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Insights on Current Pressures and Future Challenges Facing Cities: Cairo's ranking in Worldwide Indexes

Mostafa Zakaria El Attal
Researcher, Department of Urban planning, Ain Shams University, Egypt
Youhansein Y. Eid
Professor, Department of Urban Design & Planning, Ain Shams University, Egypt
Marwa A. Khalifa
Professor, Department of Urban Design & Planning, Ain Shams University, Egypt
Marwa Abdel Latif
Assistant Professor, Department of Urban Design & Planning, Ain Shams University, Egypt

Abstract:
Today, more people are living in cities than ever and turning them into critical points where social, economic, technological, and ecological changes occur. Cities in developing countries including Cairo are experiencing this growth more than those in the developed countries amid the poverty, inequality, and the pervasiveness of slums that they experience. However, despite the challenges facing these cities, there are opportunities for achieving sustainability and resource efficiency. The efficiency with which resources are used is related to the quality of life of city residents. Cities that have resource efficiency integrated in their operations have higher productivity and innovation and reduced environmental impacts. Efficient use of resources depends on several factors such as redefining the understanding of the urban systems and having a shared language or standard for the evaluation of the sustainability of cities. Additionally, resource efficiency has to be aligned with human development. This paper provides a presentation of the challenges, pressures, and trends that modern cities face. In the second section, an outline of options for realizing resource efficient cities is looked at. The third section describes the approaches that cities can use to be sustainable and resource efficient.

Keywords: *Urbanization, resource scarcity, climate change, cairo, green city index, ARCADIS*

1. Introduction

The sustainability of urban cities today is faced by several challenges that comprise several global factors such as economic change, rapid social and technological development, scarcity of resources, and environmental risks and climate change. These factors have wide impact on water, food, energy, transport, and waste that are important for sustainability in cities.[i] The impact of these factors is higher in developing countries due to poverty, lack of resources, and inequality.

2. Drivers of global pressures on cities

The current growth and development of the urban areas is faced by three major pressures. These are the expected wave of urbanization, resource scarcity and constraints, and the global climate change.

2.1. The expected wave of urbanization

By 2050, the world population is estimated to reach 9 billion people. As indicated by the second wave of urbanization[ii], most of this population will reside in cities. Cities in developing countries (majorly African and Asian) will have the highest growth rates. The first wave of urbanization took place in the now developed countries in 1750 and led to the urbanization of 400 million people in 200 years. [iii] It is estimated that the second wave will lead to urbanization of 3 billion people in 80 years. As such, the second wave is expected to provide opportunities for unlocking new areas for thinking and acting on the city due to the challenges that new cities will bring. The resolution of these challenges will facilitate the creation of sustainable cities.

World cities' population are estimated to hit over 2.5 billion by 2050 with many people expected to move from the rural areas to the urban centres. This move is likely to surpass the sum of the combined population in India and China.

The aspect of urbanization has been evidenced from the late 18th century with the growth of modern industry eliciting movement of people from the rural areas to seek employment in areas with industries. The creation of new working opportunities hastened the growth of these cities with the movement of people also increasing with time. Existing statistics indicate that by 1900 over 13% of the population was already in these cities. Subsequently, by 1950 the population had increased progressively by over 29%. It is further estimated that this

population living in the urban areas will increase to 66% by the year 2050 with the number expected to hit the 2.5 billion marks. Amongst the 2.5 billion people, an overwhelming 90% will be found in Asian and African cities. The geographical representation in the following Figure indicates the current world's most populated urban cities.

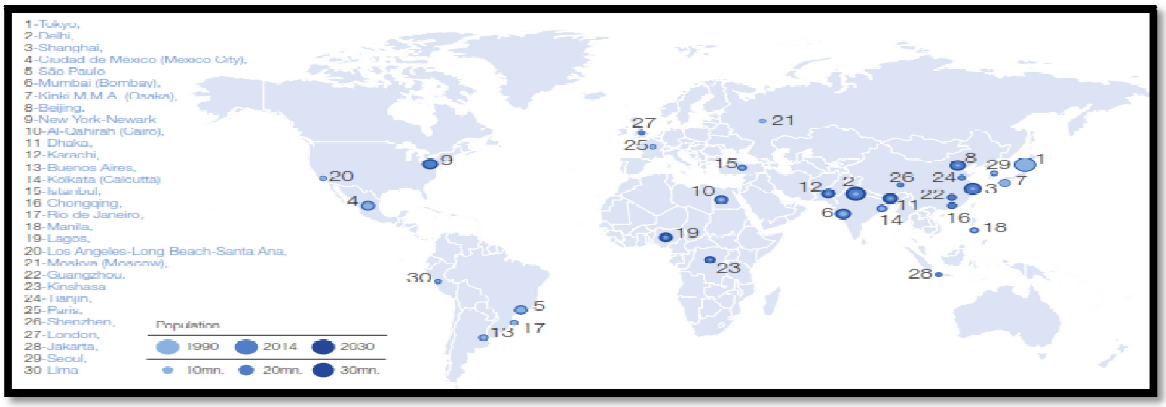

Figure 1

Source: Data from United Nations, Department of economic and social affairs, Population division. "World urbanization prospects, the 2014 revision", Highlights, 2014

Scholars attribute many advantages that city dwellers have when compared to those living in the rural areas. Amongst the opportunities that city dwellers have include; proximity, exposure to diversity and features of marketplace competition. Further statistics indicate that megacities have not only tripled since 1990 but they are likely to contain populations of around ten million each by 2030.[iv]

Urban areas or cities are growing at an alarming rate. The case of increasing population indicates that the need to enhance the rapid development of these cities. However, there is a challenge noted amongst the growing cities with cases of land use, social and economic development triggering difficulties in their management.

2.2. Climate Change

The IPCC (Intergovernmental Panel on Climate Change) reported that climate change will bring so much danger to the world. One such change is increased uncertainty. Weather patterns will vary very much with extreme summer highs and winter lows. As such, decision makers must prepare for this great variability than what regression analysis provide because of the unpredictable and non-linear changes occasioned by climate change. Daily survival in cities will also be affected by the urban heat island effect leading increasing the demand for heating and cooling. Drought may also affect the availability of water in cities affecting the family budget on food.

Cities may also be affected by the flooding, cyclonic storms, water table rise, and tornadoes. Cities will be more vulnerable in case their infrastructure cannot handle the long range of limits of the temperature, wind, and precipitation.

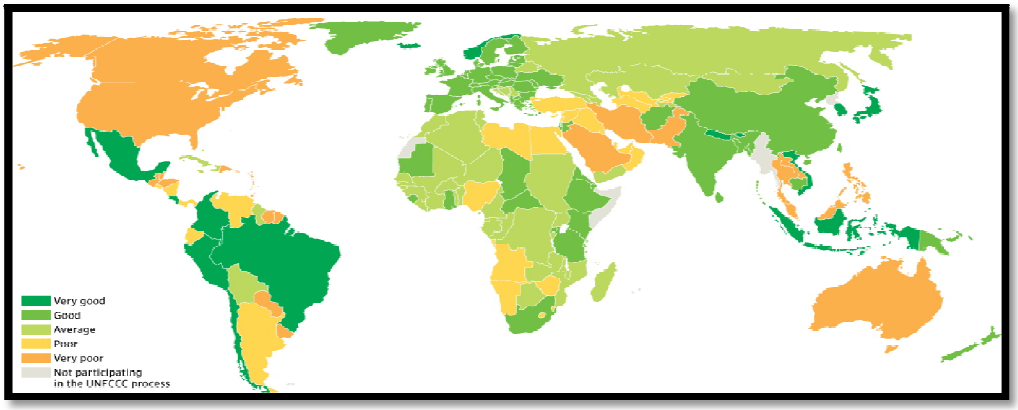

Figure 2

Source: Https://Www.Theguardian.Com/Environment/Graphic/2011/Jul/15/Smith-School-Action-Climate-Change

2.3. Resource Scarcity

The growth of cities is threatened by the scarcity of resources that comes with urbanization. The growth of cities is particularly hindered by the limited resources for production and construction such as electricity, transport, and food.[v] Resource constraints will significantly affect the next industrial transition restraining the growth of cities. Beside the scarcity of production resources, ecological sustainability is also threatened by the ecologically fragile environments. The scarcity of resources and the degradation of the ecosystem makes the next industrial transition complex. This complexity is increased by the poor historical construction of cities.

With urbanization, incomes have risen leading to an increase in consumption rates and generated wastes which significantly contribute to global climate change. Approximately 80% of the global materials and energy supply are consumed in the city and 75% of the global carbon emissions come from cities. The use of well-thought programs for resource efficiency in cities has the potential for reducing global metabolic rates resulting from material consumption.

2.4. Global Challenges

The scarcity of resources as discussed in the sections above can be made worse by climate change effects and the broader global changes such as rapid global urbanization and the changes in the global economy. Fluctuation in prices of commodities in the global market are much more likely to affect cities. The constraint of one resource is likely to produce effects in other areas. For example, the fluctuation in the price of oil is likely to affect the transportation and the food sector. Agro-economic production and the prices of food are also affected by the availability and price of water. Also, an increase in solid waste will lead to an increase in the need for landfills, the pollution of soil, and the degradation of the ecosystem. The connectedness of these challenges implies that infrastructure solutions should also be integrated if cities wants to be sustainable. Integration of the various sectors is necessary as piecemeal efforts for ensuring urban development sustainability will remain piecemeal if they are coordinated and integrated.

City infrastructure decision will have to be mutually resilient to achieve city-wide sustainability.

- Energy resilience in the building and transportation sector
- Water resilience; efficient water use, re-use, and recycling systems.
- Ecosystem resilience; keeping pollution within acceptable limits using integrated waste management practices. Land use change and regulation of human activities.
- Food security; by ensuring the stability of water and oil prices and local food production
- Oil resilience in the transportation sector.

Since the challenge of sustainable development is highest in the cities, city mayor and managers are focusing on efficient means of waste recycling, large public transportation, and city-level carbon banks among other projects which are customized according to their local contexts. The UN supports such projects through the UN Global Compact Cities Program. [vi]

3. Cairo in international indexes

The Egyptian capital has been included in many worldwide indexes assessing various aspects.

3.1. Cairo in the Green City Index (2009)

Cairo is the most densely populated city in Index, considering an estimated 19,100 people per square kilometer, in comparison to the average index of 4,600. Cairo city ranks highly in the transport sector, which attributed to the length of the metro system, which has operated since 1987. Nonetheless, the city faces traffic congestion issues. According to statistics, Cairo performs well; given the high population of city residents have access to electricity and potable water. In most of other categories, Cairo ranks average.

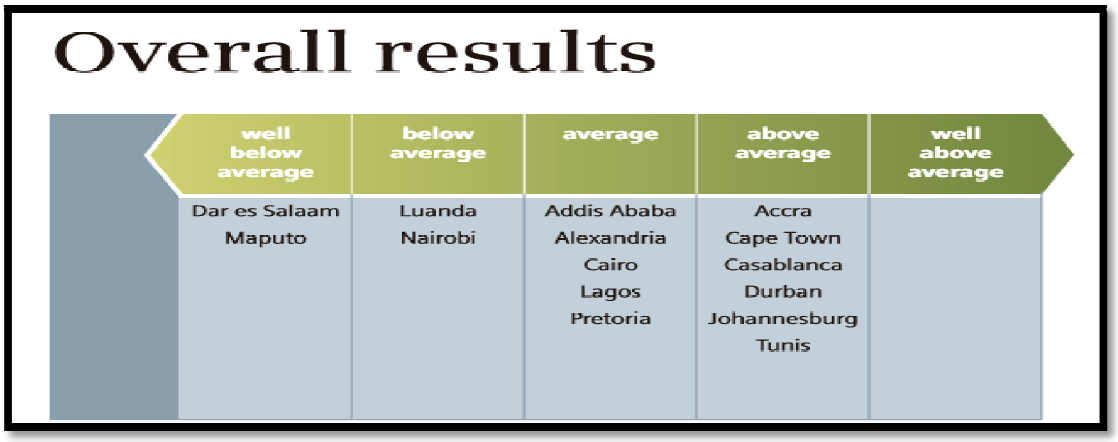

Figure 3: Cairo in Green City Index

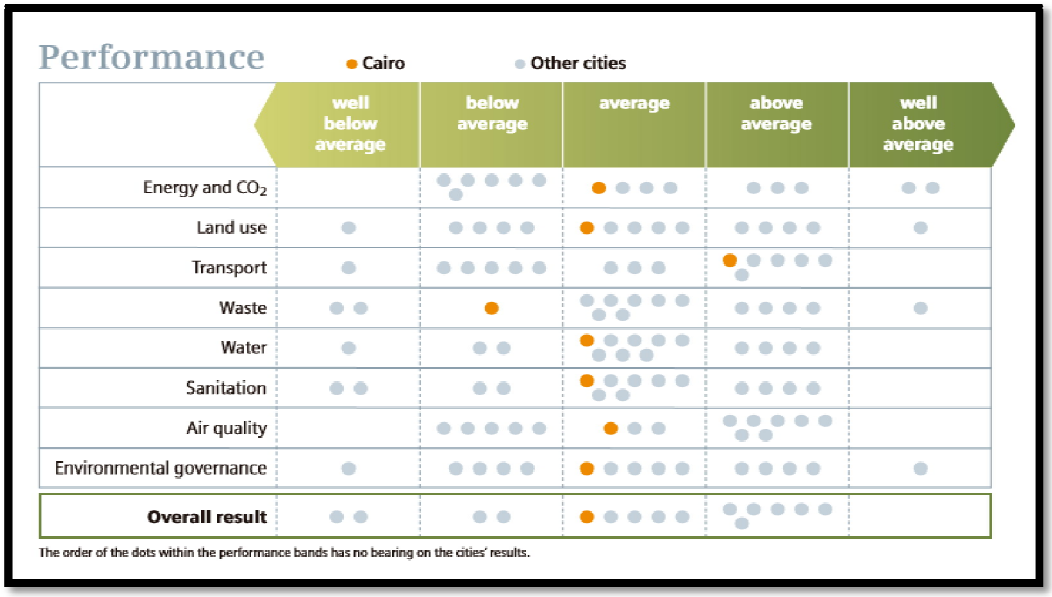

Figure 4: Cairo's Performance

3.1.1. Energy and Co2

According to a UN habitat report, most of the households in Cairo have access to electricity, although the city has failed to put in place structures aimed to conserve energy consumption. It is estimated that Cairo consumes at least 8.0 gigajoules of electric power per capital, in comparison to the Index average of 6.4 gigajoules. Even though there is a high consumption of electricity in the Cairo, the CO_2 emissions are approximated at 477 kg per capita, which is less than half of the Index average of 984 kg. An estimated 70 percent of the Cairo's electricity production is derived from natural gas. In the summer, the consumption of electricity in Cairo increases considerably and this led the government to announce measures to meet the demand as from March 2011. Additional power was to be drawn from generators powered by natural gas. Egypt has planned to increase renewable energy production, which currently accounts for the 12 percent of national electricity production[vii].

3.1.2. Land Use

Considering the high population of residents living in Cairo city, this has put pressure on the land. Based on the estimates, Cairo has 1 square meter of green space person, which falls below 74 square meters as an index average.

3.1.3. Green Initiatives

The Al-Darassa site has served as the city's dumping site for debris and rubble for several centuries. However, in 2005, the acquisition of Al-Azhar Park changed. The park provides a 360-degrees panoramic view of Cairo, and it has largely contributed to the success in the city's planning, prompting an addition of three metro lines. The idea is to encourage private-public investment partnerships. The metro system operating in Cairo has largely contributed to overcrowding and has often proven unreliable. Under the green initiatives, the officials in Cairo have implemented a program to address traffic congestion and reduce pollution from public transport service vehicles. The initiative is spearheaded by Egypt Urban Transport Infrastructure, Recycling Program, and Carbon Finance Vehicle Scrapping. These organizations have received considerable support World Bank. The objective of these undertaking is bringing to efficiency in traffic management system, through fast tracking the construction of six bus rapid transit corridors. The government of Egypt supports a pilot project in the Greater Cairo, which seeks to encourage residents to ride bicycles, through information campaign to encourage bicycle cycling[viii].

3.1.4. Wastes

It is approximated that Cairo produces 457kg waste per person, which is higher than the index average of 408kg. The city of Cairo experiences challenges in management of wastes, especially in poor neighborhoods. The prevalence of informal settlement in Cairo has complicated waste management initiatives. The government has invested in green initiatives, which include transferring 15 million cubic meters of municipal waste. The government has partnered with GIZ, a German government agency, which has helped improve waste management, particularly in poor urban areas within the city[ix].

3.1.5. Water

The city of Cairo consumes an approximated 237 liters of water per capita every day. This exceeds the Index average of 187 liters. Moreover, the quality of water supplied in Cairo is sometimes poor. The affluent families have installed their water filtration system. However, power families cannot afford such expensive system. As such, water borne diseases have become common in poor neighborhoods. Through the green initiatives, the Egypt national government has promoted 12 programs to protect River Nile. Some of the measures adopted include prevention of industrial effluents into the Nile, managing wastes from River Nile, solid waste management, treatment of agricultural wastes, as well as development of a water quality database.

3.1.6. Sanitation

It is approximated that 98 percent of Cairo's population has access to sanitation service. However, no standards have been established in the delivery of these services. As such, some regions have high sanitation standards, whereas other lag behind[x].

The implementation of green initiatives in sanitation have seen Aga Khan Trust for Culture take a proactive role in rehabilitation of water and sanitation of facilities, especially in Darb-Al-Ahmar. Under this program, the sewage services have been extended and the old lead pipes have been replaced with new ones.

Quantitative indicators

Category	Indicator	Average	Cairo	Year*	Source
ENERGY and CO_2	Proportion of households with access to electricity (%)	84.2	99.7 e	2005	UN Habitat
	Electricity consumption per capita (GJ/inhabitant)	6.4	8.0	2006	Egypt Information Portal
	CO_2 emissions from electricity consumption per person (kg/person)	983.9	477.0 1e	2007	Egypt Information Portal
LAND USE	Population density (persons/km^2)	4,578.1	19,083.5	2010	EIU calculation
	Population living in informal settlements (%)	38.0	31.3 e	2005	IDSC Egypt Information and Decision Support Centre
	Green spaces per person (m^2/person)	73.6	0.8 e	2007	CAPMAS
TRANSPORT	Length of mass transport network (km/km^2)	2.7	7.3 2	2008	CAPMAS
	Superior public transport network (km/km^2)	0.07	0.24 2, 3	2008	CAPMAS
WASTE	Waste generated per person (kg/person/year)	407.8	456.9 e	2007	Egyptian Environmental Affairs Agency
WATER	Population with access to potable water (%)	91.2	99.6 e	2005	UN Habitat
	Water consumption per person (litres per person per day)	187.2	237.0 2	2009	OECD
	Water system leakages (%)	30.5	35.0 2c	2007	Egyptian Holding Company for Water and Wastewater
SANITATION	Population with access to sanitation (%)	84.1	98.2 e	2006	Egypt Information Portal

All data applies to Cairo unless stated otherwise below. * Where data from different years were used only the year of the main indicator is listed. e – EIU Estimate. 1) National electricity generation mix used to estimate city level CO_2 data. 2) Greater Cairo area. 3) There are no light rail or BRT lines

Figure 5: Cairo's Quantitative Indicators

3.2. Cairo in the Sustainable City Index ARCADIS (2016)

In this sustainability index, an assessment of the people dimension of urban experience is provided. People are the main focus, because a city revolves around its people and sustainability ultimately improves the quality of life that people live. In this sustainability, the viability of 50 of the world cities is examined. The Arcadis Sustainable cities index ranks 100 global cities using three dimensions: people, planet, and profit.[xi]These three sustainability elements represent the social, environmental, and economic aspects of a city and therefore offer an indicative picture of the health and wealth of present and future cities. The sustainability index shows that cities around the world are not striking an effective balance between these three pillars of sustainability. The majority of cities reviewed in this index demonstrate a split personality by taking a lead in some areas and underperforming in other element of sustainability.

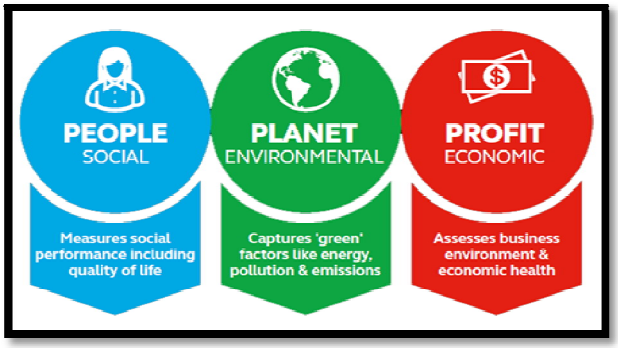

Figure 6: The Three Pillars of Sustainability Are Briefly Explained Below

3.2.1. People

Represents the social aspect of a city and measures how a cityperforms socially and quality of life that the people of the city live. In this sub-index, various social aspects of life are rated and include the following: health, income inequality, education, work-life balance, cost of housing and living, crime, and dependency ratio. These indicators are considered to be reflection of the life quality of people living in a city.

3.2.2. Planet

This sub-index captures the environmental aspects of the city including energy and pollution. In this sub-index cities are ranked based on their on-energy consumption, share of renewable energy, sanitation, recycling rates, drinking water, greenhouse gas emissions, natural risk, and city's green spaces. These indicators are considered to be capture the green aspects of a city.

3.2.3. Profit

This sub-index assesses the environmental and economic aspects of a city. This sub-index performs an assessment of a city from a business angle, transport infrastructure and traffic congestion, tourism, employment rates, GDP per capita, the importance of city in global economy, internet connectivity, and ease of doing business. These indicators are considered to capture the economic health of a city.
Cairo: (Overall Ranking 99): Compared to cities in Europe and United States Cairo is ranked at position 99 and scores poorly across the 3 indices. Find the figure 7 in the appendix part.

3.2.4.The people sub index

Cairo: it is ranked in position 92 in the people sub index. Income inequality is larger followed by crime and then affordability. Word-life balance is also a challenge for Cairo city. Education is also a big challenge for Cairo city among its people. Find the figure 8 in the appendix part.

3.2.5. The Planet Sub Index

In the planet sub-index, it is ranked 93 behind Nairobi and ahead of Chinese and Middle East cities such as Beijing and Wuhan and the Dubai and Doha respectively. In order of reducing performance, Cairo performs better in drinking water and sanitation followed by greenhouse gas emissions, energy, and environmental risks. It records poor performance in water management and very poorly in providing green spaces. Find the figure 9 in the appendix part.

3.2.6. The Profit Sub Index

Cairo city is ranked in position 98 in the profit sub-index only ahead of Indian cities Bengaluru and Kolkata. Elements of profits sub-index in which Cairo performs better include connectivity and tourism. However, compared to other cities Cairo performs dismally in economic development, transport infrastructure, and ease of doing business. Find the figure 10 in the appendix part.

3.3. Choices and Approaches

In the attempt to achieve sustainability in cities, most city authorities tend to adopt techno-centric and technocratic approaches. However, the need to think of sustainability in terms of the human dimension is fast increasing. It has become increasingly important for cities in developing countries to come up with programs that are based on social justice considerations to achieve sustainability. People-centric planning is the new way of doing things in these cities.

In regard to urban ecology, the traditional urban ecological theory is challenged by the need to incorporate and mode human communities as the integral part of the ecosystems. [xii] Hudson and Marvin also suggest ecological and material reproduction to ensure urban ecological security.[xiii] At the local level, cities especially in developing countries are more concerned with infrastructural choices that will mediate the provision of services such as waste removal, transportation, food, energy, and the recreation among others in regard to the socio-cultural and political factors.

With the aspects of green economy, carbon economy, and urban management system, cities have options for transitioning into sustainable future to increase their resilience to the global changes. However, the question facing decision makers is *"how to integrate and coordinate sector-oriented strategies andimplementation programs, and what technologies shouldunderlie their core infrastructure choices?"* UNEP identified and provides five thematic areas that may inform the infrastructure choices that city managers make. These include:

- Building energy efficiency: pressure on the energy sector can be alleviated by having energy efficient buildings
- Waste management; the demand for landfills can be reduced through solid waste management. Waste recycling and re-use can also create jobs and reduce importation of materials.
- Sustainable urban transport; can reduce dependence on oil and petroleum, congestion, and air pollution. It can increase productivity, access and mobility of urban citizens in addition to reducing the urban divide.
- Water and wastewater; water is important for production (agricultural and industrial) and household activities.
- Urban ecosystem management; involves the use of a system that integrates all the environmental impacts of urban activities including all forms of pollution. Land-use change, water quantity and quality and waste management practices are also included here.

4. Conclusion

The world's urban population is expected to hit the 2.5 billion marks by the year 2050. People are continuously moving from the rural areas to the cities for better opportunities and improve their livelihoods. Despite the range of opportunities boasted by these cities, numerous challenges are on the rise, for example, climate change and social segregation that are threatening their economic development. As such, city administrators including Cairo are tasked with the responsibility of adopting emerging models and advanced technologies in order to deliver objectives identified in the urban domain services. Moreover, there is the need to transform their planning, governance and regulatory aspects in a bid to address threats limiting the urban transformation process.

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Appendix

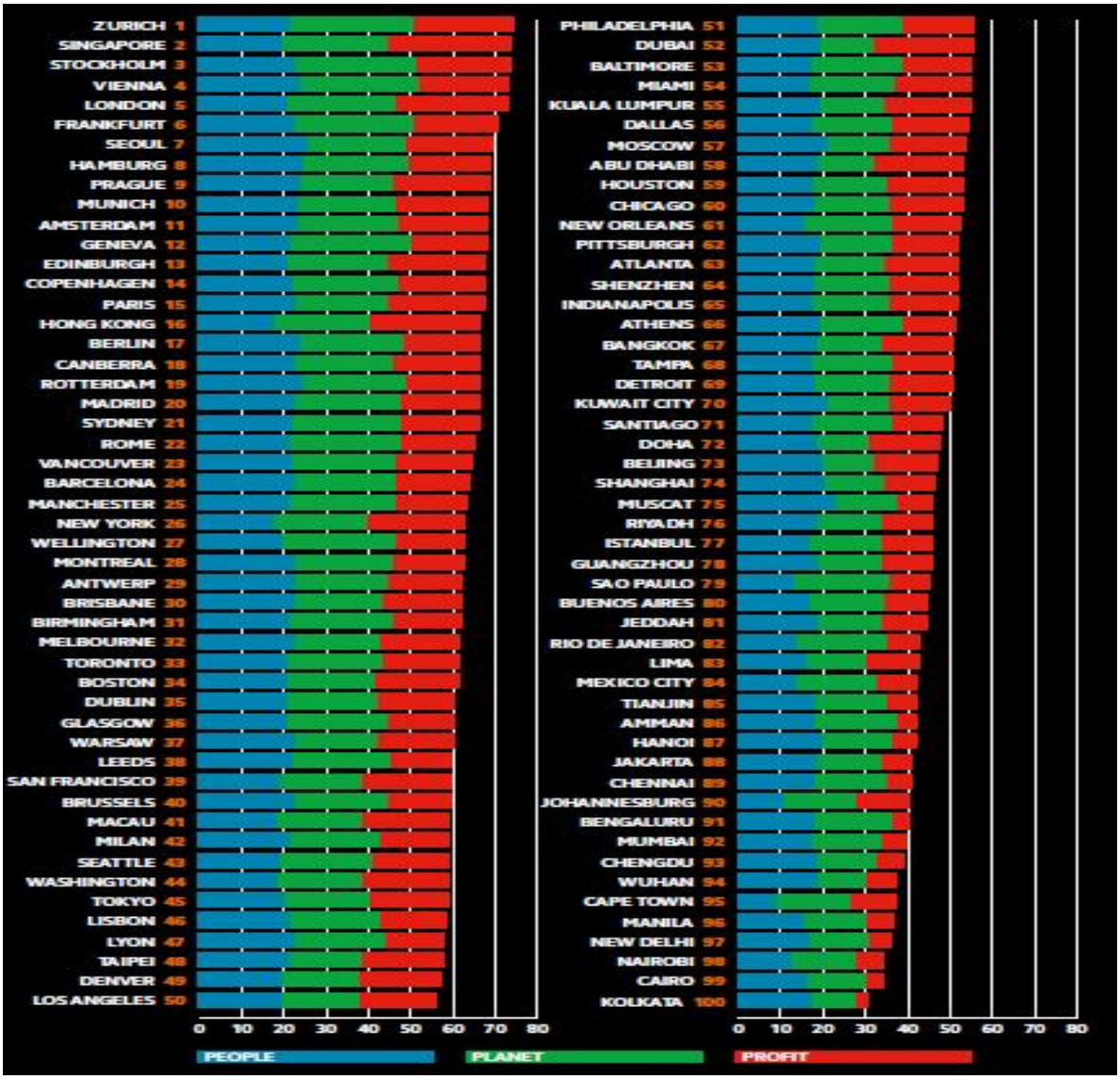

Figure 7: Cairo In The Sustainable City Index ARCADIS (2016)

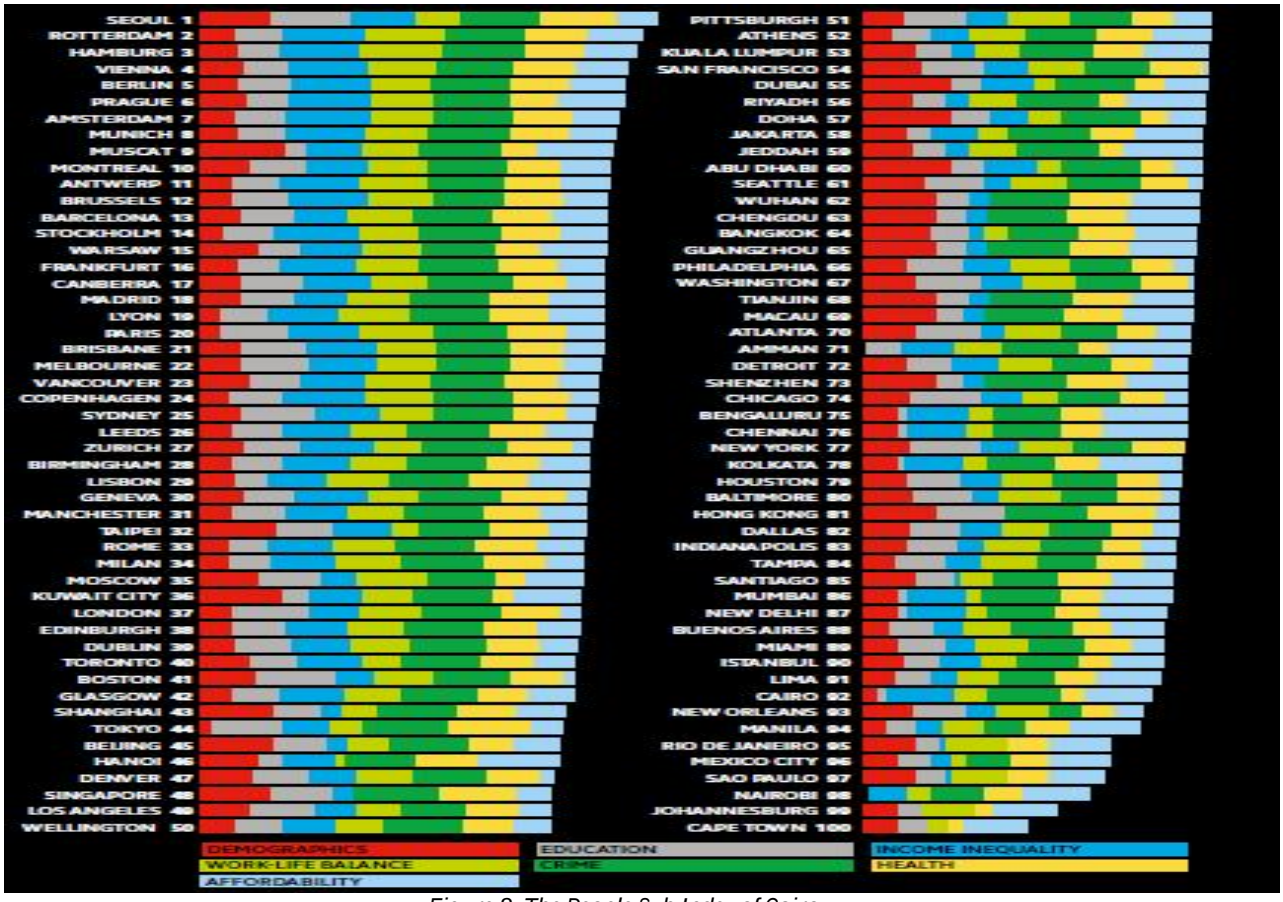

Figure 8: The People Sub Index of Cairo

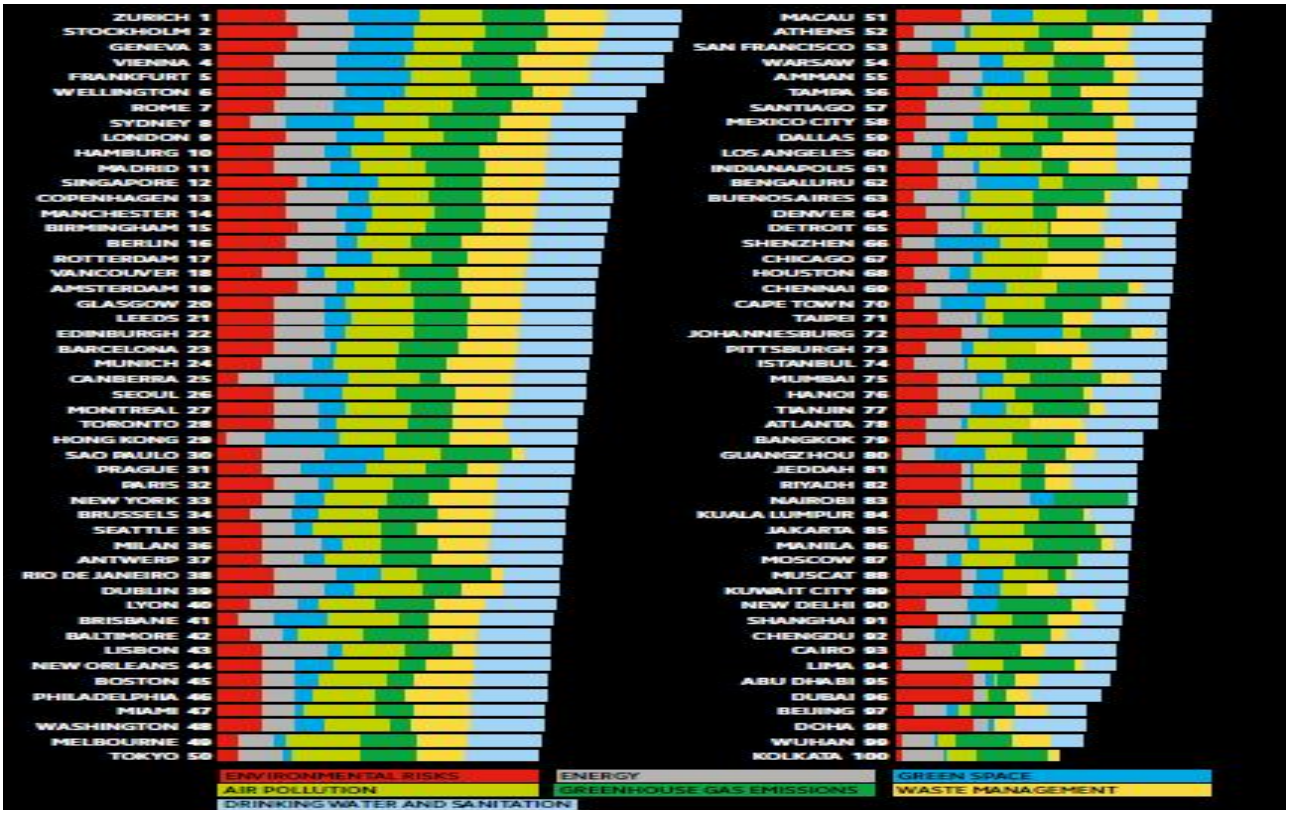

Figure 9: The Planet Sub Index of Cairo

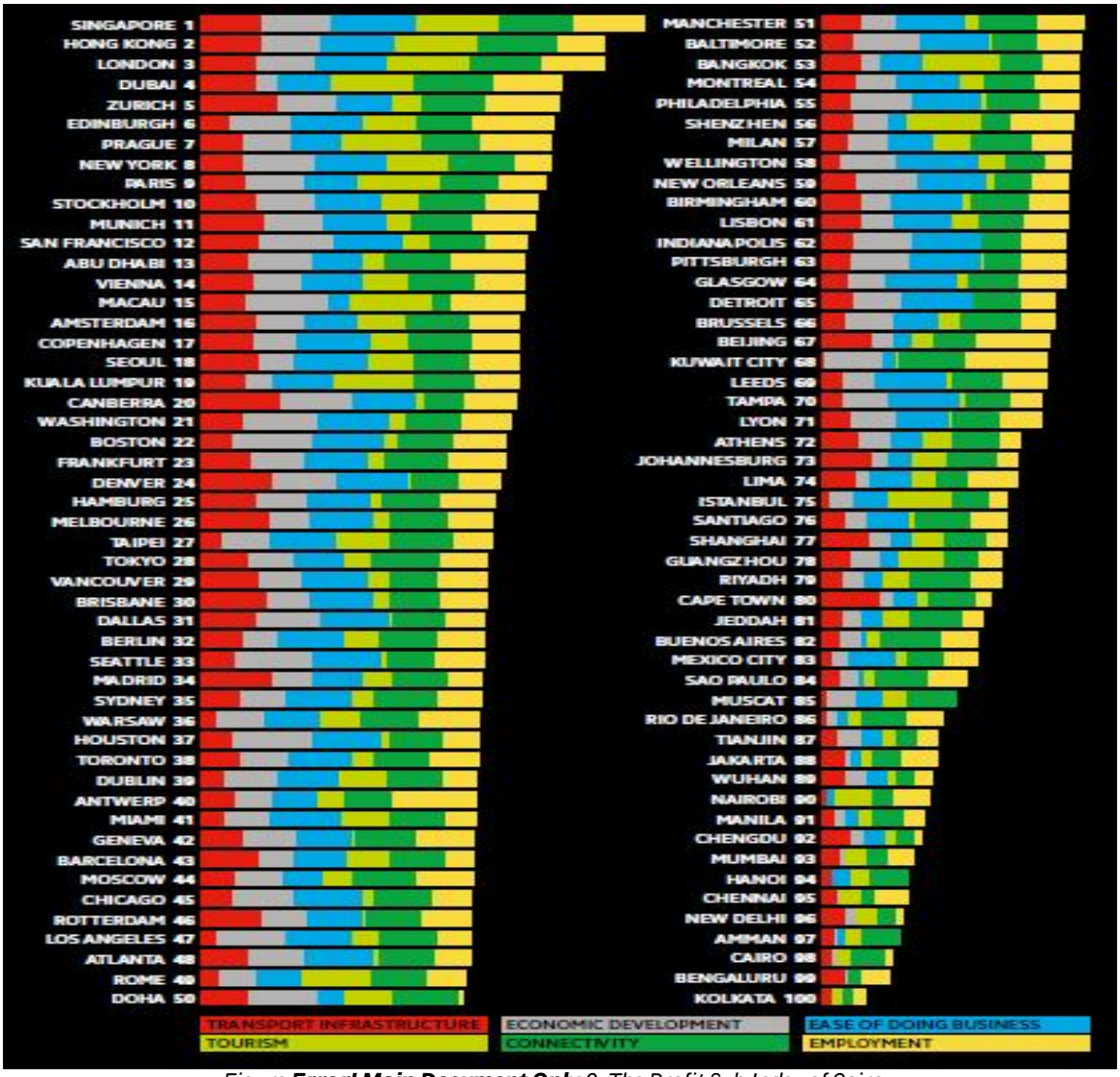

*Figure **Error! Main Document Only.**0: The Profit Sub Index of Cairo*