

Urban Growth and Its Environmental Impacts: *Case of the Nile River, Egypt*

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Abstract

Rapid urbanization worldwide has given rise to many economic and environmental issues particularly in developing countries like Egypt. This study aims to discuss the current situation of urban growth in Egypt focusing specifically on the Nile Valley and its vicinity. Ninety-five per cent of the population lives in close proximity to the Nile River valley, which is one of the most vital non-renewable resources in Egypt. In this research, the current situation of urban developments of the Nile river in Egypt, its national threat to the Nile River valley and its rich arable agricultural lands have been examined through relevant literature review. It is known that rapid growth of settlements along the Nile has been documented since the inauguration of the high dam project in 1968, making it safer for the settlers to reside closer to the river. As a result of this review paper, we provide important recommendation on how to overcome and prevent further urban escalations within the region.

Keywords: *Urban Growth, Socio-Culture Impact, Environmental Impact, Physical Impact, Nile River, Egypt*

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Introduction

During the 1990s, the world's urban population expanded from 2.4 to 3.2 billion individuals with intensive urban development (Setchell, 1995). Up to 95% of the 800 million extra individuals migrated to live in urban areas during the 1990s are from those countries which are considered a developing nation. Not only is urban development increasing rapidly a number of the large cities worldwide have developed into Megacities (Population > 10 million residence). Megacities behave as motors for financial and social development; however, the vast majority of this development coincides with increased poverty and environmental degradation (El Araby, 2002). It is estimated that by 2050 an extra 3 billion people will be residing in urban settlements, an unmatched wave of urban development (McDonald, R. Green P. Balk, D. Fekete, B. Revenga, C. Todd, M. Montgomery, M., 2011). Urbanization of riverine areas is a common phenomenon due to the assets that they provide, which include food, water, and a source of energy, with their flood plains providing level land suitable for development and transport. However, a considerable number of the world's waterways have been negatively affected by urbanization. Such urban developments have paid little attention to their environmental impacts usually oblivious to, or neglecting their ecological functions. Thus, urbanization is viewed as one of the most dramatic modifications of the ecosystem (Everard and Moggride, 2012). This happens through actions such as; expansions for impervious surfaces, channel alteration, the detachment of rivers and flood fields, high water extraction and increased contaminant inputs. These actions have led to the deterioration of all urban river systems to such an extent that some rivers stop being a viable natural resource or providing services which first made the area attractive for settlement. As freshwater ecosystems continue to be degraded and destroyed around the world, human culture is losing the wealth of environmental benefits which a healthy fresh water system provides (El Araby, 2002).

The Nile delta of Egypt is one of the most established agrarian areas in the world and has been under ceaseless development for about 700 years. The total cultivated region of the Nile delta is 1,828,840 hectares representing 56.5% of the developed regions of Egypt (Shalaby, 2012). The historical backdrop of human settlements in the Nile valley dates back to the discovery of agriculture in the sixth millennium B.C. Since then, the locals started building and concentrating their urban settlements around the Nile valley, next to their farms and an accessible source of clean water, while in the same time creating a steady and homogenous financial and living conditions along the Valley (Figure 1).

However, these conditions have fundamentally changed during the last 200 years, with the introduction of the industrial revolution and its impacts on Egypt during the mid of the nineteenth century. From that point onwards, large scale transportation, agricultural, irrigation, industrial and urban projects have been built along the Nile Valley. One of the main projects that had unprecedented impacts on the Nile Valley was the creation of the railway line that was built between Cairo and Alexandria, followed by a second line which was built along the Nile Valley. This gave rise to 12 new Nile Valley cities, all connected by these rail links (AbouKorin, 2018). The persistent expansion of population density exerts more pressure on

territories already occupied and causes a reduction in area per capita from 0.12 ha in 1950 to 0.06 ha in 1990 and to 0.04 ha in 1990 (Ghar, Shalaby, Tatesishi, 2004). Around 95% of the Egyptian population (84 million in 2012) lives on the scarce agricultural land of the Nile valley and its delta, endangering the highly prolific agricultural land. With a population density of 1500 occupants per km², it is thus far the most populated delta on the planet (Redeker & Kantoush, 2014) (Figure 2).



Figure 1. Main urban and regional development features of Nile Valley in Egypt (Map of Ancient Egypt).



Figure 2. Map showing the current new settlements along the Nile River on google earth map.

The aim of this paper is to discuss the rate of urban expansion along the river Nile and its effect on the environment. With this research the current situation of urbanization along the Nile River has been assessed and discussed.

Material and Methods

A literature review was performed on urban growth and environment, particularly focusing on urban rivers. A total of 16 literature items were reviewed (Figure 3). Additionally, all the relevant governmental documents were also reviewed, new settlement areas has been evaluated by using “google earth” tool.

Author's Name	Publication Date	Location	Title of Manuscript
Antar A. Aboukorin	2018	Egypt	Spatial Analysis of the Urban System in the Nile Valley of Egypt
Dona J. Stewart	1996	Egypt	Cities in the Desert: The Egyptian New-Town Program
Fekri A. Hassan	2010	Egypt	The Dynamics of a Riverine Civilization A Geoarchaeological Perspective on the Nile Valley, Egypt.
Hala, A., Effat, A., El Shobaky	2015	Egypt	Modelling and Mapping of Urban Sprawl Pattern in Cairo Using Multi-Temporal Landsat Images and Shannon's Entropy
John D. Milliman, James M. Broadus, Frank Gable	1989	Egypt and Bangladesh	Environmental and Economic Implication of Rising Sea Level and Subsiding Deltas: The Nile and Bengal Examples
Mustafa El Araby	2002	Egypt	Urban Growth and Environmental Degradation
Fahim, M., Elkhail, F., Hawela, H., Zaki, K., El Mowelhi, M. N., Pax Lenney M.	1999	Egypt	Identification of Urban Expansion onto Agricultural Lands Using Satellite Remote Sensing: Two Case Studies in Egypt.
Mark Everard and Helen L. Moggride	2012	Worldwide Assessment	Rediscovering the value of Urban Value
Mohamed Aboel Ghar, Adel Shalaby, Ryutaro Tatesishi	2004	Egypt	Agricultural Land Monitoring in the Egyptian Nile Delta using Landsat Data

Figure 3. List of the reviewed literature items.

Author's Name	Publication Date	Location	Title of Manuscript
Mohammed E. Hereher	2012	Egypt	Analysis of Urban Growth at Cairo, Egypt Using Remote Sensing and GIS
Pranab K, Roy Chowdhury, Budhendra L. Jacob, J. Mckee	2018	Egypt and Taiwan	Estimating Urban Areas: New Insights from Very High-Resolution Human Settlement Area
Richard L. Church and Thomas L. Bell	1988	Egypt	An Analysis of Ancient Egyptian Settlement Pattern Using Location-Allocation Covering Models
Robert I. McDonald, Pamela Green, Deborah Balk, Balazs M. Fekete, Carmen Revenga, Megan Todd, Mark Montgomery	2011	Worldwide Assessment	Urban Growth, Climate Change, and Freshwater Availability
Shalaby, A.	2012	Egypt	Assessment of Urban Sprawl Impact on the Agricultural Land in the Nile Delta of Egypt Using Remote Sensing and Digital Soil Map
Yidi Xu, Le Yum Yunyuan Zhao, Duolend Feng, Yuqi Cheng, Xueliang Cai, Peng Gong	2017	Egypt	Monitoring Cropland Changes Along the Nile River in Egypt Over Past Three Decades (1984-2015) using Remote Sensing
Zhi-Yong Yin, Dona J. Stewart, Stevan Bullard, Jared T. Maclachlan.	2005	Egypt	Changes in Urban Built-up Surface and Population Distribution Patterns During 1986-1999: A Case Study of Cairo, Egypt.

Figure 3 cont.. List of the reviewed literature items.

Results

Egypt has been battling to adapt to its quickly developing population. Egypt's dense and quickly developing population is restricted to a narrow strip of arable land along the Nile River (Stewart, 1996). Based on historical research and spatial analysis, the Nile Valley gained more importance and became a vital source for agriculture and irrigation, when the high dam project was completed in 1968. It did not only affect the surrounding Nile Valley cities but Egypt as a nation. The new high dam project was the main provider of electricity for the country (54% in 1978), as well as act as a protector from occasional floods that was caused by high in water level, which became mitigated by the dam, providing a year round agriculture opportunities and more flexibility in urban settlement development regardless of the topography or proximity to the river, therefore the local inhabitants preferred to live close to the river, and this caused urban expansion along the river (AbouKorin, 2018). Even though there are joint efforts to promote decentralization towards the desert in order to protect the arable and agricultural land, a loss of 2% in cultivated land has still been seen. This shows that the urbanization efforts have failed in its main task of decreasing the loss of agricultural land, and gaining more land areas through desert reclamation projects. At the same time the land that is being lost along the Nile valley is rich arable land which should be preserved for agricultural activities, whilst the newly reclaimed land which is nutrient poor requires huge investments and inputs in order to have the same productivity as the Nile Valley arable lands (Ghar, et al, 2004).

There is high urban population density in the central part of the Nile Valley (As-suit, Sohag and Akhmim, Qena and Luxor) with around half of the urban population of the Nile Valley (48%) situated in this sector; at the same time only 37% is found in northern segment, and c. 15% in southern division. More noteworthy greater Cairo has extraordinary effect on the north of Nile Valley, stretching out for around 215 km into the valley (AbouKorin, 2018).

Nevertheless, there are laws forbidding construction on agricultural land, however, due to the fact that there was a dramatic increase in population growth and immigration, it became very hard to enforce such laws. This led to an urban sprawl in and around cities. So without proper organization and collaboration with the government, the best way the migrants or the new settlers found was to create informal settlements, which became the solution for the city's lower and middle classes. In the ten years between 1986 and 1996, the demographic growth rate of informal settlements reached 3.4% per year compared to the 1.1% in formal districts (Effat, Mohammed, El Shobaky, 2015).

Due to the lack of enforcement and the unprecedented rapid informal urbanization which followed the 2011 revolution, the Nile delta is now turning into a highly vulnerable coastal region. An assessment in one of the coastal and valley cities suggested that a sea level rise of only 50 cm would demand the evacuation of more than 2 million people who would have to abandon their homes (Redeker and Kantoush, 2014).

The cultivated area in Egypt remained more or less the same for centuries (Giegengack, 1968). Today the arable land along with water scarcity is decreasing while the population is rapidly increasing. This is opposite to the situation 60 years ago, when Egypt was more or less self-sufficient, producing almost all of its agricultural commodities apart from cereal, oils and sugar. Moreover, currently the dynamics of informal settlements exceeded the expected area of lost agricultural land induced by sea level rise due to population increase. This will subsequently cause a negative effect to the market incentives on agricultural goods. Urban expansion is projected to be more of a threat to agricultural land than climate change, and it is a threat to the entire delta, claiming from around 12,500 to 25,000 km². Almost 10% of arable land in the Nile Valley and Delta has already been lost to largely informal urban developments. If urban growth is not monitored and restricted and the developments continues as it has for the last 20 years, the arable land along the delta will be lost in less than 120 years. A huge defector on the growth of the new desert cities is public transportation, which is a key element and motivator for decentralization that is yet to receive the appropriate level of infrastructure funding (Redeker and Kantoush, 2014).

It is important to recognize the status and value of urban ecosystems and the services that they provide, as well as those adversely impacted in the per-urban region and along extended supply chains. Restoration of severely degraded urban

river ecosystems is a priority, and avoiding future harm through new development projects, which will in turn be restorative to the river ecosystems and its biodiversity, ensuring human health and wellbeing (Everard and Moggridge, 2012).

Conclusion

When we examine the articles published so far or look at the landscape matrix maps published from the past to the present, it has been determined that many new settlements have been opened along the river. A different approach can be informed to the public on the importance of safe guarding and rehabilitation of urban rivers, as a way to enhance and improve many aspects, such as health, biodiversity, value creation and broad range of policy interests, other than putting it only as an “environmental issue.”

The government needs create a powerful campaign to tackle urban growth and all the aspects that come with it, in order to solve these national problems. Another solution could be to decentralize activities that would release stress on overcrowded areas, while identifying the current urban system in order to plan correctly for the future. This can be carried out by performing a spatial analysis of Nile valley cities. However, during the process of decentralization, houses which are generally informal or poorly planned are left standing and empty. This may mislead researchers, leading to inaccurate analysis and results. To overcome such problems, a fully coordinated approach with other sectors is vital.

Starting the national physical planning program as soon as possible will prevent the loss of productive agricultural lands. It is known that the importance of protecting wetland ecosystems is increasing day by day all over the world, especially in the improvement of global climate change. In this context it is inevitable to protect the Nile River with scientifically supported initiatives and implement conscious rural development programs around it.

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