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Sustainable and smart cities in Africa: A review

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Abstract

This paper addresses the main challenges to be overcome so that cities in the future can be sustainable and also smart cities in the African Continent. The main goal of the paper is to analyse the main constraints to urban development in the African Continent in order for these cities to become smart cities in the future. The methodology was based on a literature revision of all the papers referred in Social Science Citation Index and SCOPUS Elsevier from Q2 to Q1. The results confirm the existence of huge challenges, problems and restrictions on social, economics, environmental and political issues in Africa and also confirm that smart cities will only be possible in Africa when the current problems of sustainable development (economic, social, environmental and political) are overcome. However, the paper allows us to understand why, this is the first paper in the literature to address the topic of smart cities in Africa. It should be noted that in this continent there are at least two of the world's largest cities in terms of inhabitants and the growth of population rate of the African continent is about 2.5%. This is a global problem to handle. The concern about the problems of sustainable development in this region and how to promote it towards sustainable cities concerns everyone and the next steps will affect all of the world's sustainable development.

Keywords: Africa, cities; smart cities; urban sustainability; sustainability.

Introduction

In the last decade there have been unprecedented and often unforeseen changes of an economic, political, social and environmental nature with direct impacts on the urban environment in general in the world and in Africa in particular.

At the political level the instability arising in some regions of Africa and the Middle East such as the swift rise of the Islamic State (Fisher & Rucki, 2017), allied to the unfavorable economic conditions (due to the fact that they are mostly African countries in development), as well as economic volatility in the energy sector (Brewer et al., 2014), combined with change in environmental conditions, because nowadays climate change has severe implications for the security of individuals, communities, cities, regions in Africa and in the planet (Yigitcanlar & Kamruzzaman, 2018; Fann et al., 2015). All these factors combined has led to migratory movements out of African countries and tending towards urban centers in Africa and abroad.

Nowadays 40.6 % of the population in Africa lives in urban areas (World Bank, 2018), but the urbanization and urban rates vary across the region in the African continent. Increasing urbanization in sub-Saharan Africa was recognized by Schlesinger et al., (2015), as well the impacts and spatial configurations transformations in and around towns and cities.

Some of the biggest cities on the world are in the African continent, namely, Lagos (Nigeria) among others on the Mediterranean/African Continent. The grow rate of urban population is increasing following the world trend when about 55% lives on urban areas in 2017 (World Bank, 2017). But the year of 2007 marked an important development in the history of urban cities in the world, because, for the first time, the share of total population living in cities exceeded 50%. Urbanization has become a major global trend, with ever increasing degrees of urbanization reaching 70% (Kourtit et al., 2017, Dos-Santos, 2016): By 2050, 75% of the world's population will be living in urban areas (United Nations, 2015) and this figure will reach to over 80% at the end of the century (Dizdaroglu and Yigitcanlar, 2014; Yigitcanlar, & Kamruzzaman, 2018).

This situation implies that cities in African continent need also to be sustainable and smart. Over the last decades, these interlinked issues developments have started to converge under the new heading of smart sustainable cities (Höjer & Wangel, 2015). In recent years, the concept of smart sustainable cities has come to the fore and it is rapidly gaining momentum and worldwide attention as a promising response to the challenge of urban sustainability (Bibri & Krogstie, 2017). Despite numerous research opportunities are available and worth exploring, the field of smart sustainable cities is still in its early stages of development (Bibri & Krogstie, 2017). According to these authors, this pertains particularly to ecologically and technologically advanced nations, but are in absence in African cities. So far, there are yet few links between sustainability and smart cities in the developed countries. However, there are not yet any reference on the literature on smart sustainable cities referred to Africa. Similarly, in Africa, cities now face much greater challenges than those affecting developed countries. These challenges are related to economic, social, environmental and political factors. Therefore, in order for cities in Africa to move towards the smartness in the future it is necessary to previously solve the problems of sustainability which nowadays affects them.

In order to address the critical issue of whether smart city policy leads to sustainability of cities, the paper focuses on the following two research questions:

(1) Does smart cities bring sustainability to African cities in terms of economic, social, political and environmental impacts or the analysis must be done on the opposite way?

(2) What are the main factors that lead to sustainability and smartness of African cities.

More specifically, this paper aims to:

- a) To analyze the main economics, social, and environmental problems in the main urban region of Africa;
- b) the current state of the art in the literature about the topics of urban development, smart cities and smart cities sustainable;
- c) To analyze if the actual developments concerned about smart cities and sustainability are adjusted to African cities;
- d) To understand the main social, economic, environmental problems in African cities that can compromise the long-term sustainable development and smartness.

1.1. Contribution of the paper to the literature

This paper making a fourfold contribution in the literature:

- 1) Although there are many studies in the scientific field of smart cities, few of them had analyzed the topic smart cities and sustainability and none of them so far analyzes the complex situation in African cities nor brings to the scientific debate and forecast new insights about these topics.
- 2) This holistic approach used to analyses the sustainable and smart cities in Africa is believed to be the first of its kind and hence has not been, to the best of one's knowledge, produced elsewhere.
- 3) This paper gives insights to stakeholders and public decision-makers about the way forward in the promotion and development of cities in Africa in a sustainable way, in order to foster research in these innovative areas.
- 4) Broaden new research opportunities to explore and bring more knowledge in smart sustainable cities in general and in Africa in particular.

1.1. The African cities: Main challenges to sustainable development

Laros & Jones, (2014) analyzing the actual situation of the major urban areas and cities in African continent. Due the fact of the big differences among all the major cities in Africa

the authors and the literature separate the continent by different areas and challenges of development. According to these authors the overarching challenge for Africa in the decades to come is massive population growth in a context of wide-spread poverty that, in combination, generate complex and interrelated threats to the human habitat (Laros & Jones, 2014). Table 1 presents the main challenges of social, economics; environmental and political problems in African regions main challenges to sustainable development.

Table 1. Main of social, economics; environmental and political problems in African regions/cities

Region and cities		Main challenges			
Region on Africa	Major City	Economics	Social	Environmental	Political
Northern Africa	Cairo (11 million of inhabitants)	Low income/habitant; Low attractiveness for FDI;	Young unemployment; Exclusion; Low professional skills and education; Social struggle; Migration and refugees' problems on the borders	Climate change, projected to exacerbate existing desertification and water stress; Urban pressure and exclusion; Highly urbanized.	Political Instability from "The Arab Spring"; Political struggle.
Western Africa,	Is the most rapidly urbanizing sub-region; Has very high, albeit decelerating; Significant gaps in urban data availability and reliability in the sub-	Economic activities conducted by small, informal sector actors, as well as larger formal actors, are mediated through Urban agglomerations along corridors, which extend across borders	Lack of regional and local urban infrastructure hampers sub-regional economic growth and development. Key regional infrastructure deficits in logistics and	Current and projected climate change impacts in Western Africa take on two broad spatial dimensions. Northern parts of the sub-region, which border the Sahel, are	Conflict and instability also characterize the sub-region, with climate and environmental pressures often increasing religious and

	region.	and sub-regions. Emerging urban middle classes in the sub-region are key to sustaining growth and foreign direct investment. Economic growth is largely driven by extractive activities in the minerals and energy sectors and agriculture, whereas tertiary sector activities dominate urban economic growth been slow to follow suit.	transport, port infrastructure, information and communications technologies (ICT) and energy, persist to the detriment of efficient storage, transportation of goods and people, etc.	experiencing southward migration of the semi-arid Sahel. To the south and south-west of the region, along the coastal belt, the vulnerability of dense urban corridors and agglomerations to climate change-related pressures such as flooding, storm surges, sea-level rise, saline intrusion and coastal erosion is projected to increase. Temperature and precipitation changes	ethnic conflicts in the Sahel, placing additional pressures on cities to absorb conflict refugees and internally displaced persons.
Eastern Africa	Eastern Africa is the world's least urbanized but fastest urbanizing sub-region. By the end of the	Regional economic vulnerabilities; The subregion's mining potential remains unrealized and the agricultural	The region's cities exhibit high levels of poverty and inequality and fast growth of slums and informal settlements.	Climate change increases various threats in a sub-region where economies are vulnerable due to their	Further consequences of food insecurity and inter-communal violence contribute to internal

	<p>current decade its urban population will have increased by 50 per cent and the total number of urban dwellers in 2040 is expected to be five times that of 2010.</p>	<p>sector is far more important.</p>		<p>dependence on smallholder agriculture and pastoralism.</p>	<p>displacement and refugee flows, many of these towards “emergency” informal settlements, which soon become established as informal urban communities.</p>
<p>Central Africa</p> <p>Is rapidly urbanizing, the subregion is not expected to reach a region-wide urban majority .</p>	<p>Kinshasa (population of over 9 million), continues to dominate Central Africa as the sub-region’s largest and fastest growing urban system.</p>	<p>High levels of FDI;</p> <p>Characterized by deep poverty and inequality;</p> <p>Lower the rate of unemployment in some of the sub-region’s cities.</p> <p>urban economies in the sub-region have started to</p>	<p>Most capital cities in the region function as hubs for complex international financial transactions as well as command posts for the management of multinational organizations.</p>	<p>Climate change is projected to induce agricultural losses, increasing the threat of food insecurity.</p> <p>Deforestation, too, is a major concern for all countries in the sub-region since they are</p>	<p>The political system is corruption;</p> <p>High number of slums and informal settlements.</p> <p>Urban Governance in Central Africa is beset by deep institutional failures, which are partly</p>

		<p>struggle as they depend heavily on the export of mining, especially the exploitation and export of copper, diamond, oil and timbers.</p>	<p>Mass investments in infrastructure building, in the service sector and in the tourism industry, have helped to</p>	<p>losing large tracts of forest and tons of soil every year and experience declining biodiversity.</p>	<p>catalyzed by, and result in, informal land- and housing acquisition. Recent decentralization efforts have led to additional urban governance problems with municipal institutions not reaching the poor urban majorities due to inefficiency, over-bureaucratization, corruption and nepotistic practices that directly or indirectly give preference to the wealthy and politically connected. Municipalities</p>
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					are largely unable to collect revenues to finance their services.
Southern Africa	Southern Africa, the most urbanized region in sub-Saharan Africa, is projected to reach an overall region-wide urban majority around the end of the current decade.	Despite the region's economic success in terms of gross domestic product (GDP) growth, relative to other countries south of the Sahara, widespread inequality characterizes the primary condition of Southern African cities.	of people living in slums and informal settlements in Southern Africa is generally lower than the rest of the continent – (except for Angola, Mozambique and Zambia) - urban planning efforts in Southern African cities face key challenges in common with other sub-regions: urban sprawl; substantial housing backlogs;	With increased prevailing temperatures and changing rainfall patterns, food security is likely to become an increased concern across much of Southern Africa. Encouragement of non-polluting forms of urban and peri-urban agriculture and forestry may contribute to local food security, especially for some of the	Agents of change in Southern Africa are diverse, including the private sector and public-private partnerships as well as civil society. The large youth bulge and high levels of youth unemployment constitute both a challenge and opportunity for the sub-region; that is a labour pool for growth and a potential base for political transition towards stronger

			poverty and inequality; segregation; slum and informal settlement proliferation within city centres and on the urban peripheries; as well as inadequate infrastructure and service provision.	urban poor, enhance livelihoods	democratic practices.
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Source: Laros & Jones, (2014) adapted. Notes: (1) FDI - Foreign Direct Investment

The analysis of all the problems presented in Table 1 on the African continent shows that it is still difficult in most of these cases and urban regions to promote and develop smart cities. However, if we do not move towards good urban management and sustainability in all its dimensions, Africa's current problems will tend to increase and development will be a more distant target.

1.2.Smart cities

The topic of smart cities brings together a large number of previous studies, including research directed at conceptual, analytical, and overarching levels, as well as research on specific technologies and their potentials and opportunities. (Bibri & Krogstie, 2017). Indeed, recent years have witnessed a great interest and a proliferation of academic publications on the topic of smart cities. This reflects the magnitude and diversity of research within the field according these last authors. (Bibri & Krogstie, 2017).

Smart cities are known not only from a technological point of view, but also for its economic, social and environmental sustainability. Smart cities aim to mobilize all knowledge centers and information and communication technologies (ICT) into innovation hubs in order to strengthen the socio-economic around the world (Dos-Santos, 2016).

The focus of smart cities has been and still is seen only from the point of view of ICT, which is a reductive vision for both the cities of the world in general and those of the African continent in particular that present major challenges in the field sustainable development.

1.3.Sustainable urban areas and sustainability

The notion of sustainability appears from long decades on scientific, political and managerial debate and involve all the societal actors. This concept applied to the rural or urban, at the micro or macro level, always involves the traditional dimensions of the sustainability, namely, economics, social and environmental component. Lately, this concept has become even more comprehensive and still includes the political component, as it has become a global goal and is currently a concern of international Organizations, namely the United Nations (UN); through the Millennium Development Goals) (Dos-Santos and Diz, 2019; Kumar et al., 2016) the FAO, as well as, governments at the country level.

The notion of urban sustainability was born from the realization that the predominant paradigm of social, economic, environmental, political and urban development was oblivious to the risks of and triggering environmental crises as well as to the implications of and worsening social decays, causing ecological and social deprivation and imperiling future life (Bibri & Krogstie, 2017). Sustainability epitomizes a holistic, long-term perspective based on the premise of consciously and incessantly going with the grain of nature and providing the conditions for deploying the frameworks necessary for its operationalization and its translation into practices in a more intelligent way in order to reach a sustainable society (Bibri & Krogstie, 2017). In the light of global commitments to achieving sustainable development goals, we have to see how the corporate interest to enhance economic prosperity is in conflict with the other two pillars such as environmental and social equity (Kummitha & Crutzen, 2017).

As a societal thinking paradigm, sustainability is espoused to guide and configure societal development in its prominent spheres, including science and innovation, technology, economy, urban planning, policy, politics, and institutionalization (Bibri & Krogstie, 2017).

1.4.Sustainable Urban Development and Sustainable Cities

With more than half of the world's population living in urban areas and about 41% in Africa, this is also where the use of energy, land, food, and other resources and logistic is increasingly originating (Höjer, Wangel, 2015; Dos-Santos, 2016). The ongoing concentration of the global population in urban areas thus implies that these are increasingly important when it comes to addressing issues of sustainable development, that imply that sustainable urban development has become a prerequisite for sustainable development according to Höjer, Wangel, (2015).

Combining sustainable development and urbanization issues, the area of sustainable cities has become of interest for research, education, policy making and businesses—an interest that has been manifested in all parts of society. In academia it can be seen in scientific journals, university education, research programs and university departments specifically devoted to addressing sustainable urban development. (Höjer, Wangel, 2015).

Despite this interest by the themes smart cities and sustainable development, the research developed is still in the beginning, being addressed in a partial way and even with some contradictions. These contradictions begin with the concepts of smart cities and sustainability.

According to Vanolo (2014), smart city is an efficient, technologically advanced, green and socially inclusive city. Follow that line the focus of smart city is the technology at the forefront of generating solutions for ecological, societal, economic, and politics challenges (Yigitcanlar and Kamruzzaman, 2018). In spite of this, that point of view has been criticized by various authors for being based almost exclusively on Information and Communication Technologies (ICT) information technologies as a way of solving the majority of problems of cities. In fact, ICT is nowadays present in our life in all the domains. Therefore, the immediate association between smart cities and ICT is reductionist. Follow Höjer and Wangel (2015), most of the ICT included in the smart city concepts already exist. According to these authors the novelty is thus not so much the individual technologies, products or services but the interconnection and the synchronization of these and the systems they include, so that they work in concerted and coordinated action in all the domains in a city (urbanization; health; transport; communication, education; commerce and e-commerce, etc.). In urban or in rural environments, the use of ICT

must be managed, mostly based on *big data* and *artificial intelligence*, being part of our daily lives and presenting the best solutions in various domains and are not exclusive from smart cities (Dos Santos, 2018). The major complexity occurs because nowadays the majority or near of the population lives in urban areas.

1.5. The challenge for African urban areas toward smart and sustainable cities

The results presented for the different urban/rural regions of Africa show that despite the diversity of social, economic, environmental and political problems, there is a matrix, practically common in all regions of the African continent. This common problem involves serious social, economic and environmental risks stemming from the phenomena of climate change, and safety and food subsistence may be even more important, which will further widen the development gap and long distance of smart cities and sustainable development. Programs of technology transfer and development aid by developed countries will therefore play a key role in this region.

1.6. Conclusion and discussion

The main results highlight confirm the importance of minimizing the problems of sustainable development on the African continent, otherwise the developed world will suffer the impacts in the future. It is also clear that the development of smart cities, not being a mirage in Africa, needs a long way in the direction of sustainable development. In other words, prior to the development of smart cities, it will be necessary in Africa to create an environment that provides development in a sustainable way. Only in this way, reducing and minimizing social, economic and environmental gaps will it be possible in the future to build smart and sustainable cities.

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