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Sustainable city initiatives in Africa and comparison with the OURSUS approach

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ASC Working Paper 135 / 2016

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Paper for the IGU Congress in Beijing 22 August 2016

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Lagos Cairo Kinshasa Johannesburg

Pictures on p1:

Lagos: http://howng.com/6-reasons-why-lagos-is-the-worlds-craziest-city-3/

Cairo: https://nl.wikipedia.org/wiki/Ca%C3%AFro_(stad)

Kinshasa: https://markduerksen.files.wordpress.com/2013/09/screen-shot-2013-09-21-at-10-06-05-pm.png

Johannesburg: www.Sowetotours.co.za

Abstract

OURSUS (Our Sustainable Cities) is a flagship IGU project. The OURSUS approach and findings will be discussed in two sessions during the 33rd International Geographical Congress in Beijing: one session about 'Chinese and International Experiences' and one about 'The Way Forward'. This paper contributes to the first session: exploring international experiences. It examines the evidence in Africa regarding the intentions of municipalities and their leadership to develop more sustainable cities, and to mobilise business and popular support for more sustainable futures in a continent that is likely to have the fastest urbanization trends in the decades ahead. The paper also compares the approaches of various sustainable city networks in Africa with the OURSUS approach, and it looks at the input of geographers.

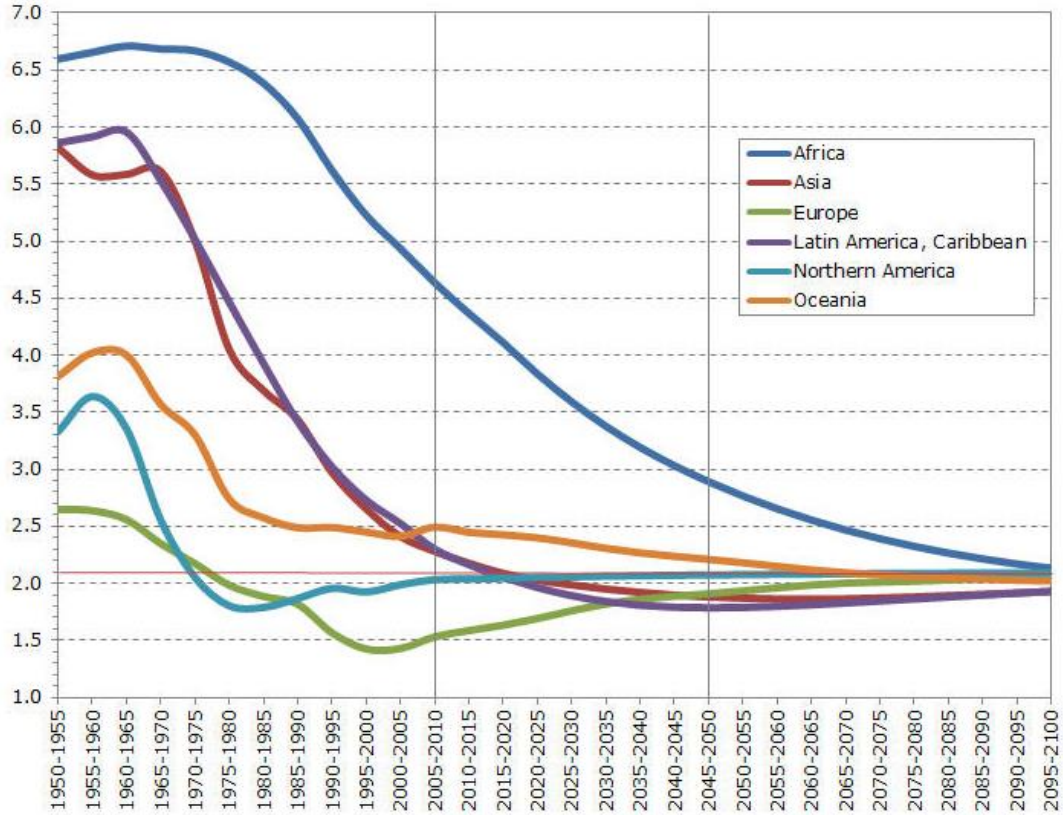
Key words: sustainable cities, intentions, sustainable city initiatives, Africa, networks, geography, geographers, OURSUS

"The challenge of achieving sustainable urban development will be particularly formidable in Africa". Cohen, 2006, p. 63.

1. Africa's Urbanisation

Many people still regard Africa as a rural continent, with few and relatively unimportant megacities, compared to Asia, the Americas and Europe. In the leading textbooks about urban geography, Africa receives limited attention (see e.g. Kaplan & Holloway 2014; Knox & McCarthy 2012; Hall & Barrett 2012; Pacione 2009). This is changing, though, because Africa is changing, and it is changing rapidly. The world's demographic transition has almost been completed, with the big exception of Africa. See figure 1.

Figure 1: The world's demographic transition (1950-2100), with Africa lagging behind



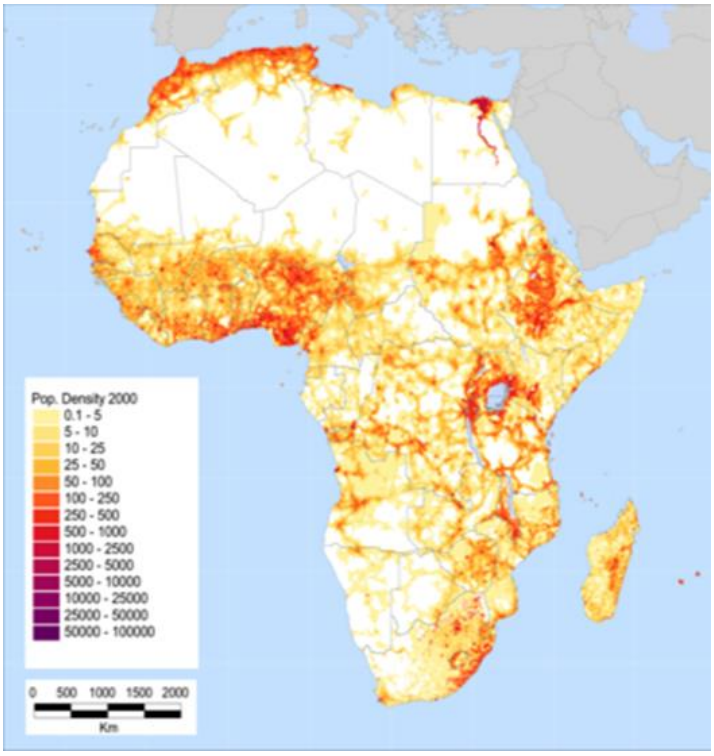
Source: http://explainingprogress.com/wp-content/uploads/2013/05/UN-Estimates-and-Forecasts-Total-fertility-by-major-regions-1950-2100-children-per-woman-UN.png

In the 1950s, most of the world's major regions had fertility levels of more than five (an average woman would have five live-born children during her lifetime), with Africa leading with more than 6.5 children per woman. But Oceania, North America and Europe also had fertility levels that were higher than the replacement rate (set at 2.1). Fertility levels for Europe and North America dropped below this replacement rate during the 1970s, while Asia and Latin America and the Caribbean started a steep descent of fertility levels after 1965. Both continents (on average) are expected to have reached replacement level (and hence to have more or less completed their demographic transition) in 2015. Africa's descent started much later (only in the 1980s, on average) and demographers expect that Africa will not complete its demographic transition until 2100. In the meantime, Africa's population has grown from 300 million in 1960 to more than 1.2 billion in 2015, and it is expected to grow to between 3.3 and 4.4 billion people by 2100. High fertility levels play a major role here, but improved healthcare, food availability and hygiene, which together result in much higher life expectancy figures, are also influential. A rapidly growing, relatively very young, and potentially very vibrant African population will become a major demographic factor in the world.

In the year 1600, Africa's relative population importance was the same as Europe's: c. 16% (100-150 million people). In 1900, Europe's demographic importance had risen to 25% while Africa's demographic importance had dwindled to a mere 5%. In 2015, Africa surpassed Europe by 60%. The demographic expectation is that Africa will have close to 40% of world population in 2100, probably more than Asia, and more than five times the figure for Europe.

Of course, there are major differences within Africa. Figure 2 gives the population densities for the continent as a whole in 2000. While the Sahara and major parts of Southwest Africa are almost unpopulated, high population densities exist in the coastal areas of Northwest Africa and in the Nile Delta, in most of coastal West Africa, and particularly in coastal Nigeria, but also in the Nigeria-Niger border areas, around Lake Victoria and Lake Nyasa, in the Ethiopian highlands, around Khartoum in Sudan, and in the Southeast African coastal area. Most of these densely populated areas in Africa have a long history of intensive human utilisation, but recently their population numbers have exploded, and they are set to explode even more.

Figure 2: Africa: Population densities in 2000

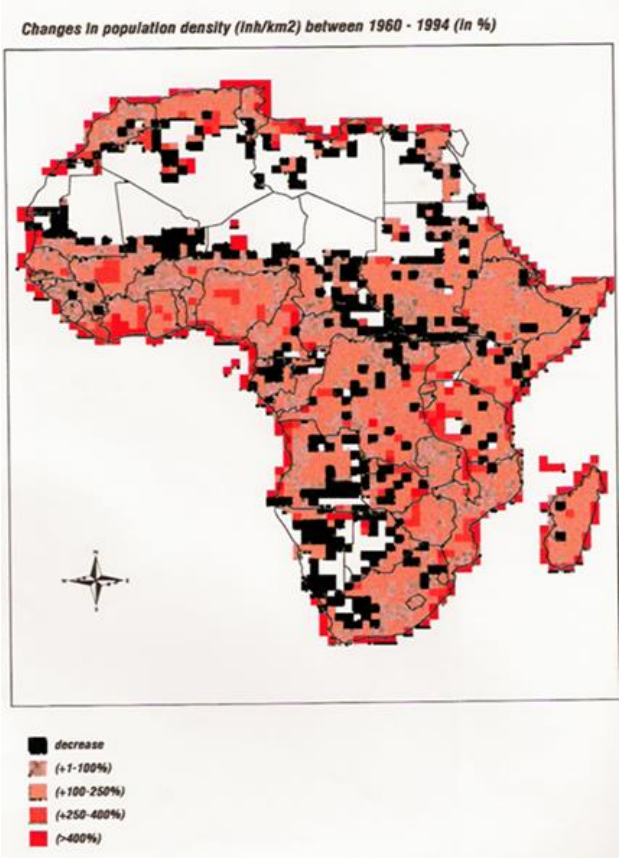


Source: https://inafu6212-001-2012-3.wikischolars.columbia.edu/Telemedicine+-+Nigeria+case+study

It is also clear that within Africa there has been a major population movement towards the coastal areas, both urban and rural. Every drought crisis in Africa's drylands produces another wave of migration towards the more humid (or very humid) coastal regions of the continent. In research about the impact of climate change in the West-African drylands, we have compared

the population densities in 1960 and 1995 for Africa as a whole and found a more than fourfold increase in most of Africa's coastal zones during these 35 years. See figure 3.

Figure 3: Africa's population dynamics



Source: Dietz & Veldhuizen 2004, p. 462 (and 80; deep red is >400% growth between 1960 and 1995).

Population densities are not the same as urbanisation figures. Many of Africa's densely populated areas in the past were overwhelmingly rural and agricultural. Africa used to have a very limited urban population. In 1600 and even as late as 1900, the continent was indeed very rural, and urban areas were mostly related to European colonial projects, with harbour, transport, and administrative functions mainly for a European expatriate population and their linkages to the colonial motherlands. In 1960, when many African countries got their political Independence, the numbers had risen (and, in the 1950s, many indigenous people had begun to move to cities – mostly to live in the slums or to work as domestic servants in the homes of their European masters), but, relatively speaking, it was still a small minority. This changed rapidly between 1960 and 2015 and currently 45% of Africa's total population lives in urban areas.[1]

[1] The World Bank still uses 'Sub-Saharan Africa' (SSA) as an indication for relevant macro-regions. The urbanisation figures for SSA in 1960 are given as 15% and as 38% for 2015. For the Middle East and North Africa it is 35% and 64%, respectively, http://data.worldbank.org/topic/urban-development?locations=ZG .

After 1960, Africa's newly independent regimes had to cope with an enormous increase in urban populations. An increase of 415 million urban people in just 55 years created a daunting task in terms of catering for housing, water, energy, and food demands as well as waste and hygiene management (and education, healthcare and much more...). Moreover, it was an increasingly difficult task to keep the young, dynamic (and generally well informed, and impatient) urban population aligned with a regime's political survival. Demographers (and I) expect the urban population to surpass the 50% level soon, and by 2050 there may be more than 1.2 billion urbanites in Africa, and in 2100 maybe more than 2.4 billion. This would mean an increase in just 35 years of at least another 720 million urban people; and an additional 1.2 billion or more between 2050 and 2100. *See Table 1.*

Table 1: Africa's urban population in relative and absolute terms; 1600-2100

Year	urban %	urban people
1600	10	10m
1900	15	15m
1960	20	65m
2015	45	480m
2050	60	1200 - 1440m
2100	70	2400 - 3100m

Sources: http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS
Estimates 2050 and 2100 for Africa: http://www.demographics.at/Growth-Decline/images/PPP2015_Africa_Tot-Pop_1950-2100.gif
For 1600 and 1900 also see: http://uaps2007.princeton.edu/papers/70296.

Also in global terms Africa's cities are becoming relatively more important. In a comparative study, Cohen presents interesting data that is summarized in *Table 2* (Cohen, 2003; p70, 71 and 75). Cohen[2] noted with concern that, around 2000, many urban Africans lacked piped water, flush toilets and electricity in their urban homes, and particularly in the smaller urban centres: in Sub-Sahara Africa 50% of the urban households lacked these amenities in cities smaller than 100,000 inhabitants; 40% in cities between 100,000 and 500,000 inhabitants; 35% in cities of half a million to a million; and 22% in cities beyond one million. This is in contrast to, for instance, North Africa (where it was only 5%, 2%, 4% and 6%, respectively) and, in fact, all other parts of the world, including Asia, where these figures were all much lower than in Africa. Cohen writes (Ibid. p. 75): "There is an urgent need to build and support the capacity of local governments to manage the environmental and social service problems that accompany rapid urban growth". He adds: "An essential feature of current African urbanization, is that unlike cities in much of Asia and Latin America, urbanization appears to have become decoupled from

[2] Nigel Barnet (Barney) Cohen [1959-2015] was the former Chief of the Population Studies Branch of the United Nations in New York.

economic development. The vast majority of African cities are economically marginalized in the new global economy and most African cities are growing despite poor macroeconomic performance and without significant direct foreign investment" (Ibid. p. 77). This was written in the mid-2000s, and based on statistics from c. 2000, when it was not yet clear that Africa was about to enter an era of rapid development, which would last until 2015, and in which many (though not all) African cities became engines of rapid economic growth and of social vitality. At the same time, it is true – and it will remain true for many decades – that managing African cities, also in terms of sustainability, is one of the major challenges of the twenty-first century.

Table 2: Africa's cities in world perspective

	No. of cities >1million In Africa	% of world cities >1m	Total urban population in Africa	African urban population as % of world	% of African population in cities
1950	2	3	33	5	15
1975	8	4	103	7	25
2000	35	9	295	10	37
2015 (pred.)	63	12			
2030 (pred.			748	15	54

Source: Cohen 2006, pp 70, 71 and 75.

In 2012, the African Studies Centre in Leiden produced a poster map about 'Africa; From a Continent of States to a Continent of Cities' (Dietz, Ton et al. 2012). Here, I will give an update of this poster map for all cities (urban agglomerations) with currently more than two million inhabitants, based on http://www.citypopulation.de/world/Agglomerations.html.[3] *See table 3.* Other sources use other definitions of urban areas and, consequently, arrive at different, often lower figures. The most important in this regard are the statistical sections in the UN-Habitat 'State of the African City' Reports (see e.g. the 2014 report), and the World Bank data on urbanisation, the annual World Urbanization Prospect reports: https://esa.un.org/unpd/wup/.

[3] According to this source: "Urban agglomerations include a central city and neighboring places mostly linked by (more or less) continuously built-up areas. Some agglomerations have more than one central city". Compared to the 2012 data from the same source, two towns in Somalia (Mogadishu and Hargeisa) dropped below the two-million threshold used here, while Pretoria had become part of Greater Johannesburg. Bamako, Maputo, Antananarivo, Lusaka, Yaoundé, Ouagadougou, Conakry, and Port Harcourt had all crossed the two-million threshold in those few years.

Table 3: Africa's major urban agglomerations in 2016

Urban agglomeration	Country	Current population in millions (1.1.2016)
Lagos	Nigeria	17.1
Cairo	Egypt	16.8
Johannesburg	South Africa	13.4
Kinshasa	DR Congo	10.6
Luanda	Angola	6.8
Khartoum	Sudan	5.6
Dar es Salaam	Tanzania	5.3
Nairobi	Kenya	5.2
Alexandria	Egypt	5.2
Abidjan	Côte d'Ivoire	5.1
Accra	Ghana	4.6
Casablanca	Morocco	4.2
Cape Town	South Africa	4.1
Kano	Nigeria	4.1
Algiers	Algeria	3.7
Addis Ababa	Ethiopia	3.5
Dakar	Senegal	3.3
Durban	South Africa	3.2
Ibadan	Nigeria	3.2
Kampala	Uganda	3.0
Bamako	Mali	3.0
Abuja	Nigeria	2.8
Douala	Cameroon	2.8
Yaoundé	Cameroon	2.7
Kumasi	Ghana	2.7
Tunis	Tunisia	2.5
Harare	Zimbabwe	2.3
Lusaka	Zambia	2.3
Antananarivo	Madagascar	2.2
Conakry	Guinée	2.2
Maputo	Mozambique	2.2
Ouagadougou	Burkina Faso	2.1
Port Harcourt	Nigeria	2.1

Source: http://www.citypopulation.de/world/Agglomerations.html .

In total, in early 2016, Africa had 32 urban agglomerations with more than two million inhabitants[4]. *See table 4.* Of Africa's current 54 states, 36 have at least one urban agglomeration with more than one million inhabitants and the total number of African multi-million urban areas is 61.[5] Almost 200 million of Africa's 1.2 billion people currently live in these multi-million agglomerations, and another 340 million are estimated to live in other (smaller) urban centres.

Table 4: Africa's countries and their multi-million cities

Country	Number of urban agglomerations with > 1 million inhabitants	Urban agglomerations with more than two million inhabitants	Urban agglomerations with between one and two million inhabitants
Nigeria	10	Lagos, Kano, Ibadan, Abuja, Port Harcourt	Kaduna, Benin City, Maiduguri, Onitsha, Aba
Morocco	5	Casablanca	Rabat, Fez, Marrakech, Agadir
South Africa	4	Johannesburg, Cape Town, Durban	Port Elizabeth
Congo DR	3	Kinshasa	Lubumbashi, Mbuji Maji
Algeria	2	Algiers	Oran
Cameroon	2	Douala, Yaoundé	
Egypt	2	Cairo, Alexandria	
Ghana	2	Accra, Kumasi	
Kenya	2	Nairobi	Mombasa
Tunisia	2	Tunis	Sousse
Angola	1	Luanda	
Benin	1		Cotonou
Burkina Faso	1	Ouagadougou	
Central African Republic	1		Bangui
Chad	1		Ndjamena
Congo Rep.	1		Brazzaville
Côte d'Ivoire	1	Abidjan	
Ethiopia	1	Addis Ababa	
Guinée	1	Conakry	
Liberia	1		Monrovia
Libya	1		Tripoli

[4] The world as a whole had 259 urban agglomerations with more than two million inhabitants; so Africa's proportion is currently 13%.
[5] The world as a whole: 538; Africa: 11%.

Madagascar	1	Antananarivo	
Malawi	1		Lilongwe
Mali	1	Bamako	
Mauritania	1		Nouakchott
Mozambique	1	Maputo	
Niger	1		Niamey
Rwanda	1		Kigali
Senegal	1	Dakar	
Sierra Leone	1		Freetown
Somalia	1		Mogadishu
Sudan	1	Khartoum	
Tanzania	1	Dar es Salaam	
Togo	1		Lomé
Uganda	1	Kampala	
Zambia	1	Lusaka	
Zimbabwe	1	Harare	
None (yet): Botswana, Burundi, Comoros, Djibouti, Equatorial Guinea, Eritrea, Gabon, Gambia, Guinea Bissao, Lesotho, Mauritius, Namibia, São Tomé & Principe, Seychelles, South Sudan, Swaziland			

Source: http://www.citypopulation.de/world/Agglomerations.html.

Predictions about Africa's urban future are, of course, tricky. It seems realistic to predict major urban growth figures in most of Africa, with a considerable growth for its existing megacities, and there is the prospect of many more to come. I have calculated the likely population numbers for the six largest urban zones in West Africa (see Lange, Dietz & Rau, 2016). I used the same source as in *Table 3* for current population numbers, and additional sources for population predictions and I have assumed that the predicted general population increase will be surpassed by 10% for urban growth.[6] The figures for 2050 show a dramatic predicted increase. The figures become even more stunning if one adds the population data for 1960, which I have done for this paper.[7] *See Table 5.*

[6] For sources see: http://www.ascleiden.nl/sites/default/files/scoping_report_final_0.pdf, p. 39.

[7] For Lagos: http://books.mongabay.com/population_estimates/1960/Lagos-Nigeria.html ; for Abidjan: Appessikka 2003, figure for 1965; for Accra: http://www.ghana.gov.gh/index.php/about-ghana/regions/greater-accra; for Dakar: http://www.nap.edu/read/4900/chapter/5#31; for Bamako: http://www.newworldencyclopedia.org/entry/Bamako; and for Ouagadougou: https://fr.wikipedia.org/wiki/Ouagadougou (it gives: 60,000 inhabitants in 1960).

Table 5: Six cities in West Africa and their populations in 1960, 2016 and 2050 (predicted)[8]

	Million people		
City	ca 1960	2016	2050
Lagos	0.8	17.1	43.8
Abidjan	0.3	5.1	12.8
Accra	0.5	4.6	9.9
Dakar	0.4	3.3	9.2
Bamako	0.2	3.0	9.0
Ouagadougou	0.1	2.1	5.8

To end this section on demographic facts about Africa's urban areas, I will present a categorization of the 61 current major urban areas in Africa by looking at their political and economic functions (capital cities and harbour cities), and their locational characteristics: coastal or inland, in drylands or more humid climatological conditions. Environmental conditions may determine the perceptions of sustainability: coastal areas are prone to storms, flooding and sea-level rise;[9] drylands can experience droughts and water stress. Political and economic conditions may determine the urge of national governments to deal with popular concerns, including living conditions. Such concerns are related to sustainability issues. *See tables 6 and 7.*

It is worth noting that there is some controversy in the scientific literature about the past, present and future urban growth figures for Africa. Many authors doubt the accuracy of population numbers, and some doubt the predictions for (further) urban growth. Even if rural-urban migration continues, urban fertility levels will probably be lower than national averages, due to the expectation that demographic transition will be more rapid in cities compared to the countryside. On the other hand, urban living conditions may result in higher life expectancy figures, although that also depends on urban health, hygiene and food conditions compared to

[8] For 1960, we use the figures for the city proper; for 2016 and 2050 the data for the agglomeration; however, this is unlikely to have added many people in 1960. Data provided by the African Development Bank in 2014 (p. 9, based on UN-Habitat data) give the following (predicted) figures for urban inhabitants in 2015 and 2025 for people in what they have defined as the urban areas: Lagos: from 12.4 to 15.8 million; Abidjan from 4.8 to 6.3 million; Accra from 2.7 to 3.5 million; Dakar from 3.3 to 4.3 million. No figures have been included for Bamako and Ouagadougou in this source. It is worth noting that the African Development Bank predicts the highest urban growth figures between 2010 and 2025 for Dar es Salaam (+85%), Nairobi (+77%), Kinshasa (+72%), Luanda (+69%) and Addis Ababa (+62%), followed by Abidjan (+53%), Dakar (+51%) and Lagos (+50%).

[9] For an assessment of Africa's cities most prone to the risks of sea level rise see: UN-Habitat 2014, p. 45: "African cities at Risk due to Sea-level Rise".

the rural areas.[10] It is certainly true that African urbanisation is not a linear process. In the 1980s and 1990s, some countries even experienced de-urbanisation (like Zambia, Côte d'Ivoire, Mali and the Central African Republic, see UN-Habitat 2014, statistics section). And UN-Habitat shows that Africa's urban growth percentages per annum have been falling steadily since 1960: from an average of 4.7% per year in the 1950-1980 period to 3.6% in the 1980-2010 period (Ibid.). However, if we compare these figures with the average annual population growth for these two periods (2.4% and 2.5%, respectively; African Development Bank 2014, p. 7) the urban growth figures have been considerably higher. Moreover, even if the demographic transition in Africa continues, and urban annual growth figures are predicted to fall from the current 3.2% via 3% in 2020-2030, 2.8% in 2030-2040 to 2.5% in 2040-2050 (UN-Habitat, 2014), these figures are higher than average continental growth figures as a whole. It is therefore safe to predict increasing urbanisation levels in Africa in the twenty-first century.

Table 6: Categorisation of Africa's multi-million cities

	Capital city and harbour	Capital city	Harbour	Other	Total no.
Coastal and Humid	Accra, Cotonou, Conakry, Monrovia, Freetown, Lomé		Lagos, Port Harcourt, Durban, Douala, Abidjan,		11
Coastal and Drylands^	Rabat, Algiers, Tunis, Luanda, Tripoli, Nouakchott, Maputo, Dakar, Mogadishu, Dar es Salaam		Casablanca, Agadir, Cape Town, Port Elizabeth, Oran, Alexandria, Mombasa, Sousse		18
Inland and Drylands^	Cairo, Khartoum	Johannesburg/ Pretoria, Nairobi, Ouagadougou , Ndjamena, Addis Ababa, Lilongwe,		Kano, Maiduguri, Fez, Marrakech	16

[10] According to the African Development Bank (2014, p. 7), Africa's average child mortality (<5years) has declined from 240/1000 in 1965 to 105/1000 in 2010. This is still very high for world standards, but, of course, much lower than half a century ago. It should be noted that all these figures refer to Africa as a whole, including North Africa.

		Bamako, Niamey, Lusaka, Harare			
Inland and Humid	Kinshasa, Brazzaville, Kampala	Abuja, Yaoundé, Bangui, Antananarivo, Kigali		Ibadan, Benin City, Onitsha, Aba, Kaduna, Lubumbashi, Mbuji Maji, Kumasi	16
Total no.	21	15	13	12	61

^Drylands: arid, semi-arid or sub-humid conditions, see Dietz et al. 2004, pp. 451-452: P/ETP<0.75. [Nairobi East is part of Kenya's drylands; Nairobi West has more humid conditions].

Table 7: Summary table of the categorisation of African multi-million cities

	Capital and Harbour	Capital	Harbour	Other	Total
Coastal, humid	6		5		11
Coastal, dry	10		8		18
Inland, dry	2	10		4	16
Inland, humid	3	5		8	16
Total	21	15	13	12	61

2. Sustainable City Initiatives in Africa

Wikipedia on Sustainable Cities and Africa

Wikipedia's lemma about "sustainable cities"[11] starts with the following introduction: "A sustainable city, or eco-city (also "ecocity") is a city designed with consideration of environmental impact, inhabited by people dedicated to minimization of required inputs of energy, water and food, and waste output of heat, air pollution - CO2, methane, and water pollution. Richard Register first coined the term "ecocity" in his 1987 book, Ecocity Berkeley: Building Cities for a Healthy Future [..][12] Other leading figures who envisioned the sustainable city are architect Paul F Downton, who later founded the company Ecopolis Pty Ltd, and authors

[11] https://en.wikipedia.org/wiki/Sustainable_city; this is the English-language version. The French-language version (https://fr.wikipedia.org/wiki/Ville_durable) does not specify any example in Africa.
[12] Register, Richard, 1987, Ecocity Berkeley: Building Cities for a Healthy Future. North Atlantic Books.

Timothy Beatley and Steffen Lehmann [..][13], who have written extensively on the subject. The field of industrial ecology is sometimes used in planning these cities.

There remains no completely agreed upon definition for what a sustainable city should be or completely agreed upon paradigm for what components should be included. [..] Generally, developmental experts agree that a sustainable city should meet the needs of the present without sacrificing the ability of future generations to meet their own needs. The ambiguity within this idea leads to a great deal of variation in terms of how cities carry out their attempts to become sustainable.[..][14]

Ideally, a sustainable city creates an enduring way of life across the four domains of ecology, economics, politics and culture.[..] However, minimally a sustainable city should firstly be able to feed itself with a sustainable reliance on the surrounding countryside. Secondly, it should be able to power itself with renewable sources of energy. The crux of this is to create the smallest possible ecological footprint, and to produce the lowest quantity of pollution possible, to efficiently use land; compost used materials, recycle it or convert waste-to-energy, and thus the city's overall contribution to climate change will be minimal, if such practices are adhered to.

It is estimated that over 50%[..] of the world's population now lives in cities and urban areas. These large communities provide both challenges and opportunities for environmentally-conscious developers, and there are distinct advantages to further defining and working towards the goals of sustainable cities. Humans are social creatures and thrive in urban spaces that foster social connections. Because of this, a shift to more dense, urban living would provide an outlet for social interaction and conditions under which humans can prosper.

Contrary to common belief, urban systems can be more environmentally sustainable than rural or suburban living. With people and resource located so close to one another it is possible to save energy for transportation and mass transit systems, and resources such as food. Finally, cities benefit the economy by locating human capital in one relatively small geographic area where ideas can be generated."

Wikipedia then continues by giving many examples. For Africa only two cases are briefly mentioned: a city in Cameroon ("Bafut, is a town and traditional kingdom which is working towards becoming an eco-city by 2020, through the Bafut Council Eco-city Project") and a city in Kenya ("Hacienda - Mombasa is the largest development of eco-friendly residential properties in East Africa; construction is currently ongoing, and it will eventually be one of Africa's first self-sustaining estates"). But that's it. And there is so much more!.

[13] Lehmann, S., 2010, Green urbanism: formulating a series of holistic principles. S.A.P.I.EN.S. 3 (2).
[14] Joss, S. ,2015, Sustainable Cities: Governing for Urban Innovation. London: Palgrave Macmillan.

The EIU/Siemens project: African Green City Index

One of the most informative overviews of sustainable city initiatives in Africa is the 2010 African Green City Index, a report by the Economist Intelligence Unit (supported by Siemens[15]). Following comparable assessments for cities in Europe, Latin America, Asia, the USA and Canada, they carried out an extensive survey in 2011 for fifteen major African cities, and they tried to apply eight different main assessment criteria, with together 25 sub-criteria (EIU 2010, p. 31; *see Table 8*). Some cities could not be included due to a lack of data (Kinshasa, Khartoum, and Algiers were explicitly mentioned); in fact, data availability and reliability was a major problem in almost all cities.

Table 8: EIU criteria for the African Green City Index

Issues (main criteria)	Sub-criteria
Energy and CO2	*Percentage of households with access to electricity. *Electricity consumption per capita *CO2 emissions from electricity *Measure of a city's efforts to reduce carbon emissions
Land Use	*Population density *Percentage of population living in informal settlements * Green spaces per capita (sum of all public parks, recreation areas, greenways) *Land Use Policy
Transport	*Public transport network: Length of superior transport network (bus rapid transit, trams, light rail and subway), and Length of mass transport network. *Urban mass transport policy *Congestion reduction policy
Waste	*Total annual volume of waste generated by the city *Waste collection and disposal policy *Waste recycling and re-use policy
Water	*Access to potable water

[15] Ericsson's networked Society City Index also assesses environmental performance, as part of their 'triple bottom line' (social, economic and environmental criteria of sustainability), next to 'ICT maturity' (ICT infrastructure, affordability and usage). However, in total only 41 cities are part of this exercise, and only two of those are in Africa: Johannesburg and Lagos; so we do not include their assessments here. See https://www.ericsson.com/assets/local/networked-society/reports/city-index/2016-networked-society-city-index.pdf.

	*Water consumption per capita *Water system leakages *Water quality policy *Water sustainability policy
Sanitation	*Population with access to improved sanitation (Share of the total population either with sanitation connections to sewerage, or access to on-site sources). *Sanitation policy: Measure of a city's efforts to reduce pollution associated with inadequate sanitation
Air Quality	* Clean air policy. Measure of a city's efforts to reduce air pollution
Environmental Governance	* Environmental management. Measure of the extensiveness of environmental management undertaken by the city. * Environmental monitoring. Measure of the city's efforts to monitor its environmental performance. *Public participation. Measure of the city's efforts to involve the public in environmental decision-making.

For the fifteen major African cities selected, the results of the assessment of environmental performance show major differences. The assessment was based on a combination of EIU judgements, Siemens judgements, and judgements by a panel of six external independent experts, which, however, did not include a single African (see EIU 2011, p. 4). *Table 9* gives the details; combining scores on a five-point scale (from ++ to --) with major and minor highlights mentioned in the text (H and h). Highlights show the most important recent initiatives by city governments in any of the eight categories of major issues.

Table 9: Assessment of environmental performance in 15 major African Cities according to EIU/Siemens (EIU 2011)

City	Energy and CO2	Land Use	Transport	Waste	Water	Sanitation	Air Quality	Env. Governance	Total[16]
Cape Town	-H	++	+	+h	+h	0	+	+	+/6
Durban	-	+	+	+h	+h	+	+	+H	+/6
Johannesburg	+	+H	+h	0	0	0	+	+	+/5
Casablanca	+	+h	0	0	+	+	+	0	+/5
Accra	+h	0	-	0	0H	+	+	++h	+/4
Tunis	-	0h	+h	+	0	+	+	0	+/3
Lagos	++h	-	0h	+H	0	0	0	0	0/2
Addis Ababa	++	+h	-	0	+	0	-	-	0/1
Alexandria	0	-	0	++h	-H	0	0	0	0/0
Cairo	0	0	+H	-	0h	0	0	0	0/0
Pretoria	-h	0	+h	--	0	-	+	+	0/-1
Nairobi	-	0h	-	0	0	0	-	-h	-/-4
Dar es Salaam	0	-h	-	--	0H	--	-	-	--/-8
Maputo	-	-	-	0h	-H	--	-	-h	--/-8
Luanda	0	--	--	0	--	0	-	--h	-/-9
Average	+1	0	-1	+1	0	-1	+2	0	0/+2

Three South African cities lead the assessment, sharing eight of the 24 highlighted examples between them, including attention for Cape Town's energy policy, Durban's overall environmental governance, and Johannesburg's efforts to improve the city's land use in a sustainable way. Two North African cities (Casablanca and Tunis) follow, as well as Accra in Ghana. Indeed, Accra gets a major highlight for its water and sanitation approaches, and a minor one for environmental governance. These six cities received a positive overall assessment. Five African cities receive an average judgement, one in West Africa (Lagos, with a special highlight for its waste management approaches), two in Egypt (Cairo, with a special highlight for its transport approach; and Alexandria, with a special highlight for water and sanitation policies), one in the Horn of Africa (Addis Ababa), and one in South Africa (Pretoria/Tshwane). Four cities were given an overall negative assessment (Nairobi and Luanda) or even an overall very negative assessment (Dar es Salaam and Maputo). For Luanda, Nairobi and Maputo the report highlights some attempts to develop better environmental governance and for Dar es Salaam and Maputo minor highlights are presented about water and sanitation initiatives.

[16] Total gives the assessment by EIU/Siemens (++ to --) and my own calculation of the number of plusses and minuses given; the cities appear in the order of best overall performance.

The scores on Energy and CO2 reflect the major differences in energy consumption and energy composition on the continent on the one hand, with South African cities surpassing all other cities by far (and mainly based on coal) and, on the other hand, the efforts to address the so-called carbon footprint, with Cape Town the continent's pioneer in this regard. However, examples given for Pretoria, Accra and Lagos (see http://lasepa.gov.ng) also show that there are serious attempts to develop solar and wind energy sources and to use the opportunities provided by carbon credit schemes to lower carbon emissions. Cape Town was the first African metropolis to launch an Integrated Environmental Policy in 2003; this was followed by the city's Climate Change Strategy in 2006, while the Cape Town Energy and Climate Change Plan was launched in 2011 (see www.capetown.gov.za; and City of Cape Town 2011). The city has also adopted an initiating role in respect of bringing African cities into the 'Compact of Mayors' (see http://www.compactofmayors.org/cities/) that was launched in June 2016. This initiative connects many African mayors (although not yet in North Africa) and its website is currently in development (see more later).

For Land Use, the main example that was highlighted dealt with the impressive attempts by the Johannesburg Development Agency (established in 2001) to combine urban renewal, inner city regeneration, transport improvements, and better security. This has attracted many private investors, and has been a catalyst for a number of public-private initiatives, particularly in the cultural economy (see http://www.jda.org.za/). Other land use improvement examples given are a major reforestation effort around Addis Ababa, as well as renewing the city's parks, urban agriculture initiatives in Casablanca, the green line project to establish a perimeter forest around the Nairobi National Park, and attempts to revitalise Swahili building styles in Dar es Salaam.

For Transport issues, Cairo was chosen as a city to highlight a combination of efforts to deal with heavy congestion problems on the city's roads. These efforts include a major extension of the metro system, changing buses to ones that use compressed natural gas,[17] and a carbon finance vehicle scrapping and recycling project to replace old taxis. Additional smaller highlights were given to the Johannesburg-Pretoria high-speed rail train, the light rail project in Tunis, together with the creation of rapid bus corridors, and finally Lagos's public-private partnership to develop rapid transit buses.

Waste management receives considerable attention. The major highlight is the way Lagos has transformed a dilapidated system into a much more effective approach, through a new Lagos Waste Management Authority (see http://lawma.gov.ng/) and its 'waste-to-wealth programme'. The report shows the importance of waste separation initiatives with Cape Town's

[17] This is a World Bank project, see: http://documents.worldbank.org/curated/en/847511468248657447/pdf/PID-Print-P149704-09-21-2014-1411299520747.pdf.

integrated waste exchange website,[18] and the City's Smart Living Handbook.[19] It also highlights how Maputo has introduced waste management in its informal settlements, Alexandria's new mercury waste processing plant, and the way that Durban has started to support informal waste pickers.[20]

Water and sanitation issues were judged separately, but the highlights combined these two aspects. Seven approaches were highlighted, including: Accra's strategic planning for urban water management and its 2030 vision for improved sanitation; Alexandria's attempts to reduce water intake from the River Nile ('Switch urban water'); a water education campaign in Dar es Salaam. Maputo's city-wide sanitation strategy received the most attention, but Cairo's rehabilitation project for water and sanitation in the old city, Casablanca's employing a private contractor to manage the city's water and sanitation, and Durban's sewage education programme were also mentioned.

Air pollution received some attention in the scores, but no cities were highlighted, despite the fact that air quality in a number of cities is a serious problem. In five of the 15 African cities that were compared, air quality was below world average levels, despite the fact that the major causes of bad air quality – industrial pollution and too many vehicles – remains a less prominent problem in Africa than elsewhere in the world.

Finally, the issue of environmental governance received (very) positive scores in Accra and in the three South African cities that were part of the comparison. Major highlights were given for Durban and a minor one for Accra, but also for three cities with (very) negative overall assessments that also had negative assessments for environmental governance (Luanda, Maputo and Nairobi). This gives cause for optimism. Durban's case is the most interesting one. The city introduced its comprehensive 'Imagine Durban' approach (see http://imaginedurban.org/Pages/Home.aspx), with much involvement from civil society and citizen organizations. It also formulated goals to become a zero waste city in 2020 and a carbon neutral city by 2050. For Accra, the report mentions the greenhouse gas emission identification efforts to prepare for a climate change mitigation policy. Despite its negative position in the assessment scores, Luanda's plans to start a national environmental database with attention for the city (supported by the African Development Bank) were highlighted, as was Maputo's environmental education programme in schools (with emphases on tree planting and beach cleaning approaches). Finally, the Nairobi government's development of an approach to enable citizens to follow their water and energy consumption online was highlighted.

[18] See https://www.capetown.gov.za/en/iwex/Pages/default.aspx.
[19] See https://www.capetown.gov.za/en/EnvironmentalResourceManagement/Documents/Smart_Living_Handbook_Eng_FULL%20VERSION_4thEd_2011-05.pdf.
[20] See http://www.durban.gov.za/City_Services/cleansing_solid_waste/Pages/default.aspx.

Institutional landscape of sustainable city collaborations/networks with African participation

The institutional 'landscape' for sustainable city collaboration in Africa, and with other parts of the world, is complicated[21]. One organisation that has been active since 1990 is the International Council for Local Environmental Initiatives (ECLEI). Since 2012, the ECLEI has had a separate Africa ICLEI Committee and there is an African office in Cape Town (the global headquarters are in Bonn), see http://africa.iclei.org/. ICLEI has been an active supporter of implementing Agenda 21 after the Earth Summit in Rio de Janeiro, in 1992. According to the latest figures, 74 municipalities in Africa, from 18 African countries, have joined this initiative and 19 of those are 'profiled members' (plus two local government associations) from twelve African countries. South Africa is by far the most active country in this network, with eight cities participating as profiled members, including Johannesburg, Durban, and Pretoria. Of the other megacities in Africa (> 2 million in habitants, see *Table 3*), Dakar and Addis Ababa are 'profiled members', and Cape Town, Dar es Salaam, Kampala, Lagos and Port Elizabeth/Nelson Mandela Bay are ordinary members.

Another relevant global network is the United Cities and Local Governments, Africa section (UCLG Africa) with its headquarters in Dakar (see http://www.afriquelocale.org/fr/ and http://www.afriquelocale.org/en/. Together with ICLEI they have become partners with UN-Habitat to produce the latest 'State of the African City' Report (UN-Habitat 2014; more on this later). Their website links to all relevant local government associations, for instance, the important South African Association of Local Government Authorities (http://www.salga.org.za/) or the Association des Maires du Sénégal (AMS) (http://www.afriquelocale.org/fr/ams). Their focus on sustainability is rather limited, however, with the exception of attention for informal settlements and their environmental problems in the 'Know Your City' Programme, with special attention for Ouagadougou and Lusaka.

A third network is the Rockefeller 100 Resilient Cities Network, with eleven participants from Africa, including a few surprising ones: Accra; Addis Ababa; Cape Town; Dakar; Durban; Enugu (in Nigeria); Kigali (in Rwanda); Lagos; Luxor (in Egypt); Nairobi; and Paynesville (in Liberia), see http://www.100resilientcities.org/. The Rockefeller Project website states: "As of May 2016, the 100 Resilient Cities network has reached 100 members. The new group of cities spans five continents and is diverse in both its makeup and the challenges the cities face. The 100 Resilient Cities Challenge is the application process by which cities join our network. 100RC selected a first group of 32 cities in December 2013, a second group of 35 in 2014, and its final round of

[21] Beyond the initiatives mentioned in the overview there are also some additional initiatives, for instance for the Middle East, which includes North Africa: http://www.carboun.com/; and Circles of Sustainability, with attention for Johannesburg (see http://www.circlesofsustainability.org/cities/johannesburg/);.

winners in May 2016 [including six new 'winners' from Africa]. Members of the 100 Resilient Cities team and a panel of expert judges reviewed over 1,000 applications from prospective cities. The judges looked for innovative mayors, a recent catalyst for change, a history of building partnerships, and an ability to work with a wide range of stakeholders". Africa is currently relatively well represented, after North America (with 31 member cities), Asia (with 20) and Europe (with 17).

A fourth network, also with a major input from the USA (funded by three philanthropic organisations), but with offices in New York, London, and Rio de Janeiro, is C40 (see: http://www.c40.org/), for so-called climate action cities. It is connected to the Clinton Climate Initiative. Nine African megacities are part of this network and there is a separate directorate for Africa within C40, directed by economist and 'environmental diplomat' Hastings Chikoko from Malawi. The participating African cities (so far) are: Cairo; Accra; Lagos; Addis Ababa; Nairobi; Dar es Salaam; Johannesburg; Durban; and Cape Town. Johannesburg plays a key role.[22]

Canada has launched its own support programme for sustainable cities (http://www.sustainablecities.net), based in Vancouver. It has three African partner cities: Dakar in Senegal, with three projects, Dar es Salaam with two projects, and Durban in South Africa, with two.[23] These form part of the so-called PLUS network for sustainability learning.[24]

A network established in Senegal (the Fondation Africaine pour la Gestion Urbaine) and based at IAGU in Dakar (see http://www.iagu.org/, and IAGU 2008) mainly deals with cities in French-speaking Africa, with projects in Dakar, Thiès and Pikine in Senegal, but also (with an emphasis on urban agriculture) in Burkina Faso (Bobo Dioulasso), Benin (Porto Novo), Rwanda (Kigali) and Mauritania (Nouakchott). With the exception of Dakar, no other African megacities (defined as an agglomeration with more than two million inhabitants) participate.

In preparation for the Climate Conference in Paris in 2015, much effort was mobilised to stimulate debates about Africa's sustainability issues (see https://afriquecroissanceverte.com/). Part of this was focused on the issues of urban sustainability (see

[22] See: http://www.jra.org.za/documents/pressrelease/8JanFACTSHEETFINAL.pdf.

[23] All three cities participate in the International youth internship programme since 2015, see http://sustainablecities.net/projects/international-youth-internship-program-iyip/. Dakar also completed a municipal nursery and vegetable gardens project (http://sustainablecities.net/projects/dakar-municipal-nursery-and-vegetable-gardens-project/ , and a composting project on Gorée Island (http://sustainablecities.net/projects/abusus-enim-multitudine-hominum/). Dar es Salaam also completed a community-based waste management project (http://sustainablecities.net/projects/dar-es-salaam-community-based-waste-management/). Durban completed an informal recyclers project (http://sustainablecities.net/projects/durban-informal-recylers-project/).

[24] http://www.mile.org.za/Be_Informed/Supporting_Learning_Networks/Documents/PlusNetwork_overview_Feb2009.pdf.

https://afriquecroissanceverte.com/2014/10/02/villes-durables-en-afrique-de-louest-7-exigences-pour-en-faire-une-realite/). According to this approach, the creation of '*villes durables*' (sustainable cities) requires a focus on seven elements: connect health and environment; stimulate resilience; emphasise popular participation (through '*sensibilisation*'); diversify finances to fund green initiatives; create stakeholder platforms ('*cerveau collectifs*'); and adapt and readjust for every city, connecting environmental, social, economic and cultural specificities.

In 2016, partly as a response to the Climate Conference in Paris, many mayors around the world formed the Compact of Mayors: http://www.compactofmayors.org/. The website construction is still in progress, but currently shows a map of all participating cities and includes the name of the current mayor, in most cases the current population figures, and what the city has done in terms of commitment, inventory, target formulation, and planning for climate mitigation and adaptation. It is the intention to add data about greenhouse gas emissions and sectoral composition for each city. Almost all African cities are still in the 'commitment phase', but Cape Town and Durban have completed all phases and it is possible to download the climate adaptation and climate action plans for these cities. To date, the Compact of Mayors has connected 18 of Africa's multi-million agglomerations and 32 other African cities, see *Table 10*.

Table 10: African member cities of the Compact of Mayors

Country	Multi-million agglomerations, as in *Table 4*	Other cities
Benin	Cotonou	
Burkina Faso		Bakata
Burundi		Bujumbura
Cameroon	Yaoundé	Angossas, Bafut, Bamenda, Bangangté, Foumban
Comoros		Moroni, Mutsamudu
Congo DR	Kinshasa	
Côte d'Ivoire	Abidjan	Grand Bassam
Ethiopia	Addis Ababa	
Gabon		Libreville
Ghana	Accra	
Guinea		Télimélé
Kenya	Nairobi	
Liberia	Monrovia	
Malawi		Blantyre
Mauritania	Nouakchott	
Mauritius		Curepipe, Vacoas
Mozambique		Nacala, Quelimane

Namibia		Ondangwa, Walvis Bay, Windhoek
Nigeria	Lagos	Isoko South
Senegal	Dakar	Latmingue, Nioro des RIP, Ziguinchor
South Africa	Cape Town, Johannesburg/Ekurhuleni Nelson Mandela Bay/Port Elizabeth, Tshwane/Pretoria, eThekweni/Durban,	Eden District, Kheis, Kwadukuza, Mangaung/Bloemfontein, Steve Tshwete/Middelburg, uMhlathuze
Swaziland		Matsapha
Uganda	Kampala	
Zambia		Kitwe
Zimbabwe	Harare	Bulawayo

With growing privatisation and many public-private partnerships in environmental management, it is also relevant to mention the global overview website of environmental companies, which also features an overview of more than 1500 companies working in Africa: 'Environmental Experts': https://www.environmental-expert.com/companies/location-africa. The majority of these companies have their headquarters elsewhere in the world, but they have an office or are distributors in Africa, and particularly in South Africa. There are also African companies and NGOs on the list (like the Water and Sewerage Company in Nairobi, and the Waste Management Society of Nigeria, based in Port Harcourt).[25]

If we look at all these initiatives and focus on Africa's multi-million agglomerations, it is clear that a number of urban areas are leading initiatives, while others are invisible, see *Table 11.*

Table 11: Summary of networks/assessments with participation of Africa's megacities

Urban agglomeration	EIU	C40	Rockefeller	SSnet	ICLEI/[UCLG]	Compact
Lagos	+	+	+		+	+
Cairo	+	+				
Johannesburg/Pretoria	++	+			+	+
Kinshasa						+
Luanda	+					
Khartoum						
Dar es Salaam	+	+		+	+	
Nairobi	+	+	+			+
Alexandria	+					

[25] See https://www.environmental-expert.com/companies/waste-management-society-of-nigeria-wamason-24860.

Abidjan						+
Accra	+	+	+			+
Casablanca	+					
Cape Town	+	+	+		+	+
Kano						
Algiers						
Addis Ababa	+	+			+	+
Dakar			+	+	+	+
Durban	+	+	+	+	+	+
Ibadan						
Kampala					+	+
Bamako						
Abuja						
Douala						
Yaoundé						+
Kumasi						
Tunis	+					
Harare						+
Lusaka					[+]	
Antananarivo						
Conakry						
Maputo	+					
Ouagadougou					[+]	
Port Harcourt						

Comparison with the OURSUS approach

OURSUS was developed as an interactive website for information about urban sustainability, to enable global exchange of information about sustainable products and cases (also called 'experiences'), challenges, and campaigns. It connects experts with the general public, and enables integrated ('holistic') attention for the large variety of environmental and sustainability issues in the world's cities, an approach that was thought to be particularly useful for geographers and geography teachers and their students (www.oursus.org). The OURSUS website also focuses on particular cities and has many special reports on particular issues.

The OURSUS website works with colour tags, using a 'rainbow concept':

Red issues deal with the transportation system, vehicles in cities, and so-called ecological traffic. There is attention for concepts like 'smart spatial organization'; 'smart transport systems'; 'energy-poor mobility'; 'virtual travelling'; 'telework'; 'mobility-poor communication'; and

connecting home-work-shop and leisure in one location ('compact cities'). There is also attention for the use of bicycles and smart forms of public transport in cities.

Orange issues deal with architecture: ecological or 'intelligent' building; energy-efficient building; indoor environments; land development issues; and urban land use or physical planning. Concepts like 'zero-energy buildings', 'new architecture', and 'smart architectural design' get a place here as well as cities as energy producers and climate- and disaster-proof buildings (also earthquake and tsunami proof buildings and urban design).

Yellow issues deal with energy: changes to clean energy; natural energy; new forms of energy; energy utilisation and the like. Concepts such as 'low-carbon cities'; 'climate neutrality'; 'smart grids'; better use of 'wasted heat and cold'; 'energy security'; and energy that is 'climate-shock proof' are being used. Also in this section are issues such as greenhouse gas mitigation, adaptation, compensation, vulnerability and resilience.

Green issues deal with the biology of city environments, with attention for 'greening', 'city or urban agriculture' (either as a livelihood or as a leisure activity or both), afforestation and biodiversity issues in cities. 'Green urban landscape planning'; the importance of urban parks, public and private gardens; 'green buffer zones'; 'greening streets and rooftops'; 're-creating urban nature'; and 'urban eco-diversity' are all related to the biology of cities, as is the 'greening of former waste dumps' and biological cleaning of polluted areas.

Blue issues deal with water in and around cities: the surface and groundwater available to cities and its quality, water resources, water planning and development, but also: coping with disastrous weather conditions and, in particular, coping with floods. In addition, the importance of water as a source of livelihoods (fisheries, aquatic leisure activities, harbour functions) gets attention here, as do: clean water transport; 'innovative water management'; ground water storage and water shortage prevention; providing citizens with clean, dependable and affordable drinking water; and industries and other economic functions with water for productive use. Aquatic biodiversity is also a relevant issue here.

Indigo issues deal with waste management, but also with pollution (air, water, soil, heavy metal, radiation, and noise pollution). Solid waste management is a major issue, but also the separation of so-called grey and black water; prevention issues (e.g. solid waste limitation); re-use of waste; waste as bio-energy; and (related to the red and yellow issues) emission-free cars/transport.

Violet issues deal with governance and lifestyle issues. Public health issues in cities and public hygiene are important here, but also 'green consumption'; eco-friendly lifestyles; the 'slow food movement'; reducing resource use; reducing consumption of meat and fish; resource efficiency; 'smart integrated value chain management'; attention for 'ecological and water footprints';

'organic living'; 'public awareness'; eco-conscious producers, traders and consumers; sustainable and fair companies; and socially and environmentally responsible business are all relevant concepts here, although these issues might partly overlap with other 'colours' of the sustainable city rainbow.

The idea is that active and passive users of the website connect these issues, and geography as a scientific discipline, as a school subject, and as a provider of experts to (local) governments, and businesses. In addition, NGOs, political parties, and 'movements' can and should play a key role in bringing all these different issues together in a holistic and broad approach to stimulate (and understand) 'sustainable cities'.

The Chinese version of the OURSUS website (http://www.oursus.org.cn/, in Chinese) is vibrant, with attention for many cities and issues in China. The English-language website still functions as a demonstration website, but from mid-2016 there are two specific cases of African cities: Cairo and, in particular, Cape Town.

Within Africa, Cape Town can be seen as a leading municipality in terms of sustainable city initiatives. Most of the examples on the OURSUS website have 'green' or 'yellow' tags. Green examples are a social enterprise stimulating the production of urban vegetable production for poor people, an initiative by the botanical gardens of Kirstenbosch to highlight its 'centenarian plants', initiatives for nature conservation and biodiversity management in and around Cape Town (e.g. the threats to the western leopard toad, an endangered species, by draining wetlands), and an initiative to deal with the many baboons in a sustainable way. The yellow examples deal with the important Cape Town Energy and Climate Change Plan, which was launched in 2011 (see above). A final example of a yellow issue is news about a Chinese company opening a Solar PV plant in the city. On the Cape Town page of OURSUS there are 'products and cases', 'experiences', 'challenges', and 'campaigns'.

The Cairo example is less informative, with one 'product', and one 'challenge', both in the 'indigo issues', i.e. domain, waste and resource use: there is news about a new wastewater treatment plant, and about a conference (in 2013) to deal with avoiding food waste as part of food and water security in arid regions (among other things).

Framed in OURSUS 'colour' terms, the examples given in section 1 of this paper show that attention for Africa's urban sustainability issues mainly focus on green issues (and much has been written about urban agriculture and land use problems), on indigo issues (waste management, in particular), and on adaptation to climate change and risks or vulnerability issues in African cities (yellow issues, but also with some attention for blue issues, particularly flood risks). Only in South Africa does there appear to be genuine and broad attention for 'violet

issues' (environmental governance, awareness building, and popular participation). In some cities, attention for red and orange issues (transport and buildings) is growing.

3. The role of geography

Geography and geographers can be expected to play a major role in the 'sustainable city'/ '*ville durable*' initiatives, but it is not always obvious that they do, either in Africa, or elsewhere in the world. This is partly to do with the fragmentation of the scientific discipline of geography and the institutional separation between 'physical geography' and its many sub-disciplines, 'human geography' (again with very many sub-disciplines) and 'urban and regional planning'. If we look at the various urban sustainability issues there are sub-disciplinary contributions from hydro-geography (in water issues); soil science (in soil pollution); climatology (in aspects of climate change); urban or urban environmental geography (e.g. in city land use planning); political geography (urban governance issues); and economic geography (energy issues, for instance), among others. But a holistic, 'one geography' approach, to connect the many different urban environmental issues, is difficult to develop in the existing institutional landscapes of geography departments, where 'environmental geography' is either a latecomer or regarded as 'applied science', or even not recognised as 'proper geography'. Sustainability issues are also difficult to include in education-oriented geography teaching and research, although many geography teachers and writers of geography textbooks and school books have tried. Indeed, many contributions to the knowledge of sustainable cities come not from geographers, but from technical sciences, economists, communication scientists and information specialists. That said, as we will see in the section below, geographers do play a role.

The institutional flagship organisation within the UN system dealing with urban issues is UN-Habitat, based in Nairobi. Since 2008, it has published three overviews of 'the state of Africa's cities', (see UN-Habitat 2008, 2010 and 2014). In 2008, the report was published together with the United Nations Commission for Africa (UNECA), the United Nations Environmental Programme (UNEP), and IDRC in Canada. In 2010, only UNEP remained a partner and, in 2014, the partnership changed to include both ICLEI and UCLG. In 2008, urban environmental challenges were one out of six major themes. In 2010, the report had a very geographical structure, with sections about the social geography of urbanisation; the economic geography of cities; the geography of urban land markets; and the geography of climate change. The report published in 2014 explicitly deals with urban sustainability in the sections on social and environmental challenges.

In South Africa the South African Cities Network was established in 2002 and, to date, has published four reports about 'the state of South African Cities' (http://www.sacities.net/). Its website states: "The South African Cities Network (SACN) is an established network of South African cities and partners that encourages the exchange of information, experience and best

practices on urban development and city management. As both a research source and a catalyst for debate, the SACN covers the full scope of the urban management process, under the following thematic areas: city development, inclusive cities, sustainable cities, well governed cities and productive cities". Under the heading of 'sustainable cities' is stated: "Creating greener and liveable cities, by promoting sustainable energy, improving waste management and water management, and mitigating climate change effects". There are now five 'state of South African Cities' (see SANC 2004, 2006, 2011 and, most recently, 2016). From the outset, 'sustainable cities' was a major and recurrent theme. In 2016, there was also a 'people's guide': http://www.sacities.net/wp-content/uploads/2016/SOCR/SoCR16-Peoples-Guide-web.pdf.

To find out what role geographers have played, we can examine the last State of the City report, published by UN-Habitat for African cities in 2014 as well as the SANC 2016 for cities in South Africa.

UN-Habitat's focus has always been very geographical, although most explicitly in its 2010 report. Geographical journals and leading environmental geographers play a role as sources of information. For instance, the authors use some of the leading 'flagship' journals of environmental geography, like Global Environmental Change (e.g. Reid & Vogel 2006; Coleen Vogel is a South African climatologist) or Environment and Urbanization (e.g., Roberts 2008; or earlier Roberts & Diederichs 2002; Debra Roberts is a South African urban bio-geographer; also: Muller 2007, but have a look at Muller 2016 as well!), in urban studies journals, like Habitat International (e.g. Gwebu 2002, a population geographer originating from Botswana), or in urban planning journals, like the Journal of Planning Education and Research (e.g. Carmin et al. 2012).

The UN-Habitat publication also draws on the work of leading global experts in urban environmental studies, geography and planning, like David Satterthwaite (Bicknell, Dodman & Satterthwaite 2009; also see some of the classics in this field: Hardoy, Mitlin & Satterthwaite 1995 and again 2001; as well as a very relevant more recent publication in which Satterthwaite has been involved: Dodman et al. 2015). Another example is the work of British geographer David Simon (see e.g. 2010 together with Hayley Leck, but also Simon, 1999, 2001, and 2013). A third example of a leading British geographer who was quoted by UN-Habitat is Mark Pelling (see e.g. his 2003 publication; and the one in 2009 together with Ben Wisner; but also see Wisner et al. 2015). Among the many co-authors of this last publication about vulnerability and climate change in Africa's smaller cities (including Mark Pelling, David Simon, Jesse Ribot and Ben Wisner), geographer Ailsa Holloway works at Stellenbosch University South Africa and Adolfo Mascarenhas as a geographer at the University of Dar es Salaam, while Babacar Ndong and social anthropologist Papa Faye originate from Africa.

There are many references in the UN-Habitat 2014 publication to the recent wave of 'climate change and cities' publications, for instance: Rosenzweig, Solecki, Hammer & Mehrotra 2011, where Cynthia Rosenzweig is a climatologist, William Solecki a geographer, and Stephen Hammer an urban studies scholar, with work experience in Ethiopia and Egypt. Another example is the ICLEI study by Kemp, Fairhurst, Rowswell & Quayle in 2011: "Sub-Saharan African Cities: A Five-City Network to Pioneer Climate Adaptation Through Participatory Research & Local Action". These authors (some biologists) were based in Cape Town when they did the study. Another relevant study about Cape Town itself was published in 2012 (Cartwright et al. 2012). One of its authors, Sue Parnell, is a leading urban geographer in South Africa. Some of these studies connect issues of climate change with urban food security, like that of Frayne, Moser & Ziervogel (2013). Bruce Frayne and Gina Ziervogel are geographers, connected to the University of Cape Town, Caroline Moser is one of the world's leading urban social anthropologists and gender specialists, based in the UK.

So, while many of the authors quoted by UN-Habitat working on urban environmental or urban sustainability issues are geographers or urban planners (although there are also biologists, anthropologists, and economists among the authors), many come from outside Africa (and a considerable number from the UK). However, there are also authors based in Africa, but the majority of these are working in South Africa.

We turn now to the type of references quoted in the SANC report on South African Cities. The chapter about sustainable cities was written by Sandiswa Tshaka, an energy and climate change expert, who previously worked for the Danish Embassy, and by Gillian Maree, who trained as a spatial planner in the Netherlands, and who has worked to support spatial economic policy and strategic environmental planning in South Africa. The key messages in the sustainability section of the report come very close to the OURSUS approach: "The typical South African city is growing in a resource-intensive way and suffers from inefficiencies across all sectors (energy, food, water, waste and transport). • The current silo approach to planning and delivery is inefficient and increases risks of exclusion. • Cities should pursue spatial transformation, which encourages compact cities and sustainable neighbourhoods that value natural and open spaces. • Sustainability and growth are interdependent, and so sustainability must be fundamentally embedded in a city's development paradigm, and not just in its long-term visions and strategies. • Cities need to tackle resource efficiency aggressively" (SANC 2016, p. 12). The sustainability chapter refers to close to 40 sources of information, most of which are institutional sources (South African municipalities mostly); but in six cases, reference was made to a scientific source of information that could be traced by Google Scholar, with 15 different authors involved. As far as is possible to ascertain, surprisingly, none of these authors have an academic background in geography; they are mostly biologists, forestry scholars, economists or health scientists. Of

course, it is possible that some of the authors of the institutional documents have had an academic training in geography, but this was not possible to trace.

However, one of the leading think-tanks about Africa's urban and urban environmental issues is firmly connected to geography and urban planning: the University of Cape Town's African Centre for Cities (ACC): http://www.africancentreforcities.net/. Many of its research projects and publications deal with Cape Town itself, but there is also a growing connection to other cities in Southern Africa, cities in Africa, and cities elsewhere, with a major attempt to connect African and Asian experiences. The ACC is a central player in major academic and think-tank networks about sustainable cities with a focus on Africa: UrbanAfrica ('communicating about African cities'; see http://www.urbanafrica.net/); the Association of African Planning Schools (http://www.africanplanningschools.org.za/); the African Urban Research Initiative (http://www.africancentreforcities.net/programme/knowledge-networks/african-urban-research-initiative/); and the African Food Security Network (http://www.afsun.org/). ACC's director, Edgar Pieterse (PhD from the London School of Economics) holds the South African Research Chair in Urban Policy at UCT, but is also one of four African members of the SDSN network (sustainable development solutions network; based in Paris and New York, as the UN's think tank for sustainable cities ('inclusive, resilient and connected'). See http://unsdsn.org/what-we-do/thematic-networks/sustainable-cities-inclusive-resilient-and-connected/. Among Pieterse's most influential publications are Pieterse 2008, and Parnell & Pieterse 2010. A recent publication by Parnell & Pieterse is about Africa's urban revolution (see Parnell & Pieterse 2015).

Other African members of the SDSN Network are Martin Oteng-Ababio, geographer at the University of Ghana at Legon, climate change expert Debra Roberts of the Ethekwini Municipality (Durban), and urban planner Rafael Tuts of UN-Habitat (with a degree as an architectural engineer from the University of Leuven, Belgium). The UN started this initiative in 2012 with a goal to "mobilize global scientific and technological expertise to promote practical problem solving for sustainable development, including the design and implementation of the Sustainable Development Goals (SDGs)" (http://unsdsn.org/about-us/vision-and-organization/). Martin Oteng-Ababio's most cited work is about waste management in Accra (Grant & Oteng-Ababio 2012; Oteng-Ababio, Martin, Melara Arguello & Gabbay 2013). Debra Roberts is mentioned above.

To summarise the role of geographers, we may conclude:

- In the flagship document of UN-Habitat, the "State of African Cities": geographers are very prominent
- In the flagship document of the South African City Network, the "State of South African Cities": geographers are almost invisible

- The leading African think tank on sustainable cities is the African Centre of Cities; University of Cape Town: with a prominent role of geographers
- In important academic publications on urban sustainability: there are many different academic disciplines involved; geography is visible; but within geographical contributions: there is a dominance of UK-based geographers/urban planners, and within Africa of South African geographers
- In most of Africa: there is a limited visibility of geographers based in African universities or think tanks
- Environmental Urban Geography: institutional traditions make it difficult to thrive, except in 'departments of geography and environmental studies', or in separate centres like the ACC in Cape Town.

As part of the OURSUS approach, it would be good to develop cases of particular African (mega-)cities, and to find out what role geographers play in each of these cities with regard to urban sustainability research, education, and 'action' (in government departments, in NGOs and citizen movements, and in businesses). With the exception of South Africa, my preliminary assessment is that in many of these megacities geographers and geography departments do not play major or pioneering roles, and that often initiatives are initiated from abroad and according to policy and research agendas formulated outside Africa. In the References section, I have included a list of relevant websites for geography departments in all mega-cities in Africa. I hope to be able to continue this type of 'meta-scientific analyses' myself, but I appreciate any additional information or corrections from colleagues, in particular those working in African departments of geography.

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https://www.citiesalliance.org/sites/citiesalliance.org/files/UNH_StateofAfricanCities_2010.pdf

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Particular city websites

http://ama.gov.gh/ama/ (Accra)

http://africa.iclei.org/members/members-in-africa/profiled-african-members/addis-ababa-ethiopia.html (Addis Ababa)

http://www.alexandria.gov.eg/alex/english/index.aspx (Alexandria)

http://www.cairo.gov.eg/CairoPortal (Cairo)

www.capetown.gov.za (Cape Town; e.g. on sustainable resource management: http://www.capetown.gov.za/en/EnvironmentalResourceManagement/functions/Pages/EnvironmetalCapacityBuilding.aspx); also see https://www.capetown.gov.za/en/iwex/Pages/default.aspx, about the Waste Exchange Website, and https://www.capetown.gov.za/en/EnvironmentalResourceManagement/Documents/Smart_Living_Handbook_Eng_FULL%20VERSION_4thEd_2011-05.pdf, about the City's smart living handbook. Cape Town adopted a climate adaptation plan in 2006: https://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/Framework_for_Adaptation_to_Climate_Change_(FAC4T)_08_20 and a Climate Action Plan in 2011: https://www.capetown.gov.za/en/EnvironmentalResourceManagement/publications/Documents/Moving_Mountains_Energy+CC_booklet_2011-11.pdf

http://www.casablancacity.ma/ (Casablanca)

http://www.iagu.org/ (Institut Africain de Gestion Urbaine). Also see: http://sustainablecities.net/projects/dakar-municipal-nursery-and-vegetable-gardens-project/ and http://sustainablecities.net/projects/abusus-enim-multitudine-hominum/ (Dakar)

http://www.dcc.go.tz/ (Dar es Salaam City Council). Also see http://sustainablecities.net/projects/dar-es-salaam-community-based-waste-management/

http://www.durban.gov.za; as well as http://www.durban.gov.za/City_Services/cleansing_solid_waste/Pages/default.aspx (Durban/eThekwini), and particularly: http://imaginedurban.org/Pages/Home.aspx Also see: http://sustainablecities.net/projects/durban-informal-recylers-project/ Durban has finished a Climate Adaptation Plan in 2011 (http://www.bbhub.io/mayors/sites/14/2015/06/Durban-Adaptation.pdf) and a Climate Action Plan in 2014 (http://www.bbhub.io/mayors/sites/14/2015/06/Durban-Action-Plan.pdf)

http://www.jda.org.za/ (Johannesburg; e.g. see he section about greenways: http://www.jda.org.za/index.php/whatwedo/programmes/greenways)

http://www.kinshasa.cd/ (Kinshasa), for instance see: http://www.kinshasa.cd/joseph-kabila-lance-programme-environnement-securite/

http://lasepa.gov.ng/ (Lagos State Environmental Protection Agency), as well as http://lawma.gov.ng/, the Lagos Waste Management Authority

http://www.cidadao.gov.ao/VerPrestadorServico.aspx?id=332 (Luanda)

http://www.cmmaputo.gov.mz/ (Maputo)

http://www.nairobi.go.ke/ (Nairobi County); about the Nairobi City Water and Sewerage Company see https://www.environmental-expert.com/companies/nairobi-city-water-and-sewerage-company-limited-48545

http://www.tshwane.gov.za/Sites/Departments/Agriculture-and-Environment-Managemental/Pages/default.aspx (Pretoria/ City of Tshwane).

http://www.commune-tunis.gov.tn/publish/content/default.asp?lang=fr (Tunis)

Websites of Departments of Geography in Universities in or near the major cities (> 3 million inhabitants according to table 4)**:**

Abidjan: Université Félix Houphouët Boigny d'Abidjan, IRD, https://www.ird.fr/les-partenariats/principaux-partenaires-scientifiques/afrique-de-l-ouest-et-centrale/cote-d-ivoire/ufhb

Accra: University of Ghana at Legon, Department of Geography and Resource Studies: http://www.ug.edu.gh/geography

Addis Ababa: University of Addis Ababa, Department of Geography and Environmental Studies in the College of Social Sciences: http://www.aau.edu.et/css/academics/geography-and-enviironmental-studies/

Alexandria University: Department of Geography and Geographical Information Systems (in the Faculty of Arts): http://www.aau.edu.et/css/academics/geography-and-enviironmental-studies/

Algiers: Université des Sciences et de la Technologie Houari Boumediene, Faculté des Sciences de la Terre, de Géographie et de l'Aménagement du Territoire http://www.usthb.dz/spip.php?article192

Bamako: Université des sciences sociales et de gestion de Bamako (USSG) Faculté d'histoire et geographie (FHG): see:
https://fr.wikipedia.org/wiki/Universit%C3%A9_des_sciences_sociales_et_de_gestion_de_Bamako

Cairo: Department of Geography in the faculty of Arts:
https://cairo.academia.edu/Departments/Faculty_of_Arts_Department_of_Geography1

Cape Town: University of Cape Town, Environmental and Geographical Science http://www.egs.uct.ac.za/ and also UCT African Centre for Cities http://www.africancentreforcities.net/ ; as well as University of the Western Cape, Department of Geography, Environmental Studies and Tourism: https://www.uwc.ac.za/Faculties/ART/Geography/Pages/default.aspx ; and University of Stellenbosch, Department of Geography and Environmental Studies:
http://www0.sun.ac.za/geography/blog/

Casablanca: Université Hassan II, Département de Géographie, Fac. Des Lettres et Sciences Humaines.
http://www.uh2c.ac.ma/flshac.aspx

Dakar: Université de Cheikh Anta Diop, Départment de Géographie, http://ucadgeo.blogspot.nl/

Dar es Salaam: University of Dar es Salaam, Department of Geography:
https://udsm.academia.edu/Departments/DEPARTMENT_OF_GEOGRAPHY_

Durban: University of Kwazulu-Natal, Discipline of Geography: http://ses.ukzn.ac.za/Homepage.aspx

Ibadan: University of Ibadan, Department of Geography: http://ui.edu.ng/staffgeo

Johannesburg: University of Johannesburg, Department of Geography, Environmental Management & Energy Studies, https://www.uj.ac.za/faculties/science/geography and University of the Witwatersrand, School of School of Geography, Archaeology and Environmental Studies,
https://www.wits.ac.za/science/schools/geography-archaeology-and-environmental-studies/

Kampala: Makerere University, Department of Geography, Geoinformatics and Climatic Sciences:
http://geography.mak.ac.ug/

Kano: Bayero University Kano, Department of Geography, Faculty of Social and Management Sciences:
http://sms.buk.edu.ng/

Khartoum: University of Khartoum, Department of Geographical and Environmental Sciences.
http://fges.uofk.edu/index.php?lang=en :

Kinshasa: Université de Kinshasa, Faculté des Sciences, Département de Géologie et Géographie. http://unikin.sciences.free.fr/; also See: https://fr.wikipedia.org/wiki/Universit%C3%A9_de_Kinshasa

Lagos: University of Lagos, Department of Geography and Planning, of the Faculties of Social Sciences, http://unilag.edu.ng/departmentdetail.php?sno=37&parentid=15

Luanda: Universidade Agostino Neto, Geodemografia, http://uan.ao/courses/geodemografia/ and Engenhario Geografica http://uan.ao/courses/engenharia-geografica/

Maputo: Universidade Eduardo Mondlane, Dep. De Geografia: http://www.flcs.uem.mz/index.php?option=com_content&view=article&id=48:departamento-de-geografia&catid=28:departamentos&Itemid=52

Nairobi: University of Nairobi, Department of Geography and Environmental Studies: http://geography.uonbi.ac.ke/ , and Kenyatta University Department of Geography: http://www.ku.ac.ke/schools/humanities/departments/geography

Pretoria: University of Pretoria, Department of Geography, Geoinformatics and Meteorology: http://www.up.ac.za/geography-geoinformatics-and-meteorology/

Tunis: Université de Tunis, Département de Géographie, (Faculté des Sciences Humaines et Sociales de Tunis: http://www.fshst.rnu.tn/d%C3%A9partements/g%C3%A9ographie

Other Websites:

http://africa.iclei.org/

http://africanarguments.org/wp-content/uploads/2012/02/Lagos.jpg

http://www.africancentreforcities.net/

http://www.africancentreforcities.net/programme/knowledge-networks/african-urban-research-initiative/

http://www.africanplanningschools.org.za/

https://afriquecroissanceverte.com/

http://www.afriquelocale.org/fr/ and http://www.afriquelocale.org/en/

http://www.afriquelocale.org/fr/ams

https://afriquecroissanceverte.com/2014/10/02/villes-durables-en-afrique-de-louest-7-exigences-pour-en-faire-une-realite/

http://www.afsun.org/

http://books.mongabay.com/population_estimates/1960/Lagos-Nigeria.html

http://www.c40.org/

http://www.carboun.com/

http://www.circlesofsustainability.org/cities/johannesburg/

http://www.citypopulation.de/world/Agglomerations.html

http://www.compactofmayors.org/cities/

http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

http://data.worldbank.org/topic/urban-development?locations=ZG

http://www.demographics.at/Growth-Decline/images/PPP2015_Africa_Tot-Pop_1950-2100.gif

http://documents.worldbank.org/curated/en/847511468248657447/pdf/PID-Print-P149704-09-21-2014-1411299520747.pdf

https://en.wikipedia.org/wiki/Sustainable_city

https://www.environmental-expert.com/companies/location-africa

https://www.environmental-expert.com/companies/waste-management-society-of-nigeria-wamason-24860

https://www.ericsson.com/assets/local/networked-society/reports/city-index/2016-networked-society-city-index.pdf

https://esa.un.org/unpd/wup/

http://explainingprogress.com/wp-content/uploads/2013/05/UN-Estimates-and-Forecasts-Total-fertility-by-major-regions-1950-2100-children-per-woman-UN.png

https://fr.wikipedia.org/wiki/Ouagadougou

https://fr.wikipedia.org/wiki/Ville_durable

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