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Cartographic Representation of Drinking Water Complexes and Projects Service Efficiency of Hilla District

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Abstract

The technological improvement that has reached the world in various fields has prompted geographical and analytical studies to keep pace with scientific development and try to take advantage of the advanced capabilities granted by modern technologies in collecting, storing and tabulating data and information, including the preparation of objective maps with the aim of revealing the efficiency of drinking water projects and complexes with reference and briefing. The effective and influencing factors, whether natural or human, to give a clear picture to know the extent of their impact on the projects in providing drinking water services to the residents of Hilla district using Geographic Information Systems (GIS), as modern geographic techniques were used to collect and survey data on drinking water projects and complexes, analyze and distribute it to know the efficiency of the service Drinking water projects and complexes, the study included five important paragraphs detailed on the efficiency of drinking water services. The first category was a study of the theoretical framework of the study, while the second paragraph included the study of geographical factors affecting the efficiency of drinking water. As for the third paragraph, it was concerned with studying project maps and filtering complexes. Drinking water and its production capacity in the study area, while the focus Paragraph four on the cartographic representation of the efficiency of serving drinking water projects and complexes in the district of Hilla. It was found from the study that there are some projects that suffer from a shortage of production capacity and therefore a deterioration in the efficiency of the service provided by drinking water projects and complexes. Therefore, we note an increase in the number of unsaved populations, this increase varies from one area to another among the administrative units in the study area.

Keywords

Cartographic representation, Service efficiency, GIS

JEL Classifications: J11, F43

1. Introduction

The design of maps for scientific purposes is very important, as it is not limited to demonstrating the geographer's ability to draw the map and his understanding of the methods of representation, but at the same time it includes the researcher's vision of how he understands the distributions and in determining the axes of change in the way of drawing, the map is an effective tool in clarify what the study of drinking water project services requires, their geographical distribution, their locations and their efficiency for the residents of the study area in filling their basic need with drinking water, as water is one of the most important natural resources on which the past, present and future of human civilization and its development depend, and one of the important problems that the population in the study area suffers from the inefficiency of drinking water project services as a result of the increasing number of the population and the inability of drinking water projects to meet the population's water needs, and thus the increasing number of the forbidden population. Urban and rural, where he established in rural areas many complexes and projects (Oxfam, 2008). Filter units whose structures are galvanized iron for the speed of their installation, that is, they are ready-made, and their filtering efficiency is less than the efficiency of projects, and they are used in villages and relatively small areas(Ibraheem, 2022).

2. Problem of the Study

The problem represents the essence of the basis for the research around which the topic of research revolves. The study problem is how the cartographic representation of the drinking water projects and complexes in the Hilla district, and the extent of the efficiency of serving the drinking water projects and complexes in the Hilla district, and whether geographical factors have an effect on the efficiency of drinking water projects and complexes in the study area.

3. Hypothesis of the Study

The hypothesis is a preliminary answer to the problem to be studied. The hypothesis of the current study is represented by maps using modern technologies and the (Arc Map) program. Its hypotheses that the population of the study area suffers from a large discrepancy in the amount of drinking water between the administrative units in the district of Hilla. Natural and human geographical factors have an impact on the efficiency of drinking water projects and complexes services.

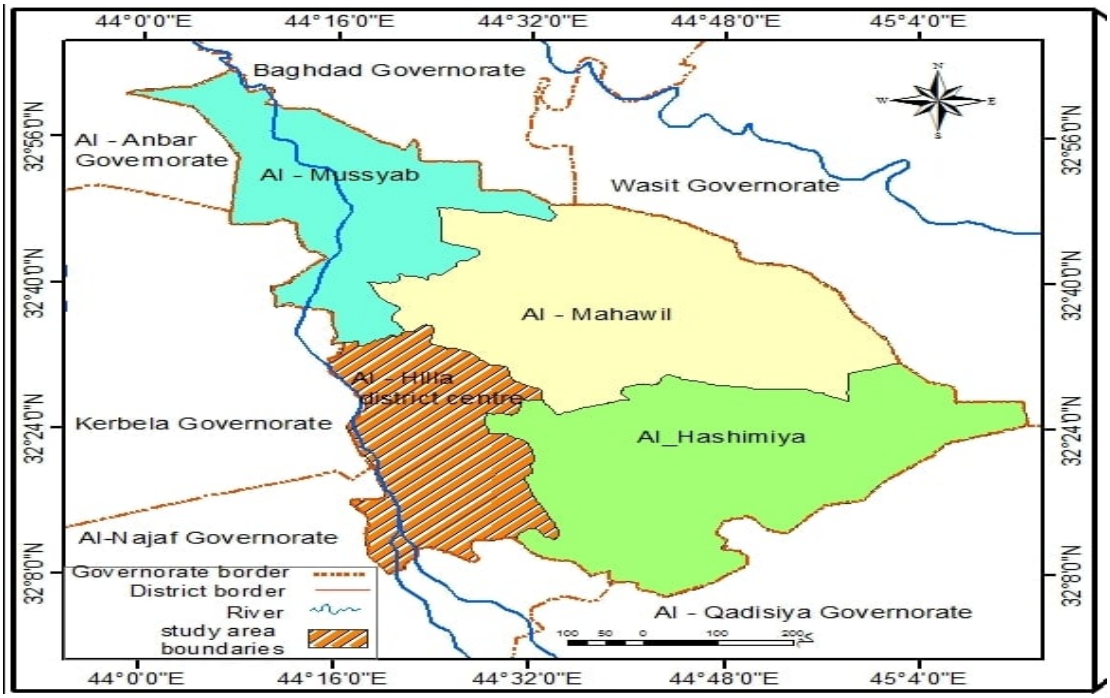
4. Limits of the Study

The limits of the study are the administrative boundaries of the Hilla district of the province of Babylon , which is located in the central part of Iraq in the middle of the sedimentary plain, where the study area is located astronomically between longitudes (15°,44 °) and (44,30,34°) east and two latitudes (36, 32°) and (32.8°) in the north, and the district is administratively bounded from the north by Al-Sadda in the Musayyib district, from the south by Kufa district in Najaf governorate, from the east by the Hashemite district, Al-Midhatiyah and Al-Qasim districts, and from the north-east by Al-Mahaweel district In the south-east, Al-Tali'a district in Al-Hashimyah district. From the west, it is bordered by Al-Hindiya district in Karbala governorate, and from the south-west by Najaf governorate, and map (1) (2) shows this. 191 km 2 sank while the district center occupies 161 km 2 as shown in Table (1).

Table 1. Administrative Units and their Area in Hilla District

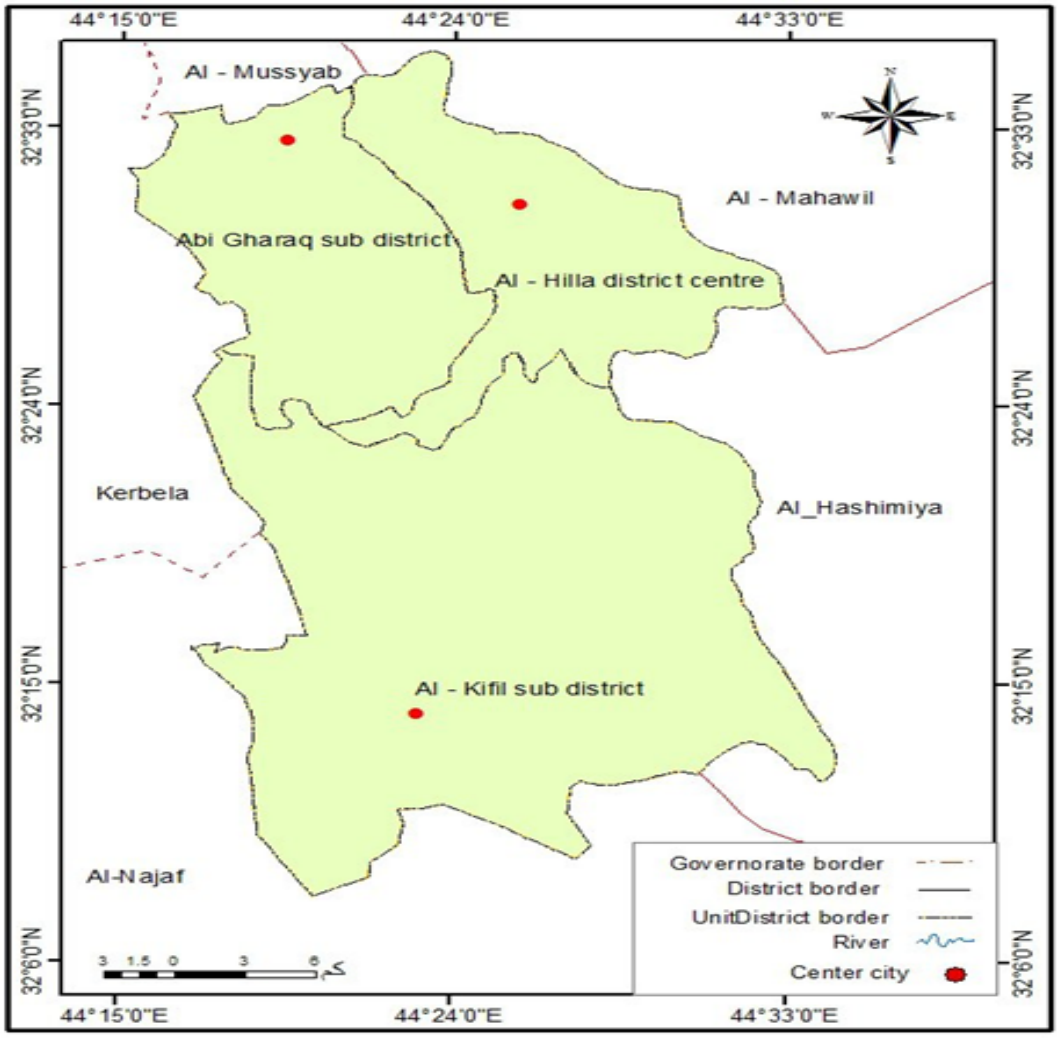
Administrative Unit		Area/km2
District	Sub District	
Hilla	Hilla - District Center	161
	Al-Kifl	526
	Abi-Gharaq	191
The total of Governorate	878	

Source: Republic of Iraq, Ministry of Planning and Development Cooperation, Central Bureau of Statistics, Population and Manpower Statistics, 2021 estimates.



Map 1. The location of the study area

Source: General Authority for Survey, Map Production Department, Hilla District Administrative Map, 2021.



Map 2. The Administrative Unit of the study area
Source: General Authority for Survey, Map Production Department, Hilla District Administrative Map, 2021.

5. Importance of the Study

The study reveals the extent of the importance of cartographic representation and its role in determining the efficiency of the service provided by drinking water projects to the population of the study area, and it has great importance in knowing the stages that drinking water goes through to obtain potable water, and also the importance of research lies in the geographical distribution of drinking water projects and how it is Mapping it with (GIS)

6. Aim of the Study

The research aims to clarify the efficiency of the service provided by drinking water projects to the population of the study area by knowing the production capacity and the extent of the proportion of the population served and deprived of this production capacity and the amount of water that reaches the population of the administrative units in the study area. This study reveals the extent of the

importance of modern technologies Including the GIs program in the cartographic representation of projects and complexes in the study area.

First Subject: Geographical Factors Affecting Drinking Water Projects and Complexes in Hilla District

First: The Natural Characteristics Represented By:

1. The geological nature of the study area: The geological structure has a significant impact on the stability of the region and the ability of the land to bear weights, constructions and the nature of rocks, i.e. knowledge of the natural characteristics of any region, so it will have an important impact in determining the characteristics of surface water resources, both quantitatively and qualitatively, as it affects the amount of river flow and the morphology of rivers In contrast, the river seepage losses. (Abdul-Taha, 2013) Thus, it affects the services of drinking water projects on the one hand, and on the other hand it has a direct impact through the nature of the structure of the area on which the drinking water projects are built, as the study area represents part of the Babylon Governorate, which is located within the sedimentary plain formations. Which is one of the most recent sections of the surface of Iraq in formation, and this plain was formed from the Tigris and Euphrates rivers and by the influence of lakes and sedimentary materials that were deposited within its land by floods with wind sedimentation, and other studies indicate that the sedimentary plain was at a higher level than its current level, but the weight of the sediments The accumulated on its surface helped to continue its descent and in a way that corresponds to a rise in the terrain areas surrounding it (Al-Janabi & SA, 1992), and on the basis of this, the rocks that make up the area To study it is a sedimentary rock consisting of sand, alluvial clay and silt, which are loose deposits and do not contain any solid rock formations (Al-Tamimi, 2003) and this in turn is reflected in the characteristics of water resources.

2. Characteristics of the surface and topography of the area: The nature of the surface is one of the natural controls that have an influential role in the various activities practiced by man, including the establishment of projects (Sha'aban, 2010), especially water projects, because the surface affects the extension of water networks, if the level of the brightness helps to establish water purification projects and extend Water pipes with ease, both in terms of height, slope, gradient direction, elevation maps, and maps showing surface sections and have a great impact in determining and choosing the location of drinking water projects and thus have a great impact on the services they provide. Therefore, the surface characteristics have been studied, and the Hilla district represents part of the sedimentary plain, occupying some Its central divisions, and this means that the characteristic of flatness is clear in its lands, as is the case with the rest of the sedimentary plain regions with slow slope towards the south, and when studying the surface of the region, the extreme northwest is (32) m above sea level and reaches (20) above sea level in southeast of the area.

3. Climatic characteristics: Climate is one of the most important natural characteristics that determine the identity and geography of a region, due to the reflection of the effect of its elements (solar radiation, heat, relative winds and rain) on most human activities and various economic activities (Al-Shami, 1976) and humidity, as these elements directly and indirectly affect its efficiency. Serving drinking water projects where the climate affects the formation of the hydrological characteristics of the extended water network in the study area, especially that the study area is located within the dry and semi-arid areas that are characterized by the low amount of rainfall and high temperatures and the accompanying impact on other climate elements, which in turn work in changing the characteristics of surface water resources, as well as its impact on the soil of the region, the distribution of the population and their economic activity, and the effects left by the climate, either negative or positive, or both. The type and intensity of the effect is due to the type of climate or its class (Al-Behairi, 2006). The study area, which is part of the middle Euphrates region in Iraq, is characterized by a gradual rise in temperature during the summer, which is associated with the angle of solar radiation and the accompanying increase in the number of daylight hours and an increase in acquisition values. Thermal season where the hot season is formed (Makki, 2006), as the study area is located within the dry or semi-arid climate according to Koppen classification (Talib, 2000). This affects the rest of the other elements of the climate as temperature is the main element that controls the climatic characteristics.

4. Soil map: The soil map is of great importance, as it shows the types of soils and their characteristics in terms of the degree of porosity and permeability and their geological nature that are spread in the study area and which have a major role in selecting the optimal sites for drinking water projects and affecting the efficiency of these projects, where the soil is known as the layer The thin and fragmented surface that covers the dry surface of the earth's crust by a few centimeters to some metres, meaning that it varies in thickness from one place to another according to the medical geological structure, which resulted from the disintegration of rocks due to the ancient and modern transformations that occurred in the rocks by the effect of many processes available in nature (Al-Khashab & Al-Sahhaf, 1976) and because the site of The province of Babylon is within the sedimentary plain of Iraq. Its soil is of the type of Iraq's silt soil. Such soils are formed as a result of the gathering of various materials carried by rivers, whether they are fragmented rocky materials or in the form of molten salts. Sediments brought by the winds from areas outside the plain have been added to these river sediments. Sedimentary or from other sedimentary areas that are in the form of aerobic sediments (Eolian), that is, they are types of transported soils, so the soil of the study area is characterized by the presence of The stratigraphic cat and its surface is almost flat with the presence of some small terrain, and it is deep and reaches a depth of several meters (AR Karbel, 1972), the most important feature of which is the high level of the internal water, especially during the high

water levels in the Euphrates River and the streams branching from it, so salts accumulate in the soil and this is what made it need to additional quantities of water for reclamation (Wikipedia).

5. Surface water: It is one of the important water resources in the province of Babylon, whose importance lies in the adoption of maintaining this type of water in all human uses, including industrial activity. The Euphrates River is the source of surface water in the province and enters it from its northwestern part after leaving the Anbar province is adjacent to it, and the general direction of the river flow is from the northwest to the southeast, and it runs in a unified stream in which torsion prevails, where it can be counted from the rivers that are in the late maturity stage and are surrounded by a natural payment whose height is higher than the level of the bottoms of the basins adjacent to it by about (3 m) (AR Karbel, 1981) The main source of water resources for the study area is the water of the Euphrates River with its branches, the main source of surface water in the study area.

Second: The Human Characteristics Represented By:

1. Demographic characteristics: The demographic characteristics are one of the main characteristics of any study that depends on the land and what is on it, through which the relationship between the population on the one hand and where they are located and the variation of their distribution on the other hand is highlighted, in addition to knowing the distribution patterns and their impact on the uses of the land of all kinds (Abdullah, 2006) and the residents has important role in the economic development of the country, as the degree of investment of natural resources and their transformation into economic materials depends on the ability of the population and their energies, which highlights its importance in the production unit, which ultimately determines the amount of national income and the type of general economic level of the country (Al-Ani, 1990), for this the population study enjoys Of particular importance because it reveals the changes that occur in the population's preparation, distribution, movement, composition, degree of concentration and dispersion in the spatial units, and thus it shows the most important human phenomena changing on the surface of the earth (Al-Jawhary, 1997). Which is one of the factors that have a significant impact on the production and distribution of water, as the demand for water is affected by the number of people and their growth rates. Population growth is considered one of the most prominent demographic phenomena in the modern era, especially in developing countries whose population increases at a large rate that exceeds the rate of economic development. Therefore, the population factor is considered one of the important basic factors that affect and are affected by the distribution and production of drinking water (Abu Ayanah, 1986)

2. Urban land uses: Land uses vary within cities, no matter how small they are. The establishment of drinking water projects is part of these public services, where water is one of the necessary needs of the human being, without it, it is

impossible to live or practice any activity. In the Babylon Water Department, the old and new Babylon water projects and complexes, and thus this service occupies a part of the uses space in the province of Babylon, and therefore the other uses of the land have a major role in influencing the selection of the optimal site for drinking water projects and complexes, in what suits them in terms of proximity or distance from or from Where the area is in the entire province of Babylon. And the larger the city's size and the more important its location, the greater the diversity of land uses in it, and new jobs were added to its functions, such as industrial, health, educational, recreational (recreational) use and land uses for transportation... etc (Al-Hiti & Hassan, 2000).

In the study area, all land uses developed during successive time periods, and some uses expanded, one at the expense of the other, through their competition for land, which caused a change in the functional structure of the city (Al-Rubaie, 2002).

3. Electric energy: It is the ability inherent in any material to perform work, and it is not seen, but its effects appear in one way or another. The energy used in industry may be in the form of heat as a result of direct burning of fuel sources, or in the form of heat capacity and motive power at the same time when Converting it to electrical energy, and energy in its two forms is the source of movement in everything. Without it, nothing can be done to help in the establishment of any kind of industries (Sharif, 1982), and electricity services in the city occupies an importance no less than the rest of the services, as the various activities of the city are linked to them. As some of them cannot work, electric power is one of the services that has an impact on the site of choosing industrial projects in general and the drinking water project in particular, as it represents the only source that moves water pumps inside drinking water projects, so when electing the site of drinking water projects, it must be taken into account The presence of high-voltage electrical stations.

4. Governmental water policy: The government's water policy is one of the most important characteristics that are no less important than other human factors in their impact on water resources in general and surface water resources in particular. Sewage and pure water are a vital part of the infrastructure system and perform very important functions for modern cities and their departments in order to ensure the achievement of water security that is sufficient and suitable for various economic uses. Governmental measures are represented in supporting the water sector and control and control projects in terms of water control, efficiency of its management and good organization (Al-Masoudi, 2000).

Second Subject: Cartographic Representation of Drinking Qater Projects and Complexes in The District of Hilla

First: Cartographic Representation of Drinking Water Projects in Hilla District

Babylon Governorate has observed a great urban growth since the beginning of the seventies until now, until the population growth rates have increased significantly, and Hilla district is part of Babylon Governorate, Where the population of the district reached (908,940) people in 2021, which led to an increase in the demand for potable water as a result of the high rates of consumption by citizens, and this is what worked to increase interest in this service aspect as it is a legitimate and legal right and duty to provide to citizens, so the Babylon Water Directorate worked on Establishing a number of projects and complexes in rural and urban areas to cover the needs of the population according to the administrative units. The number of projects in the study's logic reached five projects (the new Hilla project, the old Hilla project, the old Al-Tayarah water project, the Al-Kifl water project, the strategic Abi Gharq water project) Distributed in three districts (Hilla Center, Kifl, Abi Gharq) as shown in Map (3), where they were distributed on the map based on Table (2). These projects differ in their capacity, design capacity and date of establishment. These projects can be classified into the following:

1. The Old Hilla Project: This project is located in the center of Hilla within the district of Hilla in the province of Babylon, on the right side of Shatt Hilla in the neighborhood of al-Tayarah and is located far north of the city with the project of the plane and the reason for choosing this site for its mediation in the city of Hilla as shown in Map (3) (Republic of Iraq 2022) It is one of the oldest projects in the city of Hilla, where it was established in 1954. Table (2). The area of the project is about (26 dunums), as the project contains a number of units, one of which is for pumping raw water, and the pumps are away from the project about (600 m), Two refineries and three domes supply the project with energy alone. The filtration device alone for chemical applications is located on the right side of the Shatt Al-Hilla. The project's function is to feed the old plane project to pump water to the consumer, and the project also contains a unit for water withdrawal and its function is to withdraw water from the Shatt Al-Hilla to the project and sedimentation unit (sinks).

It is the process by which suspended and sedimentable materials are removed, the filtration unit and the process of following the sedimentation process in the sequence of treatment operations whereby suspended and fine materials that have not been deposited in the sedimentation basins are removed, and the water sterilization unit is one of the important processes for water treatment as it works on the extermination of living organisms The pathogenic microscopic in a number of sterilization methods, the method used in the complex is to add chlorine to the water to get rid of impurities, the laboratory unit and its function is to analyze the water and verify it before pumping it to the consumer, and the water pumping unit, and this unit pumps water to consumers in a center to solve, and the old Hillah project contains two basins in a manner circular water passes to them from the mixing basins through openings in the wall between the sedimentation basins and the mixing basins, and these basins were built It is made of concrete and contains

a mud sweeper, which removes the deposited mud inside the basins ("Research Based on the field study of the project on February 23," 2022), its production capacity is 1140 m 3 / hour and its design capacity is 120000 m 3 / day and the operating hours vary according to the seasons. Water use, but in the summer the operation is 24 hours / day (Salah, 2022).

2. The Old Tayyara Project: This project is located in the center of Hilla, affiliated to the district of Hilla, on the right side of the Shatt Hilla in the north of the city in the al-Tayyara neighborhood. In 1975, its design capacity is about (25200 m3/h), and its production capacity is (1260 m3/h) (Republic of Iraq, 2022). Table (2)

This project consists of two sedimentation basins and the dimensions of one basin (9 m2) with a circular shape and the size of the basin about (4000 m3). It contains eight filters that perform the water filtration process. It is equipped with four pumps, which are about (500 m) away from the project. It also contains payment pumps amounting to six pumps. It pumps potable treated water directly to the consumer without passing through a pumping or fortification station. The project contains a number of units, like the projects. The filtration unit alone is filtered alone for the laboratory, not for chemical, physical and biological analyzes, and the sterilization unit. The method used for sterilization is the method of sterilization with chlorine gas, where The project contains six bottles of chlorine used to filter water from impurities such as hydrated aluminum sulfate. The water is measured in a Jart device to determine the amount of alum added. As for water transport pipes, plastic pipes that carry water are used and do not use iron because steel is subject to rust and corrosion. ("Research Based on the field study of the project on February 23," 2022).

3. The new Hilla project (Abu Khastawi): It is one of the projects located in the center of the city of Hilla within the district of Hilla. This project serves Abi-Gharaq and the city of Hilla and the neighboring villages. It was established in 1991 with a capacity of 6000 m3 / hour and a design card of 120000 m3 / day. This project serves the city of Hilla, Abi Gharq and the neighboring villages, and the source of its water is from the Shatt Hilla (Republic of Iraq, 2021). The project contains a number of units and processes necessary to purify drinking water, starting from the intakes, water reception wells, sand filters, a ground tank, pumps, a building for administrators and employees, a building for an energy source and a building for chemical applications, in which there are three Twenty reinforcement stations, the united Hilla project is one of the largest and largest projects in the study area, as it contains basins and each basin has a mud sweeper and contains two halls, each hall contains (18) filters, and each filter contains 8 rooms, and these filters are a concrete building that contains A filling of medium-large gravel, then sand, and then goes through doors to a large pipe with a diameter of (1000 inches) and then goes to the ground tank with a filtration rate per square meter (5 m3/h) ("Research Based on the field study of the project on February 23," 2022)

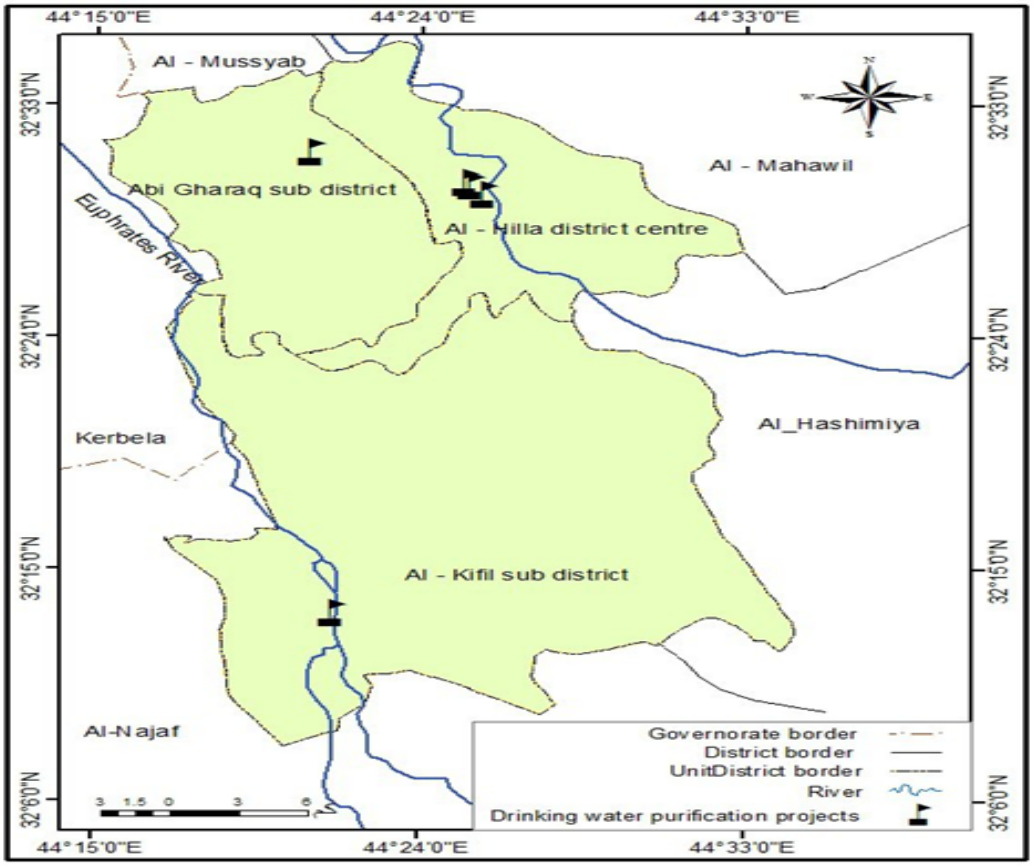
4. Al-Kifl Water Project: This project is located in the Al-Kifl district in the old Kasbah area, located on the Euphrates River in Hilla district. It was established in 1968, with a capacity of (180 m 3 / hour) and a design card of (2000 m 3 / day) (Abdel, 2022) with an area of about (2500) m3 This project is one of the old projects with an old design, as it contains a large hall with a size of about 25 m divided into a number of units, and each unit works differently from the other (Abdel-Hassan, 2022), and contains two pumps to extract raw water working alternately and then transfers the water to the sedimentation basin To leak water from mud and plankton, where alum is added, and then the water is transferred to the collection basin and from the collection basin to the sterilization unit or the so-called filter unit, where the water is filtered and then sterilized by the method of sterilization with chlorine, and then the water is pumped to consumers in each of (city center - neighborhood). Al-Hussein Al-Abbas neighborhood - Safir neighborhood - Al-Mustafa neighborhood. The project contains a warehouse for storing maintenance tools, two rooms for workers, and a number of facilities and services for workers, technicians and engineers ("Field study Field study of the region on," 2022).

5. Abi-Gharaq Strategic Project: This project is located in the area of Abi-Gharaq, Al-Hussein district, with an area of ten acres. It was established in 2019 and has a capacity of 4000 m3 / hour and a design card of (80,000 m3 / day) ("Republic of Iraq Ministry of Municipalities and Public Works," 2022) with an area of about ten acres. It contains twenty-one rooms and eleven halls and a number of units, including the outlet where it takes water from the Shatt Al-Hilla to feed the project with raw water. The intake unit also includes the intake well, where the raw water that was withdrawn from the Shatt is collected and then transported through stainless and fracture-resistant pipes, as well as It contains two pumps that work alternately to withdraw raw water from the intake well to the mixing and sedimentation basins (Abdel-Hassan, 2022). One of the important units in the project is the sedimentation unit, which is one of the most prominent units in the project. Any defect in the efficiency of the work of these units is negatively reflected on the other units and then on the quality of Produced water, as poor sedimentation may allow external turbidity from clays and suspended matter to flow into the filter unit whereby the suspended and fine materials that have not been sedimented in the sedimentation basins are removed. Then the water is pumped into the sterilization basins where chlorine is pumped to sterilize the water Then it is pumped by pumps, which are three lines, and each line contains three pumps, and then they are distributed to the regions of (Kazim Al Musa village - Awfi village - Abi Gharq Al-Awsat - Abi Gharqa station - Al-Raghila station) by means of a network of pipes. The project contains a number of Of the facilities and services for the workers and a number of rooms, as well as the project contains rooms for maintenance, and the project contains a unit of electrical energy corresponding to a unit of alternative energy by means of generators ("Field study Field study of the region on," 2022).

Table 2. Geographical Distribution of Drinking Water Projects in Hilla District

S.	Project Name	Geographical location of the project	Project Status	Issuance	Capacity Design m3/day	Served Locations
1	New Hilla Project	The Center of Hilla	Active	1991	120000	The Center of Hilla and a part area of
2	Old Hilla Project	The Center of Hilla	Active	1954	22800	Serving Tayarah Project
3	The Old Tayarah Water Project	The Center of Hilla	Active	1975	25200	The Center of Hilla
4	Al Kifl Water Project	Al Kifl	Active	1968	3600	City Center - Al-Hussein Suburb, Al-Abbas Suburb, Safir Suburb, Al-Mustafa Suburb
5	Abi Gharaq strategic water project	Abi-Gharaq	Active	2019	80000	Kadhim Aal Musa village - Awfi village - Abi Gharq Al-Awsat - Abi Gharq station - Raghila station

Source: The researcher's work, based on the Directorate of Water in Babylon Governorate, Planning and Follow-up Division, unpublished data, 2022.



Map 3. Map of the geographical distribution of drinking water projects in Hilla district

Source: the researcher's work based on table (2)

Second: Cartographic Representation of Drinking Water Complexes in The District of Hilla

As a result of the increased demand for drinking water and the inability of the main projects to meet the population's need for water, and some of them were disrupted due to their old age, the administrative units were equipped with complexes, and some of them became the main source for feeding the population with drinking water. These complexes share that they are named after the site in which they are located. The number of small and large water complexes in the district of Hilla reached (104) complexes, and their total design capacity was (19390 m3 / hour) distributed among the centers of the districts and districts of the study area as shown in Table (3) They were represented by dotted maps on all administrative units within the district. Map (4) is shown as follows:

- The Center of Hillah: The number of complexes reached (39) complexes, and these complexes were divided according to the location into the Al-Hussain complex, including (Aal-Fattal Complex, Burmana Complex, New Dulab 2 Complex, Al-Rawashid Complex, Mushaimesh Complex, Al-Nakhila Al-Sharqiah Complex, Al-Dullab 1 Complex, the old complex Al Tayyara complexes, Abu Khastawi complex 1, Abu Khestawi complex 2, and Al-Maimrah complexes, which include (Tasaed Apartments stations complex 1, Tasaed stations, Tasseed complex 2, Al-Sajjad complex, Ibrahim Khalil complex 1, Karim Radi complex, Al Ghalis complex, Khafajah complex, Al Mutaba complex, complex Al-Masoudi, Hor Al-Shouk Complex, Abu Daba' Complex, Al-Maamra Complex, Hawa Al-Sham Complex, Ibrahim Al-Khalil Complex 1, Huweish Al-Sayed Complex, Kuss Swailem Apartment Complex 2 Pay, Kuss Swailem Apartment Complex 1 Pay) and Al-Wardiya Complex and Al-Atayej Complex include (Al-Wardiya Complex 1, Al-Ayfar Complex, Al-Wardiya Complex 2, Al-Atayej Complex) and Ananah and Barnoun complexes including (Jemjimah Village Complex, Anana Village Complex, Babylon Antiquities Resort Complex, Old Anana 1 Complex, Al-Nakhila Al-Gharbiyeh Complex, Old Barnoun 1 Complex, Old Barnoun 2 Complex, Barnoun 3 Complex, City Complex Archaeological Babylon 2, the new) and the total design capacity of the complexes was (11814) as It is shown in Table (3) (Field study, 2022)

- Al-Kifl Sub-district: It includes (33) complexes for the purification of drinking water distributed in separate areas within the Kifl sub-district and its outskirts. It represents each of the complexes of (Al-Tallqnin, Al-Samri, Al-Basarwa, Ibrahim Al-Khalil, Raranjieh 3, Al-Nabi Ayoub, Al-Maghadbeya, Al-Khammas, Juzor Al-Khanyab 2 and Mallawiyah Al Jadeeda, Um Na'ajah Al Jadeeda, Juzor Al -Khanyab (1), Imam Zaid bin Ali (peace be upon him) 2 Al Jadeed, Bani Muslim Al Jadeed, Rashid Al Hijri, Al Jaziriyah, Al Himsaniyah 1, Al Mughadbeya 1 Al Qadeem, Abu Samij, Al Hussainiya and Al Nuaimia, Al Musharaka, Al Tufail, Al Alqami, Al Kifl The new French, the old imam Zaid Ibn Ali, the old Raranjieh 2, the Raranjieh, the Himsaniya, Khan Sayed Noor, the Kifl Red Cross, Albu Hawwa, Al-

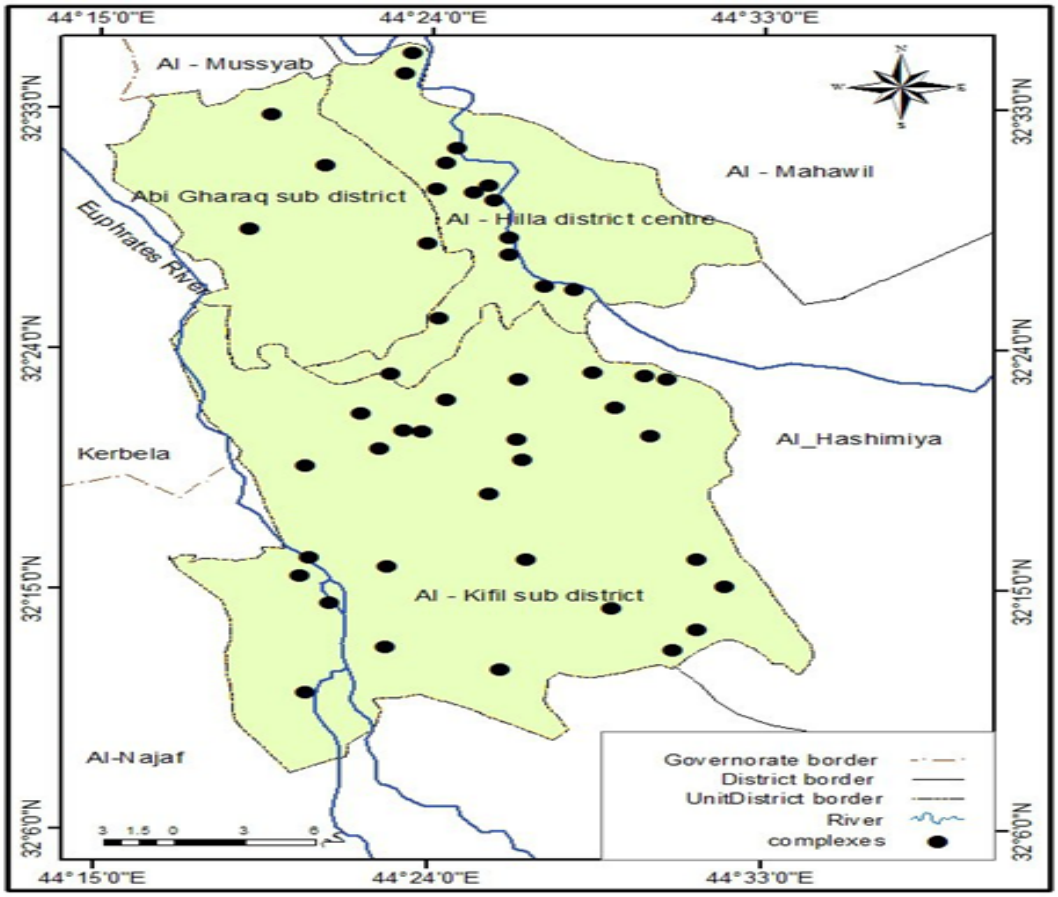
Majatim, Al-Barthawil) and its total design capacity is (4898 m3 / h) as shown in Table (3)

- Abi-Gharaq Sub-district: It includes (15) complexes, namely, (Al-Nakhila Al-Gharbiyye (2)), Awfi (2) Al-Jadid, Al-Bashiliya (Al-Nidal), Bani Sala, Al-Raghila, Kes Sweilem, Al-Batoul, Al-Youssefiya and Al-Maleh, Zghair Al-Anun, Al-Mukhallat. Zgheib Al-Arab, Ghanem Al-Shamran and Al-Ayfar Lamamarah, Bani Sala and Al-Zarkan, Abi Gharq Al-Jadeed Al-Awsat, Al-Kim (Al-Kimyah) and its total design capacity was (2678 m3/h) as shown in Table (3)

Table 3. Distribution of Complexes in The Province of Babylon

Administrative Unit	The number of water complexes	Capacity Design of the complexes m3/day
Hilla - District Center	39	11814
Al-Kifl	33	4898
Abi-Gharaq	15	2678
The total of Governorates	87	19390

Source: the researcher's work based on the Republic of Iraq, Ministry of Municipalities and Public Works, Babylon Water Directorate, unpublished data, 2021



Map 4. Geographical distribution of drinking water complexes in Hilla district
Source: The researcher source based on Table No. (3)

Third Subject: Cartographic Representation of The Efficiency of Serving Drinking Water Projects and Complexes in The District of Hilla

The efficiency of the drinking water production service depends on the production capacity of each project that is sufficient for the number of people served in all administrative units. All of it to consumers, as the produced water is wasted as a result of unjustified consumption and abuse of potable water. Among the other processes is water leakage. Water leakage is actually present in every system, and it ranges from 10% to 50% (Wismanathan, 1999).

It is noted in Table No. (4) a clear discrepancy in the preparation of projects and complexes between administrative units and different production capacity. In the Al-Kifl district, it was represented by the lowest ratios among the districts, where the production capacity reached (58,119) for (33) complexes and one project distributed to the number of serviced population that reached (107,071)) with a percentage of (15%), followed by Abi Gharq district, with a production capacity of (105,515 m/day), representing the production capacity of one project (15) complexes, and the number of serviced population reached (114,075) at a rate of (16%), while Hilla Center represented the highest percentage in the district, reaching The number of projects was (3) projects, and the number of complexes was 39 units in the center of Hilla, and the total production capacity of drinking water projects and complexes reached (236,272 m/day), representing the highest production capacity in the study area, distributed over the number of served population in the center of Hilla, which reached (491,110) and at a rate of (69%) as shown in map (5), where the yellow color indicates the lowest percentage in the Kifl district, while the brown color has the highest percentages in the Hilla Center district.

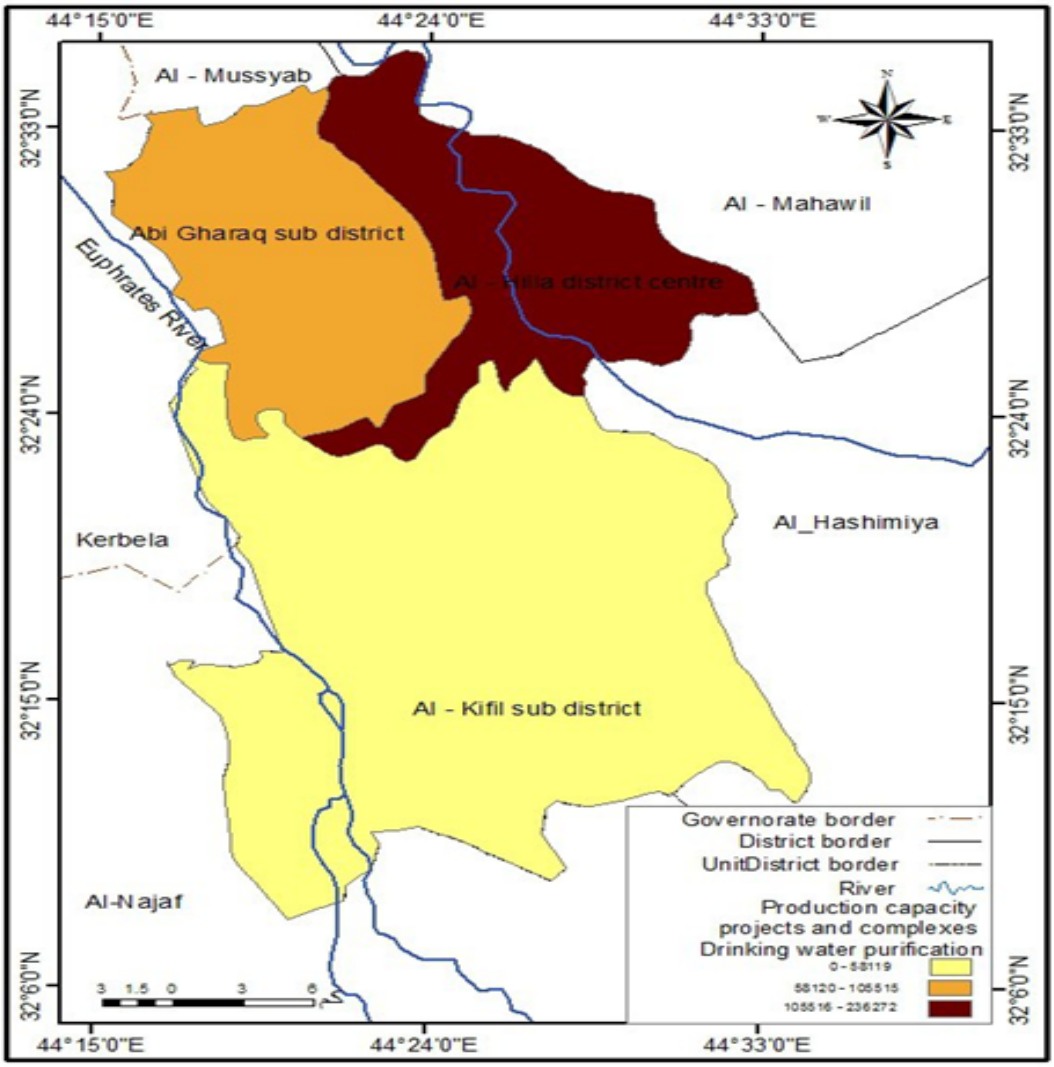
Table 4. Production Capacity of Drinking Water Projects in the Study Area for the Year 2021

Administrative Unit	The number of drinking water stations		The total capacity of the actual projects and complexes m3 / day	Number of served population	Percentage %
	Number of Complexes	Number of Projects			
Hilla - District Center	39	3	236,272	491,110	69
Al-Kifl	33	1	58,119	107,071	15
Abi-Gharaq	15	1	105,515	114,075	16
The Total of Governorates	87	5	399,906	712,256	100

Source: The table is from the researcher's work based on: Republic of Iraq, Ministry of Municipalities and Public Works, General Directorate of Water,

Directorate of Water of Babylon Governorate, Planning and Follow-up Department.

When comparing the number of people served and served for each administrative unit, we find that there are deprived people who are not provided with water or who receive an amount of water less than the quota of one individual according to the international standard for water quota. The total population deprived of water in the study area reached (196684), where the highest percentage Of the deprived population, the center of Hilla reached (137,751) with a rate of (70%), as shown in Table (5), despite the large number of complexes and projects inside the center, but its production capacity is low in relation to the number of the population that is constantly increasing, as the usable water suffers from a lack of usable water In the areas far from the city and the city's slums as a result of the continuous increase in the number of the population, the same applies to the rest of the governorate's districts, where Al-Kifl is followed by (50745) and (26%), followed by Abi-Gharaq (8188) and (4%) as shown. In map (6), the numbers of the serviced and the deprived population were represented.

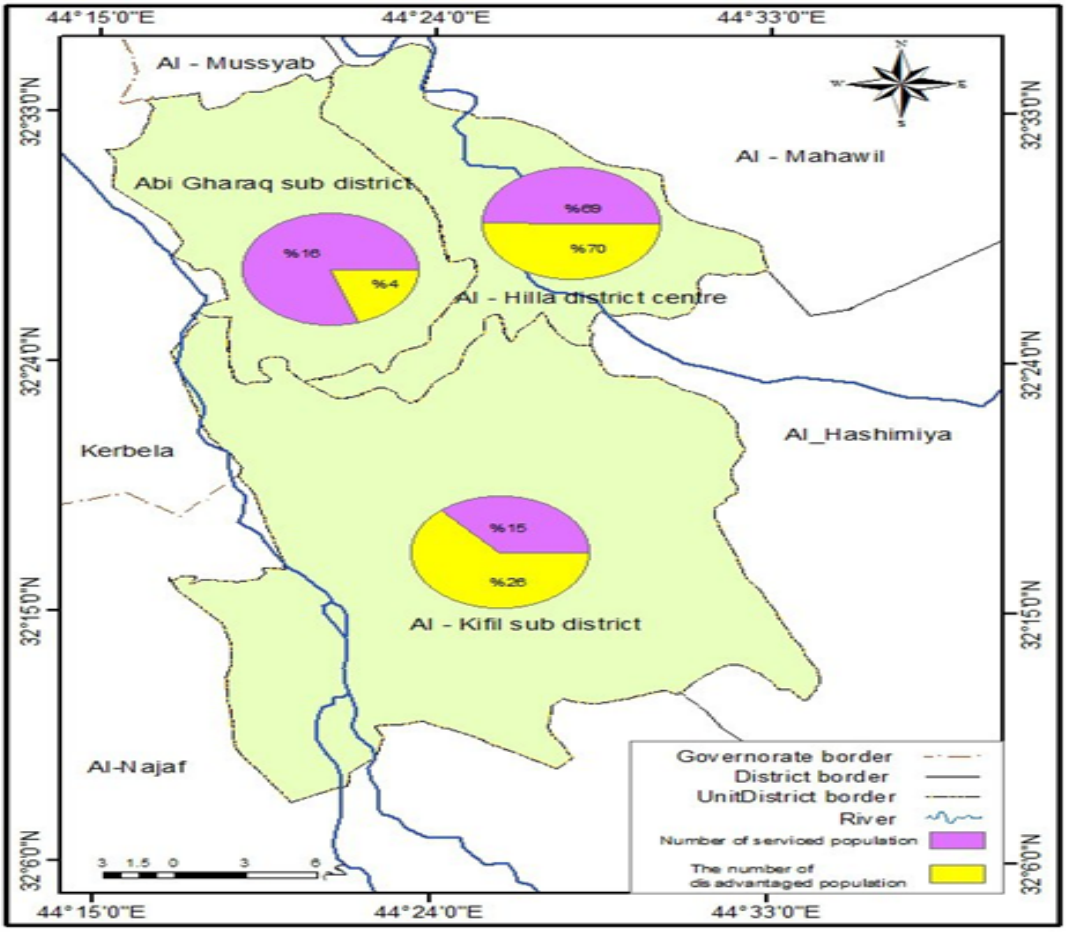


Map 5. Production capacity of drinking water projects and complexes
Source: the researcher's work based on table (4)

Table 5. Served and Unsaved People of Drinking Water

Administrative Unit	Population / person	pct. %	Served population	pct. %	Unserved population	pct. %
Hilla - District Center	628861	69.2	491,110	69	137751	70
Al-Kifl	157816	17.3	107,071	15	50745	26
Abi-Gharaq	122263	13.5	114,075	16	8188	4
The Total of Governorates	908940	100	712,256	100	196684	100

Source: The table is from the researcher's work based on: Republic of Iraq, Ministry of Municipalities and Public Works, General Directorate of Water, Directorate of Water of Babylon Governorate, Planning and Monitoring Department.



Map 6. Geographical distribution of the number of employed and unserved population

Source: the researcher's work based on table (5)

7. Conclusions

1. The study shows the importance of using modern technologies in cartographic representation for the distribution of drinking water projects and complexes

2. The study confirmed the significant impact of geographical characteristics, whether natural or human, on the services of drinking water projects and complexes

3. It was found from the study that there is a difference in the quantity of drinking water needs from one area to another, depending on the population of that area.

4. The study confirmed an increase in the number of the deprived population with the increase in the number of the population in the study area, where the number of the deprived population reached (196684), while the number of the serviced population reached (712,256).

5. It is clear from the study that there is an imbalance between the productivity of water purification projects and the population meter, and consequently the inefficiency of serving drinking water filtration projects and complexes in the study area.

8. Recommendations

1. Work to raise awareness among citizens in general in the field of water use and how to preserve it.

2. Working with the metering system to collect water fees, which determines water fees according to the amount of water consumed

In every sector (domestic, commercial, government) and this has a role in reducing sowing and waste in the use of

water.

3. Establishing strict laws and regulations that would prevent factory owners from relying on drinking water for the purpose of production.

4. Work to restore the balance between the preparation of projects and their production capacity in the study area and the population at the level of neighborhoods in the study area.

5. The government should develop future plans for the establishment of projects to purify drinking water with a large production capacity that will work to accommodate the growing population.

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