaces to “survive”.

Secondly, there is a need to work with change, in terms of both complexity and the generation of opportunities. It is, therefore, important that urban and landscape designers plan for change through increased adaptive capacity. Given this, resilience planning and design are not only important at city and neighbourhood level through the creation of a system that can change (Masnavi, Gharai, and Hajibandeh 2019). It is also crucial at the micro-level, where more resilient public spaces can facilitate the generation of increased opportunities for people through access to green space, as well as greater physical, social and virtual access (through public WIFI) (Landman 2019). In an environment where many people are poor, access to Wifi opens numerous possibilities to connect to friends and relatives and look for employment opportunities. In this way, a rich and complex environment can develop over time that simultaneously responds to the changing needs of the city and its people through layers of intervention and modification (Dewar and Uytenbogaardt 1991; Salat and Bourdic 2012). Bearing this in mind, instead of placing an overemphasis on master planning, the focus should rather be on the collective production of significant public spaces and infrastructure to support the evolution of cities without the need to control in detail every single action (Moroni and Conzolino 2019).

For those committed to more resilient public spaces and cities towards sustainable urbanism, there is a need, not only for a more defined understanding of resilient public spaces but also for a greater commitment to spatial resilience in cities. This means that urban planners and designers need to be aware of the directives of spatial resilience and to promote them at various levels, including public spaces and their immediate environment, as well as to incorporate the learning into urban design guidelines and codes. It also means that all built environment professionals and local authorities should strive to create the pre-conditions for adaptation and transformation of various parts in the urban system to allow different nested systems to absorb stresses and shocks without losing the functionality in terms of both use and structure.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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