TOWARDS ENVIRONMENTALLY SUSTAINABLE CITY IN EGYPT
"Challenges and Learned Lessons"

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ABSTRACT

This paper deals with the study of the sustainable city focusing on environmental sustainability through sustainable urban form. The study was intended to offer a comprehensive picture of the challenges for human settlements and improved living conditions today and in the future. The need increases for developing more innovative and new ways, such as sustainable city, for conceiving the urban areas and future built environment'. Sustainable Development and sustainable urban development (SUD) is now becoming the basic concept for sustainable cities solving problems, meeting the acute and systemic challenges and improving the living conditions of people – without neglecting the needs and life chances of the future generations.

The aim of this paper is to conclude lessons from the historic cities and from the present experiences of foreign countries in the context of sustainable cities. The paper is composed of three parts, Fig. 1:

The *first part* discusses the challenges facing world cities in general and Egyptian's in particular, and the sustainable development and sustainable urban design as a tool to achieve Environmental sustainability in cities.

The *second part* reviews the different experiences of sustainable city's urban form, through historic cities and present examples

The *third part* presents proposed actions that help to reach the environmental dimensions of sustainability in the Egyptian cities

KEY WARDS: Sustainable Development, Sustainable Urban form, Environmental sustainable cities

PROBLEM

Urban settlements in all parts of the world are being influenced by new and powerful forces that require governments to reconsider how they manage urban futures. Urban areas in both developed and developing countries will increasingly feel the effects of phenomena such as climate change, resource depletion, food insecurity and economic instability.

Fig. 1- Proposed Structure of the Research (Researcher)

INTRODUCTION

"*The environmental future of the planet is closely linked to the management of our cities, towns and*

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** Anna Kajumulo Tibaijuka, Director UN-Habitat

villages…The relationship between the environment and human settlements is like the proverbial chicken and egg paradox. Good environmental governance requires good urban governance and vice versa**".

Cities, home to 67% of the world's population by 2050[1], serve as a double-edged sword in the context of sustainable development. On one hand, they are important engines of economic growth-producing more than 80% of national income today[2]. On the other hand, cities are vulnerable to a number of social and environmental perils, particularly climate change related risks and other natural disasters.

Cities account for the vast majority of global energy use, natural resource consumption, green gas emissions and solid waste. Egypt remains to rank as one of the highest polluters in Africa after Tunisia and South Africa, producing in 2010 2.3 Giga tons of Carbon dioxide per capita while 10 years before the value was 1.3 Giga tons[3].

There has been a call for governments throughout the world to respond to environmental issues, especially within cities and including: "need to renew older cities; the impact of climate change; carbon emissions; and, depleting resources[4].
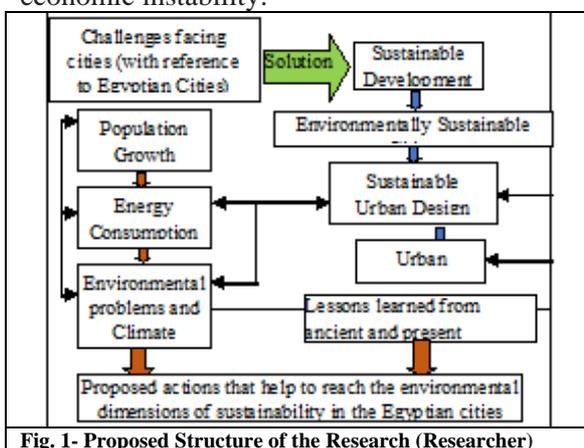
Past experience with development policies in most countries on this planet has shown that they are not capable of dealing with the most important issues for the people and their future. Therefore a new basic approach has been created and has further evolved among experts and innovative decision makers during the last decade: SUSTAINABLE DEVELOPMENT. The Second United Nations Conference on Human Settlements 'The City Summit' held in Istanbul in 1996, set human settlements at the core for achieving *sustainable development*.

1- Present and Future Challenges facing Cities in concern with Egyptian Cities

Egypt faces a broad array of challenges to sustained urban development, which had not been openly put for discussion and debate before, and needed to be identified upfront and highlighted

1-1- Urban growth and population

World's cities occupy about 2 % of global land surface, but they use 75% of the world's resources and release about the same percentage of global wastes. It has already been noted that more than 50 % of the world's population will soon be living in cities, contributing to a massive consumption of global resources[5].

A common problem of today is the fact that the world's population is using up natural resources at a faster pace, then it takes the earth to regenerate it[5]. In addition, the rapid population growth and the increasing urbanization put a strain on governments to manage the flow of people into urban areas. The consequence of these processes generates a stress on the environment as well as the human society[6].

According to the last UN (Fig. 2), population estimate, 60% of the world population is expected to live in urban areas in 2030. Beyond the demographic growth, urbanization is an ultimate cultural process and a key issue for sustainable development[7].
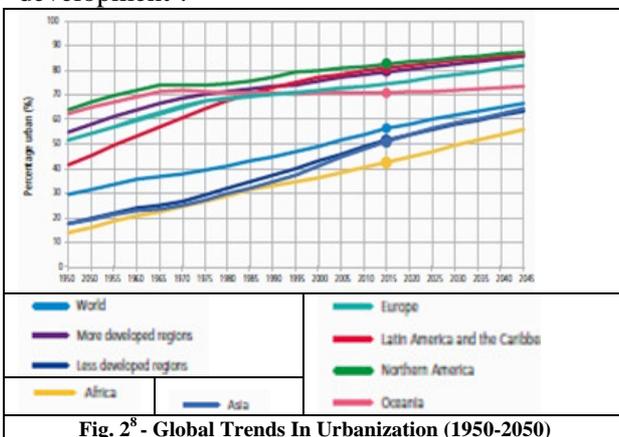

Fig. 2[8] - Global Trends In Urbanization (1950-2050)

Like much of the world, Egypt is witnessing rapid growth of its cities. To date 43% of the population in Egypt lives in 223 cities, of which 56 % are concentrated in the Greater Cairo Region (GCR) and Alexandria. This rapid urbanization represents one of the biggest challenges that face Egypt's urban development[10].A World Bank report stated[11]: *"Egypt is facing a daunting urban challenge.*

In the last fifteen years, Egypt's population increased by 27 million inhabitants to reach over 100 million. Most of this increase occurred within urban areas and in the "urban villages". Consequently, a constant rise in urban population (Fig. 3) and land consumption has led to high demands for energy for lighting, heating, cooling and transport being concentrated in cities.
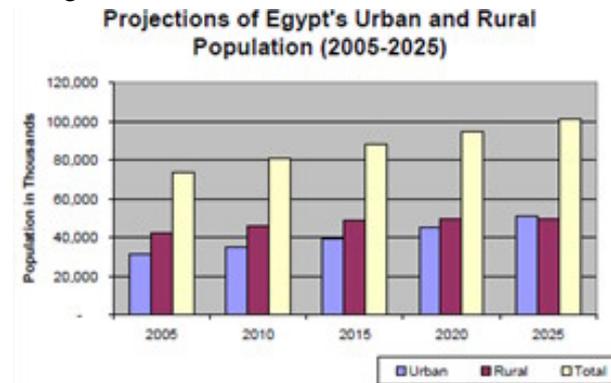

Fig. 3- Projections Of Egypt's Urban And Rural Population (2005-2025)[11]

1-2- City and Energy

Much of the atmospheric pollution is caused by the burning of fossil fuels in the creation of energy to support city life. This energy is used: in the building of city structures (energy capital); during the lifetime of the structure; and in the transportation of people and goods between and within cities (energy revenue). Therefore, the design of cities and the ways in which they are used have a great impact on the natural environment. There is overwhelming support in the literature for the idea that urban planning does matter in determining the level of energy consumption in urban areas. Thus urban planning is an important instrument for promoting sustainable development. Egypt's recent demographic and economic growth patterns make it a near certainty that its energy use and emissions will continue to grow rapidly if there is no change in course (fig.4). The United Nations Development Program forecasts that, based on current trends, energy demand in Egypt will increase threefold by 2030. Conservation measures are thus required, not only to reduce emissions, but also to avert potential energy shortages that may hinder economic development[13].
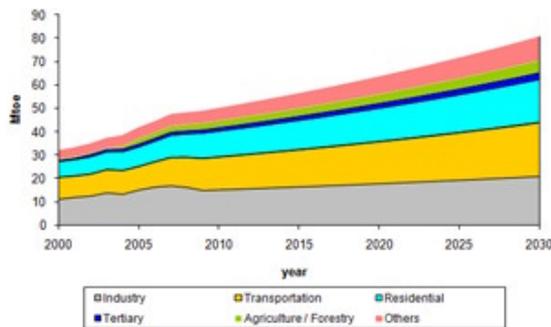
Fig. 4[9]- Total Final Energy Consumption In Egypt (2000-2030)

1-3- Environmental problems and Climate change

Many studies examine the environmental problems that cities suffer from and how these contribute to the degradation of the global environment. Due to rapid urbanization, industrialization and heavy population density along the limited and confined green valley of the River Nile, several environmental problems exist.

Egypt's environmental wellbeing is facing grave challenges as a result of global warming. The most conservative estimates of global sea level rises project that 34 percent of the Nile Delta will be flooded, displacing approximately 7 million people and causing substantial economic damage due to the loss of the fertile soils, according to the Arab Environment Climate Change report[13].

2- Sustainable development

There seems to be widespread agreement that solving global problems means the adoption of policies and programs that lead to sustainable development. Sustainable development has many different meanings. It is a fact that sustainable development is an ideology that has be founded on western grounds and norms of combined social, economic, political and cultural development which delivered a demand on this theme in this part of the world. The origin of the word within the Brundtland report in 1987 marked the beginning of a conquest of the world; *'Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*[14]*'.*

It has reached the developing countries quickly in 1990 with the first report on Human Development by the United Nations Development Program for the Development and the Earth Summit in Rio in 1992; "*sustainable development became a global strategy for planning professionals, architects and development officials to address human developments effects on the environmental crisis*[15]*"* And then the Habitat II Summit held in Istanbul in 1996 which clearly states the priority to improve the living conditions of the city dwellers - a goal set in the heart of the global environmental agenda.

These new guidelines for action have been spread in Cairo and Egypt in general for the last thirty years, as elsewhere in the region, through the multilateral and bilateral aid for development and the construction of global environmental governance involving Arab countries on emerging and world-wide issues like global warming, biodiversity, desertification or deforestation.

3- Environmental Sustainable Cities

One of the earlier references to the term 'sustainable city' is included in Agenda 21, one of the chief outcomes of the United Nations Conference on Environment and Development 1992, which inter alia proposed integrated urban management to ensure that environmental, social, and economic factors are considered together in a framework for the sustainable city. The Sustainable Cities Program was established by the United Nations Human Settlements Program (UN-HABITAT), the agency responsible for the promotion of sustainable urban planning[18].

The concept of the sustainable city first emerged and evolved as Western countries were striving to tackle increasing urban sprawl and environmental issues in the 1970s. The concept, now known as Sustainable Urban Development (SUD), has gained even greater prevalence in recent years, as the world has begun to place increasing emphasis on the importance of controlling the effects of rapid urbanization and climate change[16].

Since the early 1990s, *environmental sustainability* has become one of the most critical areas of concern for sustainable development.The Rio Summit, with its Agenda 21 Principles for Action has inspired urban planners and the Local Agenda 21 movement. More recently, the widely shared recognition of climate change as the new challenge faced by the global and local environment has provided new impetus for consideration of the linkages between the 'brown and green agendas[17]'. The primary goal of environmental sustainability is the maintenance of stocks of natural capital by reducing the need for the use of land, energy, production of emissions and the limitation of inter-regional substance exchange. In the context of this paper, a sustainable city can be described as an urban environment designed with the primary aim of contributing to improve environmental quality.

4- How to achieve Environmental Sustainability for the City?

A city is complex set of intersecting systems, both physical - such as the energy grid and transport network - and socioeconomic - including law enforcement and governance - whose efficiency

and productivity can be improved through strategic vision and modern technology. Based on the literature review the paper concluded that environmental sustainability could be achieved by the following points (from the viewpoint of the researcher):

* Cities should be understood as living organisms with a complex and interconnected metabolism.

* One important notion of a sustainable city is one that understanding it as a complex system, and looking for ways to reduce the size of the flows (e.g., the amounts of energy consumed the amount of solid waste generated). Figure (5) is a system model to compare the characteristics of unsustainable city with sustainable one.

* Collaborative innovation is essential to make the most out of the collective talent of a city.

* It requires vision, strategy and tactics, design of tools and methods, concerted action and communication[7].

*Sustainable cities are green, environment-friendly cities where the absorptive capacity of resources and local environmental systems are balanced. This balance would be achieved by upgrading the resources usage efficiency, and attaining the minimum level of polluted outputs in order to enable the renewal of the ecological system, and preventing pollution by minimizing waste.

* Urban planning and management regimes usually don't take account of these flows, at least in any systemic way.

* Despite the challenges, well managed urban development could give rise to cities more conducive to economic growth and social inclusion, environmentally sustainable and resilient to climate change.

Fig. 5- System Model to Compare the Characteristics of Unsustainable City With Sustainable One.
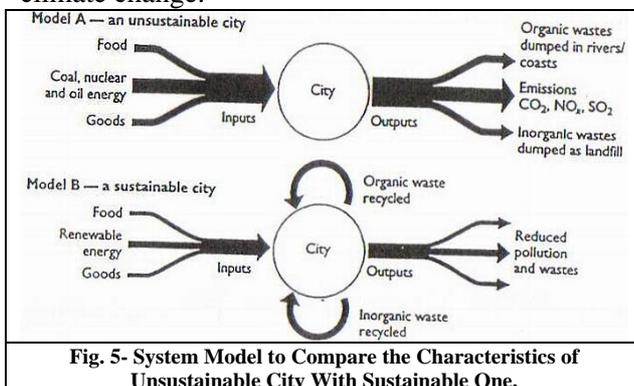
4-1- Sustainable Urban Planning for Environmental Sustainable Cities

The concepts of sustainability and sustainable development have been applied to urban planning and design since the early 1990s[2], thereby the emergence of the notions of urban sustainability

and sustainable urban development. Urban design has a decisive role to play in climate change resilience because it influences activities that lead to GHG emissions and guides patterns of land-use as well as energy use.

On the first point of the Rio Declaration, 1992, identifying in urban design the suitable tool to change and define the structures and land uses compatible with sustainability's principles. It is, in fact, the urban morphology which depends on the ability of sunlight to reach buildings facades and the use of natural ventilation in dwellings, acts directly on urban microclimate, affecting urban energy consumptions.

4-2- Sustainable Urban Form for Environmental Sustainable City

Urban form and land use patterns significantly influence a city's energy consumption and, consequently, its GHG emissions. It is widely believed that physical urban form affects urban transportation energy consumption, and there are numerous studies on the relationship between urban form and transportation energy use.

It is largely agreed that urban design with environmental consideration 'deals with the holistic morphology of the city, as well as with urban details, such as street width, form, configuration and orientation, building heights, city compactness, or dispersion, urban open space, integration or segregation of land uses, and other related physical issues'[5]

Environmental problems have some bearing on the development of sustainable urban form and structure. There are now important and highly contested debates on what forms of urban planning are best suited to dealing with the problems of sustainable development that urban settlements currently face, and will face in the future.

Second part experiences of sustainable cities

4-2-1- Sustainable cities today: Lessons from the past[5]

Various schools of thought tried to explain city form throughout history. Lynch (1960) identified three main metaphors that attempt this task: ***One of them*** comprises the analogy of a city to an organism composed of cells, which is thought to be 'most in tune with the ethos of sustainable development. Early settlements strove for such an approach where, although 'designed and planned, they were constructed to respect rather than override the environment'.

Figure (6) the most important goal of 'organic theory is its holistic view of the city as part of nature', where process and form are one, where:
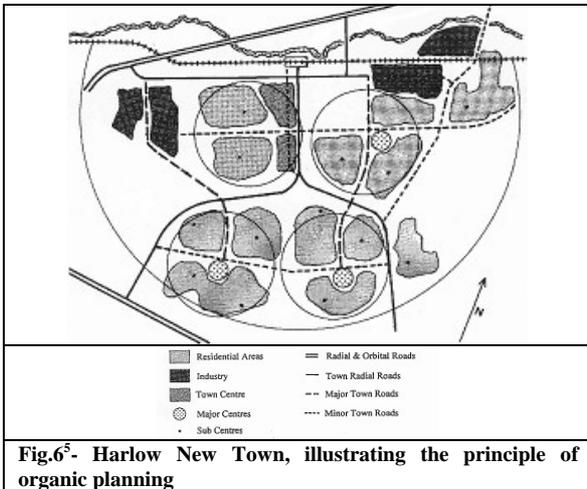
Fig.6[5]- Harlow New Town, illustrating the principle of organic planning

… The pattern is in the seed, at the point of origin… With the sustainable city, pattern evolves from the principles used for the design and linkage of the parts… The urban structure of the organic city is non-geometrical: roads follow a curving path… The limitation, however, of organic cities is that they are not as their organic natural counter parts, self-reproducing and self-healing; the main element for their change is man.

4-2-2- Masdar City: A Model of Urban Environmental Sustainability[21]

Masdar city represents an important advance in the field of sustainable urban design. The city's master planners took inspiration from traditional Arabian city planning. This indigenous design incorporates numerous strategies to address the desert climate. It is characterized by relatively low overall energy consumption. That's because traditional Arabian cities are compact and densely populated. Hence the city has a population density 140 people/hectare and average Environmental pyramid approach was adopted. As this simple pyramid shows, the biggest environmental gains come from the least financial investment: the city's orientation and form. This is equally true of the buildings.

Fig.7: Abu Dhabi & Masdar City - Vision

Masdar City - Core Principles
• Minimize the solar gains   * Maximize the wind flows   • Reduce energy consumption

| **Fig.7.a** - Proper Orientation | **Fig.7.b** - Compact Built form | **Fig.7.c**- Wind Movement | • Minimize the solar gains Maximize the wind flows. • Reduce energy consumption |

Fig.7.d - Open Space Network

RESULTS

Energy Consumption	40% Reduction
Operational Waste	50% diversion from landfill
Construction Waste	70% diversion from landfill
Embodied Carbon in materials	15% reduction in overall construction
Sustainability Rating System	3 Pearl minimum

DISCUSSION

The previous part reviewed two examples of urban forms from the view point of environmental sustainability, the first one from the past experience and the other is a recent one. It is obvious that there is no an ideal form for all regions, countries or cities. Instead, a framework for change is offered, where different places are given the opportunity to define and interpret their own priorities. The first key aspect in both cases has been the

holistic view of the city as part of nature', where process and form are one. The planning of Masdar city has a more holistic approach with well integrated strategies and defined goals such as minimize solar gains (Fig.7.b), maximize air flow through the proper orientation of the city streets (Figs. 7.a, 7.c) and reduce energy consumption. The second has been inspiration from traditional city planning. There is a noticeable difference between pleasant micro-climate in the Masdar city's narrow streets, in comparison to rest of the country.

Part three
5- Proposed actions that help to reach the environmental dimensions of sustainability in the Egyptian cities

To achieve a more sustainable urban design, the aim should be to reduce the lifetime environmental impact of any development by reducing the energy and resources used and waste produced at each stage of the development life cycle – construction, occupation and, if necessary, demolition. This can be achieved by making any development both in its original construction, and throughout its lifetime, as self-sufficient as possible[22].

From the viewpoint of the researcher, it is can be achieved through a holistic, integrated approach depending on the collaboration between the governmental, civic and educational organizations to implement a conscious policies and environmental legislation.

It is recommended that concern for energy efficiency should be felt by planners, urban designnners and architects at an urban neighborhood scale, where intervention is made possible rather than enforced.

6-1- Urban Policies
* Urban policies have very serious implications with regard to future levels of greenhouse gas emissions and use of most resources in each nation which is related both to the design and construction of urban buildings and the spatial form that cities and urban systems take[23].

* Urban policies should consider all measures to radically reduce the environmental shadow of cities.

... The well-governed city must establish a clear vision, where all policies and programs contribute to high-quality urban development. In partnership with its citizens and its business leaders, the city authorities have a flexible city-wide strategy which brings together core economic, social and environmental objectives. It is, therefore, a city characterized by strong political leadership, a proactive approach to spatial planning, effective management, and commitment to improve its skills base[7]'.

* Policy formulation should be comprehensive, able to adapt to evolving development needs, and incorporate incentives that promote wide-ranging stakeholder coordination and participation[16].

* The success of policy implementation depends upon the close cooperation between various groups of society, and between policy-makers and stakeholders; thus, research–community policy interfaces should be highlighted and encouraged.

* Sustainable urbanization is multifaceted, and it is for this reason that national urban policies must look at urban development through multiple lenses such as Planning and Design, Urban Economy, Housing and Services, and Governance.

6-2- Legislations and laws addressing environmental issues
Urban legislation must be enforced, not just enacted; solve problems instead of creating some more; set out clear, unambiguous, comprehensive, reliable and well circumscribed rules, for the sake of easy, inexpensive implementation and access.

6-3- Strengthening Planning Education to achieve sustainability
Education for sustainable development must be high on the agenda of cities, governments and international organizations in Egypt. The initiative "Hamburg is Learning Sustainability" makes Hamburg an inspiring role model. Hamburg, Germany's second largest city and Europe's second largest port, has 13% parks and 7% nature reserves. In 2006, Hamburg was the first city in Germany to be awarded the title "Official City of the UN Decade Environment for Sustainable Development 2005–2014".

Conclusion
Cities in all parts of the world are being influenced by new and powerful forces that require governments to reconsider how they manage urban futures. Urban areas in Egypt will increasingly feel the effects of phenomena such as climate change, resource depletion, food insecurity and economic instability. Recently more attention has been given to urban sustainability because these human-made settlements are the source of air, water, and land pollutions and the main consumers of natural land, food, and energy.

Environmental Sustainable city is the way for conceiving the urban areas and future built environment. The second part of the paper investigated the achievement of environmental sustainability for the city with regard to the sustainable urban planing and sustainable urban form.

Reviewing different experiences of sustainable city's urban form, through historic cities and

present example, it is concluded that:

* There is no one single solution exists. Instead, a framework for change must be offered, where different places are given the opportunity to define and interpret their own priorities.

* The Urban form that facilitates shorter commutes significantly reduces energy consumption and consequently carbon footprint.

* Sustainable cities are often the outcome of good governance that encompasses effective leadership; land-use planning; jurisdictional coordination; inclusive citizen participation; and efficient financing. Appropriate building codes

The third part of this paper discussed proposed actions help to reach the environmental dimensions of sustainability in the Egyptian cities. The researcher suggested that it important to adopt a holistic, integrated approach depending on the collaboration between the governmental, civic and educational organizations to implement a conscious policies and environmental legislation.

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