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Impact of Ethiopian Renaissance Dam and Population on Future Egypt Water Needs

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Abstract: *The Nile River is the main source of water for most regions of Egypt, water needs is a function in population and the various uses of water. The objectives of this research is study the impact of the Ethiopian Renaissance Dam on the Nile Rive, to study future population of Egypt Governorates, to link population with the location using Geographic information system and to manage water resources and utilization. Egypt Governorates has been selected as the study area. Proposed research methodology based on using the available information about the population which can be obtained from the census , statistics and local records in order to estimate future population by using the appropriate mathematical models. Also, geographic information systems and administrative border has been used to produce population maps and population density maps in the level of the ggovernorate. The obtained results showed that the construction of the Renaissance dam and will have a negative impact on the water resources of Egypt, especially the period of filing the dam. Population estimation is very essential for decision maker to use it in supporting planning processes. Management and protection of this vital source of water of Egypt is essential.*

Keywords: *GIS; water recourses and utilization; Population growth; Mathematical approach*

I. INTRODUCTION

On April 2011, The Ethiopian governorate decided to build the Grand Ethiopian Renaissance Dam (GERD) or the Millennium Dam (i.e. El-Nahda Dam in Ethiopia) "(Tesfa BC., 2013; GERD Fact Sheet; 2014). The most important river in the world the Nile is 6,671 km long. The Grand Ethiopian Renaissance Dam located in the Benishangul-Gumuz Region of Ethiopia, about 45 km east of the border with Sudan. At 6,000 MW, the dam will be the largest hydroelectric power plant in Africa when completed at 2017(IPoE, 2013). The establishment of the Renaissance Dam on the Blue Nile, up 145 and a storage capacity of 74 billion cubic meters floccus height of 50 meters and a power plant capacity of 6000 MW and the planned completion of the project in 2017 to be generating electricity in late September 2014. The project costs $ 4.78 billion that the concern of the dam can run individually do not take into account the interests of downstream countries. The river basin covers about 11 African countries. Nile basin countries are facing mainly rapid changing economies and population, strong socio-economic dependency on water, absence of basin-wide management and others. This leads to increase water demand, increase energy demand and more effluent flows into water bodies (NBI, 2012). The White Nile provides approximately 40 percent while Blue Nile or the Ethiopian tributaries provide about 60 percent of the Nile's water at Aswan dam in Egypt (Mohammed El Bastawesy, S. et al., 2015). Egypt's main source of fresh water is the Nile River. There is the lack of gauges on the Blue Nile in Ethiopia, which means that data on the flow of the Blue Nile is inadequate (Tesfa BC., 2013; GERD Fact Sheet; 2014). The river supplies 55.5 billion m^3 of freshwater every year by the agreement between Sudan and Egypt since 1959 (Abdin A, Gaafar I., 2008). This represents 97% of all renewable water resources in Egypt. Average rainfall in Egypt is estimated at 18 mm or 1.8 billion m^3 per year. Furthermore, Egypt has four different groundwater aquifers: the Nile Aquifer, the Nubian Sandstone Aquifer, the Moghra Aquifer and the Coastal Aquifer. Many researchers have been studied in detailed Water recourse and water utilization of Egypt. Water balance of the river Nile has been studied according the Egyptian Minister of Water Resources and Irrigation (MWRT., 2009). Also, available and potential of water resources has been studied according to (Abouzeid, 1992 and FAO, 2003). Since 2005, Egypt is classified as water scarce country as it has less than 1000 m^3 of fresh water per year per capita. Water in Egypt is used mainly in agriculture, industry and domestic uses which represent 86%, 6% and 8% respectably. The installed drinking water supply capacity ranges from 70 l/c/d in Upper Egypt to 330 l/c/d in Cairo. Water consumption in Alexandria is about 300 l/c/d. Distribution of the used water in various sectors has been studied according to (Abouzeid, 1992 and FAO, 2003). Water recourse and

water utilization has been studied based on basic design study report on the project for water supply development I northwest part of Sgarqia Governorate in the Arab Republic of Egypt", Sep. 2003. (JICA, 2003). Agriculture's share of the water budget is about 81% (and increased to 85% in 2006 (El-Beltagy, A. T. & A.F. Abo-Hadeed. 2008). According to Sustainable Agricultural Development Strategy Towards 2030 (SADS, 2009) per capita fresh water is expected to decline from 711.0 m^3 in 2008 to 550 m^3 in 2030. Recorded share from cultivable land was about 504 m^2 per inhabitant in 2006. An increase in water availability and efficiency could result from proper management of water through more effective on-farm water management practices, changes in cropping patterns towards less water consuming crops, the introduction of improved irrigation systems as well as re-use of drainage water and treated sewage water (Abouzeid, 1992; FAO, 2003). The aim of this research is explaining the methods for calculating future population estimates for various countries of the world, including those where demographic statistics are scanty and imperfect. There are numerous possible methods of calculating future population estimates. The calculations can be carried out directly with reference to the net rate of population growth, or the assumed birth rates, death rates, and rates of immigration and emigration may be calculated separately and added to obtain the rate of growth for each future period. The population of the Nile Basin countries was estimated around 372 million in 2005 with 54% of the total population lives within the Nile basin (ITT Nile Group, 2013). The Central Agency for Public Mobilization and Statistics (CAPMAS) is responsible about all census process. Population estimation approaches in this study based on using a real interpolation approaches: this approach uses census population data (CAPMS, 1986; CAPMS,1996; CAPMS, 2006) as the input and applies interpolation techniques to obtain future population. This research proposed to forecast population of Egypt Governorates to from last census 2006 year 2025, analyze the variation of population and to study water resources and demand for management water shortage issue. The construction of GERD will affect the quota of Egypt this will decrease the Aswan high dam discharges (IPoE, 2013). Sudan and Egypt, reported that the Aswan High Dam (AHD) will reach the minimum operational level during 4 consecutive years. Consequently, this project could significantly affect the water supply to Egypt, in case if the first impounding of the GERD occurs during dry years (Fahmy S. Abdelhaleem, and Esam Y. Helal, 2015).

II. IMPACT OF CONSTRUCTION OF ETHIOPIAN RENAISSANCE DAM

- Enable Ethiopia to fully control the Blue Nile revenue
  Reduce the electricity production of the High Dam and Aswan Reservoir by 20%. Water deficit in the river with an average annual income of 10 billion cubic meters on average, the Nile flow into Egypt could be cut by 12-25% during the filling period.
- Destroyed millions of acres of agricultural area.
- Lack of cultivated irrigated pelvic area.
- Lower the water level in the Nile and braches and canals will affected navigation and Nile cruises.
- Environmental degradation and an increase in pollution an imbalance in the natural system of life in North Lakes due to Water shortage.
- Increase in sea water intrusion in coastal aquifers in North Delta
- Threatening Groundwater quality and increased salinity in these reservoirs.
- Land reclamation programs in Egypt affected.
- The direct impact in generating energy from the High Dam, which may be as high as between 20 and 40%.
- In the case of the collapse of the dam, the flowing water will sink Sudanese cities, especially Khartoum.

III. STUDY AREA AND DATA SETS

In this study, Egypt Governorates has been selected as study area. Figuer (1) shows location map of study area. Egypt has a total area of about one million square kilometer; of which only 5% is inhabited by over 85 million people, while the inhabited area is restricted mostly to the Nile Valley and Delta while the remaining 95 % of the area is almost non-inhabited desert. Egypt is in the north-eastern corner of Africa between latitudes 21^O and 31^O North and longitudes 25^O and 35^O East with a total area of 1 001 450 km^2; the country stretches 1 105 km from north to south and up to 1 129 km from east to west. It is bordered in the north by the Mediterranean Sea, in the east by the Gaza Strip and the Red Sea, in the south by Sudan and in the west by Libya. Egypt consists of 4 major physical regions: Nile Valley and Delta, Western Desert, Eastern Desert and Sinai Peninsula.

3.1 Data Collection

The study area has been covered with demographic data and administration borders. Demographic data source which has been used in this study from census, statistics, surveys, population studies, local records and from estimates of central agency for public mobilization and statistics Future population projections from (2011-

2031) by (Low-Medium-High) Variant assumption or scenarios according to CAPMAS, Source: population estimates based on the results of 2oo6 population census.

IV. METHODOLOGY

The proposed methodology in this research involves many steps based mainly on collecting data: administration borers, demographic data and mathematical approach to forecast population. The proposed methodology can be summarized as following:

- Data collecting, demographic data and population data from census, statistics, surveys, population studies, local records and from estimates of central agency for public mobilization and statistics.
- Collecting administrative borders of study area in the level of country and Governorates.
- Dividing study area to zones and sub zones to compare the results with census data.
- Producing vector map of Upper Egypt, lower Governorates and Egypt Governorates.
- Forecasting population using mathematical approach after studying numerous possible methods of calculating future population depends on number of variables: number of used data and suitable mathematical models.
- Analysis accuracy and errors due to used data and mathematical models
- Producing population and density maps in present and future.
- Studying water resources and utilization of Egypt.
- Forecasting water demand or needs of Egypt according to future population.
- Results, analysis and comparative studies.
- Extracting conclusions and recommendations.

V. RESULTS

The proposed methodology has been applied step by step. Vector maps of Egypt and Egypt Governorates have been prepped based on administrative borders of the study area to produce population and density maps. Figure (1) shows vector map of Egypt Governorates

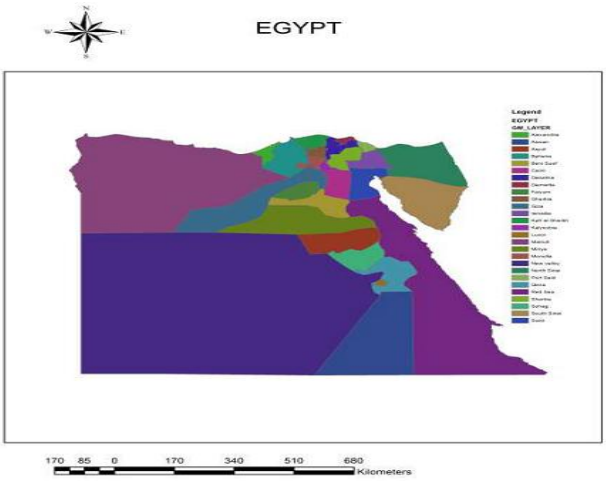

Figure (1) vector map of Egypt Governorates

In this study mathematical approach has been proposed to forecast population after studying numerous possible methods of forecasting future population. Used Mathematical methods were: straight line regression, 2nd order polynomial, exponential regression curve and Logarithmic regression.

1- Straight line regression

$$y = ax + b$$

2- 2nd order Polynomial

$$y = ax^2 + bx + c$$

3- Exponential regression curve

$$y = ac^x$$

4- Logarithmic regression

$$y = a + cLn(x)$$

Where:
X represents time
Y represents population.

Forecasting future population has been carried out depends on number of variables: number of used data and suitable mathematical models. Census data of Egypt were from 1882 to last census 2006 has been used to forecast population to 2025. 13, 9, 7, and 4 census points have been used with the best mathematical model. Table (1) shows forecasted population of Egypt from census Data based on 13, 9, 7, and 4 census points. Table (2) shoos forecasted population and Population Density of Egypt based on 4 point census from 1976 – 2006 (best equation/ Linear equation) The results shows that last 4 points census from (1976 to 2006) data is the suitable case with the facts for Egypt with linear regression equation than the other cases. According to Linear regression based on census data 4 points from 1976 to 2006: Egypt population 2015, 2020 and 2025 are: 82,945,000, 88,923,000and 94,902,000 Capita, respectively. Egypt density 2015, 2020 and 2025 are 82.86, 88.83 and 94.80Capita/km2, respectively.

Table (1) Forecasted population of Egypt from Census Data based on 13, 9, 7, and 4 census points

Year	Forecasting Population of Egypt from Census Data			
	1882 t0 2006	1927 to 2006	1947 to 2006	1976 to 2006
No. of Data points	13	9	7	4
Best Function	Logarithmic	Logarithmic	Linear	Linear
Unit	000 Capita			
2014	116862	110398	75889	81749
2015	124896	116951	76805	82945
2016	134112	124328	77721	84141
2017	144790	132693	78637	85336
2018	157308	142259	79553	86532
2019	172188	153307	80470	87728
2020	190168	166207	81386	88923
2021	212328	181470	82302	90119
2022	240318	199810	83218	91315
2023	276787	222261	84134	92511
2024	326276	250380	85050	93706
2025	397272	286625	85966	94902

Table (2) Forecasted population and Population Density of Egypt based on 4 point census from 1976 – 2006 (best equation/ Linear equation)

No. of Data points	4	
Best	Population	Population Density Capita/km2
Function	Linear	
	000 Capita	
2014	81749	81.66
2015	82945	82.86
2016	84141	84.05
2017	85336	85.25
2018	86532	86.44
2019	87728	87.64
2020	88923	88.83
2021	90119	90.02
2022	91315	91.22
2023	92511	92.41
2024	93706	93.61
2025	94902	94.80

Population has been forecasted of upper and lower Egypt Governorates. Table (4) Forecasted Linear regression equation of Upper Egypt based on 4 point census data from (1976 to 2006). Table (3) shows forecasted density of Upper Egypt based on 4 point census data from (1976 to 2006) using linear regression model. Table (4) shows future population Model, Model name and correlation of Lower Egypt Governorate

Table (3) Forecasted Linear regression equation of Upper Egypt based on 4 point census data from (1976 to 2006)

Governorate	Linear regression Equation	Correlation
Al Fayyūm	y=45634.74961 x - 89062045.23	0.9922
Banī Suwayf	y=39629.34951 x - 77226459.12	0.9920
Al Minyā	y=70315.42109 x - 136950011.9	0.9911
Asyūt	y=58178.08041 x - 113292009.6	0.9765
Sūhāj	y=61321.17057 x - 119278082.9	0.9764
Qinā	y=40768.05293 x - 78818987.65	0.9825
Aswān	y=18657.63012 x - 36252480.82	0.9633
Luxor	y = 9081.5 x - 17766171	1
Al Bahr al Ahmar	y = 7084.35 x - 13955739.1	0.9716
Al Wādī al Jadīd	y=3357.319971 x - 6552555.064	0.9974

Table (4) future population Model, Model name and correlation of Lower Egypt Governorate

Governorates	Model	Model Name	correlation
Alexandria	Y = 57849.49X + -112009786.34	Linear	0.9929
Giza	Y = 126397.83X + -247365145.28	Linear	0.9981
Ismailia	Y = 19434.11X + -38054773.76	Linear	0.9983
Beheira	Y = 73835.52X + -143383320.82	‘ linear	1
Dakahlia	Y = 74804.78X + -145075799.98	Linear	0.9999
Suez	Y = -157198574.2402 + 20741588.4364Ln(X)	Logarithmic	0.9957
Sharkia	Y = 0(1.0239^X)	Exponential	0.9989
Gharbia	Y = 56818.52X + -109980576.32	Linear	0.9997
Kalyoubia	Y = 84776.07X + -165857127.12	Linear	0.9994
Monufia	Y = 52096.78X + -101232945.98	Linear	1
Port Said	Y = -149962568.4885 + 19797366.054Ln(X)	Logarithmic	0.9921
South Sinai	Y = 0(1.0854^X)	Exponential	0.9913
Damietta	Y = 17789.53X + -34592626.98	Linear	0.9999
North Sinai	Y = 8412.35X + -16536381.6	Linear	0.9998
Kafr el-Sheikh	Y = 40667.2X + -78957238.2	Linear	0.9999
Matruh	Y = 0(1.0349^X)	Exponential	0.997
Cairo	Y = 88431.74X + -169639239.84	Linear	0.9984

*Linear: Y = AX + B
*Logarithmic: Y = G + H(Ln(X))
*Exponential: Y = C(D^X)
*X= Year
*Y=Population

Figure (2) shows Population map of Upper Egypt Governorates 2025. Figure (3) shows population map of Lower Egypt Governorates 2025.

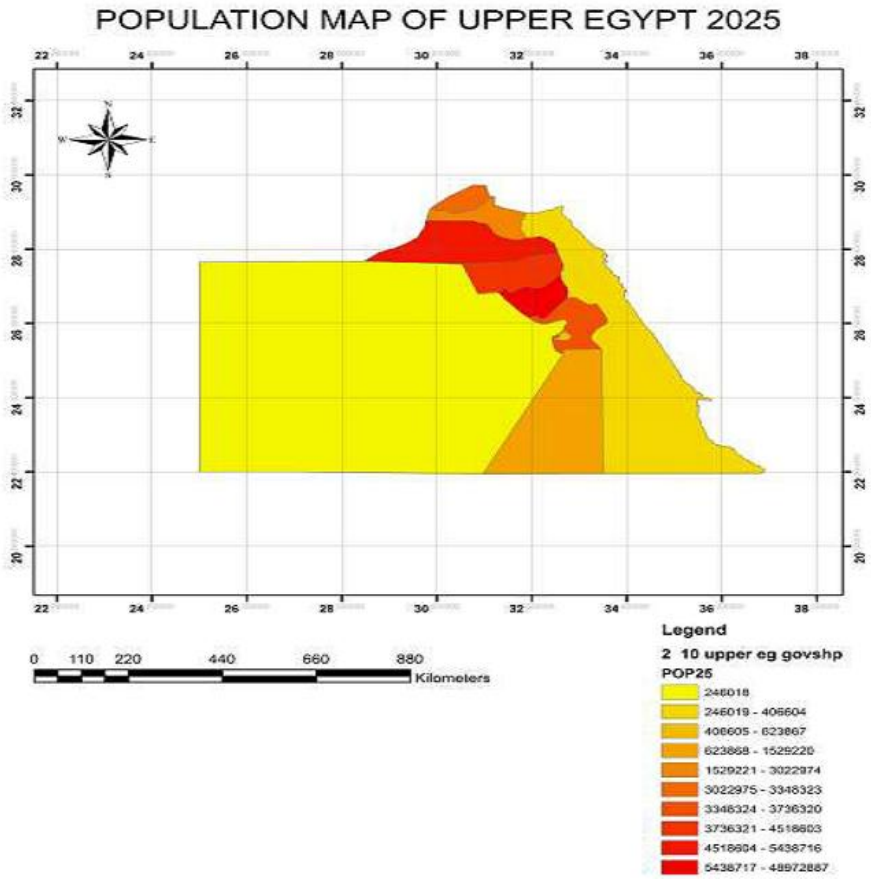

Figure (2) population map of Upper Egypt Governorates 2025

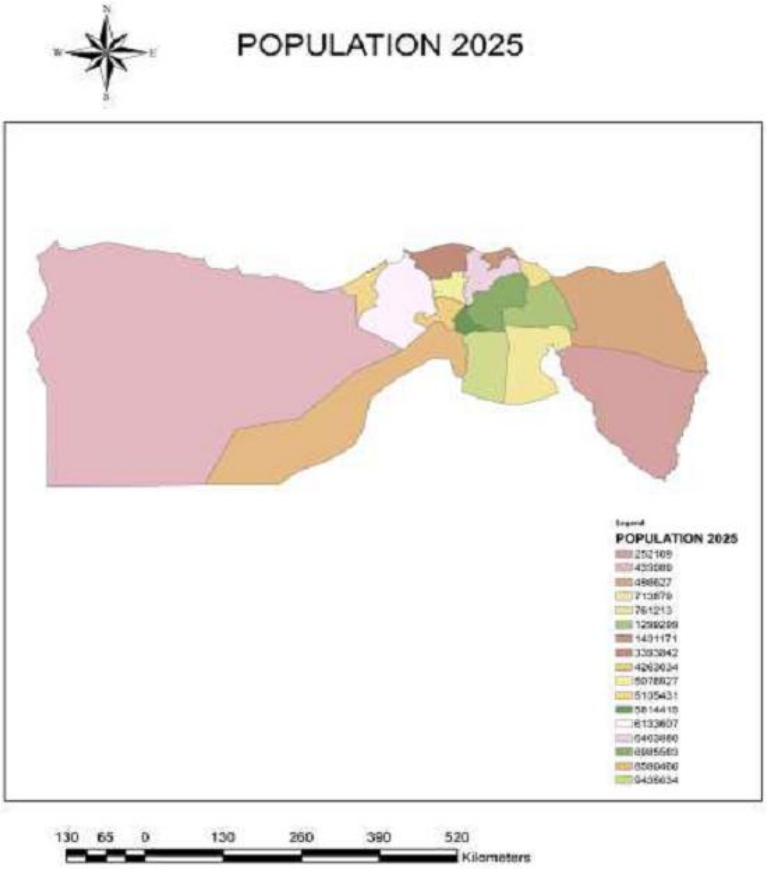

Figure (3) population map of Lower Egypt Governorates 2025

Table (5) shows population of all Egypt Governorates Years 2013, 2015, 2017, 2020 and 2025. Figure (4) shows population map of Egypt Governorates 2020. Figure (5) shows population density map of Egypt Governorates 2020.

Table (5) population of all Egypt Governorates Years 2013, 2015, 2017, 2020 and 2025

LAYER	POP13	POP15	POP17	PP20	POP25
Alexandria	4441237	4556936	4672635	4846183	5135431
Giza	7073687	7326482	7579278	7958471	8590460
Ismailia	1066090	1104958	1143826	1202128	1299299
Beheira	5247581	5395252	5542923	5764430	6133607
Dakahlia	5506222	5655832	5805441	6029856	6403880
Suez	590600	611198	631775	662602	713879
Sharkia	5902650	6083135	6263621	6534349	6985563
Gharbia	4395104	4508741	4622379	4792834	5076927
Kalyoubia	4797102	4966654	5136206	5390534	5814415
Monufia	3637872	3742066	3846259	4002550	4263034
Port Said	643546	663206	682846	712270	761213
South Sinai	179901	191936	203970	222022	252109
Damietta	1217697	1253276	1288855	1342224	1431171
North Sinai	397679	414504	431328	456565	498627
Kafr el-Sheikh	2905835	2987170	3068504	3190506	3393842
Matruh	351488	365088	378688	399088	433089
Cairo	8373853	8550716	8727580	8992875	9435034
Aswan	1305329	1342644	1379959	1435932	1529220
Asyut	3820466	3936822	4053179	4227713	4518603
Red Sea	315145	330371	345598	368438	406604
Faiyum	2800706	2891975	2983245	3120149	3348323
Minya	4594931	4735562	4876192	5087139	5438716
New valloy	205730	212445	219159	229231	246018
Beni Suef	2547421	2626680	2705939	2824827	3022974
Sohag	4161433	4284076	4406718	4590682	4897288
Qena	3247103	3328639	3410175	3532479	3736320
Luxor	514889	533052	551215	578459	623867
total	80241297	82599416	84957493	88494536	94389513

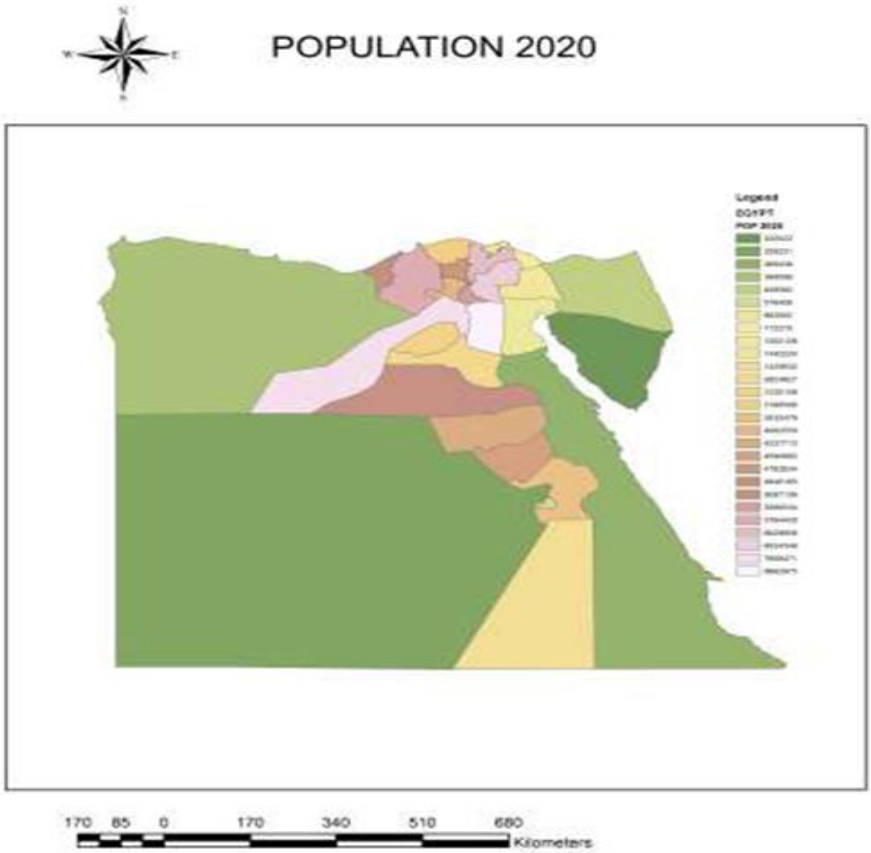

Figure (4) population map of Egypt Governorates 2020

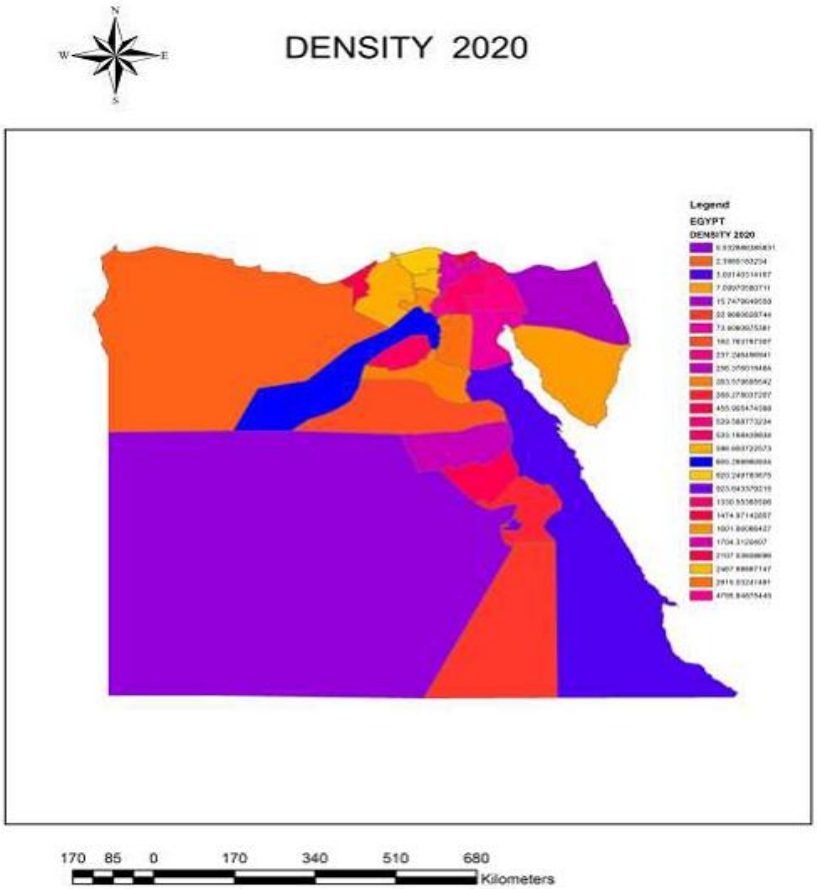

Figure (5) population density map of Egypt Governorates 2020

5.1 Results Analysis

Results of forecasted population of Upper Egypt Governorates using different regression equations showed that:

There are significant variations in the obtained results of the calculated future population of Upper Egypt due to number of used data. Also, the obtained results should that the linear model is the best model for forecasting population for Upper Egypt Governorates.

- Red Sea (Al Wādī al Jadīd) governorate is lowest population among Upper Egypt Governorates
- Al Minyā governorate is highest population among Upper Egypt Governorates
- Faiyum governorate is l highest population density among Upper Egypt Governorates
- Red Sea (Al Wādī al Jadīd) governorate is lowest population density among Upper Egypt Governorates

Results of forecasted population of Lower Egypt Governorates using different regression equations showed that:

- Sharkia, South Sinai and Matruh Governorates regression model was exponential equation.
- Suez and Port Said Governorates regression model was Logarithmic equation.
- The obtained results should that the linear model is the best model for forecasting population for Lower Egypt Governorates.
- South Sinai governorate is lowest population among Lower Egypt Governorates.
- Cairo governorate is highest population among Lower Egypt Governorates.
- Matruh governorate is lowest population density among Egypt Lower Governorates.
- Cairo governorate is highest population density among Lower Egypt Governorates.

Results of forecasted population of all EGYPT Governorates showed that:

- New valley governorate is lowest population among Lower Egypt Governorates.
- Cairo governorate is highest population among Lower Egypt Governorates.
- New valley governorate is lowest population density among Egypt Lower Governorates.
- Cairo governorate is highest population density among Lower Egypt Governorates.
- Results of forecasted population of Egypt based on census data of Egypt were from 1882 to last census 2006 has been used to forecast population to 2025. 13, 9, 7, and 4 census points have been used with the best function. The results shows that last 4 points census from (1976 to 2006) data are the suitable case with the facts for Egypt with linear regression equation than the other cases. According to Linear regression based on census data 4 points from 1976 to 2006:
- Egypt population 2015, 2020 and 2025 are: 82,945,000, 88,923,000and 94,902,000 Capita, respectively. Egypt density 2015, 2020 and 2025 are 82.86, 88.83 and 94.80Capita/km2, respectively.

5.2 Comparative Etudy Of Forecasted Population Of Egypt

Figure (6) shows population of Egypt based on census data last 13, last 9, last 7 and last 4 census data. According to the obtained results population of Egypt based on census data last 13, last 9, last 7 and last 4 census data, linear regression equation is the best model for forecasting population for both last 7 and last 4 census data.

Logarithmic regression equation is over estimate model for forecasting population for both last 13 and last 9 census data.

The obtained results should that the linear model is the best model for forecasting population of Egypt based on last 7 census data and last 4 census data.

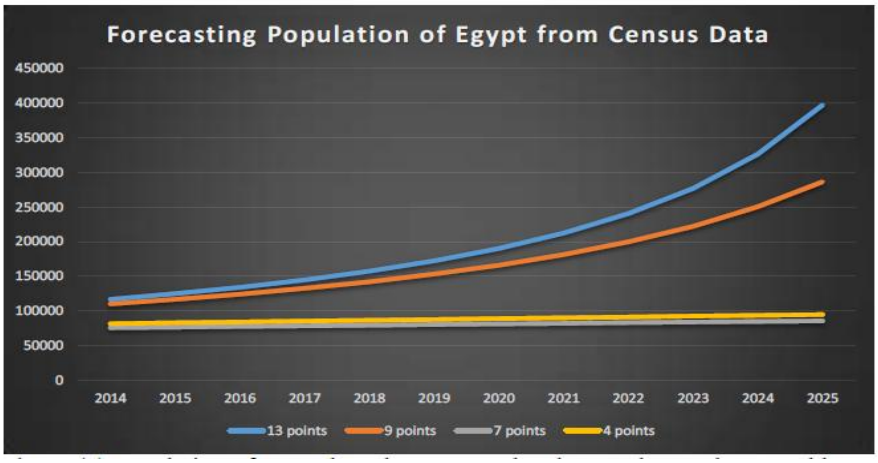

Figure (6) population of Egypt based on census data last 13, last 9, last 7 and last 4 census data.

Comparative of forecasted Population of Egypt based on:
1. Egypt estimate According to CAPMAS
2. Last 7 Census data of Egypt
3. Last 4 Census data of Egypt
4. Sum of forecasted Egypt Governorates Last 4 Census data

Table (6) shows future population years 2013, 2015, 2017, 2020 and 2025 (Low-Medium-High) Variant according to CAPMAS, Last 7 Census data, Last 4 Census data and Sum of forecasted Egypt Governorates Last 4 Census data.

Results showed that population of Egypt estimate according to CAPMAS with low variant is compatible or similar with population according to Last 4 Census data and similar approximately to population according to sum of furcated population of Egypt Governorates.

Table (6) Future population years 2013, 2015, 2017, 2020 and 2025 (Low-Medium-High) Variant according to CAPMAS, Last 7 Census data, Last 4 Census data and Sum of forecasted Egypt Governorates Last 4 Census data

year	Egypt estimate According to CAPMAS			Last 7 Census data of Egypt	Last 4 Census data of Egypt	Sum of forecasted Egypt Governorates Last 4 Census data
	Variant			Regression Equation		
	Low	Medium	High	Linear	Linear	Linear
	Unit 999 Capita					
2013	82000	82340	83030	74587000	79865000	80241297
2015	84400	84880	85840	76805000	82945000	82599416
2017	86740	87380	88590	78637000	85336000	84957493
2020	90080	91060	92570	81386000	88923000	88494536
2025	95180	96740	98780	85966000	94902000	94389513

VI. Water Resources And Water Utilization Of Egypt

Egypt depends on the Nile for almost all of water resources; naturally, it is a crucial issue on how to preserve water quality of the River Nile. On the other hand, water in desert area is in deep sandstone aquifer and is generally non-renewable source. The availability of a reliable water supply from the High Dam in Aswan is governed by the water-sharing treaty with the countries of the Nile Basin under which 55.5 billion m^3 per annum is allocated to Egypt. Egypt has no effective rainfall except in a narrow band along the northern coast. Consequently, Egypt has only one main source of water supply, the Nile. The installed drinking water supply capacity ranges from 70 l/c/d in Upper Egypt to 330 l/c/d in Cairo. Water consumption in Alexandria is about 300 l/c/d.

The water resources in Egypt can be classified into the following categories:
1-Nile water
2-Groundwater:
a- In the Delta and New Valley
b-In the desert
3-Renewable resources from rain
4-Desalinated water
5-Reuse of agricultural drainage water
6-Treated sewage water
7-Management and saving wasted water

Table (7) shows Water resources.

Table (7) Water resources

Year	1999
Unit	Billion m^3/yr)
Nile water	55.5
Flood discharge	1.0
Groundwater: Delta and New Valley	2.6
Groundwater: Desert	0.5
Reuse of agricultural drainage water Treated sewage water	4.7
Treated sewage water	0.2
Management and saving wasted water	--
Desalinated water	--
Total	63.5

6.1 WATER UTILIZATION OR WATER DEMANDS

Water in Egypt used mainly in agriculture, industry and domestic uses as example at year 1999 Total water utilization or water demands= 59.2 Billion m^3/yr can be classified as following?
Agriculture-Irrigation water=49.7 billion m^3/yr which represent 83.95%
Households-Domestic water=3.1 billion m^3/yr which represent 5.24%
Industrial water=4.6 billion m^3/yr which represent 7.77%
River Navigation and water mouth out flow=1.8 billion m^3/yr which represent 1.8%

6.2 EXPECTED SHORTAGE IN WATER

Water demand is function of population and water uses which can obtain from statistics and future population. Forecast study was undertaken in order to evaluate the expected shortage in water. A major challenge facing Egypt today is to manage escalating demand for water from growing population and industrialization. Forecasted water utilization or demand has been estimated based on future population from census data taken into consideration: River Navigation and water mouth out flow = 1.8 Billion m^3/yr (constant); Forecasted of Households-Domestic water has been estimated based on linear relation between population and 3.1 Billion m^3/yr of year 1999. Forecasted Industrial water and households-Domestic water has been estimated based on linear relation between population and 4.6 Billion m^3/yr of year 1999; Water supply at 1999=59.2 Billion m^3/yr (constant); Water deficit in the river due to construction of Ethiopian dams on Egypt will be 10 billion cubic meters annually start from year 2017. 10 billion cubic meters will be reduced from agriculture-irrigation water share. Table (8) shows forecasted water utilization or demand based on forecasted population from census data.

Table (8) forecasted water utilization or demand based on forecasted population from census data at the level of Egypt

Year		1999	2015	2017	2020	2025
Population (Forecast ed from census)	Capita	64158887	82599416	84957493	88494536	94389513
Water deficit due to construction of Ethiopian dam	Billion m^3/yr)	-	-	10	10	10
Water supply	Billion (m^3/yr)	59.2	59.2	59.2-10=48.2	59.2-10=48.2	59.2-10=48.2
	%	100%	100%	100%	100%	100%
Households-Domestic water	Billion (m^3/yr)	3.1	3.99	4.10	4.28	4.56
	%	5.24%	6.74%	8.51%	8.88%	9.46%
Industrial water	Billion (m^3/yr)	4.6	5.92	6.09	6.34	6.77
	%	7.77%	10.00%	12.63%	13.15%	14.05%
River Navigation and water mouth out flow	Billion (m^3/yr)	1.8	1.8	1.8	1.8	1.8
	%	3.04%	3.04%	3.73%	3.73%	3.73%
Total	Billion (m^3/yr)	9.5	11.71`	11.99	12.42	13.13
	%	16.05%	19.78%	24.88%	25.77%	27.24%
Agriculture-Irrigation water	Billion (m^3/yr)	49.7	47.49	48.2-11.99= 36.21	48.2-12.42= 35.78	48.2-13.13= 35.07
	%	83.95%	80.22%	75.12%	74.23%	72.76%

6.3 SOLUTIONS

Egypt's entry into the scope of extreme water poverty with an average per capita less than 600 cubic meters of water annually. As a result of construction of Ethiopian dam, drought in the Ethiopian plateau and population increase The Egyptian government assigned to all ministries and government put priority on the issues, especially Ministry of Water Resources and Irrigation. Egyptian government has decided to control water deficit and provide 14 billion cubic meters by:

- Development of irrigation system
- Rationalization of Water use.
- Reduction of infringements on the water Nile.
- Maximize the use of ground water wells in Egypt, and rainwater.
- Seawater desalination and high salinity, pointing out that the Gulf produces 60% of desalinated water in the world.

- Egypt will reduce water budget from Nile by reusing irrigation water more than once, after mixing the water with irrigation waste water.
- Expansion in the agricultural and sewage treatment and reuse in agriculture and industry, and this system in place in most developed countries, as a result of water scarcity.
- Work to change the culture of the citizen to adapt to with water poverty era
- Start the implementation of the reduction of voracious crops of water.
- Assigning specialized agricultural research centers to devise new agricultural varieties to drought tolerant and thirst.
- Full coordination and compatibility between Egypt and Ethiopian side on the rules of filling and operating, with the importance of reaching a legal and technical mechanism to allow full participation in the filling operation and management So that there will not be any damage to the Egyptian water interests (Whittington et al. 2o14).
- The agreement with Sudan and South Sudan to attract losses regions of Upper Nile (Jonglei, and Bahr el Ghazal, and giraffes), would provide 7 billion cubic meters to be split between Egypt and North and South Sudan.

VI. CONCLUSIONS

The construction of the Renaissance dam will have a negative impact on the water resources of Egypt, especially the period of filing the dam, and also the population increase will have a negative impact on future water needs. The cooperation between the Nile Basin countries is essential for the management and protection of this vital source of water of Egypt with the need to providing solutions to manage water consumption. Population estimation is very essential for decision maker to use it in supporting planning processes Proposed function to calculate future population of Egypt Governorates is regression equation either linear, Logarithmic or power function based on last census data 4 point data from (1976 to 2006) in majority cases the regression linear model is the best model for forecasting population. Egypt population 2015, 2020 and 2025 are: 82599416, 84957493, 88494536 and 94389513 respectively. Water deficit in the river due to construction of Ethiopian dams on Egypt will be 10 billion cubic meters annually start from year 2017. 10 billion cubic meters will be reduced from agriculture-irrigation water share. Water supply at 1999, 2015, 2017, 2020 and 2025 is 59.2, 59.2, 48.2, 48.2 and 48.2 Billion (m^3/yr), respectively. Households-Domestic water at 1999, 2015, 2017,2020 and 2025 represents 5.24%, 6.74%, 8.51%, 8.88% and 9.46%, respectively. Industrial water at 1999, 2015, 2017, 2020 and 2025 represents 7.77%, 10.00%, 12.63%, 13.15% and 14.05%, respectively. River Navigation and water mouth out flow at 1999, 2015, 2017, 2020 and 2025 represents 3.04%, 3.04%, 3.73%, 3.73% and 3.73%, respectively. Agriculture irrigation water at 1999, 2015, 2017, 2020 and 2025 represents 83.95%, 80.22%, 75.12%, 74.23% and 72.76%, respectively. Agriculture sector will bear the brunt of the deficit in the waters of the Nile. Studies should be carried out to increase production per acre and the development of other methods of irrigation to increase productivity per acre and to provide water. The results of this study most probably assist decision makers to identify possible solutions to overcome water shortage problem.

VII. RECOMMENDATION

Analysis water demand by Governorates should be study on the net research in detailed based on forecasted population and collecting data about irrigation water from Nile for each Governorate.

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