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Urban nexus as a transformative pathway towards a resilient Gauteng City Region

by
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Summary

Urban migration, coupled with climate change impacts and ageing infrastructure, have brought with them some debilitating challenges that require immediate strategies to adapt cities to cope and continue providing services. Current urban infrastructure in the fast-growing cities in developing countries was not designed to cater for large populations, and as a result, often breaks causing service delivery challenges. This study provides a detailed analysis of the rapid urbanisation of the Gauteng City Region, highlighting major challenges related to the spatio-temporal inequalities and changes in relationships through qualitative and quantitative analysis. The focus is on the drivers of urbanisation, particularly projected demographic and climatic changes, assessing migration and climatic variables, as well as the risks associated with rapid urbanisation like flooding, heat waves, increased crime, and unemployment. Rapid urbanisation is fuelling urban sprawl, exacerbating the challenges associated with the insecurity of water, energy, and food (WEF) resources. The challenges are identified to be detrimental to achieving the 2030 Global Agenda on sustainable development as well as national goals. The premise is to guide policy formulation and support decision-making on coherent strategies that lead to resilience and achieve SDG 11 that relates to sustainable cities and communities. Whilst urbanisation could be an adaptation strategy, there is need for contextualised strategies to build resiliency through the WEF nexus.

Introduction

Sub-Saharan African (SSA) cities face challenges of failing to provide basic services due to rapid urbanisation, and are often unsuccessful in providing clean water and sanitation, sufficient food, and clean and affordable energy (Dos Santos et al., 2017; Simatele and Simatele, 2015). The challenges are, however, compounded by climate change, which is accelerating resource degradation (Beard et al., 2016). The projected population increase of about 2 billion people in SSA by 2050 will only exacerbate the challenges associated with rapid urbanisation, which include pollution, resources insecurity, urban sprawl, high unemployment, and crime rates, poor service delivery, among others (Van Bavel, 2013). These challenges require policy- and decision-makers to rapidly come up with effective adaptation strategies aimed at increasing the resilience of cities. Major factors delaying the implementation of effective adaptation strategies include the current sector-based approaches in resources management and the lack of transboundary and regional cooperation (Mpandeli et al., 2018; Nhamo et al., 2018). Sectoral adaptation strategies and slowing regional integration only exacerbate vulnerability or undermine net resilience by decreasing capacity or increasing risks in another place or sector, resulting in maladaptation (Rasul and Sharma, 2016). Knowledge of current and projected changes in demographic and climatic variables provides the basis for evidence-based adaptation strategies (Gagnon-Lebrun and Agrawala, 2006).

The challenges brought about by climate change require innovative and evidence-based new approaches to achieve sustainability, particularly, considering the complex interactions between climate, social and ecological systems. Climate change is amplifying existing stresses on water quantity and quality, food security, and access to clean and affordable energy (Mpandeli et al., 2018). These are some of the challenges that culminated in the formulation of the Sustainable Development Goals in 2015 by 198 countries, members of the United Nations (UN) (UNGA, 2015). Thus, the aim is to have a sustainable Earth by 2030, at the same time improving preparedness and resilience to future environmental and climatic changes. Climate change refers to variations in climate, which is supported by scientific evidence and the use of statistical tests (Brown et al., 2011). Climate change includes changes in the mean and/or the variability of atmospheric properties and this can persist for an extended period, typically decades or longer (Trenberth, 2011). Thus, climate change is complex as it is regulated by complex interactions among components of the Earth system (Steffen et al., 2018). In its complexity, climate change, together with rapid urbanisation, are severely impacting urban development, causing a host of climate and environmental-related problems that are significantly affecting industrial production and urban life, particularly in developing countries (Satterthwaite et al., 2010). The focus should now be on developing tools and models to effectively mitigate climate change and build resilient communities and cities.

One approach that is being widely adopted to achieve sustainability in an environment of climate change is the water-energy-food (WEF) nexus, a polycentric, holistic, and integrated approach in resource management (Nhamo et al., 2019b). The WEF nexus is based on the interlinkages between the three essential resources as food production needs water and energy; water management (extraction, treatment, and redistribution)

requires energy; and energy production requires water (Hettiarachchi and Ardakanian, 2016; Mabhaudhi et al., 2016). The approach has become a mantra in sustainability circles as the world increasingly recognises the importance of the three fundamental sectors as inextricably interconnected (Alagh, 2010; Martin and Fischer, 2012). The value of the WEF nexus has grown in recent years, as it has shown its worth in various fields like Urban Planning, Sustainability, Climate Change, Livelihoods Analysis, Circular Economy, among others (Mabhaudhi et al., 2019). It has also become very relevant in scenario planning, an innovative technique for formulating adaptation strategies with a higher degree of certainty (Star et al., 2016). The approach is, therefore, very important for building a Circular Economy for urban areas as, being an integral part of urban planning and resilience building, it ensures the most efficient use and recycling of resources for sustainable development (Lehmann, 2018). This is particularly relevant as urban areas have become important centres of development and climate change adaptation (Satterthwaite et al., 2010). A Circular Economy is closely linked to the WEF nexus in that both concepts are concerned with sustainable development and are ideal for tackling urgent problems related to environmental degradation and resource scarcity (Lehmann, 2018). The WEF nexus provides analytical tools for informed Circular Economy planning.

Projecting possible climatic changes and the resultant impacts on resources and facilities is an important lens by climate scientists and adaptation specialists to foresee possible threats and to effectively allocate the necessary resources (Mabhaudhi et al., 2021; Star et al., 2016). Scenario planning is a preferred method for formulating adaptation strategies, as climate models present a higher degree of uncertainty (Dessai and Hulme, 2004; Star et al., 2016). Focusing only on projections poses the risk of limiting decision-makers' abilities to successfully and effectively prepare for future climate change (Granderson, 2014). As a result, decision-makers prefer scenario planning, which present a higher degree of certainty and alternatives to future changes outside currently observed trends (Granderson, 2014). Thus, scenario planning is a pathway to explore a variety of future conditions and consider alternative response options. They create a set of alternatives (scenarios) that span key uncertainties, providing the basis for discussions about policy formulations, the relative efficacy of management options, innovation, and community visions (Granderson, 2014; Nhamo et al., 2020). The advantage of scenarios is that they are not predictions, and they do not assign likelihoods to future changes. Rather, they broaden possibilities that include a range of potential responses that eliminate uncertainty, at the same time retaining flexibility in preparing for an unpredictable future (Buurman and Babovic, 2016).

Urban areas in SSA are fast-growing due to migration and have been unable to provide basic services as a result (Satterthwaite, 2017). The challenges have been attributed to poor planning and lack of foresight, as well as lack of resources to adapt (Aliyu and Amadu, 2017). The eruption of unplanned urban settlements has increased the rate of flooding, infrastructure breakdown, the emergence of shanty towns, and high unemployment and crime rates (Aliyu and Amadu, 2017). Thus, effective planning is essential for increasing urban resilience and reducing related social and economic risks to urban livelihoods and environments. The increasing competition for scarce resources poses the risk of triggering conflict, particularly where there is no transboundary cooperation (Wolf, 2007). South

African cities attract migrants from within and outside their borders as they are industrially and economically more developed than the other cities in Africa. They have well-developed mining, transport, energy, manufacturing, tourism, agriculture, and service sectors, thus attracting people (Baffi et al., 2018). Its ports provide an important gateway for some of the landlocked countries of the region. South Africa's historical development and the attraction of its economic strength and stability have resulted in a diverse and immigrant population profile (Baffi et al., 2018). Its changing urban landscape due to rapid urbanisation adds further complexity to efficient water, energy and food supply, and other basic services (Todes and Turok, 2018).

It is against this background of rapid urbanisation of South African cities that this study focuses on climatic and demographic trends and their impacts on service delivery, highlighting adaptation pathways for the Gauteng City Region. The aim is to provide a platform for contextualised adaptation strategies and build resilient cities. This is based on the findings of the Intergovernmental Panel on Climate Change (IPCC) that identified cities as important sites of global climate action and adaptation, and for addressing and mitigating greenhouse gas emissions (Hoegh - Guldberg et al., 2018).

Description of the study area

The Gauteng City-Region (Figure 1) refers to an integrated cluster of urban areas that together make up the Gauteng Province, an urbanised province and economic heartland of South Africa. The province includes the cities of Johannesburg (South Africa's largest city), Tshwane (the capital city and formerly called Pretoria), Ekurhuleni, as well as industrial and mining centres of Germiston, Springs, Alberton, Boksburg, Benoni, Vereeniging, Vanderbijlpark, Krugersdorp, Randfontein, and Westonaria (Fig. 1).

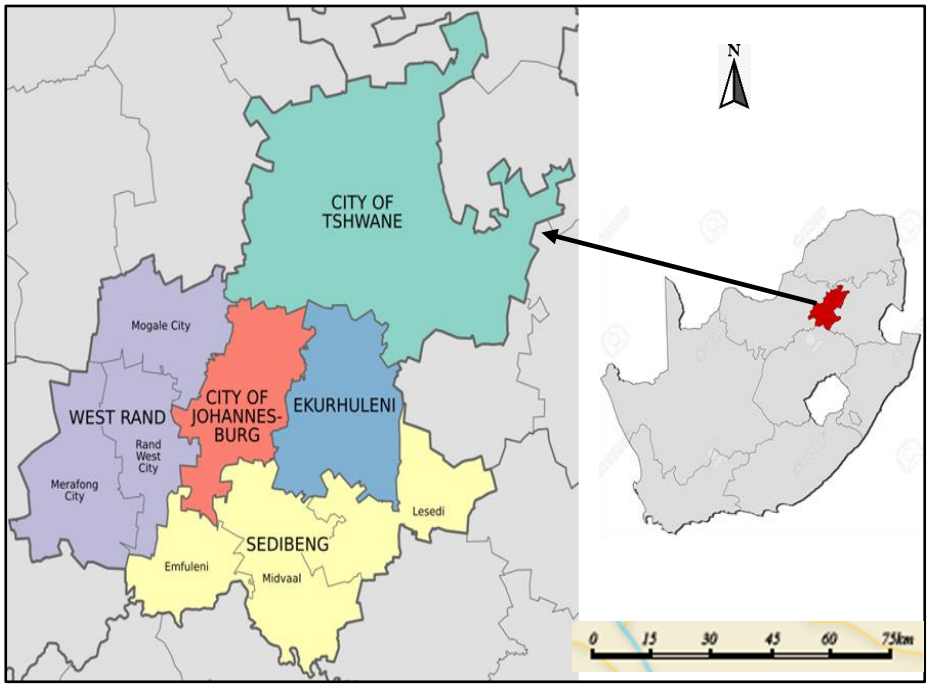

Fig. 1. Locational map of the Gauteng Province showing the metropolitan areas

The industrial and economic development of Gauteng Province has made the province the main centre of trade, commerce, and industrial development of South Africa, and is the largest economic hub of southern Africa and the rest of the African continent (Chakwizira et al., 2018). The province contributes 40% to the national gross domestic product (GDP), making it an attractive destination for migrants (Baffi et al., 2018). The employment opportunities presented by the Gauteng City-Region due to its industrial and economic development have contributed to its rapid urbanisation.

Although the province is important to national and regional economies, its total land area is only 18 182 km^2, the smallest of all the nine provinces of South Africa, but the most densely populated with a population of over 15 200 000 people (Chakwizira et al., 2018). Besides its importance, the province is faced with a host of challenges that include unprepared rapid urbanisation due to migration, high levels of poverty, unemployment, and social exclusion (Baffi et al., 2018). The spatial distribution of diverse populations in the province is characterised by the high number of informal settlements surrounding highly affluent suburbs (Baffi et al., 2018).

Literature search

We firstly consulted literature on urban growth and trends, rapid urbanisation, challenges of rapid urbanisation, urbanisation and migration, climate change impacts on urban areas, adaptation strategies for urban areas, WEF nexus and urbanisation, Urban nexus, linkages between WEF nexus and Circular Economy, climate change and scenario planning. While the search was on global literature, we focused mainly on cities in southern Africa and South Africa in particular. The terms were searched from search engines such as Web of Science, Scopus, and Google Scholar. We developed a database of published articles from the listed terms. To cover a wide range of relevant publications, we complemented the publications with terms such as resilient pathways for urban areas, WEF nexus and urban planning, urbanisation as an adaptation strategy, drivers of urbanisation, among other useful terms.

Climate change impacts and adaptation strategies on urban areas have been considerably studied as evidenced by the immense publications available. However, little has been done from a context-based perspective as impacts and adaptations vary from city to city depending on socio-economic, political, and geographic factors. Broad and generalised impacts and strategies on adaptation do not always work at the local level. However, we note the importance of preparedness for urban growth and associated challenges, that urban areas may continue providing basic services in the long run and contribute to the achievement of the United Nations' 2030 global agenda on sustainable development. We also note that little has been studied with regards to the role of WEF nexus in urban planning, as well as the relationship between WEF nexus and the Circular Economy in building resilient cities. This article focuses on urbanisation trends as influenced by climate change, social inequities, uneven distribution of resources, lack of regional integration as well as transboundary cooperation in Gauteng Province of South Africa. We establish the role of the WEF nexus in informing decision-makers in developing a Circular Economy for

urban areas to achieve sustainability and resilience. The study provides a platform to develop contextualised adaptation strategies for urban areas of the Gauteng City Region. Gauteng Province was chosen as it is generally an urban province composed of three metropolitan areas of Johannesburg, Tshwane (Pretoria), and Ekurhuleni, which are surrounded by other industrial and mining centres. The province is the economic hub of the country and the most industrialised on the African continent, thus attracting migrants from the continent and beyond.

We also note the existence of the Gauteng City-Region Observatory (GCRO), which was established to build data and analyse it for the region and help inform development and policy, that it may become more functionally integrated, spatially coherent, economically competitive, innovative, environmentally sustainable and socially inclusive region (Chakwizira et al., 2018). The GCRO has also published a lot of literature on the province and its cities, which we also consulted.

Conceptual framework

The study discusses the drivers of urbanisation as influenced by climate change and migration, highlighting the pull factors attracting people into Gauteng City-Region (Fig. 2). We acknowledge that urbanisation can be an adaptation strategy if the receiving city has coping strategies in place to absorb the influx of people without disturbing its systems. We consider that moving into urban areas could be an option of adaptation, other than staying at a place that may result in reactive measures to mitigate shocks if people continue staying in a vulnerable place. The focus is on building resilient cities in the Gauteng City-Region by linking the WEF nexus as a decision support tool to develop a Circular Economy for an urban. Developing a Circular Economy is regarded as an important pathway towards a resilient city (Lehmann, 2018). We also analysed the role of other pathways in building urban resilience, focusing on the Gauteng economic hub.

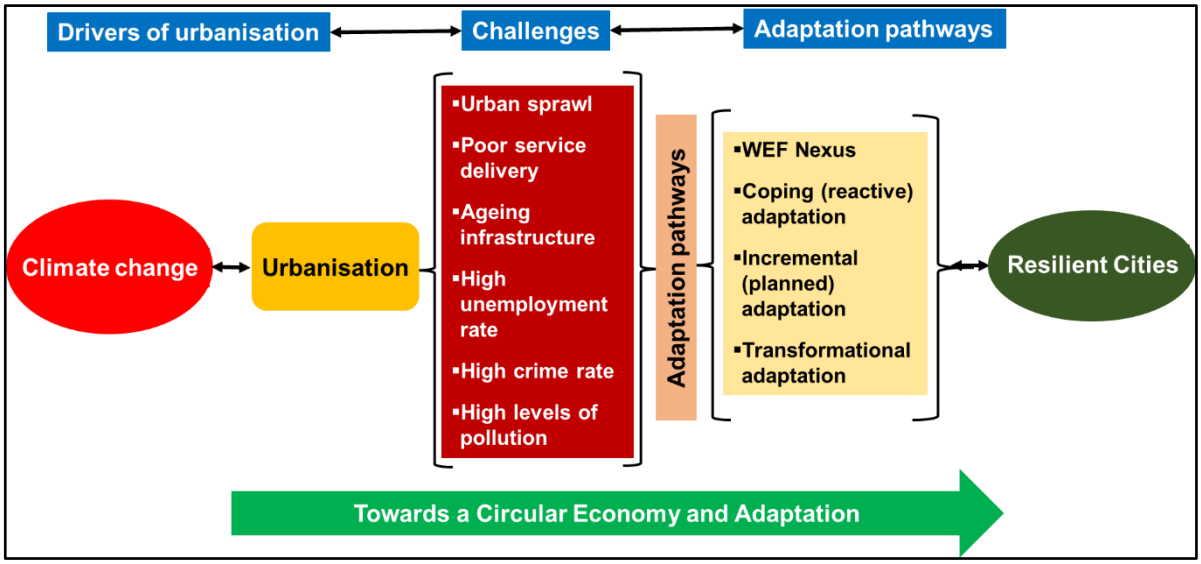

Fig. 2. The conceptual and methodological framework for building resilient cities

We also identified and highlighted the challenges associated with rapid urbanisation where there are no coping mechanisms to mitigate and adapt to the anticipated changes. Then, we detailed the adaptation pathways that can be adopted by policy-makers to build resilient cities in the advent of climate change and rapid urbanization (Figure 2). The aim is to build a Circular Economy and adaptation strategies to build resilient cities in the Gauteng City Region.

Drivers and trends of urbanisation in the Gauteng City-Region

As already alluded to, urbanisation is generally influenced by migration, and the two concepts are always analysed together (Turok and McGranahan, 2013). Studies on migration suggest that migrants are generally forced out from their areas of origin by low incomes and limited opportunities to improve their livelihoods, and are attracted by better prospects in more affluent urban areas(Castelli, 2018). The movement of people in southern Africa is a social and household decision-making as it is motivated by the need to spread risk, rather than an individual matter (Gubhaju and De Jong, 2009).

The Gauteng City-Region (comprised of Johannesburg, Ekurhuleni, and Tshwane metros) is the economic hub of South Africa, contributing about 40% of the gross domestic product (GDP) to the South African economy (Bobbins and Culwick, 2015). Thus, economic and social opportunities are spatially concentrated in Gauteng, although the province occupies only 2% of the total land area of South Africa. The rapid urbanisation at a rate of 30.7% between 2001 and 2011, which increased by a further 7.5% between 2011 and 2015 is an indication of high levels of immigration into the province (Bobbins and Culwick, 2015). The rapid spatio-temporal changes taking place in the Gauteng City-Region are accompanied by a host of challenges, as well as opportunities as its towns attract the largest number of migrants (both inter and intra-migration), with a recorded net increase of about 543,000 migrants between 2011 and 2016 (Bobbins and Culwick, 2015). About 67% of the migration in Gauteng Province is intra-regional, as people from other regions are attracted by the economic growth of the province (Chakwizira et al., 2018). The remaining 23% comes from other continents. The influx of people into Gauteng cities is influenced by better social and economic opportunities, as there is rampant environmental degradation in other regions, as well as the impacts of climate change (Castelli, 2018). As a result, the province is spatially fragmented, scattered, and sprawled in nature, making it difficult to provide basic services to all (Chakwizira et al., 2018).

However, the Gauteng City-Region has been incapacitated to meet the increasing demands for basic services by the growing urbanised population, as the infrastructure was not designed to cater to the high number of people. Thus, the region is facing challenges of unemployment (currently standing at 31%, against a rate of 29.1% at the national level), lack of access to land and basic amenities, which often leads to negative and reactive policy positions (StatsSA, 2019). Despite these challenges, urban areas are becoming not just the dominant form of habitat for humankind, but also the engine-rooms of human development and growth (Wray and Cheruiyot, 2015).

Therefore, the influx of people into the Gauteng City-Region is informed by the following factors: economic (unemployment and lack of economic development), social (education opportunities or marriage), political (discrimination or persecution), demographic (population density and structure and risk of disease), and environmental (exposure to hazards and poor land productivity) (StatsSA, 2019). The social development and transformations processes occurring in Africa project an increased influx of people in Gauteng in the near future (Chakwizira et al., 2018).

Challenges associated with rapid urbanisation

One major challenge of the rapid urbanisation in the Gauteng City-Region is related to high levels of pollution and poor management of waste. Table 1 indicates the contribution of vehicular pollution and CO_2 emissions in Gauteng Province in comparison with national figures (Chakwizira et al., 2018). Gauteng City Region has the highest pollutant emission rates for all pollutants in the country, which is worsened is worsened by the continued breakdown of the ageing sewerage infrastructure as it was not meant to cater for the huge population.

Table 1. Vehicular pollutants and CO_2 in 2015 in Gauteng compared to national emissions (tons per annum)

	NO_2	SO_2	CO	PM_{10}	NMVOC	Benzene	Lead	CO_2
Gauteng	74,015	1734	440,222	3313	63,921	105	0.15	16,213,749
National	251,390	6952	1,241,295	13,646	184,161	319	0.53	54,258,926

Source: Chakwizira et al., 2018

Urban sprawl is another challenge facing the Gauteng City-Region as evidenced by the number of mushrooming informal settlements. Apart from the challenge of poor waste management in informal settlements, the emergence of informal settlements poses a major health hazard as these unplanned settlements mushroom on undesignated areas without any facilities (Owusu-Ansah et al., 2016). As a result, shanty towns become crime hot spots and all sorts of vices (Chakwizira et al., 2018). The challenges are exacerbated by the high unemployment rate which stands at 31% in the province. Poor service delivery in informal settlements often results in illegal electricity connections, endangering human life, particularly children (Louw and Bokoro, 2019). Thus, the region faces the challenge of providing safe and clean water and sanitation, safe and clean energy, and most of the households are food insecure (Mabhaudhi et al., 2019; Nhamo et al., 2018). This highlights the need to ensure the security of water-energy-food (WEF) resources in the region and the adoption and operationalisation of the WEF nexus as a decision support tool in adaptation and resilience initiatives (Naidoo et al., 2021; Nhamo et al., 2018; Nhamo et al., 2021).

Climate change adaptation pathways for urban areas

1. Reactive or autonomous adaptation

Responses and strategies to climate change impacts range from autonomous strategies to reactive interventions, and proactive interventions to long-term adaptation strategies,

as well as transformational strategies (Mpandeli et al., 2018). Thus, adaptation actions are either reactive and autonomous or anticipatory and planned (proactive adaptation), or transformational. Reactive/autonomous adaptation refers to spontaneous ex-post interventions undertaken after a climatic shock or extreme weather event (Rahman and Hickey, 2019). They are based on immediate and localised needs but often result in a maladaptive trajectory because of a lack of planning and foresight (Rahman and Hickey, 2019). Reactive adaptation is thus, an endogenous adjustment to a shock, and is short-term as it focuses on managing risks and vulnerability in the thick of a shock (Chhetri et al., 2019). An example of a reactive adaptation is to temporarily move people settled in lowlands or wetlands to higher altitudes during flooding, but they move back soon after the floods subside without rectifying the underlying problem. Transformational adaptation involves complete and innovative changes in the whole system to adapt to the new norm after historic approaches have been stretched and become insufficient for prevailing climate risks (Chhetri et al., 2019).

2. Anticipatory or planned adaptation

On the other hand, anticipatory and planned adaptation actions (proactive) refer to large-scale and long-term scenario planning based on goal-specific ex-ante actions (Chhetri et al., 2019). They are focused on longer-term livelihoods security and are largely based on scientific evidence, require a large pool of resources, technological know-how, and institutional capacity to implement (Rahman and Hickey, 2019). Anticipatory adaptation involves planned policy and investment decisions that enhance the adaptive capacity of an urban area or any other system that includes building satellite towns away from the city centres to avoid congestion and pressure on infrastructure. While reactive/autonomous responses are important during short-term interventions, it is proactive interventions that that should be pursued as they enhance long-term resilience sustainability.

3. Transformational adaptation

Transformational adaptation refers to an adaptation that completely transforms the fundamental attributes of a system in response to climate variability and change (Few et al., 2017). It is a total transformation and evolution from the norm to one adapted to prevailing conditions in response to climate change. It is generally informed by a system that has reached the limits of its ability to maintain its functionality (Few et al., 2017). Transformational adaptation is different from the other strategies because of its innovation, magnitude, and intensity of change, as well as its transformative effect on society (Chhetri et al., 2019). Its implementation has seen the emergence of new concepts like Green Village/City and Sustainable City.

The role of the WEF nexus and Circular Economy in adapting cities to rapid urbanisation

Climate change is a complex and cross-cutting problem that affects all sectors, and therefore requires integrated and transformative approaches like the WEF nexus to respond to its impacts (Mpandeli et al., 2018). Sectoral approaches to adaptation in urban

areas and elsewhere often create imbalances in the system and retard sustainable development (Mpandeli et al., 2018). Rapid urbanisation often results in resource insecurity if there are no integrated approaches in planning using an approach like the WEF nexus, which is perceived as an integrated approach for sustainable resource management (Lehmann, 2018). Terms such as "urban nexus" have emerged as a result, referring to the broad linkages and interdependencies of urban systems that include energy, water, and food, as well as material provisioning systems, and the need for integrated holistic approaches to understanding the intricate relationships between these systems (Lehmann, 2018). The use of the WEF nexus in urban planning is essential for integrated resource management as it results in resource use efficiency, as well as the efficiency of infrastructural systems, transformations in planning practice and waste management, and reductions in carbon emissions (Lehmann, 2018; Nhamo et al., 2018).

The WEF nexus is particularly relevant for urban areas as urban land-use changes during development and growth, the landscape is completely transformed, modifying the hydrological cycle, ecosystems services, energy balance, and local climate in the process (Sharmina et al., 2016). Such land-use modifications affect resource availability, with the possibility of impacting the provision of healthy food, essential energy, and clean water supply for a growing urban population (Mabhaudhi et al., 2019). Thus, urban planning requires an integrated approach like the WEF nexus for integrated resources management for sustainable development and the creation of a Circular Economy, which has emerged as an important concept for urban sustainability and resilience (Lehmann, 2018). A Circular Economy refers to an economy that balances economic development with environmental and resources protection, by emphasising the most efficient use and recycling of resources, and environmental protection (Murray et al., 2017). It differs from a Linear Economy in that it is characterised by low consumption of energy, low emission of pollutants, and high efficiency in resource use through the application of cleaner production processes in companies, eco-industrial park development, and integrated resource-based planning for development in industry, agriculture and urban areas (Murray et al., 2017). Thus, a Circular Economy is restorative and regenerative, ensuring resource security (Kalmykova et al., 2018). There are therefore similarities between the WEF nexus and the Circular Economy concepts as both emphasise resource use efficiency

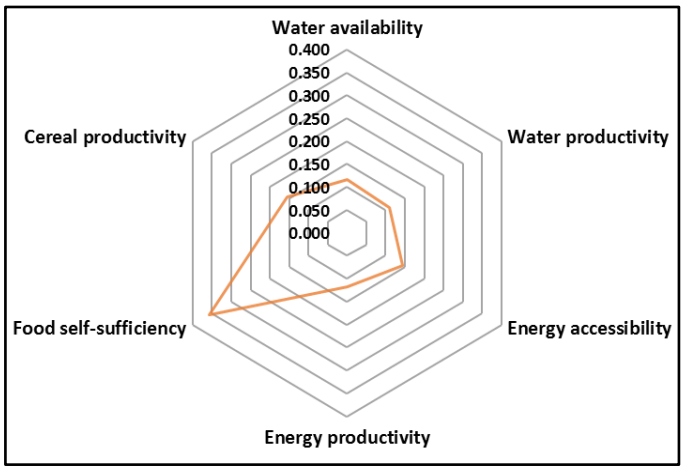

Fig. 3. Performance of WEF nexus indicators in southern Africa in 2018

through integrated planning and management (Lehmann, 2018). The adoption of the WEF nexus in urban planning has the benefit of achieving a Circular Economy for a sustainable and resilient city.

As a Circular Economy promotes economic growth by creating new enterprises and employment opportunities as well as ensuring resource use efficiency and security, while at the same time reducing environmental pressures, the WEF nexus is well placed to inform decision-making to develop resilient and sustainable urban environments. For example, the WEF nexus is capable to indicate priority areas for intervention through integrative analysis of indicators as shown in Fig. 3 (Nhamo et al., 2019b). The deformed shape of the spider graph (Figure 3) shows imbalanced and unsustainable resource management in southern African, an indication of resource scarcity, where there is an emphasis on food security (Nhamo et al., 2019b). The other indicators are low sustainable as indicated by low values, a situation that often triggers migration to affluent urban areas where resources are concentrated. Low indicator values are an indication of resource insecurity, which is a push factor of migration. Without compromising food security, the region should thrive to improve on other areas and create a conduce environment for would be migrants to be encouraged to stay.

Characteristics of a resilient city

A resilient city can withstand and absorb the impact of shocks through resilience or adaptation and is capable to cope and mitigate the impacts and minimise damage (Kim and Lim, 2016). In the course of a crisis, a resilient city maintains its basic functions and structures without much external intervention (Kim and Lim, 2016). This is possible through anticipatory policy measures and strategies that require investments beforehand as informed by WEF nexus analysis (Chhetri et al., 2019). Such planning highlights the preparedness of a city which also determines the magnitude of damage extreme events could cause (Nhamo et al., 2019a). Proper planning provides for proactive interventions, as there is enough lead time to prepare for any shock that may occur in a system (Nhamo et al., 2019a). Thus, a resilient city withstands shocks, and extreme events may not end as disasters. They are cities designed in advance in anticipation of any shock, can recover without major hitches. Usually, build from past experiences and shock, resilient cities may bend from shock, but do not break, but remain composed and quickly adapt and rebound to new levels of sustainability with minimum loss or damage (Chhetri et al., 2019). Examples of such cities are Tokyo in Japan and Auckland in New Zealand, which, besides the many devastating earthquakes they go through, remain steadfast with limited fatalities. With the accelerated influx of people into the Gauteng City Region, the cities should prepare themselves to receive more people, particularly in the advent of increased frequency and intensity of extreme weather events, as well as economic advancements and instability in other countries.

Certain values identify a resilient city, and cities should thrive to achieve these characteristics as we anticipate environmental and climatic changes that may result in rapid urbanisation (Carter et al., 2015). These values include:

a. Capacity to reflect as both policy-makers and the people learn from previous experience to inform the formulation of strategies that stimulate resilience. This shows the **reflectiveness** of the city.
b. A resilient city also shows **robustness** as its physical structures are designed in such a way that they can resist high-impact climate events and can serve a high number of people during rapid urbanisation.
c. They also have space for **redundancy**, that is, they create spare capacity so that they can build into the system to cater for future disruptions and surges in demand.
d. Resilient cities are also **flexible** in that they can adjust rapidly to the new norm and can adopt new alternatives in response to a sudden change in the system. Technological advancement and new knowledge play an important role in this type of adaptation.
e. They are also resourceful in that established institutions and the people are well informed about climate change risks that when a climate shock or any other natural disaster occurs, they are capable to adapt and respond positively to a changing environment.
f. Resilient cities posse an **inclusive** characteristic in that decision-makers consult broadly and consider the views of their people to create a sense of shared ownership and have a joint vision to build city resilience.

They also apply **integrated** approaches like the WEF nexus that brings together and aligns systems for policy and decision-makers to make evidence-based interventions. Integrated approaches promote consistency in decision-making and the right investments to achieve sustainability in the system. The integration of all components of the system allows a city to function collectively as a single unit and will be able to respond rapidly.

Recommendations

Urbanisation should no longer be viewed as a problem but as an adaptation strategy to adverse environmental and climatic changes (Chhetri et al., 2019). Not implying that people should be encouraged to move into urban areas, but were necessary to move from imminent disaster or climate shock, urbanisation should be viewed as an adaptation option. There are many advantages of urbanisation to the receiving city if it possesses the qualities of a resilient city. In any case, decision-makers need to address the drivers of migration in places of origin, as well as putting adaptation strategies that would transform the receiving urban area into a resilient city (Chhetri et al., 2019). Migration is considered here as the main cause of rapid urbanisation. Therefore, addressing the drivers of migration, as well building resilient cities should be a priority in a fast-changing environment, and the following factors should be considered in adaptation strategies for building resilient cities in South Africa and the rest of the region:

a. There are great opportunities to benefit from leveraging and enhancing the flow of intra-regional labour migrants into Gauteng cities as South Africa is faced with the challenge of scarce skills. Free movement of skilled labour in the region should be viewed as an opportunity for regional integration.

b. The Southern Africa Development Community (SADC) should oversee intra-regional migration, viewing it as a means of regional integration. South Africa is a water-scarce country and its water resources fast deteriorating, it should consider focusing on industrial development and invest in other countries in the region that have abundant water resources to focus on agriculture and other viable projects suitable in those areas (Nhamo et al., 2018). This will motivate people to stay other than to migrate. This is only possible through regional integration.
c. Where urbanisation is considered as an adaptation strategy, migrants are viewed as resources that are beneficial to themselves, as well as the communities they come from (Satterthwaite, 2017). This positive perspective of urbanisation does not take migration as a burden on destination urban areas or lost brain drain on sending countries. There is a need to tap into migrants' capabilities and transform them into useful resources, other than placing them into refugee camps. This model has been successful in the European Union (EU) where there is free movement of labour (Schmidt et al., 2018).
d. Regional integration enhances coordinated development, creates employment opportunities in countries of origin through resource sharing as most of the resources are shared through transboundary river basins, but unevenly distributed (Nhamo et al., 2018). For example, investing in untapped agriculture and hydropower generation potential in the Democratic Republic of Congo and Zambia could solve the challenges of food and energy insecurity in the whole SADC region (Mabhaudhi et al., 2016). However, the slow pace in integration is the reason why the regions have chronic challenges of water, energy, and food insecurity, yet are blessed with abundant resources. Regional integration and exploiting own resources reduce unemployment and poverty, ensure economic development through skills development and income-generating projects for the youth in migrant-sending countries, reducing migration and rapid urbanisation. The spatial inequalities in development will not be evident where there is regional integration as there is inclusive development in all areas.
e. The region needs to collect disaggregated data systematically and use it for informed policy decisions that holistically address the drivers of migration and be able to make context-based adaptation decisions. The analysis of such data provides long-term solutions to the challenges posed by migratory patterns such as demographic transitions, and structural transformation in the society as driven by climate change.
f. There are great opportunities for policy and decision-makers to formulate urban strategies that turn cities and towns into engines of sustainable structural transformation and adaptation. The 2030 Agenda for Sustainable Development (UNGA, 2015) and the 2016 common African position on urban development provide the basis for understanding migration and urbanisation as a means of promoting regional integration in the SADC region, as the two documents advocate for people to live and work in a healthy, safe and secure environment in an urban area or anywhere in the continent.

Conclusions

South Africa is witnessing rapid urbanisation, with migration and climate change being recognised as the main causes of the rapid urban growth. Although rural-urban migration continues, the country also receives migrants from throughout Africa due to its economic and industrial development. The trend is projected to continue, and urban areas, particularly the Gauteng City-Region, need to strategize now, other than later, in anticipation of the huge influx of people. Urbanisation is no longer viewed as a problem, but as an adaptation strategy that can promote regional integration and development. With most southern countries of the SADC region classified as water scarce, but industrially developed, the region ought to develop the agriculture and energy potential of northern countries as a means of creating employment in other regions. In an increasingly urbanised world, the development of the African continent in the 21st century lies in its cities and towns as we witness the 4th industrial revolution. Urban areas have developed into major centres of development other than rural areas. Specialised labour should be allowed free movement in a continent experiencing scarce skills in essential fields. Gauteng cities should thrive to become resilient to rapid urbanisation and climate shocks. This will go a long way in achieving SDG 11, which commits to "make cities and human settlements inclusive, safe, resilient and sustainable by 2030". Policy and decision-makers should change the negative perception of viewing cities as vessels of problems, but as centres of accelerated and sustainable adaptation and development. Managing urbanisation trends in a holistic and integrated will facilitate simultaneously harness the benefits of migration and rapid urbanisation, which include regional integration.

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