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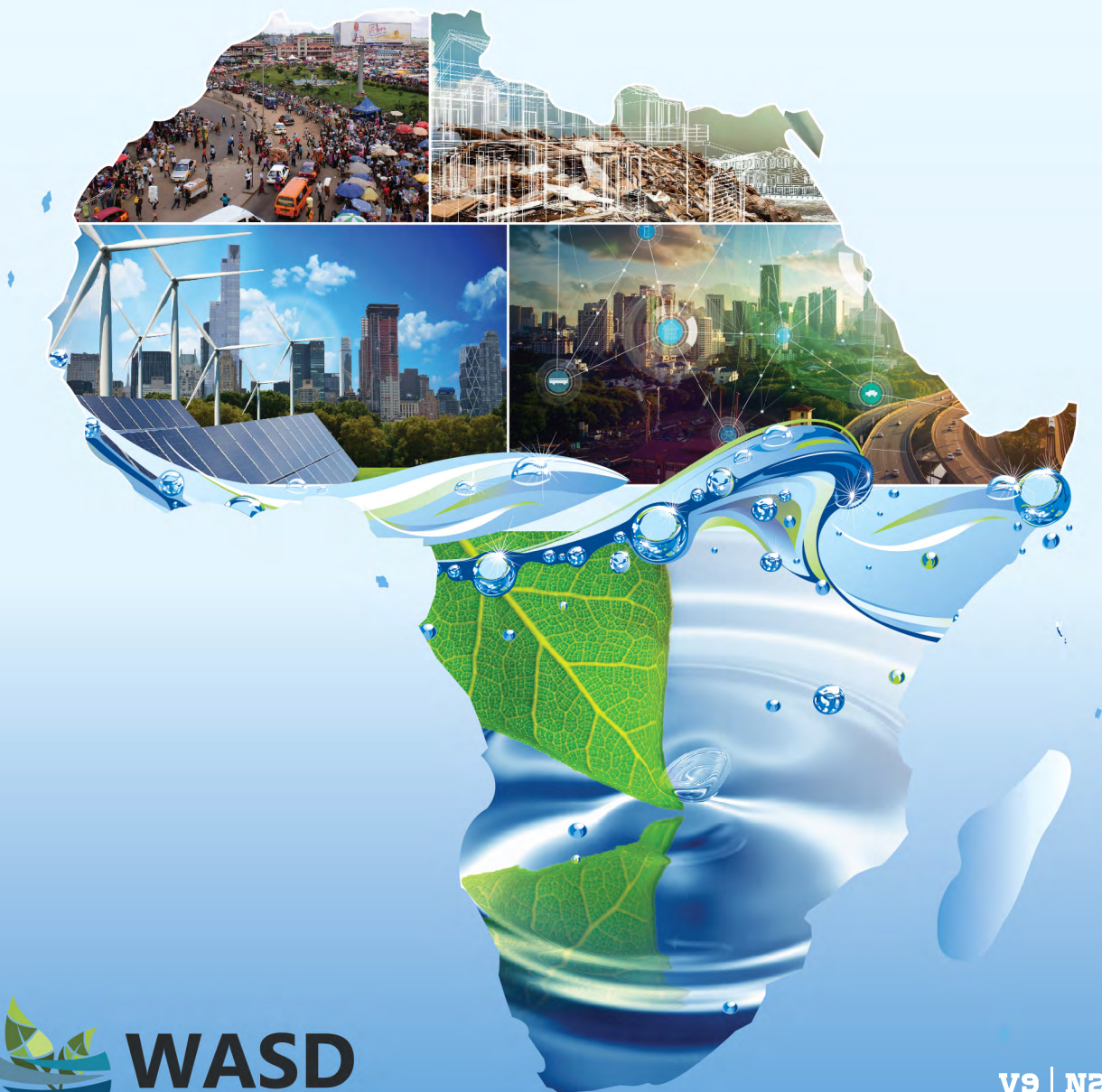
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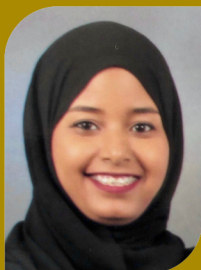
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OVERCOMING THE BIGGEST CHALLENGES IN AFRICA'S DEVELOPING CITIES USING INTERDISCIPLINARY THINKING APPROACHES



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Abstract

The growing attention on urbanisation, and the sustainability and resilience of cities, has driven the dialogue of the challenges that developing cities are expected to face over the next 10 years. This paper considers the challenges in urban housing and water in Africa through critically assessing the trends, causes, and implications from several interdisciplinary perspectives. To attain the goal of developing adequate, accessible and affordable housing in Africa, cross-border investment, land grab, and land rights need to be considered in order to prevent the formation of ghost towns and the displacement of people. For the development of sustainable water resources in Africa, attention to the needs of all people is essential and decentralised water management initiatives are beneficial. The Sustainable Development Goals (SDGs) and New Urban Agenda (NUA) acknowledge developing cities as opportunities for policy change, systems thinking, a renewed focus on small/medium cities and a context-specific and/or people-centred approach to development.

Purpose

This paper considers the challenges in urban housing and water in Africa through critically assessing the trends, causes, and implications from several interdisciplinary perspectives.

Design/Methodology/Approach

This paper undertakes a literature review and systems thinking approach.

Findings

This essay analyses the biggest challenges developing cities are likely to face in their attempt to achieve sustainable development in the next 10 years.

Originality/Value

By considering the progress and learning lessons from past projects (i.e., the importance of interdisciplinary perspective, systems thinking, context and a people-centred approach and the focus on small/medium cities), the outwardly overwhelming challenge of achieving inclusive, resilient and sustainable cities becomes more achievable.

Keywords

Sustainable Development Goals (SDGs), New Urban Agenda (NUA), urban resilience, interdisciplinary perspectives, systems thinking, context-specific/people-centred approaches, decentralised water management systems

Introduction

Cities across the developing world are experiencing rapid urbanisation and industrialisation. By 2020, approximately 60% of the world's population will be concentrated in cities (Dubbeling et al., 2010). An increasing number of cities will face severe environmental problems; global cities will face unified development crises, and urban areas will become critical locations for implementing sustainable development strategies. In cities of limited resources that are susceptible to the effects of climate change and where social inequalities are increasing exponentially, accommodating these urban dwellers effectively and equitably becomes increasingly difficult. However, the challenge is not to influence an urban explosion, but to suitably achieve a sustainable urban transition (McGranahan and Satterthwaite, 2014). An urban transition can be achieved through urban sustainability and resilience; however, these are complex and contested solutions. The literature shows that there are many aspects, views and interpretations from diverse experts within differing fields. Interdisciplinary perspectives allow all the different aspects of urban sustainability and resilience to be taken into consideration when devising urban planning policies and services.

By identifying the key components that constitute sustainable urban planning and development, urban planners and policymakers can gain a better understanding of their interconnections. Urban planning professionals and policymakers can work together to bring about long-lasting holistic and positive sustainable measures and policies for these cities through the New Urban Agenda (NUA) (United Nations, 2015). The NUA in developing cities should be responsible for meeting the challenges and opportunities of urbanisation: it should address the unmet objectives of the Millennium Development Goals (MDGs). This is to make sure cities are “sustainable, inclusive, resilient and liveable” (United Nations, 2015).

This paper highlights the key challenges (namely, housing and water) faced by developing cities in Africa over the next 10 years. It seeks to provide an understanding of why many cities are struggling to overcome their urban challenges. It explores how urban sustainability and resilience can ensure the positive urban transition of social, environmental,



political and economic pressures of cities in the developing world. It also serves to highlight the potential opportunities offered by the focus on urban sustainability and resilience under an integrated system and interdisciplinary framework. Finally, it explores the gaps in the literature, and suggests further work that would be required to prompt these urban transitions.

Urbanisation in Africa

The urbanisation of African cities has developed rapidly in recent years, and rural-to-urban migration has provided the impetus for urbanisation. However, problems still exist, such as scarcity of public services and serious poverty. Therefore, many cities do not have capacity to meet the demands of housing, infrastructure, employment, and social services (UN-Habitat, 2016b). The economics of most African cities are vulnerable due to the single economic structure (Rakodi, 2016). In the past 15 years, although African cities have achieved rapid economic growth, this growth has not brought about fundamental structural changes. The main drivers of economic growth in Africa are external factors, such as aid, debt relief, investment, and rising raw material prices in the international market. However, internal factors, such as internal demand, government reform, and management systems, as well as production, capacity and industrial competitiveness, have not promoted economic growth. Moreover, this type of externally dependent development model relies on a single resource-based economic structure, which seriously hampers the autonomy of most African cities.

Cities in Angola are a typical example of downside risks to economic growth caused by a single economic structure. Driven by the oil industry, the average economic growth rate from 2002 to 2010 was 12%; the inflation rate dropped from 76.6% in 2003 to 13.99% in 2009. However, because of the impact of the international financial crisis and the decline in crude oil prices in the international market, since 2008 Angola's foreign trade has declined, and the slowdown of economic growth is apparent. The economic growth rates of each year in the period 2010-2015 were 3.4%, 3.9%, 5.2%, 6.8%, 4.5%, and 3.8%, respectively (AfDB Statistics Department, 2018). The weakness in infrastructure construction of African cities has long been one of the main obstacles to achieving sustainable development. By the end of 2012, Africa had yet to form a transport system that was evenly distributed across the continent. In terms of power supply capacity, approximately 70% of people in other developing countries can use

electricity, whereas in African countries this figure only reaches 20% (Cho and Tien, 2014). In terms of drinking water supply capacity, only 69% of the population in South Africa have access to drinking water resources, whereas this figure is much higher in other developing areas (WHO, 2015). These infrastructure shortcomings not only constrain the sustainable development of the African economy but also affect foreign investment.

There is also a serious lack of governance capacity in African countries. Corporate financing capacity remains low and most African countries have not eliminated their dependence on foreign capital. From the perspective of attracting foreign investment, international aid is still the main financing method for African countries, accounting for 64% of total financing (De Vries et al., 2015). By contrast, the governments' ability to formulate and implement the distribution and secondary distribution policies is low, leading to widespread poverty and polarisation between the rich and poor. More specifically, many African countries have serious problems in the form of wealth inequality. For example, in the Central African Republic, Rwanda, Swaziland, and Uganda, 10% of wealthy people account for 40% of wealth, whereas the same proportion of poor people only account for 3.5% of the wealth (AFDB, OECD & UNDP, 2014). Many African countries lack ideological independence (Mentan, 2017). Although African countries have experienced rapid economic development for more than a decade, they still lack a localised thinking system to correctly understand the world's sustainable development. Whether it is to choose the capitalist development path of Western countries, or study the socialist development model of the Soviet Union, most African countries will not avoid the high possibility of failure. This is not only because political systems of colonial heritage cannot support economic development, but also because most African countries have not adapted their thinking systems from the colonial period.



Key Challenge: Housing

From the early 1990s onwards, there has been an unprecedented growth in the world's population living in urban areas (UN-Habitat, 2016a). This is shown by an extraordinary upsurge in the absolute numbers of worldwide urban dwellers, and there are no findings to suggest that there has been a decrease in population in any major urban areas since then.

“From a yearly average of 57 million between 1990-2000 to 77 million between 2010-2015, in 1990, 43 per cent (2.3 billion) of the world's population lived in urban areas; by 2015, this had grown to 54 per cent (4 billion)” (UN-Habitat, 2016a).

The rate of urban growth has been a lot faster in some areas compared to others. The record growth rate between 1995 and 2015 was undoubtedly in the least developed countries in the world: African cities have the highest rapid urban growth rate. This is due to rural-urban migration, spatial development of urban settlements, the reclassification of rural areas, and, in some countries, harmful events such as war and natural disasters (UN-Habitat, 2009).

As African cities are amongst the poorest in the world, their growth rates indicate a key challenge to their resource allocation. They also face challenges in building and sustaining infrastructure and public services for their increasing populations (UN-Habitat, 2016a). Over 20 years ago, so their governments could support a reduction in rural poverty by allowing migration to be more sustainable, aid and support were provided to many developing countries from aid agencies. These agencies wanted to instigate policies

to reduce migration to large cities and to boost migration to assist the poor to move from lagging to leading areas (IMF and World Bank, 2013). As urban population rises, the area of land used by cities also rises at an even greater rate. Angel et al. (2011) estimated that, by 2030, the urban population of developing countries will double, while the area covered by cities would triple (largely made up of low-density urban sprawl and pockets of high-density slums). This urban expansion is inefficient due to unsustainable land and energy consumption. It will also contribute even more greenhouse gas emissions to the planet and will lead to a massive change in ecological systems in many cities (UNEP, 2007).

Housing, an essential aspect in the quality of life, is central to the success of sustainability and resilience in cities, as stated in the SDGs and NUA. In addition to being a valuable commodity, housing affects people's accessibility to the most fundamental basic infrastructure and services (e.g., water, transport and environment). There is a rapidly rising demand for housing around the developing world, as reflected by the 828 million people currently living in slums (Croese et al., 2016). This number is rising, particularly for Sub-Saharan Africa, where over the past 27 years, the entire continent's population has doubled from 500 million to 1 billion, a total projected to reach 2 billion by 2050 (UN-Habitat, 2008). Along the four dimensions of slum living (overcrowding, informal

housing, insecure tenure, and lack of access to water and sanitation), 37% of slums in Africa experience three or four of these conditions; this is compared with 5% in Southern Asia and 8% in Latin America (Pieterse, 2011). Despite high economic growth over the past ten years, around half of Africans receive incomes below US\$1.25 per day (UN-Habitat, 2013). The twofold pressures of a rapid urban population growth and widespread poverty mean that African governments face an increasingly acute challenge of providing shelter for the poor.

The causes for the severity of housing issues in Africa are complicated and need to be contextualised both historically and contemporarily. The colonial legacy of Africa in many ways still haunts its urban development today (Rodney, 2018). For instance, ill-devised master plans created during colonial times catered predominantly toward the elite, therefore giving rise to segregation, inequality, inadequate urban services, and unevenness in planning across zones (Peters, 2004). The failure of governments to understand and manage informal development and its social, political, and economic dynamics, led urban development to unravel in a spontaneous and non-transparent fashion in the post-independence period (Dos Santos et al., 2017). On the other hand, during the last three decades, the backdrop of economic stagnation and the burden of structural adjustment policies (which limit public spending) led to poor infrastructure. Additionally, the rural-urban migration, coupled



with excessive urban population growth rates, produced poverty-driven rapid urbanisation with a rising number of people in slums (Myers, 2011). Furthermore, although Africa is regarded as the 'last frontier' for real estate (Watson, 2014) and anticipated with rising middle class and domestic consumer market expansion, Foreign Direct Investment (FDI) (Grant, 2014) has yet to solve the issues with inaccessibility to water, basic sanitation, proper housing, and secure tenure (Grant, 2015).

Scholars have examined the progress of housing policy in Africa, and the emerging consensus suggests that the combination of all aforementioned factors have fuelled the government's preference for quick-fix mega-housing projects that often ignore the existence of slums and poverty, and ultimately fail in achieving sustainability and resilience (Watson, 2014; Cain, 2014; Croese et al., 2016; Zoomers et al., 2017). The infamous 'ghost town' at Kilamba City, Angola is a case in point. The housing project, funded by the Industrial and Commercial Bank of China through a public-private partnership, aimed to build 750 apartment buildings, schools and more than 100 retail units in 2010. However, it stagnated and sat empty for two years due to unaffordable house prices (Cain, 2013b). It created empty spaces in the central city with high land values, while displacing the original inhabitants and informal settlers, expropriating the assets and savings of the poor (Cain, 2013a). The government eventually had to lock-in its budget to heavily subsidise these properties. This resulted in a lack of spending on what otherwise would be sensible policies, such as *in situ* urban upgrading, strategic urban infrastructure geared towards slum prevention (Muchadenyika, 2015), health and education (Dasgupta et al., 2014).

The popularity of urban expansion based on the construction of new satellite cities also has dire environmental and social implications (Turok, 2015; Lindley et al., 2018). This is because expansion encroaches on the surrounding environment by destroying nature's provision of ecosystem services (e.g., agricultural production, freshwater availability, toxic-filtration), and by contributing to

global environmental change (e.g., greenhouse gas emissions, deforestation, and the deterioration of habitat and biodiversity). Moreover, satellite developments will add to urban sprawl and do little to reduce urban dependence on automobile transportation; it will also exacerbate the difficulties of poor Africans who travel on foot (Sietchiping et al., 2012).

Given the negative economic, social and environmental implications and the reliance on undependable and profit-driven FDI, the current trend of housing policy in Africa is both unsustainable and non-resilient. Solving the housing problem requires an integrated system and interdisciplinary approach. It means considering the historical and contemporary context (colonial past; emergence of cash flow), and prioritise 'inclusive urbanism' (Patel and Baptist, 2012) as opposed to 'privatised urbanism' (Herbert and Murray, 2015). It also needs to refocus on people's needs of everyday livelihood and embrace the creative spirit and resilience of the informal economy in reimagining African cities and their future possibilities (Grant, 2015).

The project, iShacks, represents a promising example of sustainable slum-upgrading at the informal settlement of Enkanini, Cape Town. Under the cooperation of the local community, researchers, NGOs and the Bill & Melinda Gates Foundation, it uses fire resistant, low-cost materials for building construction (zinc sheets coated in flame-retardant paint) and solar energy for lighting, mobile phone charging, and powering a 12-volt television (Luque-Ayala et al., 2014). As the project is implemented at a household-level across the community, social cohesion and capacity building are generated in the process of learning, purchasing, and protective vigilance (to protect units against crime). This subsequently prompted their engagement with central and municipal governments by requesting green subsidies and accelerated upgrading (Swilling, 2013). This example demonstrates the potential and benefit of a context-specific and people-centred policy approach in the face of sustainability and resilience crisis.

Key Challenge: Water

Water is fundamental to people's health, and by extension the nation's health (Smith et al., 2000): without it, humans die within three days (Gleick, 1996). Currently, 9% of people worldwide lack access to potable water, and 6.3% of deaths globally can be attributed to the lack thereof (Omole and Ndambuki, 2014). Water was a key MDG and its successor, SDG Target 6; this aims to provide unhindered access to safe and economical drinking water and sanitation for all by 2030 (UN-Habitat, 2016b), making the water issue one of the most urgent challenges within the next decade. The MDG target on water was achieved by 2010, five years ahead of the target deadline: Sub-Saharan Africa (SSA) and Oceania failed to reach their goals. With the projected tripling of population and a doubling in water demand by 2100 (Dos Santos et al., 2017), this poses serious sustainability and resilience implications to both the resource itself and its associated infrastructure and services.

The challenges for achieving sustainable and resilient water for all, lies in the lack of appreciation for the complexity of water in people's everyday lives and the subsequent inappropriate water management policies (Harvey and Reed, 2006). The UNICEF/WHO Joint Monitoring Programme's (JMP) definition of access to drinking water as the "proportion of population using an improved water source" has been criticised for its failure to capture the reality of water users. For example, its definition of improved water source may not necessarily be safe to drink, demonstrating the lack of attention to water-borne diseases (Gundry et al., 2006; Lim et al., 2012). Additionally, global indicators of water access often fail to capture the pronounced urban disparities in informal and peri-urban settlements (Dagdeviren and Robertson, 2009); it also downplays the severity of the water issue. For instance, official statistics show that 99% of people in Ouagadougou, the capital city of Burkina Faso, have access to an improved water source. However, when factors such as the quantity of water available in the domestic environment and the distance to the water point are considered, the statistic drops to 50% (Dos Santos et al., 2017). The lack of

interdisciplinary understanding can even be found in the internationally renowned eThekweni Water and Sanitation Services (EWS) municipality. Despite being praised for its technical capacity for providing enough water to communities across South Africa, its disaster risk reduction strategy precludes the impact of climate and environmental change and focuses solely on the provision of potable water (Johannessen and Wamsler, 2017).

The limited attention to the spatial dimension of water access and cost has also restricted the benefit of domestic water taps. In Ado-Odo/Ota, South West Nigeria, the cost of water connection is calculated based on the consumer's proximity to the public source: the farther the house is to the public source, the higher the cost. This policy discourages people living further away from the source from using tap-water and instead incites them to use nearby untreated water sources, e.g., ponds and rivers (Emenike et al., 2017). The lack of water also prevents the implementation of proper hygienic practices such as hand washing (Cairncross et al., 2010), known to be among the most effective methods in combatting waterborne illnesses (Hunter et al., 2010). Additionally, the unequal gender access to motorised transport (e.g., scooters and cars) also means that women usually spend more time, money, and effort in getting water of lower quality from further afield (UN-Habitat, 2013). These examples show that a failure to incorporate interdisciplinary sustainability and resilience thinking into project development and implementation will ultimately lead to ineffective results.

Withstanding the progress (or lack thereof) and lessons of past water projects, people have begun to call for a reconceptualisation of water issues, redefining water sustainability and resilience (Damkjaer and Taylor, 2017). This requires more in-depth and interdisciplinary urban water studies that answer people's needs. The decentralised water management system in Valle de Chalco, Mexico City is a case in point (Nanninga et al., 2012). It coordinates local community, authority

and researchers, and provides innovative solutions that harmonise multiple issues; these include water provision, flood risk management, conservation of groundwater and freshwater environment, and community empowerment. The decentralised management delegates power from the central institution to the community who have a greater interest in the preservation of quality water and sustainable use of precious freshwater resources. It is more resilient to the deterioration of pipes as the risk of damage is reduced by fragmentation into smaller structures (Parker and Tsur, 1997). Community-led flood risk management promotes the creation and preservation of recreational spaces, providing both amenities and buffers to possible flooding during rainy periods, as well as in-district relocation to avoid the deracination of the local population. Research has shown that decentralised rainwater harvesting utilisation can potentially minimise up to 70% of domestic water usage per household, enabling self-sufficiency even during times of water stress, whilst reducing urban flooding and damage (Nnaji and Mama, 2014).

Research has shown that a sole market-based water service is no more efficient than those managed by the government (Dos Santos et al., 2017), with limited success in improving water access for poor urban/peri-urban communities, in both the public and private domain. Increasing attention is being given to the potential of alternative strategies that centre on people's everyday needs; this requires a diverse partnership across public, private, NGOs, and local water users (Nzengya, 2015). Human agencies are vital to enable the transition to sustainability and resilience, given sufficient risk awareness and action capacity (Johannessen and Wamsler, 2017). Additionally, social learning within the community and across different levels of stakeholders (e.g., regional and national), and different sectors is essential to ensure that the resource footprints do not exceed the carrying capacity of the system or inadvertent negative consequences are not created (e.g., long-term trends such as salinisation and groundwater depletion) (Van Weert et al., 2009).



Discussion

The longstanding framework of urban sustainability was based on the three pillars of sustainability (social, economic and environmental) devised under the Bruntland report in 1987. The theory is that if any of these pillars is fragile, then the system is unsustainable. However, this framework has been criticised by various experts who argue that this depiction adopts the separation and even self-sufficiency of the economy, society and environment from each other. It misses the interconnectedness of the three pillars by assuming sectoral approaches (Giddings et al., 2002). The division mirrors the common approach to the study and portrayal of human life and the world about us; this is subjugated by a host of distinct disciplines (Giddings et al., 2002). Van der Ryn and Calthorpe (1991), the famous urban planning scholars, clearly indicated that sustainability means finding a balance between the social, economic, and ecological environments, so that resources in urban areas are continuous. According to Haughton (1999), "A sustainable city is essentially one that contributes effectively to the global aims of sustainable development, where sustainable development is seen as much as a process as

an end-product." Haughton and Hunter (1994) recognise different methods to attaining sustainable urban development. These include "self-reliant cities"; these use resources from within the surrounding regions, and diminish consumption by implementing renewable consumption practices. Haughton and Hunter (1994) also emphasise the importance of "redesigning cities", making them not only socially and economically vibrant and viable but also bringing nature back to the cities.

This definition also fits well with Daly and Cobb's (1999) input-output resource management theory; this advocates for renewable resources to be used at such a rate that they can be restored, and that finite resources are used at a rate that does not outstrip the rate at which renewable substitutes are developed. The theories and ideas of Ryn, Calthorpe, Haughton, Daly and Cobb are also connected to the recent theories around urban resilience that has become an appealing perspective regarding cities; it is frequently summarised as highly complex, adaptive systems (Meerow et al., 2016):

"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 et al., 2016.)



Moreover, urban resilience is a crucial component in achieving sustainable development. Resilience is a widely used concept that is ubiquitous in the real world. Neuman (2005) believed that the five traditional perceptions of sustainability included resilience, which is a response to the flaws and complexity of adaptive theory. Walker and Salt (2012) elaborated on the main point of view of resilience, asserting that it is a new ecological outlook for human beings facing sustainable development issues. Urban resilience is the ability of cities to regulate their own development patterns, through which they can reduce their dependence on traditional energy sources, adapt to climate change, and achieve the characteristics of sustainability.

Urban resilience experts also highlight the importance of understanding the 'socio-political complexity' of the term resilience, and to ensure that its use is made up of a more unified set of indicators (Vale, 2013). Regarding cities, this is especially true where the term can have many opposing definitions on whether its emphasis is placed on physical infrastructure or social infrastructure (Vale, 2013). The scale is also equally important as cities and city-regions are structured in ways that equally produce and imitate fundamental socio-economic disparities. Therefore, some areas are much more resilient than others, and vulnerability is frequently related to both topography and income (Vale, 2013). The literature implies that there are "three mechanisms or pathways to a resilient state: persistence, transition, and transformation" (Meerow et al., 2016). Persistence suggests that, through the engineering principle, systems must defy disturbance, for example, that buildings are robust enough to withstand natural disasters (Meerow et al., 2016). Transition and transformation refer to the capacity of a city or urban area to adapt

(transition) or, more drastically, transform. For example, when a system is in a strongly undesirable state, and struggles to build resilience, it may pursue a route to decisively and profoundly modify its structures (Meerow et al., 2016). The threat of uneven resilience can halt the capability of cities to function economically, socially and politically (Vale, 2013). Many experts argue that resilience can only persist in being beneficial as a theory and as a reformist practice if it is clearly allied with the necessity to improve the life prospects of deprived groups (Vale, 2013).



Therefore, to achieve the goal of transitioning to a 'sustainable, inclusive, resilient and liveable city' as set out in SDGs and NUA, the following is recommended. Drawing on the accumulated knowledge and respective strengths in the field of sustainability science and resilience theory, it is known that understanding the system's interrelations and dynamics is crucial in working towards a liveable city (Yigitcanlar and Teriman, 2014; Dos Santos et al., 2017; Grabowski et al., 2017).

We should combine the focus of the sustainable approach on practical transformation of the status quo and embrace the resilience approach for open-ended and emerging dynamics (Redman, 2014). This will allow us to examine the challenges brought by rapid urbanisation critically, through the interdisciplinary lens and the perspectives of multiple stakeholders. This will enable us to understand and address the needed transition in an integrated and cross-sectoral manner, well-aligned with the system approach thinking originating from the Systems Theory (Von Bertalanffy, 1969). In the case of developing adequate, accessible and affordable housing, cross-border investment, land grab, and the colonial legacy need to be

considered in order to avoid the creation of ghost towns and the displacement of people (Zoomers et al., 2017). For the development of sustainable water resources, attention to the water needs of all people is essential; simple solutions such as rainwater harvesting are effective with multiple benefits. Both important 21st century challenges show that despite the urgency and scale of the problems, mega-projects and smart technologies are not a panacea (Watson, 2014; Kaika, 2017).

Stakeholders, including the local community, policymakers, privatised firms and scholars, need to work together to form a consensus, and focusing on the 'discensus' can also be useful (Kaika, 2017). This means a critical examination of where, how, why, and by whom conflict and disagreement are generated. It involves empowering vulnerable groups and local communities so that 'being included' does not mean being forced to accept legitimised inequalities and accept compensation (Kaika, 2017). The mechanism of justice-seeking needs to go beyond compensation and provide strong legal protection based on sensible policies. 'Right to city' and slum upgrading in the case of housing (Zoomers et al., 2017) and a pro-poor water subsidy (Dos Santos et al., 2017) will be able to provide a much more direct, efficient and effective solution to problems people face in everyday life and overcome any potential shocks and stresses (e.g., extreme weather brought about by climate change).

Returning to the question of urgency and magnitude of urban housing and water issues, there is an emerging consensus that the focus of sustainability and resilience should be on small and medium developing cities with populations between 500,000 and 5 million, located in Africa and Asia (Birkmann et al., 2016). This is because these cities are growing at a rapid rate and they are more widespread. Across the globe, populations in small/medium and large/mega cities are projected to rise by more than 32% and 26% between 2015 and 2030 respectively, a rise of 469 and 203 million more people, respectively (Satterthwaite, 2016). This is compounded by the fact that the former typically have higher poverty rates, much poorer basic infrastructure, limited political power, personnel, and resources, a realisation that leads

to a different set of challenges and opportunities than if growth were confined to a limited number of very large cities (Cohen, 2006). Additionally, mirroring the rapid transformation of the urban landscape, the governance of cities throughout the developing world has also undergone a process of decentralisation, delegating power towards local and municipal institutions; this is due to the rise of civil society, democratisation and political pluralism (Sharma, 2004). Relying on national government or international organisations to do the job is risky, since they have less legitimacy and familiarity with local conditions (Turok, 2015). This emphasises the urgency to capacitate local governments into managing the negative sustainability and resilience problems that accompany rapid urban growth (Cohen, 2006).

The opportunity for a more sustainable and resilient future is clear. However, in the 2015 SDGs and Habitat III's 2016 NUA, there is yet to be an explicit focus on small/medium developing cities (Birkmann et al., 2016). Studies have shown that smaller cities are easier to manage than megacities (Kraas et al., 2016), and that sustainability and risk reduction embedded now can develop as cities grow. The negative impacts of extreme events, and the benefit of reducing these, are felt more directly. Also, harmonisation between different stakeholders is more achievable in smaller cities. Academia should therefore help policymakers realise the potential benefits in this approach. Research in how context, community involvement and interdisciplinary coordination might shape outcomes, should be further explored through in-depth urban studies (Dos Santos et al., 2017).

One of the most notable gaps in academic discourse and in the practice of urban resilience is a systems thinking approach for cities and their development. This element is frequently displaced in definitions of resilience, especially those drawn from engineering and ecology (Vale, 2013). To advance the prospects of cities, Vale (2013) argues that there is a need to combine the visions and ideas from the various professions and disciplines that use urban resilience as a framework, inputting these into a bigger system with interlinking factors and feedback loops, between those whom are proactively and reactively involved in solving the

urban challenge. Systems thinking is assumed to “facilitate complex decision-making. But relatively little is known about its psychological underpinning” (Lezak and Thibodeau, 2016). A small number of studies has shown that “many people do not naturally engage in intuitive systems thinking” (Lezak and Thibodeau, 2016), but that the value of systems thinking is imparted generally in a corporate or managerial setting (Lezak and Thibodeau, 2016). Whiteman et al. (2013) agree and suggest that it is important to successfully address persistent societal pressures such as climate change, social inequality, unemployment, and ecological degradation. Researchers and managers can benefit from an improved understanding of the “dynamic interactions within and across interconnected systems” (Williams et al., 2017). Many management researchers have acknowledged that the challenges of extremely interdependent systems require a systems approach that observes social systems nested within natural systems and identifies the reliance of business on nature hypothesises (Williams et al., 2017). Notwithstanding, these early and consistent acknowledgments of the systemic nature of sustainability, “To date, a literature review of systems thinking as a theoretical lens to better understand sustainability management has not been conducted” (Williams et al., 2017). Sustainability

research literature reviews are available; however, these tend to emphasise outdated management theories, such as resource management, competitive policy or institutional principles.

Systems thinking can do more in the way of increasing the understanding of the intricacy of economic, social and ecological systems (Holling, 2001). A multifaceted system is a set of interrelating variables that act according to governance tools or forces (Williams et al., 2017). Within the application of systems thinking, researchers in sustainability management will be able to “identify the points at which a system is capable of accepting positive change and the points where it is vulnerable” (Holling, 2001). It is widely noted in research that there is an interdependence between governance organisations and the environment. Therefore, further work must be done to devise a systemic sustainability management framework, with the emphasis that the inputs and governance actions directly influence the natural environment through feedback loops (Williams et al., 2017). This established outlook of governance acknowledges systemic boundaries to growth within the capacity of the planet, finite resources and the reliance of governance on society, the economy and the natural environment (Williams et al., 2017).



Conclusions

A city is the most intense indication of human activities on the environment (Yigitcanlar and Teriman, 2015), with the increasing number and concentration of populations in urban areas. This has brought about multiple complex and interconnected challenges for urban infrastructure and services, including housing, water and transport, together with implications for climate change, environmental degradation and resource consumption (Parnell, 2016). It is increasingly recognised that sustainable development cannot be achieved without significantly transforming the way in which we build and manage our urban spaces. Therefore, more attention is given to the sustainability and resilience of developing cities (Geissdoerfer et al., 2017), evident in the establishment of the United Nation's (UN) 17 Sustainable Development Goals (SDGs) in 2015, and the global commitment to the UN's New Urban Agenda (NUA) (UN-Habitat, 2016b). The latter builds on the current progress in SDGs and focuses on the need to create a mutually reinforced relationship between urbanisation and the SDGs (Spence et al., 2009); it has been adopted by around 170 countries. Cities, as the confluence of people, resources and money, are the major drivers of national economies. They are envisioned as a key to achieve the SDGs, ranging from creating healthy environments and improving gender equality to risk reduction and enhancing resilience against climate change (Zoomers et al., 2017).

For African cities, the structure of economic development is pivotal and homogeneous. The economic growth of most cities depends on external factors such as aid, capital reduction and investment. Additionally, the resources dependent on development are also homogeneous, based on the current economic development model, once the external influencing factors or the conditions of limited resources change. For example, if the international community stops aiding African countries, or foreign enterprises stop investing, it is very likely that an economic recession will occur. Moreover, the long-term infrastructure defects of African cities have also constrained the

sustainable development of the African economy; this will remain one of the biggest challenges over the next 10 years. In addition, the management capacity of African cities is seriously undeveloped, and the government's ability to formulate and carry out development projects, as well as their financing ability, is at an all-time low. Finally, the lack of ideological independence will also create obstacles in policy-making, which is needed for the development of African cities.

With an unprecedented rise in urbanisation and population, developing cities in Africa face a multitude of serious sustainability and resilience challenges, particularly in the housing and water sectors. The SDGs and NUA recognise cities not only as problems, but also as opportunities for broad-reaching policy changes, providing a renewed focus on the role and the potential of cities to promote much needed sustainability and resilience practises. By heeding the progress and lessons from past projects (i.e., the importance of interdisciplinary perspectives, systems thinking, context-specific, people-centred approach, and the focus on small/medium cities), the seemingly daunting challenge of achieving 'inclusive, resilient, liveable and sustainable' cities becomes more attainable.

In conclusion, this paper has explored how urban sustainability and resilience ideas can support the positive urban transition of social, environmental, political and economic dimensions of a city in the developing world. It explored the gaps in the literature and further work that would be required to prompt this urban transition. It has drawn on research that suggests the possible key challenges facing developing cities over the next 10 years are not going to be met through urban sustainability and resilience actions alone. But rather by incorporating diverse actions from interrelated disciplines into an interdisciplinary systems thinking approach.

References

- AfDB Statistics Department (2018):** *African Economic Outlook 2018*. Retrieved from <https://www.afdb.org/en/knowledge/publications/african-economic-outlook/>.
- AfDB, OECD and UNDP (2014):** *African Economic Outlook 2014: Global Value Chains and Africa's Industrialisation*. OECD Development Centre.
- Angel, S., Parent, J., Civco, D. L. and Blei, A.M. (2011):** *Making Room for a Planet of Cities*, Lincoln Institute of Land Policy, Cambridge, MA.
- Birkmann, J., Welle, T., Solecki, W., Lwasa, S. and Garschagen, M. (2016):** Boost resilience of small and mid-sized cities. *Nature News*, Vol. 537, No. 7622, pp.605-608.
- Cain, A. (2013a):** Luanda's post-war land markets: reducing poverty by promoting inclusion. *Urban Forum*, Vol. 24, No. 1, pp.11-31.
- Cain, A. (2013b):** *Housing finance in Angola*. Centre for Affordable Housing Finance in Africa. Retrieved from <http://www.housingfinanceafrica.org/country/angola>.
- Cain, A. (2014):** African urban fantasies: past lessons and emerging realities. *Environment and Urbanization*, Vol. 26, No. 2, pp.561-567.
- Cairncross, S., Hunt, C., Boisson, S., Bostoen, K., Curtis, V., Fung, I.C. and Schmidt, W.P. (2010):** Water, sanitation and hygiene for the prevention of diarrhoea. *International journal of epidemiology*, Vol. 39, Suppl_1, pp.i193-i205.
- Cho, Y. and Tien, B.N. (2014):** *Sub-Saharan Africa's recent growth spurt: an analysis of the sources of growth*. The World Bank.
- Cohen, B. (2006):** Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in society*, Vol. 28, Nos 1-2, pp.63-80.
- Croese, S., Cirolia, L.R. and Graham, N. (2016):** Towards Habitat III: Confronting the disjuncture between global policy and local practice on Africa's 'challenge of slums'. *Habitat International*, Vol. 53, pp.237-242.
- Dagdeviren, H. and Robertson, S.A. (2011):** Access to Water in the Slums of Sub-Saharan Africa. *Development Policy Review*, Vol. 29, No. 4, pp.485-505.
- Daly, H.E. and Cobb, J.B. Jr. (1999):** For the Common Good. *Journal of Business Administration* & *Policy Analysis*, 1999: 27-29, 2001:65-86.
- Damkjaer, S. and Taylor, R. (2017):** The measurement of water scarcity: Defining a meaningful indicator. *Ambio*, Vol. 46, No. 5, pp.513-531.
- Dasgupta, B., Lall, S.V. and Lozano-Gracia, N. (2014):** *Urbanization and housing investment*. Policy Research Working Paper 7110. Washington: World Bank.
- De Vries, G., Timmer, M. and De Vries, K. (2015):** Structural transformation in Africa: Static gains, dynamic losses. *The Journal of Development Studies*, Vol. 51, No. 6, pp.674-688.
- Dos Santos, S., Adams, E.A., Neville, G., Wada, Y., De Sherbinin, A., Bernhardt, E.M. and Adamo, S.B. (2017):** Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment*, Vol. 607, pp.497-508.
- Dubbeling, M., Zeeuw, H.D. and Veenhuizen, R.V. (2010):** *Cities, poverty and food: multi-stakeholder policy and planning in urban agriculture*. Practical Action Publishing.
- Emenike, C.P., Tenebe, I.T., Omole, D.O., Ngene, B.U., Oniemayin, B.I., Maxwell, O. and Onoka, B.I. (2017):** Accessing safe drinking water in sub-Saharan Africa: Issues and challenges in South-West Nigeria. *Sustainable cities and society*, Vol. 30, pp.263-272.
- Geissdoerfer, M., Savaget, P., Bocken, N.M. and Hultink, E.J. (2017):** The Circular Economy: A new sustainability paradigm? *Journal of cleaner production*, Vol. 143, pp.757-768.
- Giddings, B., Hopwood, B. and O'Brien, G. (2002):** Environment, economy and society: fitting them together into sustainable development. *Sustainable Development*, Vol. 10, No. 4, pp.187-196.
- Gleick, P.H. (1996):** Basic water requirements for human activities: Meeting basic needs. *Water international*, Vol. 21, No. 2, pp.83-92.
- Grabowski, Z.J., Matsler, A.M., Thiel, C., McPhillips, L., Hum, R., Bradshaw, A., Miller, T. and Redman, C. (2017):** Infrastructures as socio-eco-technical systems: Five considerations for interdisciplinary dialogue. *Journal of Infrastructure*

Systems, Vol. 23, No. 4, p.02517002.

Grant, R. (2014): *Africa: Geographies of change*. New York, NY: Oxford University Press.

Grant, R. (2015): Sustainable African urban futures: Stocktaking and critical reflection on proposed urban projects. *American Behavioral Scientist*, Vol. 59, No. 3, pp.294-310.

Gundry, S.W., Wright, J.A., Conroy, R., Du Preez, M., Genthe, B., Moyo, S., Mutisi, C., Ndamba, J. and Potgieter, N. (2006): Contamination of drinking water between source and point-of-use in rural households of South Africa and Zimbabwe: implications for monitoring the Millennium Development Goal for water. *Water Practice and Technology*, Vol. 1, No. 2.

Harvey, P.A. and Reed, R.A. (2006): Community-managed water supplies in Africa: sustainable or dispensable? *Community Development Journal*, Vol. 42, No. 3, pp.365-378.

Haughton, G. (1999): Environmental Justice and the Sustainable City. *Journal of Planning Education and Research*, Vol. 18, No. 3, pp.233-243.

Haughton, G. and Hunter, C. (1994): *Sustainable Cities*. Jessica Kingsley Publishers Ltd, DOI: 10.2307/144514.

Herbert, C.W. and Murray, M.J. (2015): Building from Scratch: New Cities, Privatized Urbanism and the Spatial Restructuring of Johannesburg after Apartheid. *International Journal of Urban and Regional Research*, Vol. 39, No. 3, pp.471-494.

Holling, C.S. (2001): Understanding the complexity of economic, ecological, and social systems. *Ecosystems*, Vol. 4, No. 5, pp.390-405.

Hunter, P.R., MacDonald, A.M. and Carter, R.C. (2010): Water supply and health. *PLoS medicine*, Vol. 7, No. 11, p.e1000361.

IMF and World Bank (2013): *Global Monitoring Report 2013: Rural-Urban Dynamics and The MDGs*. Retrieved from <https://openknowledge.worldbank.org/handle/10986/13330>

Johannessen, Å. and Wamsler, C. (2017): What does resilience mean for urban water services? *Ecology and Society*, Vol. 22, No. 1.

Kaika, M. (2017): Don't call me resilient again!: The New Urban Agenda as immunology... or... what happens when communities refuse to be vaccinated with 'smart cities' and indicators. *Environment and Urbanization*, Vol. 29, No. 1, pp.89-102.

Kraas, F., Leggewie, C., Lemke, P., Matthies,

E., Messner, D., Nakicenovic, N., Schellnhuber, H.J., Schlacke, S., Schneidewind, U., Brandi, C. and Butsch, C. (2016): *Humanity on the move: Unlocking the transformative power of cities*. WBGU-German Advisory Council on Global Change.

Lezak, S.B. and Thibodeau, P.H. (2016): Systems thinking and environmental concern. *Journal of Environmental Psychology*. Vol. 46, pp.143-153. Doi: 10.1016/j.jenvp.2016.04.005.

Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., Shibuya, K., Adair-Rohani, H., alMazroa, M.A., Amann, M., Anderson, H.R., Andrews, K.G. and Aryee, M. (2012): A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010. *The Lancet*, Vol. 380, No. 9859, pp.2224-2260.

Lindley, S., Pauleit, S., Yeshitela, K., Cilliers, S. and Shackleton, C. (2018): Rethinking urban green infrastructure and ecosystem services from the perspective of sub-Saharan African cities. *Landscape and Urban Planning*, Vol. 180, pp.328-338.

Luque-Ayala, A., Marvin, S. and Bulkeley, H. (2018): *Rethinking Urban Transitions: Politics in the Low Carbon City*. Routledge.

McGranahan, G. and Satterthwaite, D. (2014): *Urbanisation Concepts and Trends*. London: International Institute for Environment and Development.

Meerow, S., Newell, J.P. and Stults, M. (2016): Defining urban resilience: A review. *Landscape and Urban Planning*, Vol. 147, pp.38-49.

Mentan, T. (2017): *Dilemmas of weak states: Africa and transnational terrorism in the twenty-first century*. Routledge.

Muchadenyika, D. (2015): Slum upgrading and inclusive municipal governance in Harare, Zimbabwe: New perspectives for the urban poor. *Habitat International*. Vol. 48, pp.1-10.

Myers, G. (2011): *African cities: alternative visions of urban theory and practice*. Zed Books Ltd.

Nanninga, T.A., Bisschops, I., López, E., Martínez-Ruiz, J.L., Murillo, D., Essl, L. and Starkl, M. (2012): Discussion on sustainable water technologies for peri-urban areas of Mexico City: balancing urbanization and environmental conservation. *Water*, Vol. 4, No. 3, pp.739-758.

- Neuman, M. (2005):** The compact city fallacy. *Journal of planning education and research*, Vol. 25, No. 1, pp.11-26.
- Nnaji, C., & Mama, N. (2014):** Preliminary Assessment of Rainwater Harvesting Potential in Nigeria: Focus on Flood Mitigation and Domestic Water Supply. *Water Resources Management*, Vol. 28, No. 7, pp.1907-1920. Doi: 10.1007/s11269-014-0579-1.
- Nzengya, D.M. (2015):** Exploring the challenges and opportunities for master operators and water kiosks under Delegated Management Model (DMM): A study in Lake Victoria region, Kenya. *Cities*, Vol. 46, pp.35-43.
- Omole, D.O., Ndambuki, J.M. and Balogun, K. (2015):** Consumption of sachet water in Nigeria: quality, public health and economic perspectives. *African Journal of Science, Technology, Innovation and Development*, Vol. 7, No. 1, pp.45-51.
- Parker, D.D. and Tsur, Y. (1997):** *Decentralization and coordination of water resource management*. Kluwer Academic Publishers.
- Parnell, S. (2016):** Defining a global urban development agenda. *World Development*, Vol. 78, pp.529-540.
- Patel, S. and Baptist, C. (2012):** Documenting by the undocumented. *Environment and Urbanization*, Vol. 24, No. 1, pp.3-12.
- Peters, P.E. (2004):** Inequality and social conflict over land in Africa. *Journal of agrarian change*, Vol. 4, No. 3, pp.269-314.
- Pieterse, E. (2011):** Rethinking African urbanism from the slum. *Power*, Vol. 26, No. 14.1, pp.40-48.
- Rakodi, C. (2016):** The urban challenge in Africa. In Keiner, M., Koll.Schretzenmayr, M. and Schmid, W.A. (Eds): *Managing Urban Futures: sustainability and urban growth in developing countries* (pp.63-86). Routledge.
- Redman, C.L. (2014):** Should sustainability and resilience be combined or remain distinct pursuits? *Ecology and Society*, Vol. 19, No. 2.
- Rodney, W. (2018):** *How Europe underdeveloped Africa*. Verso Trade.
- Satterthwaite, D. (2016):** Background Paper: Small and intermediate urban centres in sub-Saharan Africa. *Urban Africa Risk Knowledge (Urban ARK) Working Paper*, 6.
- Sietchiping, R., Permezel, M.J. and Ngoms, C. (2012):** Transport and mobility in sub-Saharan African cities: An overview of practices, lessons and options for improvements. *Cities*, Vol. 29, No. 3, pp.183-189.
- Smith, A.H., Lingas, E.O. and Rahman, M. (2000):** Contamination of drinking-water by arsenic in Bangladesh: a public health emergency. *Bulletin of the World Health Organization*, Vol. 78, pp.1093-1103.
- Spence, M., Clarke, A.P. and Buckley, R. (Eds) (2009):** *Urbanization and growth*. Washington DC: World Bank/Commission on Growth and Development.
- Swilling, M. (2013):** Contesting inclusive urbanism in a divided city: The limits to the neoliberalisation of Cape Town's energy system. *Urban Studies*, Vol. 51, No. 15, pp.3180-3197.
- Sharma, A.K. (2004):** Cities Transformed. Demographic Change and its Implications in the Developing World. *Population Review*, Vol. 43, No. 1, pp.90-91.
- Turok, I. (2015):** Turning the tide? The emergence of national urban policies in Africa. *Journal of Contemporary African Studies*, Vol. 33, No. 3, pp.348-369.
- UNEP (2007):** *Global Environmental Outlook: Environment for Development*, Progress Press Ltd, Valletta, Malta. Retrieved from <http://wedocs.unep.org/handle/20.500.11822/7646>.
- UN-Habitat (2008):** *The State of African Cities: A framework for addressing urban challenges in Africa*. Geneva. Edited by Programme UNHS.
- Un-Habitat (2009):** *Global Report on Human Settlements: Planning Sustainable Cities*, Earthscan, London and Sterling, VA.
- Un-Habitat (2013):** *Water and sanitation in the world's cities: Local action for global goals*. Earthscan, London.
- UN-Habitat (2016a).** *Urbanization and Development: Emerging Futures: World Cities Report*. UN-Habitat, Nairobi.
- UN-Habitat (2016b):** Chapter 9. Principle for a new urban agenda. In *World Cities Report 2016*. Retrieved from http://wcr.unhabitat.org/main-report/#section_nine.
- United Nations (2015):** *Transforming Our World: The 2030 Agenda for Sustainable Development*. Retrieved from: http://Www.Un.Org/Ga/Search/View_Doc.Asp?Symbol=A/Res/70/1&Lang=E.
- Vale, L.J. (2013):** The politics of resilient cities: whose resilience and whose city? *Building Research & Information*, Vol. 42, No. 2, 191-201,

DOI: 10.1080/09613218.2014.850602.

Van der Ryn, S. and Calthorpe, P. (1991): *Sustainable communities*. American Planning Association, US. 238pp.

Van Weert, F., Van der Gun, J. and Reckman, J. (2009): *Global overview of saline groundwater occurrence and genesis*. International Groundwater Resources Assessment Centre, 105pp.

Von Bertalanffy, L. (1969): General systems theory and psychiatry: an overview. *General systems theory and psychiatry*, Vol. 32, No. 4., pp.33-46.

Walker, B. and Salt, D. (2012): *Resilience thinking: sustaining ecosystems and people in a changing world*. Island Press.

Watson, V. (2014): African urban fantasies: dreams or nightmares? *Environment and Urbanization*, Vol. 26, No. 1, pp.215-231.

Whiteman, G., Walker, B., Perego, P. (2013): Planetary boundaries: ecological foundations for corporate sustainability. *Journal of Management Studies*, Vol. 50, No. 2, pp.307-336.

Williams, A., Kennedy, S., Philipp, F. and Whiteman, G. (2017): Systems Thinking: A Review of Sustainability Management Research. *Journal of Cleaner Production*. Vol. 148, pp.866-881. DOI: 10.1016/j.jclepro.2017.02.002.

World Health Organization (WHO) (2015): Use of basic and safely managed drinking water services Retrieved from https://www.who.int/gho/mdg/environmental_sustainability/water/en/.

Yigitcanlar, T. and Teriman, S. (2015): Rethinking sustainable urban development: towards an integrated planning and development process. *International Journal of Environmental Science and Technology*, Vol. 12, No. 1, pp.341-352.

Zoomers, A., van Noorloos, F., Otsuki, K., Steel, G. and van Westen, G. (2017): The rush for land in an urbanizing world: From land grabbing toward developing safe, resilient, and sustainable cities and landscapes. *World Development*, Vol. 92, pp.242-252.

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