Towards Smart Urban Areas in Western Desert in Egypt: Kom Ombo – Aswan Axis as A Case Study

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1. Introduction:

Urban development projects in Egypt are generally based on the idea of urban expansion in unpopulated areas outside the narrow Nile Valley with considering preserving agricultural lands from urban sprawl. Therefore, many development plans supported the establishment of urban communities in the Eastern and Western deserts. In addition, many national development projects in Egypt have been approved to establish new smart cities, such as Galala Plateau development project, New Administrative Capital, and New El-Alamein City project, which is one of the fourth generation cities with its distinguished location, which can be considered Egypt's gateway to Africa. The current strategy to establish new smart cities in Egypt opens broader horizons that can contribute to increase in economic growth, improve the quality of life for citizens, provide many direct and indirect job opportunities, improve services, preserve the environment, encourage investment and activate the real estate market. Many research studies confirmed the readiness of Egyptian cities for the ideas of digital transformation and the creation of smart and sustainable urban areas. The analysis of the current situation in Egypt, which was carried out by the research paper entitled “Smart Urban Design in Egypt: Potentials and Challenges” in 2018 clarified the availability of many potentials that pave the way for the implementation of many development plans based on the idea of integrating technology and applying smart solutions to solve many of the current problems, as shown in Figure (1).

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Figure 1: The current potentials of achieving smart governance in Egypt

2. Research aim:

The current research paper clarifies the definition of smart urban area and the six main dimensions of designing this type of areas. This paper focuses on the proposed development and reconstruction corridor in the Western desert and the potential of developing its transversal axes by creating smart and sustainable areas which consider the required balance between the available potentials and the current constrains and do not focus only on the use of modern high technology but also ensure that the suggested solutions are appropriated to the local context in terms of social and cultural determinants in order to ensure efficiency and continuity of these solutions. The research paper supposes that in the case of Egypt which occupies only 5% of its total area, the smart urban design should be used as an approach for establishing sustainable communities in deserts. In addition, the proposed development and reconstruction corridor in the Western desert represents one of the available opportunities and future scenarios which can be utilized to realise the research hypothesis.

This research paper aims to set certain strategies to develop Kom Ombo – Aswan which is one of the transversal axes of the proposed development and reconstruction corridor in the Western desert. Strategy is dynamic in nature, and it is more comprehensive than a plan because it has a wide scope and looks at the end result, indicates a long-term effort, and is evolving over time. Therefore, the research paper tries to translate strategies into proposed scenarios that describe alternative future possibilities with an indication of the expected results from them, which requires a great ability to analyse and know the influencing factors before developing plans and implementing projects.

3. Discussion:

- **Smart urban areas**

Smart urban areas can be defined as vibrant places in which electronic systems and modern technologies are employed in developing elements of urban spaces to provide amenity, flexibility, ease of use and information in an attractive urban setting that targets a wide range of users (youth - children - the elderly - people with special needs). A smart urban area is an area that takes into account the balancing act between physical reality, social reality, and continuous technological development. Successful smart urban design must respect the goals of sustainable economic development and achieve high quality of life for citizens through the wise management of available resources, the achievement of investments in human and social capital and the development of energy infrastructure "Electricity-Gas", which indicates the importance of achieving integration between smart and sustainable urban design. Smart urban design is a way to develop traditional ideas of urban design so that they become more capable of meeting the urban needs of citizens (the goal) through the use of information and communication technology (the method) and data collection and analysis (simulation) to determine the variables of smart urban design.

There are six main dimensions of smart urban areas which are; Smart economy, smart management, smart mobility, smart environment, smart user, smart life. There are three main goals of smart urban design which are; Sustainability, efficiency of urban systems, and quality of life. Technology in itself is not a goal in designing smart urban areas, but rather an aid that works to improve the efficiency of smart urban projects. Intelligence in designing urban areas is a relative process that differs from one region to another according to different social and economic determinants and contexts.

- **The development and reconstruction corridor in the Western desert**

The Western desert was selected to establish the proposed development and reconstruction corridor based on the study of the terrain and the available potentials for development, as this area adjacent to the Nile Valley extends from a flat plateau with a slight inclination from south to north, it does not intersect with sand dune lines, and the solar radiation increases in it. The great amount of solar energy and the speed of the wind can be used in the generation of renewable energy in the future. The development and reconstruction corridor is represented by 1200 km highway parallel to the Nile River connecting El Alamein on the Mediterranean coast to the borders with Sudan. The road will contain a railway, water pipeline, and a power line, and it will link twelve cross axes to the cities on the Nile Valley, as shown in Figure (2). The current paper focuses on Kom Ombo-Aswan axis and how to incorporate the principles of smart urban design in the strategies of developing this axis with the aim of creating sustainable and smart communities in the Western desert.

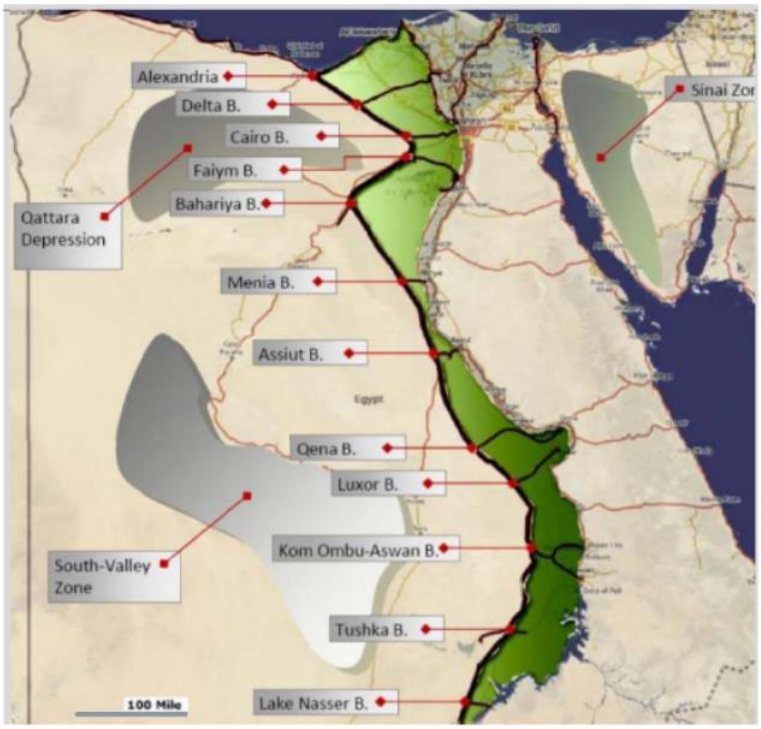

Figure (2): The transversal axes of the development and reconstruction corridor

Kom Ombo-Aswan axis is divided into two branches; a northern branch of Kom Ombo, with a length of 91 km, and a southern branch of Aswan, with a length of 58 km, separated by Mount Barqa. The lands located on the axis west of the city of Aswan are flat, as it is a wide plain separating the course of the Nile River from the Western Desert Plateau. The Kobaniya Valley passes in the middle of the plain, which was connected to the Abu Sabira Valley, which lies east of the current Nile course. All these sites are suitable for agriculture and can be developed in the east and north of Mount Barqa, especially since the area used to receive surface water in the past, and al-Kobaniya Valley was pouring into it, as well as the Nile passed through its east. These properties indicate that there is a great potential for agricultural activities using ground water. The potentials of the Kom Ombo-Aswan axis can be summarized in Figure (3).

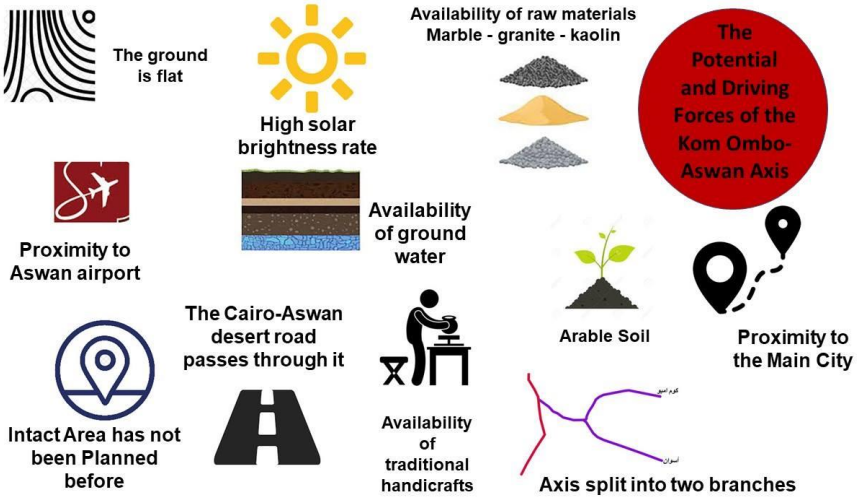

Figure (3): The main potentials of Kom Ombo- Aswan axis

- **A methodology for establishing smart urban areas in Western Desert:**

The suggested methodology for establishing smart urban areas in Western Desert is based on a group of criteria which can be classified as following:

- Criteria for selecting the types of projects to be established in the transversal axes of the suggested development corridor:

These criteria include the available potentials and opportunities, the availability of employers to manage and operate projects, the needs and requirements of the region and the goals that society seeks to achieve in the future, the sustainable performance of projects to ensure continuity for long periods of time with the same effectiveness and efficiency, enhance the competitive value in order to attract experts to participate in the development of these projects and measure the indicators of cost, profitability, marketing and consumer satisfaction about the products and the project's role in serving the community and its ability to persuade investors to invest their money in these projects , achieving integration and harmony between the various projects to ensure their management in a balanced manner, taking into account the expected environmental impact of the project on the surrounding sites, the expected impact of the project and determining the needs of energy sources as well as visual features, the impact on the visual image of the region, whether positive or negative.

- Criteria for selecting the appropriate site for the proposed projects:

These criteria include; land topography and soil characteristics, the prevailing climate in the region, wind directions and their impact on neighbouring areas, the proximity of the site to the sources of raw materials to reduce transportation costs, the proximity to energy sources and the quality of available energy sources, the proximity to road and transportation networks, the availability of services and basic infrastructure in the area, the possibility of future expansion such as the availability of free lands.

- **Kom Ombo-Aswan Axis: Suggested Scenarios:**

For developing Kom Ombo – Aswan Axis, this research paper suggests four potential scenarios according to environmental data, the prevailing activities and the results of studying the determinants and potentials which are available in the region as shown in figure (4). Scenarios can provide a reference guide for planners because they describe a possible future situation, probable or desirable, based on the existing situation or an assumed initial position. Therefore, the scenario technique is a probabilistic analytical method that enables the researcher to track or monitor the process of development of events and phenomena up to scenarios that can be changeable, as they are not considered fixed solutions, but they are flexible in proportion to the developments that may arise during the stages of experimentation, training and preparation, so it is an appropriate technique for forward-looking research that depends on long-term future plans. The current research paper proposes four scenarios that can be applied to reconstruct the Kom Ombo-Aswan axis, as illustrated in the following tables. The provision of housing services, the provision of infrastructure, and the integration of information and communication technology were considered a common factor in all scenarios.

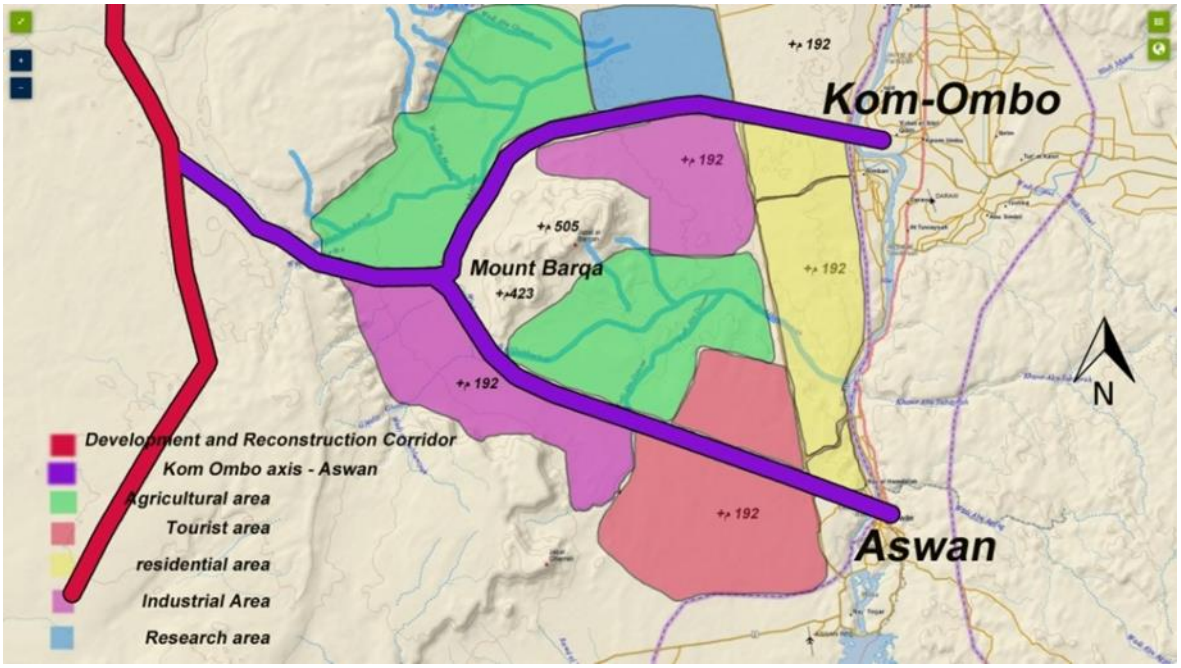

Figure (4): The suggested land uses for developing Kom Ombo – Aswan axis in Western desert

Table (1): The first scenario for the development of Kom Ombo – Aswan axis: Components - objectives - components - mechanisms

The first scenario: The suggested agricultural project	
Potentials	•The area used to receive surface water and Kobaniya Valley poured into it. These are indications of the existence of underground water in this area. •The lands are mostly flat and have faults that can carry water from the Nile's path. •Using the satellite thermal images, it was found that there are large faults and underground water paths parallel to the Nile River and towards the western plateau •The land is suitable for growing all agricultural crops due to the fertility of its soil and the appropriate degree of salinity.
Aims	• Creating advanced agricultural area based on the efficient use of natural resources, especially water resources • Achieving sustainable food security and attracting efficient human resources to work and live in this region to serve as a nucleus for future social development. • Reducing production risks by using techniques of forecasting or simulation in order to expect production outputs and planning for their distribution. • Encouraging resettlement and investment. • Developing the tourism and economic movement, facilitating financing and marketing procedures, and developing the agricultural or rural tourism program. • Providing the required infrastructure to establish the agricultural project. • The use of modern technologies in irrigation and cultivation of various crops.

Components	•Farms producing various crops. •Fertilizers and pesticides stores equipped with sensors to know the required quantities. •Stores for tools and machines. •A unit for recycling agricultural waste and producing biofuels. •Vocational centers that carry out simple processing of agricultural and animal products. •A veterinary unit for animal follow-up. •Center for agricultural research and technology for desert land reclamation.
The suggested Techniques	•The use of smart self-driving agricultural vehicles equipped with "GPS" sensors. •The use of devices and sensors to map agricultural lands, discover problems and monitor changes that occur to them. •Using a system to monitor water quality and irrigate crops according to their need for water. •Using sensors to monitor soil components, light and wind, and monitor and detect pests and diseases. •Use of equipment to monitor agricultural equipment and facilities, and monitor and control the validity of machinery. Implementing programs to support contract farming, waste recycling, developing rural projects, and enhancing the role of women in agricultural development issues.

Table (2): The second scenario for the development of Kom Ombo – Aswan axis: Components - objectives - components - mechanisms

The second scenario: The suggested agricultural project	
Potentials	•Archaeological and heritage potentials, whether in the West Aswan region, Kom Ombo, or in the Jabal Barqa area. • Proximity to Aswan International Airport. • Availability of flat lands far from crowded places. • Proximity to the western desert road. • Proximity to Benban Solar Power Station. • The environmental and geographical features of the region.
Aims	• Developing the tourism movement and employing traditional Nubian industries and handicrafts. • Activating the concept of creative tourism. • Promoting medical, historical, cultural and recreational tourism. • Activating the participation of women in the production of tourism goods and the provision of various tourism services. • Encouraging partnerships between the public and private sectors. • Supporting tourism marketing and promotion, and using GIS applications and modern technologies in marketing tourism sites.

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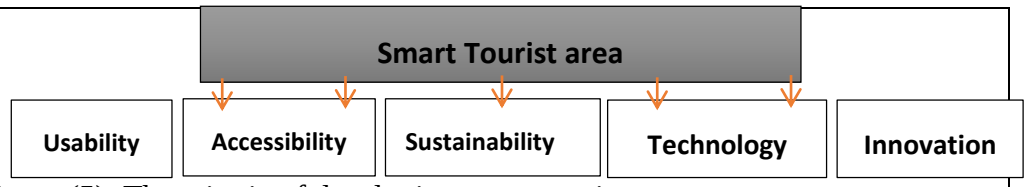
<tr><td></td><td> 

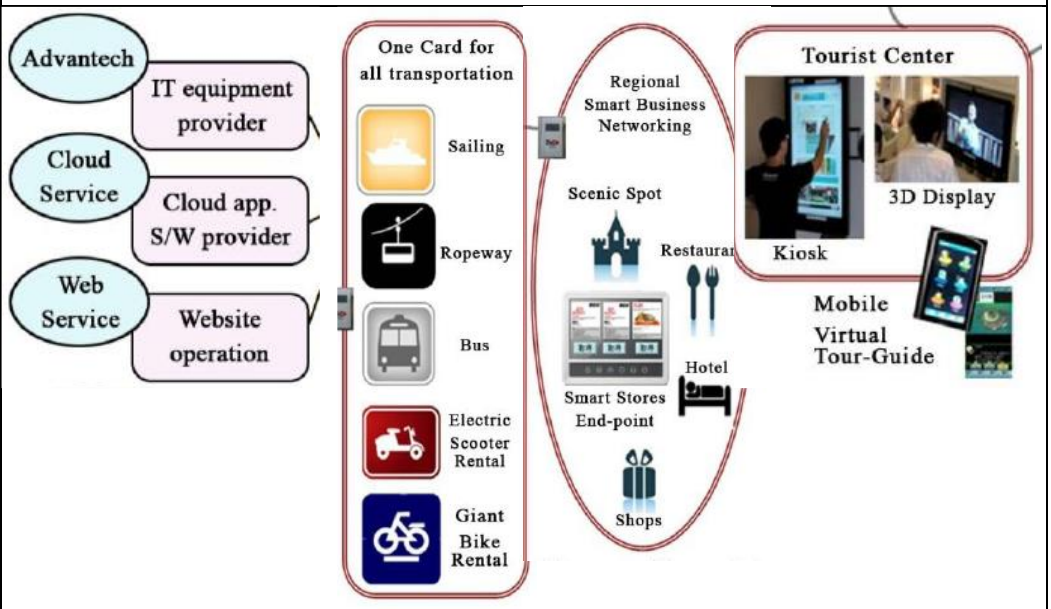
Figure (5): The criteria of developing smart tourist area</td></tr>
<tr><td>Components</td><td>•Tourist hotels of different categories that respect the Nubian and Pharaonic architectural styles.
•Various types of smart hotel establishments that respect the local character of the region.
•Medical resorts and tourist centers.
•Commercial centers to provide the needs of tourists and workers.</td></tr>
<tr><td>The suggested Techniques</td><td> 

Figure (6): Smart techniques of tourist areas

•Applications on smart phones for hotels, resorts, and medical treatments on the axis.
•Applications that support digital maps to facilitate mobility and movement in the region and provide information on shopping places and museums.
•Activating and using "VR" virtual reality technologies that allow tourists to roam and live a distinctive city experience.
•Interactive screens to guide users and learn about tourist areas, restaurants, universities and events.
•Sensors for irrigating green areas in resorts and public parks.</td></tr>
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Table (3): The third scenario for the development of Kom Ombo – Aswan axis: Components - objectives - components – mechanisms

The third scenario: The suggested industrial project	
Potentials	• The availability of raw materials near the area, as shown in Figure 11. • Proximity to Aswan International Airport and the Western Desert Road. • The area's proximity to the main city (Aswan), so light industries converge with the urban structure. • Away from residential areas. • Observing wind direction and preventing fumes from reaching residential and tourist areas. • Proximity to the Benban Solar Power Station area. • Proximity to Faris Solar Power Station. • The land is flat and devoid of plains and heights.
Aims	• Supporting economic development and integration between different activities. • Enabling the private sector and small investors to demonstrate their creativity. • Integration between large and small factories and encouraging local investments. • Attracting different age groups and increasing and diversifying job opportunities. • Achieving and implementing environmental protection standards. • Sustainable use of natural resources and wealth.
Components	• Factories based on extractive materials such as marble and granite. • Specialized factories for tourism supplies, hotels and fishing boats. • High-tech factories that manufacture electrical and electronic products, and factories and workshops for traditional handicraft industries. • Solar cell factories near Benban and Faris for solar energy. • Equipment and machinery factories, factories for the manufacture of solar panels and plants for bio-energy. • Food factories that process, package and freeze vegetables and fruits and extract vegetable and aromatic oils. • Waste recycling factories and workshops. • Shopping center.
The suggested Techniques	• Creating a multi-modal smart model transport corridor. • Using advanced applications that coordinate between factories within the industrial area and exchange information and resources. • Factory owners' awareness of the benefits of networking and the use of information and communication technology.

Table (3): The fourth scenario for the development of Kom Ombo – Aswan axis: Components - objectives - components - mechanisms

The fourth scenario: The suggested research project	
Potentials	• Proximity to residential areas. • Proximity to Benban and Fars Solar Power Station. • The land is flat in this area. • Proximity to Aswan International Airport and the Western Desert Road.
Aims	• Creating a research nucleus in the field of solar energy. • Activating and encouraging scientific research. • Contributing to the development of various industries. • Attracting different age groups and increasing and diversifying job opportunities. • Producing creative ideas and programs that develop social values and improve the quality of life. • Encouraging innovation and entrepreneurship, and this is done with the participation of leading institutions and companies in the world of innovation.
Components	• Benban Solar Energy Zone. • Technology and agricultural schools and schools for solar energy systems. • Educational institutions and research centers in a variety of fields, such as an agricultural information center. • Halls for conferences, workshops and seminars. • Exhibitions specialized in various scientific fields. • Technology incubators. • A residential area serving different groups of society. • Shopping center.
The suggested Techniques	• Communication between the different research centers, the private sector and businessmen. • The participation of the administration or the government in developing ideas and directing research. • Providing human and financial support. • Providing the appropriate buildings, devices and laboratories that researchers need with a high level of competence and readiness. • Organizing science, technology and innovation events and forums to support competition. • Using simulation programs to predict various changes. • Establishing a network of smart roads and lanes that serve the project. • Create a network of lanes for walking and cycling. • Use of interactive screens to guide users. • The use of sensors for irrigating green areas in public gardens. • The use of sensors to save energy and control the general lighting level. • The use of various applications, sensors to control waste disposal and collection.

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