American Journal of Sciences and Engineering Research E-ISSN -2348 – 703X, Volume 4, Issue 5, 2021



The influence of Climate and Geological Constraints on the Selection of Sites for New Cities in Egypt – An Applied Study on the New West Assiut City

Mayada Abd EL Kader Abd Al Aziz¹; Mohamed Embaby²; M.A.M. Mahmoud³

¹Faculty of art, Geography department, Port Said University, Egypt
²National Water Research Center, Egypt
³Nuclear Materials Authority, Egypt

ABSTRACT: Thinking about establishing new cities in Egypt away from the narrow border of the Nile valley and the delta, began in the last three decades. The aim of establishing them was to create new civilized cities, to redistribute the population away from overcrowding and congestion in order to reduce pollution extends urban axes and links them to the Nile valley.

Whereas the influence of climate and the different geological features of the importance of choosing the sites of new desert cities, it was necessary to study these factors and indicate the extent of their impact on the selection of sites for these cities.

The new west Assiut city, which is located on the airport – durnka road and near Assiut airport, is one of the areas within the arid region characterized by increased temperature and evaporation on the one hand, wind activity, dry surface, fluctuation of rainfall and scarcity of vegetation cover on the other hand, and lower and adjacent surface due to the activity of sand and its exposure to the risk of floods from the third hand, making it one of the areas prone to many climatic and desert problems.

The research is to study some of the geological features prevailing in the study area, as well as using the space visualization, ArcGis program to identify climatic and hydrological problems to develop appropriate solutions.

Keywords: New west Assiut, Drunka, Hydrology, Astra, Geological factors

I. INTRODUCTION

The geological, geomorphological and climate phenomena that characterize the areas of the new cities in Egypt have a great influence in the selection of these sites for the establishment of new urban communities. There are natural and human factors that cause the risks on the new cities sites such as floods, rise in temperatures, formation of atmospheric depressions, and geomorphological shapes of the main course of the valleys and its tributaries.

The changes in climatic elements for a long time such as temperature, humidity, wind, solar radiation and precipitations are important for all our life, which including production of crops, general healthy, management of water, land resources, activities of human, and energy and its resources. [1], [2], [3].

During the Pleistocene age, climate of the Nile basin varying from wet to dry. The dry conditions event is continued onward from 5000 years ago until today. This coincided with land retrogression due to removal of plant coverage and also to human dominion on vegetated areas [4].

Climate changes are one of the issues that top the agenda of news and international conferences come after the events of torrential rains, floods, collapses, earthquakes, volcanoes and other geological phenomena, which dominated on the human safe life.

Floods are one of the natural hazards that threaten the cities and villages adjacent to the desert hinterland, causing heavy losses in lives and destruction in possessions. Floods are mostly produced by gathering heavy rain, which flow through mountains and valleys, and its push towards cities and villages causing destruction for anything in its path, so countries must take into account these conditions for building dams in order to avoid any problems that the residential and agricultural areas may face when choosing new urban and industrial areas.

This study used three forms of data; the first being numerical data, which is satellite imagery (ASTER digital altitudes), the second is non-numerical data, which consists of topographic, geological, hydrological maps and meteorological data from the global website of the National Center for Environmental Forecasting (NCEP) [5]. The meteorological data are obtained from the global website of the National Center for predicting environmental number six monitoring stations meteorological covers the entire study area.

II. THE STUDIED AREA

The new city of west Assiut is located on Drunka- airport high way nearing the Assiut airport. Its bounded between latitudes, 27° 01 48.9" and 27° 06 7.1"N and between longtitudes, 31° 03 36.5" and 31° 06 53.3"E (Fig.1).



Fig. (1): location map of the new west Assiut City, Egypt

III. GEOLOGICAL AND GEOMORPHOLOGICAL FEATURES

The lithological unit of the studied area is limestone rocks (Drunka and Minia formations), which belong to lower Eocene age (Fig. 2). Drunka formation is composed of thick, creamy, highly fossiliferous bedded of chalky limestone. It is contains mudstone, carbonate, wackestone and flint bands. Red soil, karst breccia, and calcit are several dissolution deposits have developed in Drunka formation. Minia formation is composed of well-bedded of grey marine limestone. The studied area is covered by recent surface sediments, such as; gravel, aeolian sand, reddish soil, and reddish breccia[6], [7].



Fig. (2): Geologic map of the new west Assiut City, Egypt

Geomorphologically, the studied area is a part from plateau, which extends along the Nile Valley at the western desert. The linear or semi-circular limestone hills having 5 to 30 m in height are spreading on the surface of plateau (Fig.3). The studied area has small, dry drainage wadies drained into the Nile Valley. Another type of limestone hills are mainly consist of conglomerate, which concentrated in the eastern part that displays a turtleback pattern, rising between 3m and 8m (Fig.4).



Fig. (3): Limestone hills of the new west Assiut City, Egypt



Fig. (4): Cover from conglomerates in the new west Assiut City, Egypt

The slope map (360°) represents a tool for calculating the direction of the slope or gradient and its amount in degrees in a clockwise direction, starting from the north with zero and ending towards the north in a full 360° cycle. Figure (5) shows the trends of the studied area in relation to the four main directions in addition to the subsidiary directions, and indicates the steepest zones. This map is possible to determine the wind directions and its type for each part of the studied area, and determine its impact on the establishment of economic projects.

The map showed that the flat areas represent about 90% of the studied area, which can be divided according to the main and secondary directions. The classification of erosion processes from deep to shallow, according to the direction and type of wind is useful to identify all the factors affecting the determination of land uses.



Fig. (5): Slope map (360^o) in the new west Assiut City, Egypt

The contour map of the studied area is of a great importance map to in determine the sites of various residential and industrial constructions areas, and locations of dams and reservoirs, and calculating their capacity, as well as its used in leveling lands.

The contour map gives accurate comprehensive data on the surface of the land, such as identifying the different terrain shapes from rugged to flat. It is also contributes with the geological map in studying the soil and its types. Figure (6) shows the highest lands are located in the northwest of the study area, while the flat lands in the east and south part.



Fig. (6): Contour map showing the high and the low lands in the new west Assiut City, Egypt.

IV. CLIMATE

The climate of Egypt is widely different from hot climate in Upper Egypt region to Mediterranean climate in the northern coastal area. From the six meteorological stations covers the Assiut governorate (Fig.7), it is clear that the changing in temperatures are played important role in the rates of seasonal rainfall and relative humidity.



Fig. (7): Location map of Six meteorological stations cover the Assiut governorate, Egypt.

4.1-Temperature

The annually wide variations of the temperatures are commonly observed in arid area. The inconstancy of temperatures consequently affects the life activities in soil, as well as the soil chemical processes such as the dissolution and solubility of soil compounds.

The average of maximum temperatures through ten years (2004-2014), was the highest rates through the 2010 than the others (Fig. 8 & Table 1). The maximum temperature is distinguished by the fact that there is homogeneity and little differences occur in temperature degrees, so the annual average temperature sometimes were ranged between 29.24°C to 30.55°C.



The average of minimum temperatures through the ten year (2004-2014) was ranged between 12.86°C to 14.05°C (Fig. 9 & Table 2). The minimum temperature is distinguished by the fact that there is homogeneity and little differences occur intemperature degrees.



4.2-Relative humidity

One of the most important climatic factors, is the relative humidity, which has an important role in human life. The coastal areas of the delta is like to the Western Mediterranean coast climate, while the Nile Valley has a low relative humidity, high temperature, high evaporation, and little rainfall [8].

The average of relative humidity through the ten years (2004-2014) (Fig. 10 & Table 3), were the highest rates through the 2011 than the others. The relative humidity is distinguished by the fact that there is homogeneity and little differences occur in its percent, so the annual average rate sometimes is ranged between 36%- 41%.



4.3-Solar radiation

El-Hussainy (1992), presented that the global solar radiation of Egypt fall to 0.7% yr⁻¹, due to the natural increase in cloud amounts, and anthropogenic activities [9].

The distribution of large values of solar irradiation (Fig. 11 & Table 4) shows the annual average hourly global irradiation (2004-2014) for the six stations of Assiut governorate. The figure and table show that there are homogeneity distribution values of global irradiation at the studied area. The radiation is distinguished by the fact that there is homogeneity and little differences occur in degrees, so the annual average of the solar radiation is ranged between to 23.46 to 25.18 kw/m².

4.4-Winds

Egypt is the mainly a desert area, therefor the speed and the direction of winds are very important as climatic factors. Two different winds directions in Egypt are found; NW- NE winds at the north coastal areas of Egypt, which mainly is coming in summer and SW – NE winds from the south of Egypt [8].

The average annual speed of northwest and southwest winds in the studied area is ranged between 2.09-2.22m/s, from 2004 to 2014 (Fig. 12 & Table 5).

Sandstorms sometimes occur in the spring and autumn seasons, called the Khamaseen winds, along the northern African coast [10]. These winds accompanied with a jet stream, therefore, the relatively high topography in the north and northwest of the studied area plays an important role in reducing the influence of winds.

American Journal of Sciences and Engineering Research

Solar

radiance

(kw/m²)

23.55

23.50

23.49

23.46

23.53

23.45

23.71

23.60

23.52

23.76

25.18



Wind	Years	Wind(m/s)	Τ
2014 2004	2004	2.22	1
2012 9% 2012 9% 2010 9% 2010 9% 2009 9% 2008 9% 2007 9% 9% 2007 9% 9% 2007 9%	2005	2.20	
	2006	2.13	1
	2007	2.09	1
	2008	2.14	
	2009	2.09	
	2010	2.17	
	2011	2.13	
	2012	2.04	
	2013	2.19	
Fig. (12) & Table (5): The average of winds values of ten years (20	04- 2014	2.15	1
2014) from six meteorological stations at the studied area.			

V. HYDROLOGY

5.1-precipitation

The precipitation (rainfalls) is exists and low on the narrow north coastal areas of Egypt. The rainfalls vary from 0mm/y at the desert areas to around 200 mm/y at the northern coastal areas [11]. The maximum of the total annual precipitation of 401mm was recorded in Marsa Matruh during 1994 [12]. During October 2016 at Ras Gharib city, a heavy rainfall event with strong storms caused a flood disaster at the oil production area [13]. In Assiut governorate, the strong flash flood path has a bad history since a flash flood occurred in November 1994 caused to at least 200 people were killed in Durunka village [14].

Based on the availability of the rainfall data (2004–2014) obtained from six meteorological stations at Assiut area, Figure (13) and table (6), show that the annual average precipitation ranged from 0.001 to 0.080 mm/y.

American Journal of Sciences and Engineering Research



5.2- Drainage basins

In this study, the morphological characteristics of the extracted network digital data of remote sensing are used to estimation, description, assessment, forecasting and identifying the relationships between morphological factors of drainage basins and the risk of flooding with its impact environment. The severities of the floods depend on various factors, such as morphological drainage basins, geological conditions, weather and climate.

To the west of the Nile Valley at Assiut governorate, there are linear depressions, which extend up to more than 30km and ranged between 100 m to 10km in width [15]. Some of these depressions are called valleys, which their orientation is NW-SE causing catastrophic flood (Fig. 14).



Fig. (14): Wadi depression at the studied area.

According to the morphological factors for all drainage basins at the studied area, and then have been identified prone sites for torrential rains and floods, where classified as relatively in terms of risk as high, medium and low. The eastern main basin, which covers approximately 90% of the studied area, is considering the dangerous basin (Figs. 15).



VI. CONCLUSION

The studied area is nearly rainless, and ranging from semi-arid to strongly arid climate. The changes in climate is a very important in several countries around the world in particular the urban development. The climate changes include the risk of flash floods and increasing temperature as well as decreasing crop productivity.

The studied area is a suitable region for urban development because it characterized by a good climate, flat desert area and safe for flash floods, beside it is near to the Nile valley.

VII. RECOMENDATION

From this study, we recommended that must be establish the numbers of small dams at the out border of west new Assiut City to ward off the dangers of flash floods.

VIII. REFERENCES

- [1] Chen WY, Suzuki T, Lackner M (2017) Handbook of climate change mitigation and adaptation. Springer International Publishing Switzerland. <u>https://doi.org/10.1007/978-3-319-14409-2</u>
- [2] Omambia AN, Shemsanga C, Hernandez IAS (2017) Climate change impacts, vulnerability, and adaptation in East Africa (EA) and South America (SA). In: Chen WY et al (eds) Handbook of climate change mitigation and adaptation. Springer International Publishing Switzerland, pp749–799. https://doi.org/10.1007/978-3-319-14409-2_17.
- [3] Wesseh PK Jr, Lin B (2017): Climate change and agriculture under CO2 fertilization effects and farm level adaptation: where do the models meet? Appl Energy 195:556–571
- [4] Issawi, Bahay, Francis, Maher H., Youssef, El-Sayed A.A., Osman, Rifaat A., (2009): The Phanerozoic Geology of Egypt: a Geodynamic Approach, second ed. Ministry of Petroleum and The Egyptian Mineral Resources Authority Special Publication 81 Cairo, p. 571.
- [5] Weather. gov> The global website of the National Center for EnvironmentalForecasting (NCEP).

- [6] Said, (1981): The Geological Evolution of the River Nile. viii + 151 pp., 73 figs. Berlin, Heidelberg, New York: Springer Verlag. Price DM 148.00; U.S. \$68.90. ISBN3 540 90484 0.
- [7] Klitzsch, Eberhard, List, Franz K., Pohlmann, Gerhard, (1987): Geologic Mapsof Egypt, € 1:500,000 Scale: the Egyptian General Petroleum Company (EGCP) and Conoco Coral, Asyut, Luxor, and El-saad El-ali Sheets
- [8] Abdel Meguid M (2017): Key features of the Egypt's water and agricultural resources. In: Negm AM (ed) Conventional water resources and agriculture in Egypt, Handbook of Environmental Chemistry, Springer International Publishing AG. <u>https://doi.org/10.1007/698_2017_41</u>
- [9] **EI-Hussainy FM (1992):** Climatic features of surface radiation budget components over Egypt IRS'92'. Current problems in atmospheric radiation, 3±8 Aug. 1992, Tallin Estonia.
- [10] UNESCO, (1977): Map of the global distribution of dry regions, Paris
- [11] Abdel-Shafy HI, El-Saharty AA, Regelsberger M, Platzer C (2010): Rainwater in Egypt: quantity, distribution and harvesting. Mediterr Mar Sci 11(2):245–257
- [12] Gado TA (2017): Statistical characteristics of extreme rainfall events in Egypt. In: Twentieth international water technology conference, IWTC20. Hurghada, Egypt
- [13] Elnazer AA, Salman SA, Asmoay AS (2017): Flash flood hazard affected Ras Gharib city, Red Sea, Egypt: a proposed flash flood channel. Nat Hazards.<u>https://doi.org/10.1007/s11069-017-3030-0</u>
- [14] Hedges, (1994): 200 Egyptians die when blazing fuel floods their homes, NewYork Times, A8.
- [15] Brookes, I.A., (2001): Possible Miocene catastrophic flooding in Egypt's Western Desert. J. Afr. Earth Sci. 32 (2), 325e333.