Future Spatial Development Of The Optimal Location For Drinking Water Projects In Babylon Governorate

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Abstract

The study dealt with (the future spatial development of the optimal location for drinking water projects in Babil Governorate using Geographic Information Systems (GIS)), as modern geographical techniques were used to collect and survey data on the locations of drinking water projects and complexes in Babil Governorate and their geographical distribution. The study also aimed to use and employ information systems Geographic GIS to evaluate the future distribution of the locations of drinking water projects and complexes in Babil Governorate in terms of the future spatial development of drinking water projects and complexes in Babil Governorate after finding the numbers of the served and deprived population for the year 2031. When estimating the future forecast, the study revealed an increase in the number of deprived residents in the study area, a stability in the production capacity of each project, and a stability in the number of current projects until the year 2031. This increase varies from one region to another among the administrative units in the study region. We notice a discrepancy in the number of sites for drinking water projects and complexes

Introduction:

Water has attracted human attention and thinking from ancient times until today. Water was not only an important element necessary for the beginning and continuation of life, but rather a major factor that controls human existence. It is also the basic element in human growth and development throughout the ages, as humans use it in various aspects and areas of life that are accustomed to them. It is beneficial, and the population's need for water increases with the increase in their number and scientific development. Therefore, it is necessary to know the number of drinking water filtration stations and the number of people benefiting from them.

1- **Theoretical framework**
- **The problem of the study**: Choosing the study problem is the first and basic step in any scientific research because it serves as the basis upon which subsequent steps in the research are based. The problem of the current study is centered on answering the following questions:
1- Is there a discrepancy in the numbers of deprived residents served by drinking water projects for the year 2031?

2- Does the number of drinking water projects and complexes differ according to the future forecast for the year 2031 for housing numbers in the study area ?

- **Study hypothesis**:The hypothesis is a preliminary answer to the problem to be studied and is represented by the following:
1- Variation in the numbers of the deprived population and those served by drinking water projects, spatially and temporally.
2- There is a large difference in the number of drinking water projects and complexes in the study area for the year 2031
- **The importance of the study:** The study reveals the importance of future spatial development of optimal locations for drinking water projects and complexes and its role in knowing the future need for drinking water complex projects. It has great importance in knowing the efficiency of drinking water projects in meeting the needs of the growing population.

•**Study methodology and method:** Scientific research requires that the researcher follow a solid, specialized methodology to communicate accurate and highly objective results. The research methodology relied on the descriptive approach, as it relies on describing the phenomenon as it is in reality to describe it descriptively, as it was done through a field study of drinking water projects and complexes in the governorate. Babylon. The study also relied on a statistical analytical approach aimed at adopting modern statistical methods. This was done by analyzing and evaluating data for the distribution of drinking water projects and complexes in Babylon Governorate, which was collected from relevant departments and agencies.

• **The boundaries of the study area:** The boundaries of the study are the administrative boundaries of Babil Governorate, which is located in the central part of Iraq in the middle of the alluvial plain between two latitudes (-09 ˚32 - -05 ˚33) north, And in two longitudes (-97 ˚43 - 12 - 45 ˚) to the east, the study area is bordered to the north by Baghdad Governorate, to the east by Wasit Governorate, while to the west it is bordered by the Karbala and Anbar governorates, and to the south it is bordered by the Najaf and Qadisiyah governorates. With this location, the governorate takes a shape close to a triangle with its base in the south, then the area of the governorate narrows in its northern part, whose geographical area takes a longitudinal extension from the northwest towards the southeast. Map (1) The governorate's area is (5,119 km2) and constitutes a percentage of (1.2%) of the area of Iraq, which is (435,052 km2) (1), and is administratively divided into (4) districts, as in Table (1)

Table (1) Administrative units and their area in Babil Goverrate.
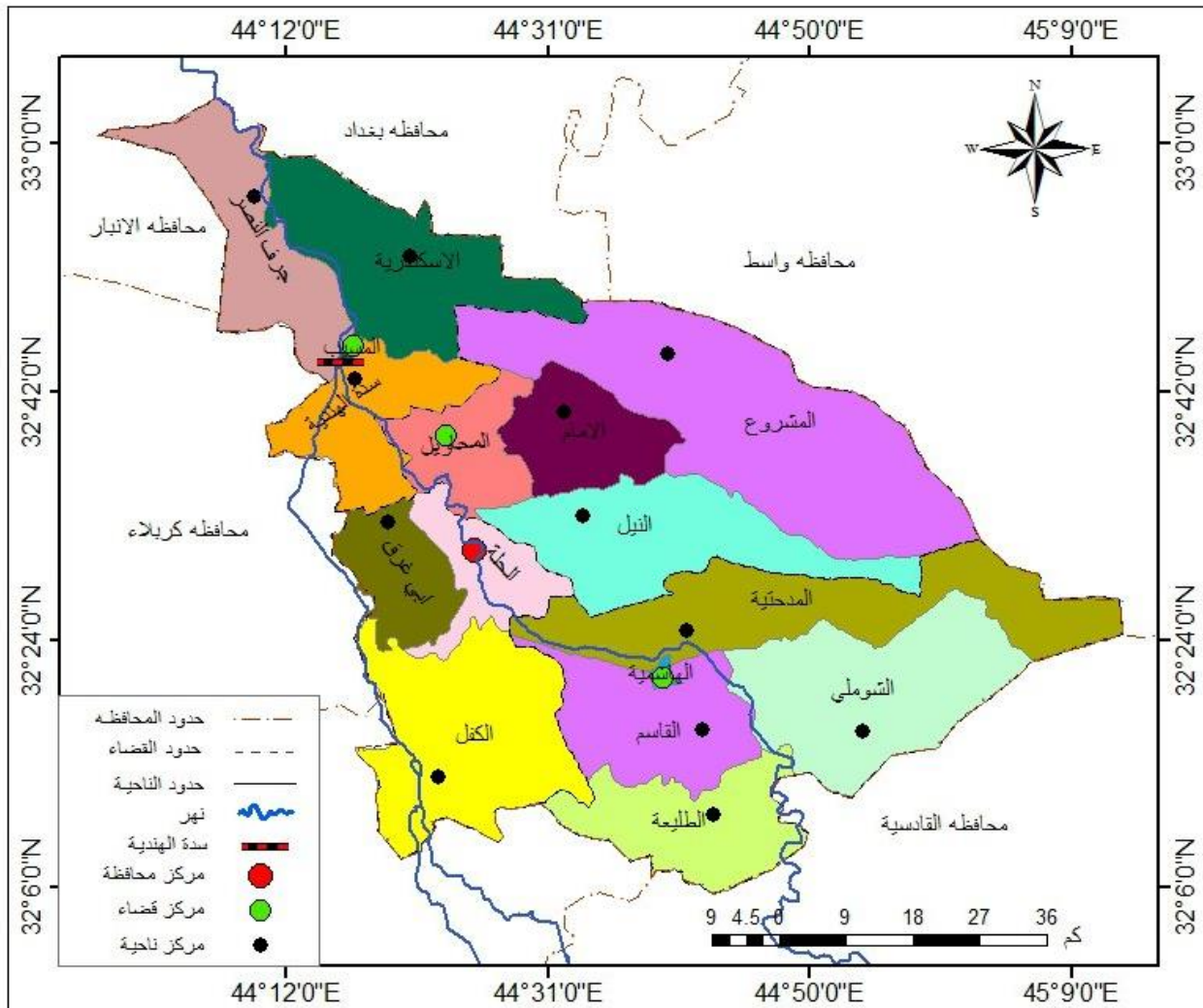
	Musayyab	
	Hindi dam	257
	Jurf al-Sakhar 170	170
	Alexandria 388	388
Total governorate		5119

Source: The researcher's work based on the Republic of Iraq, Ministry of Planning and Development Cooperation, Central Bureau of Statistics, Babylon Statistics Directorate, 2021.

Map (1) Administrative units in Babil Governorate

Source: Based on Table (1), the DEM digital elevation model, and the outputs of the GiS program Based on the Republic of Iraq, General Authority for Survey, Map Production Department, Administrative Map of Babil Governorate, on a scale of 1/1000000, 2021.

2- Expectations of the population of Babylon Governorate in 2031 and its impact on the future expectation of services for drinking water projects and complexes in the study area

Population studies depend on the expected population number for any region of the world, including Babylon Governorate, where it relies on population estimates or what is expressed in population projections. These projections (population estimates) are a set of calculations aimed at knowing the development of the total population in the future, based on assumptions about trends. Fertility, mortality, and migration. These are future calculations of population size and characteristics based on future trends in mortality, fertility, and migration .(2)

  According to the population projection equation, the total expected population in Babil Governorate reached (5,172,568 people) for the year 2031, as shown in Table (2). This increase in population must be accompanied by development and expansion of services in general and central infrastructure services in particular, but as a result of the situation The economic situation that the country is going through, in addition to the fact that the process of developing strategic projects with high capabilities requires years to build them and large financial capabilities for any future development plan for drinking water projects in the study area, as the population numbers for the year 2031 were represented in the map (45) using the color cadastral method. The first category was represented by With a light purple color, the population numbers for the year 2031, which range between (3.74-2.10), represent the lowest percentages in the expected population number for the year 2031. It includes Al-Kifl district, where the population number reached (103,622), with a rate of (2.1%), followed by Al-Qasim district, where the population number reached (117,398). With a percentage of (2.27%), followed by the center of the Hashimiya district, where the expected population reached (144,368), with a percentage of (2.79%), followed by Al-Shamli district, where the population reached (175,216), with a percentage of (3.39%), followed by Alexandria district, where the population reached (193,596), with a percentage of (3.74%.(

  The second category with the purple color represented the population numbers, which ranged between (8.41-3.75). It included Abu Gharq district, where the expected population number reached (218,218), with a rate of (4.22%), followed by Al-Musayyab district, where the population number reached (222,075), with a rate of (4.29%), followed by Hilla District Center, where the population reached (225,441), with a rate of (4.36%), followed by Siddat al-Hindiyah District, with a

population number of (233,476), with a rate of (4.51%), followed by Al-Mahawil District Center District, where the population number reached (234,804), with a rate of (4.54%), followed by the District. The project's population reached (255,751), at a rate of (4.94%), followed by Jurf al-Sakhar district, at a rate of (348,858), at a rate of (6.74%), followed by the Nile District, at a rate of (434,859),

at a rate of (8.41%.(

While the third category with a dark purple color was represented by population numbers ranging between (15.10 - 8.42), it was represented by Al-Imam district, where the population number reached (740,826), at a rate of (14.3%), followed by Al-Madhatiya district, where the population number reached (741,808), at a rate of (14.3%), followed by Al-Madhatiya district, at a rate of (14.3%). The vanguard, as the population reached (782,252), at a rate of (15.1%), as shown in Table (2)

Table (2) I expect the population number in Babil Governorate according to population expectations in 2031

Administrative unit	Number of drinking water stations		Total capacities of actual projects and complexes m3/day **	Population numbers for 2021	Projected population numbers in 2031 *	percentage %
	Number of pools	Number of projects				
District Center Hilla	39	3	236,272	628,861	225441	4.36
Al-Kifl	33	1	58,119	157,816	103622	2.1
Abu Gharq	15	1	105,515	122,263	218218	4.22
Mahaweel District Center	22	2	33,945	131,556	234804	4.54
moshro	19	1	37,234	143,292	255751	4.94
Imam	7	0	11,730	41,507	740826	14.3
Nile	19	0	22,358	66,229	434859	8.41
Al-Hashimiya District Center	7	2	25,970	40,271	144368	2.79
Al-Qasim	17	0	57,557	179,260	117398	2.27
Medhatiya	18	2	52,521	152,898	741808	14.3
Al-Shamali	42	1	25,745	98,170	175216	3.39

altla	12	0	19,708	43,828	782252	15.1
District Center Al-Musayyab	13	2	48,896	61,947	222075	4.29
Hindi dam	8	2	45,288	130,812	233476	4.51
Jurf al-Sakhar 170	12	2	23,596	53,131	348858	6.74
lexandria 388	9	1	52,424	179,296	193596	3.74
	292	20	856,878	2,231,137	5172568	100

Source: The table was created by the researcher based on:

Republic of Iraq, Ministry of Municipalities and Public Works, General Directorate of Water, Babil Governorate Water Directorate, Planning and Follow-up Department.

Republic of Iraq, Ministry of Planning, Central Bureau of Statistics, Annual Statistical Collection, and Population Estimates for the Years (2021(

 *The population for the year 2031 was estimated based on the population estimation equation pn = po (1+r)n
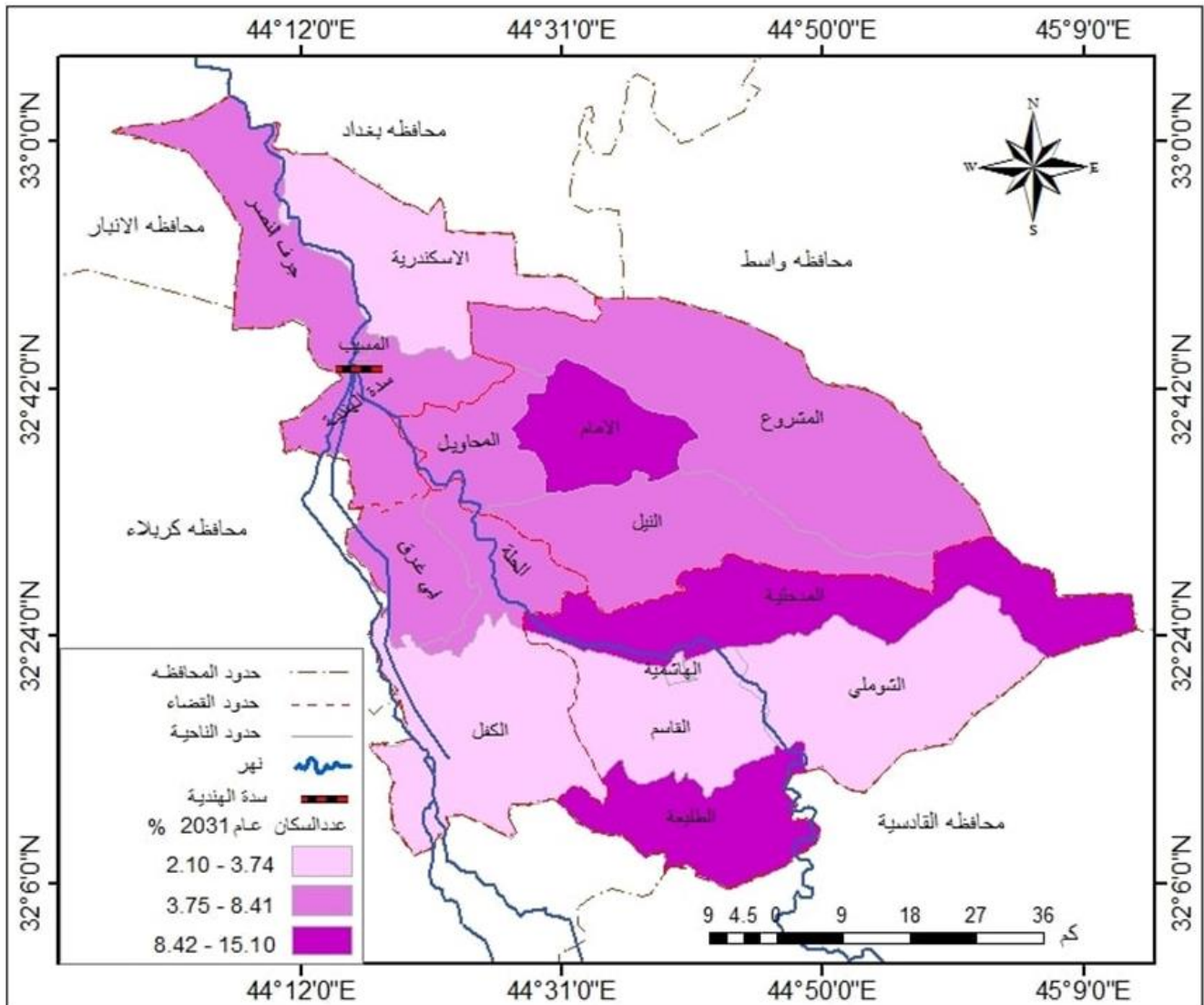
Where: Pn= population in the forecast year

  Po = population

  R = population growth rate

  N = number of years between the two pluralities

(**) 1 cubic meter = 1000 litres.

Map (2) Expected population numbers in Babil Governorate for the year 2031

Source: The researcher's work based on Table (2)

3- Expected number of deprived population in Babil Governorate according to population expectations in 2031

When estimating the future forecast for the number of deprived population in the study area, the researcher relied on the stability of the production capacity of each project with the number of current projects remaining constant until the year 2031. As a result of the increase in the number of population expected for the year 2031, the number of deprived population has increased, as their number has reached a rate of (3,617,951), and this percentage is very high. As in Table (3), this increase in the number of deprived residents means an increase in the population's deprivation of potable water, especially in rural areas. Future plans

must be made to develop drinking water projects or establish new projects that meet the population's need for drinking water and choose optimal sites for these projects. Research links. Water to all residents, the administrative unit. Therefore, a future model was created to show the ideal location for drinking water projects that achieve the sufficiency of the future need for drinking water, as the number of deprived residents was represented in map (3) using the color cadastral method as follows:

The first category in yellow represented the number of deprived residents, ranging from (0 - -734) and included all of Al-Kifl district, where the number of deprived residents reached (-3,449), with a rate of (0.1%), followed by the Hilla District Center district, where the number of deprived residents reached (-265,669). (- 7.34%.(

The second category in orange represented the number of deprived residents, which ranged between (10.90 - 0.01). It included Alexandria district, where the number of deprived residents reached (73,233), with a percentage of (2.02%), followed by Al-Qasim district, where the number of deprived residents reached (77,825), with a percentage of (2.15%), followed by Al-Shumali district, where the number of deprived residents reached (97,413), with a percentage of (2.69%). Abu Gharq district, where the number of deprived residents reached (104,143), at a rate of (2.88%), followed by the center of the Hashimiya District, where the number of residents reached (104,214), at a rate of (2.88%), followed by the district center of Al-Mahawil District, where the number of deprived residents reached (129,556), at a rate of (3.58%). It is followed by Saddat al-Hindiyya sub-district, where the number of deprived residents reached (152,631), at a rate of (4.22%), followed by Al-Musayyib District Center, where the number of deprived residents reached (160,822), at a rate of (4.45%), followed by Al-Mashrou' sub-district, where the number of deprived residents reached (164,927), at a rate of (4.56%). Followed by Jurf Al Sakhr district, where the number of deprived residents reached (320,557), at a rate of (8.86%). Followed by the Nile region, where the number of deprived residents reached (394,503), with a percentage of (10.9%.(

The third brown-colored category represented the number of deprived residents, which ranged between (20.74 - 10.91). It was represented by Al-Madhatiya district, where the number of deprived residents reached (643,569), at a rate of (17.79%), followed by Al-Imam district, where the number of deprived residents reached (713,533), at a rate of (19.72%), followed by Al-Taliah District, with a population rate of (750,143) and a rate of (20.74%), as shown in Table (3).

Table (3) Number of deprived population in Babil Governorate according (to population expectations in 2031

Administrative unit	Projected population numbers in 2031 *	Number of population served in 2031	percentage %	Number of deprived population in 2031	percentage %
District Center Hilla	225441	491,110	31.59	-265,669	- 7.34
Al-Kifl	103622	107,071	6.89	-3,449	0.1
Abu Gharq	218218	114,075	7.34	104,143	2.88
Mahaweel District Center	234804	105,248	6.77	129,556	3.58
Moshro	255751	90,824	5.84	164,927	
Imam	740826	27,293	1.76	713,533	4.56
Nile	434859	40,356	2.6	394,503	19.72
Al-Hashimiya District Center	144368	40154	2.58	104,214	10.9
Al-Qasim	117398	39,573	2.54	77,825	2.88
Medhatiya	741808	98,239	6.32	643,569	
Al-Shamali	175216	77,803	5	97,413	2.15
Altla	782252	32,109	2.07	750,143	17.79
District Center Al-Musayyab	222075	61,253	3.94	160,822	2.69
Hindi dam	233476	80,845	5.2	152,631	20.74
Jurf al-Sakhar 170	348858	28,301	1.82	320,557	4.45
Alexandria 388	193596	120,363	7.74	73,233	
Total	5172568	1,554,617	100	3,617,951	4.22

Source: The researcher's work based on

Republic of Iraq, Ministry of Planning and Development Cooperation, Central Bureau of Statistics and Information Technology, Annual Statistical Collection, 2021, 2031

Republic of Iraq, Ministry of Municipalities and Public Works, Babylon Water Directorate, unpublished data, 2021

Map (3) Distribution: Number of deprived population in Babil Governorate according to population expectations in (2031)
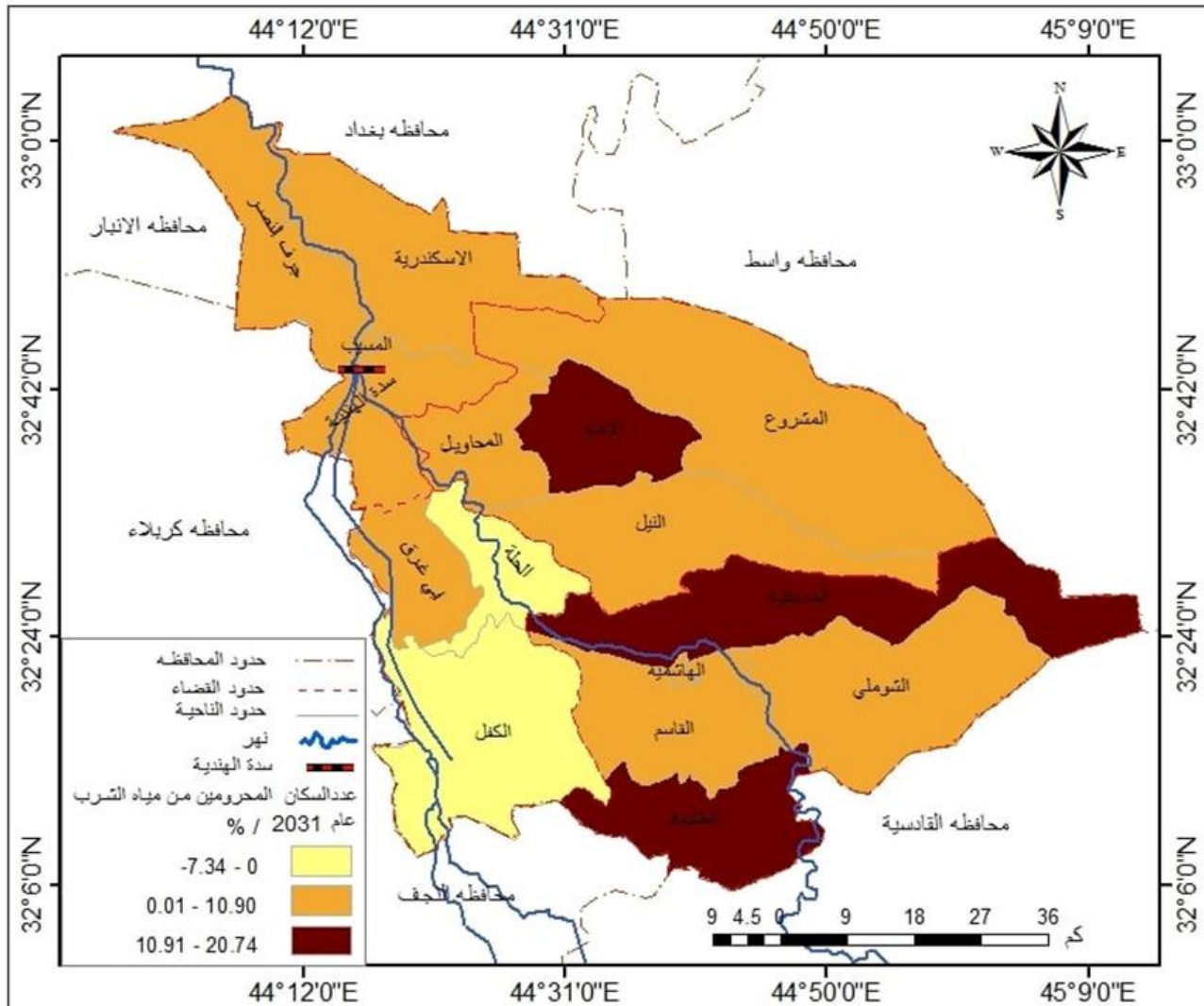
Source: The researcher's work based on Table (3)

4: The possibility of future development of optimal drinking water filtration project sites in Babil Governorate

The essence of development is to find methods that are compatible with spatial ownership and the characteristics and advantages it possesses. The spatial dimension affects the development process, by determining the most appropriate location for investments and the best distribution of activities and services based on the best relationships. Development is based on three dimensions: the spatial dimension, the temporal dimension, and the The third is the interaction of spatial relations that link the phenomena. Development represents the stage of reaching

a better situation economically, socially and environmentally. Therefore, development is a complex and multi-dimensional process that includes conscious strategies and processes with specific goals and objectives, and with general and comprehensive goals for a dynamic process that occurs in the place and appears in a series. Of the structural and functional changes that affect the components of that place, relying on controlling the size and quality of the financial and human resources available to reach the maximum possible benefit in the shortest possible period of time to achieve economic and social well-being.

One of the important goals that countries seek is to achieve comprehensive spatial development in their regions and regions in a way that guarantees the well-being of peoples. Spatial development aims to spatially distribute development projects and investments in various productive and service sectors in regions and territories (3). The geographical distribution of projects must take into account the population numbers in the regions. Urban or rural, with the aim of eliminating cultural differences and developing the regions and their requirements, whether this will result in balanced spatial development and thus achieving well-being for all. If the emergence of large regional differences between regions creates a clear imbalance that leads to the concentration of development in regions and deprivation in other regions, then it is unbalanced spatial development (4)

The future development of drinking water filtration projects takes place through selecting the optimal sites, which is achieved by laying the correct future foundations for choosing the future sites, as they were represented in the form of a layer and each layer was given a specific weight according to the degree of its influence, as in Table (4), the density layer of the river networks took the weight. (15) as it is more important as it is one of the important foundations on which the project site is built. The layer of the expected population size for the year 2031 took the weight (15), the surface sections layer took the weight (15), the layer of river drainages took the weight (14), and the layer of the number of deprived population is considered one of the foundations. The task also took a weight of (14), the rocky exposure layer took a weight of (12), the soil types layer took a weight of (5), and the elevations layer took a weight of (10).

Table (4) Layers prepared to determine the optimal location for drinking water projects and their weights.

Class	Value Class Weight	Classes of Class Variables	Weights of Class Variables Classes
	12	Sand deposits	1

		Deposition of depressions, marshes and swamps	2
Rock detectors		Angana, teddy bear, floodplain sediments	3
Height/m	10	41- 72	1
		40-33	2
		11-32	3
River discharges	14	Low drainage	1
		Medium drainage	2
		High drainage	3
Density of river networks	15	Low density	1
		Medium density	2
		High density	3
Surface sections	15	Plateaus - sand dunes	1
		Buried marshes and swamps	2
		River shoulders - river basins	3
Soil types	5	Mixed gypsum desert lands - mobile dunes	1
		Buried marshes and swamps - poorly drained river basin depressions	2
		Basin depressions - river basins buried in silt - river shoulders	3
Number of deprived population in 2031	14	(0- -7.34)	1
		(10.90- 0.01)	2
		(20.74- 10.91)	3
Projected population size in 2031	15	(3.74-2.10)	1
		(8.41-3.75)	2
		(15.10- 8.42)	3

Source: Worked by the researcher based on map (1), map (2), map (3) and the program (ARC GIS V10.3)

Thus, we will produce a cartographic model for the optimal future forecast for drinking water projects and complexes after introducing the layers and giving their weights according to the degree of importance, as in map (4) showing that the current locations of drinking water projects and complexes were represented in green, while the optimal future locations were represented by a dot in red, as the number The ideal future sites in the study area are (55) sites distributed in large areas near riverbeds throughout the areas of Babylon Governorate. In addition to the presence of water resources, these sites have a flat surface and little indentation, as rocky exposures decrease. These areas enjoy a high population increase and an increase in numbers. The deprived population and other important foundations on the basis of which the program was chosen as optimal sites, as shown in Table (5), where the highest numbers were recorded in the ideal future sites in each of (Al-Qasim District, Al-Hilla District Center), each of which reached (7) sites, with a percentage of (12.73). %), followed by Alexandria district, which reached (6) locations, with a percentage of (10.91), followed by Siddat al-Hindiya district, which reached (5), and a percentage of (9.1), followed by Al-Madhatiya, Al-Mashrou', Al-Mahawil District Center, and Al-Kifl, which reached (4).) locations with a percentage of (7.27%), followed by (Al-Shumali, Nile, and Abu Gharqa sub-districts), each of which reached (3) locations with a percentage of (5.45%), followed by Al-Tali'ah sub-district, Al-Imam sub-district, Al-Musayyib District Center Subdistrict, Al-Hashimiyeh District Center Sub-district, Jurf Sub-district. Al-Sakhr) reached one site for each of them, at a rate of (1.82%). We notice a discrepancy in the numbers of sites for drinking water projects and complexes, which are represented in map (4) based on table (4) in the form of purple graphic columns that explain in detail this discrepancy

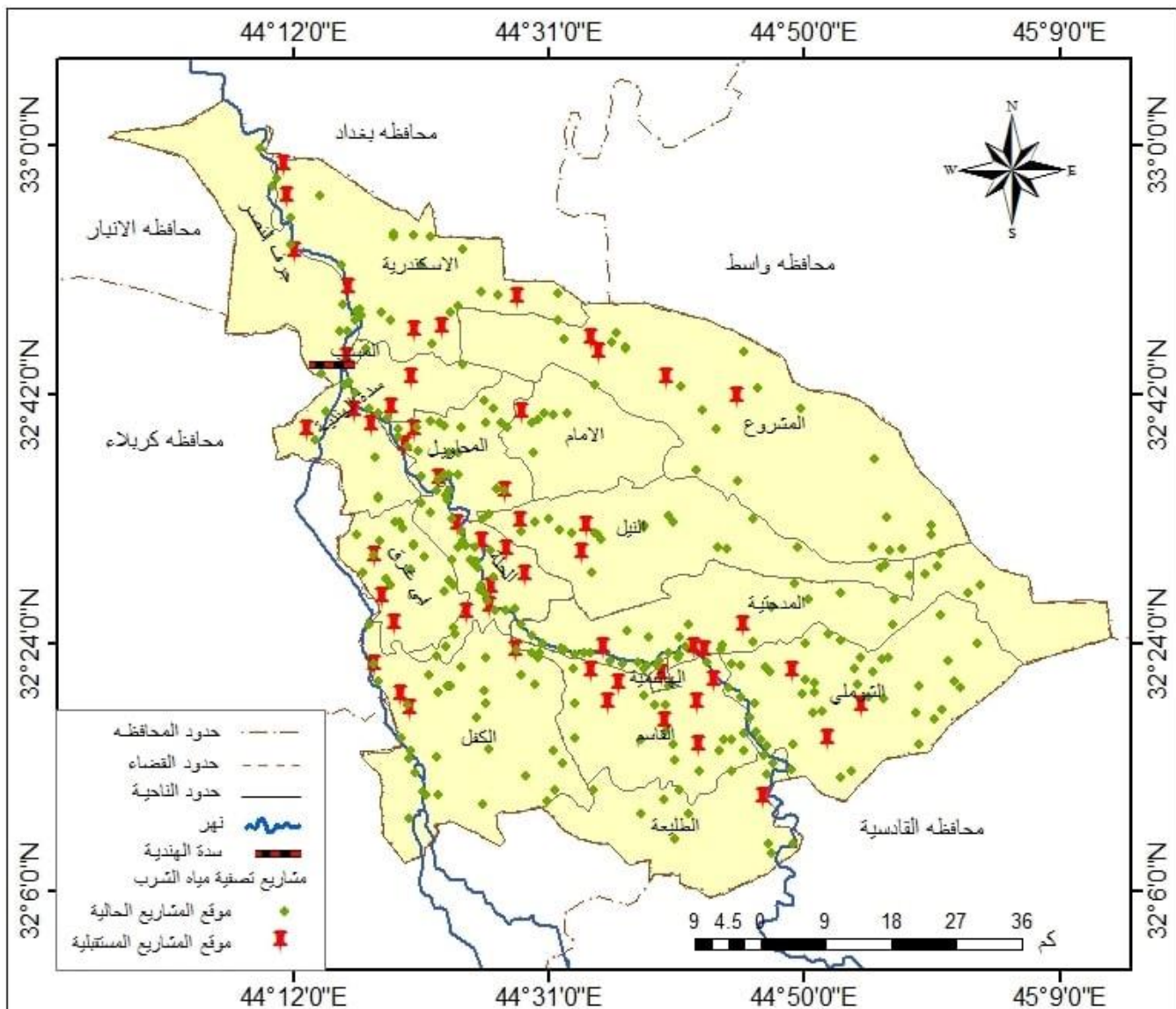**Map (4) The optimal future forecast for drinking water projects and complexes in Babylon Governorate**

Table (5) Preparing the optimal locations for the proposed water filtration stations in Babil Governorate

Administrative unit	Preparing the optimal locations for the proposed water filtration plants	percentage %

District Center Hilla	7	12.73
Al-Kifl	4	7.27
Abu Gharq	3	5.45
Mahaweel District Center	4	7.27
Moshro	4	7.27
Imam	1	1.82
Nile	3	5.45
Al-Hashimiya District Center	1	1.82
Al-Qasim	7	12.73
Medhatiya	4	7.27
Al-Shamali	3	5.45
Altla	1	1.82
District Center Al-Musayyab	1	1.82
Hindi dam	5	9.1
Jurf al-Sakhar 170	1	1.82
Alexandria 388	6	10.91
Total	55	100

Source: The researcher's work based on map (4)

- **Conclusions**

1- According to the population projection equation, the total expected population in Babylon Governorate reached (5,172,568 people) for the year 2031.

2- When estimating the future forecast for the number of deprived residents in the study area, the researcher relied on the stability of the production capacity of each project, with the number of current projects remaining stable until the year 2031 as a result of the increase in the number of residents expected for the year 2031. The number of deprived residents has increased, reaching a rate of (3,617,951).

3- A clear discrepancy in the number of optimal sites for the proposed water filtration stations in Babil Governorate, as the number of optimal future sites in the study area reached (55) sites distributed in large areas near riverbeds throughout all areas of Babil Governorate.

4- The increase in the number of deprived residents means an increase in the population's deprivation of potable water, especially in rural areas.

- **Recommendations**

1- Work to establish projects and complexes to filter drinking water in the study area in a way that is sufficient for the population

2- Establishing an integrated data base that includes water filtration plants and facilitating the process of obtaining this data so that it can be explained in the form of easy-to-read maps.

3-   Encouraging students to pursue studies that are concerned with studying services and monitoring their development and the extent to which they keep pace with the development of the population.

- **Reviewer**

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