

Geographical analysis of drinking water services and their development potential in Dhi Qar Governorate

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Abstract

Access to clean and potable drinking water is among the most important infrastructure services for achieving development. It is a key indicator for measuring societal development and determining whether a society is progressing on the path of development and progress. This research analyzes the geographical reality of drinking water services in Dhi Qar Governorate and their potential for development, examining the spatial distribution of drinking water production plants, their actual production capacity, and their adequacy to meet the growing demand for potable water in the governorate's districts. It also compares these conditions with Iraqi planning standards for drinking water. Moreover, the research identifies the challenges facing the achievement of sustainable development in this vital sector, such as water scarcity, population growth and urban expansion, inadequate maintenance and funding, high rates of water loss, and poor water quality in most areas of the governorate, along with a clear gap between supply and demand. The research proposes a set of strategies to improve drinking water services in Dhi Qar, including expanding the construction of new water purification projects, rehabilitating outdated networks, adopting modern treatment technologies, and strengthening integrated water resources management. Developing and sustaining drinking water services in Dhi Qar Governorate is a necessity. Urgent development is needed to achieve spatial justice and improve the quality of life. This requires a comprehensive development strategy based on accurate geographical analysis to ensure the sustainability of water resources and the efficiency of their future distribution. This research adopted a descriptive and analytical approach and official statistical data to reveal the reality of drinking water services and the spatial variations in the size of the supply, production, and service level among the administrative units of the governorate. The research reached several conclusions, the most important of which is that Dhi Qar Governorate suffers from a significant deficit in clean drinking water services, poor quality of service, and deteriorating service standards. The main challenges arise from reliance on unsustainable drinking water sources, such as purchasing RO water. The researcher hopes that these findings and proposals will contribute to achieving sustainability in the drinking water services sector, which will, in turn, reflect positively on the development of Dhi Qar Governorate and raise its overall development indicators.

Keywords: Development, Sustainable Development, Drinking Water Services, Potable Water Dhi Qar Governorate.

1- Introduction

Drinking water services are among the most vital services any society needs sustainably for continued health and well-being. The need for drinking water is fundamental and essential for the lives of the population, as its availability in sufficient quantities is crucial. Quality is one of the important measures of human development and quality of life, as it is one of the measures that reflects the civilized level of society. Water is an indicator of development in general and human development in particular, due to its importance in the lives of the population (World Health Organization, 2004, p. 11). With increasing population pressures, environmental changes, and the accelerating demands of sustainable development, drinking water services have emerged as a vital pillar of human security and socio-economic stability, particularly in areas suffering from structural imbalances in water infrastructure, such as Dhi Qar Governorate. This governorate faces complex challenges related to water scarcity, fluctuating releases from the Tigris and Euphrates rivers, deteriorating water quality, inefficient filtration and distribution networks, and a widening gap between supply and demand due to population growth. Access to safe drinking water is a fundamental pillar of sustainable development. It is not merely a human right and a health issue, but a pivotal factor in the social, health, and economic dimensions of development. From a social and health perspective, clean water reduces the spread of waterborne diseases such as cholera and diarrhea, thus improving quality of life and boosting productivity. Economically, it supports water availability for industry, contributes to lower healthcare costs, and supports comprehensive economic growth. Societies with access to clean water are more capable of achieving stability and prosperity, and vice versa. Therefore, developing the infrastructure for clean drinking water services represents one of the most important opportunities for sustainable development. One of the keys to achieving its goals, and with regard to drinking water services in Dhi Qar Governorate, will be studied in terms of the reality and challenges of achieving sustainable development for it, as well as strategies for developing this sector.

1-1. Research Problem

The research problem can be summarized in the following questions:

1-1-1. What is the current state of drinking water services in Dhi Qar Governorate?

1-1-2. Do the available drinking water services meet the needs of the governorate's population? And to what extent do they conform to Iraqi planning standards for drinking water?

1-1-3 Does the process of achieving sustainable development for drinking water services face any challenges that hinder it?

1-1-4. What strategies and solutions can be implemented to overcome the challenges and achieve sustainability in providing clean drinking water in Dhi Qar Governorate?

1-2. Research Hypothesis

1-2-1. The reality of drinking water services in Dhi Qar Governorate indicates a severe shortage in them, and thus they do not meet the needs of the population.

1-2-2. The drinking water services in the study area do not meet the needs and requirements of the population, nor do they conform to their planning standards.

1-2-3. There are many challenges that hinder the achievement of sustainable development of clean drinking water services in the governorate.

1-2-4. There are a number of strategies which, if implemented, could contribute to reducing the challenges that hinder the achievement of sustainable development of drinking water services in Dhi Qar Governorate.

1-3. Research objective

This research aims to achieve sustainable development in drinking water services in Dhi Qar Governorate, due to its importance in various aspects of comprehensive development. The research also seeks to reveal the most prominent challenges that hinder the achievement of sustainability in drinking water services. This research also aims to develop a strategy to eliminate the challenges and achieve sustainability in drinking water services.

1-4. Boundaries of the search area

The boundaries of the research area were represented by the Dhi Qar Governorate, located astronomically between latitudes (30.33°–32°) north and longitudes (45.37°–47.12°) east; it is bordered administratively by Maysan Governorate to the east, Al-Muthanna and Al-Qadisiyah Governorates to the west and northwest, Wasit Governorate to the north and Basra Governorate to the south (Map 1). The research focused on the districts of the governorate according to the new administrative units, which number (15) districts, namely (Nasiriyah, Al-Bathaa, Sayyid Dakhil, Al-Islah, Al-Shatra, Al-Dawaya, Al-Gharraf, Al-Rifai, Al-Nasr, Qalat Sukkar, Al-Fajr, Suq Al-Shuyukh, Karma Bani Saeed, Al-Jubayish, Al-Fahoud) (Table 1, Figure 1 and Map 2). As for the time frame, it was limited to studying the current situation in 2024..

Table (1) Districts of Dhi Qar Governorate and their areas for the year 2024

%	Area (km ²)	Districts of the Governorate
6.4	894	Q. Al-Nasiriyah
13.7	1906	Q. Al-Bathaa
3.9	546	Q. Sayed Dakheel
8.3	1150	Q. Reform
2.9	397	Q. Al-Shatra
6.2	852	Q. Al-Dawaya
5.0	692	Q. Al-Gharraf
9.8	1350	Q. Al-Rifai
7.0	970	Q. Al-Nasr
5.1	711	Q. Sugar Castle
3.7	509	Q. Al-Fajr
7.4	1024	Q. Souq Al-Shuyoukh
2.2	301	Q. Karma Bani Saeed
14.0	1933	Q. Al-Jubayish
4.4	605	Q. Al-Fahoud
100	13840	Governorate total

Source: Based on: Republic of Iraq, Ministry of Planning, Central Statistical Organization, Annual Statistical Abstract, 2020-2021, Table (5/1).

1-5. Scientific Concepts and Terminology

Linguistically, the concept of development is derived from the verb “nama,” meaning to increase, with the meaning of increase and abundance. From it comes the meaning of “yunmi” or “namaa,” meaning gradual increase. Thus, development is the act of growth and working to bring it about (Ibn Manzur, 2010, p. 4551). As for development in its technical sense, it means elevation in one aspect of knowledge or aspects of life (Al-Razi, 2009, p. 49). A clear change occurred in the concept of development, its strategies, and its content after the Second World War, as it included only economic growth strategies. Then came the second stage from the sixties until the middle of the seventh decade of the twentieth century, as the concept of development began to include social aspects. This development was a reaction to the type and dimensions of the problems facing development in all societies in general and developing societies in particular. Moreover, this development in the concept is a real and realistic embodiment of international and regional experiences that have accumulated over time on the ground (Ghanim, 2017, p. 42).

The United Nations defined development as a set of means and methods used to unify the efforts of the people with the public authorities to improve the standard of living in economic, social and cultural aspects in national and local communities, and to bring these communities out of their isolation to participate positively in national life; and to contribute to the progress of the country (Gharbi et al., 2003, p. 32). It was also defined as a process aimed at changing the reality of the economic, social, service and urban structure of society for the better, through investing the available natural, human and economic capabilities in the region in a planned manner and according to a sustainable development strategic vision; that ensures the availability of an economic and social level and services for every individual in the present as well as in the future (Al-Ghazi, 2018, p. 4). Development was defined as removing all developmental obstacles with the aim of achieving the optimal use of the available geographical resources in the region to reach the stage of balance in development (Al-Dulaimi, 2017, p. 71).

Regarding sustainable development, global interest in this new concept (sustainable development) has emerged through seminars and meetings. Global efforts began with the Stockholm Conference on Human Development in 1972, continued through the Rio de Janeiro Earth Summit on Environment and Development in 1992, and culminated in the Johannesburg Summit in 1990. (Kafi, 2017, p. 42), and the concept of sustainable development did not come into existence until the beginning of the eighties when it took on many new meanings, and began to attract renewed scientific and intellectual interest. This concept has seen development on every global occasion (Bou Acha, 2008, p. 1). The World Commission on Environment and Development (Brundtland) defined it most famously when the United Nations published the report that completed the work of the World Commission on Environment and Development and was formed in 1983, which indicates that it is development that meets the needs of the present without diminishing the ability of future generations to meet their needs, and this is the definition that is most accepted by all institutions, institutes and governments (Al-Hiti, 2009, p. 14). The European Union defined it in 1992 as an organizational method and strategy aimed at ensuring the continuity over time of social and economic development within a framework of respect for the environment without threatening the natural resources that are essential for human activities. (Benhayoum, 1999, p. 69) It is also defined as the development process that meets the hopes and needs of the present without compromising the capabilities of future generations. The future depends on meeting their needs at risk (Mouschet, 2000, p. 63).

2- The reality of drinking water services and their development indicators

The reality of drinking water services indicates a significant shortfall in meeting the needs of the population of Dhi Qar Governorate. It is evident that the number of drinking water treatment and production complexes in Dhi Qar Governorate reached (187) complexes with an actual production capacity of (306,253 m³/day). The number of people served by these water complexes reached (1,055,194), representing (43.3%) of the total population of the study area (2,440,887). The per capita share of the served population in the governorate as a whole reached (290 liters/day), which is below the established indicator of (350 liters/person/day). The overall deficit in the quantity of potable water reached (548,054 m³/day), equivalent to (548,054,000 liters/day). Regarding the geographical distribution of these services, it is observed from Tables (2, 3) and Maps (3, 4) that Suq Al-Shuyoukh District had the largest number of water complexes, with (30) complexes and a production capacity of (8,861 m³/day), while the number of people served reached (83,289 people) and the percentage of (27.7%) of the total population of the district, which is (300,491 people). As for the per capita share of the people served by drinking water, it reached (104 liters/day), while the size of the deficit reached about (96,511 m³/day), which is equivalent to (96,511,000 liters/day), and the percentage of the deficit reached (17.6%) of the total deficit in the governorate. The lowest number of water treatment plants was recorded in Al-Fajr district (6 plants), with a production capacity of 14,460 m³/day. The population served by these plants was 73,381, representing 100% of the district's population of 73,381. The per capita share of water served was approximately 197 liters/day, below the standard of 350 liters/day. The drinking water deficit reached 11,223 m³/day, equivalent to 11,223,000 liters/day, representing 2.1% of the total drinking water deficit in Dhi Qar Governorate. Furthermore, the highest deficit was recorded in Nasiriyah district at approximately 24.6% due to its high population density as the governorate's capital. The lowest deficit was recorded in Al-Fahoud district at 0.3%, due to the availability and production of drinking water in quantities close to the population's needs, in addition to the district's small population.

It is clear from the above that there is a major problem with drinking water services in Dhi Qar Governorate, as the percentage of the population not served by this water reached about (56.8%) and only (43.2%) are served. These are negative indicators with regard to the provision of services and community development. Moreover, most of the governorate's residents, whether they have access to drinking water services or not, rely on water stations to meet their needs for clean drinking water. (RO), as a result of pollution and poor quality of the water reaching them for drinking

and domestic consumption purposes, so work should be done to improve this vital type of service because of its direct link to human life, health and productivity. The availability of drinking water is a crucial pillar for achieving sustainable development, as it is directly linked to achieving its health, social, economic and environmental goals. The absence of clean water hinders public health, increases disease rates and limits opportunities for education and productivity. Therefore, it is very important to provide clean and healthy drinking water to all members of society. Ensuring the sustainability of water resources requires adopting effective management policies, investments in infrastructure and rationalizing consumption. Achieving justice in the distribution of safe drinking water and securing it is an essential condition for a prosperous and balanced future, as it is an integral part of the potential and goals of sustainable development.

Table (2) Drinking water complexes and their actual production capacity in Dhi Qar Governorate by district for the year 2024

Actual production capacity (m3/day)	Number of drinking water production complexes	Districts of the Governorate
119380	16	Q. Al-Nasiriyah
9060	11	Q. Al-Bathaa
5260	14	Q. Sayed Dakheel
6970	10	Q. Reform
28104	16	Q. Al-Shatra
9874	11	Q. Al-Dawaya
8248	8	Q. Al-Gharraf
12160	13	Q. Al-Rifai
22620	9	Q. Al-Nasr
21520	8	Q. Sugar Castle
14460	6	Q. Al-Fajr
8661	30	Q. Souq Al-Shuyoukh
9120	13	Q. Karma Bani Saeed
12920	15	Q. Al-Jubayish
17896	7	Q. Al-Fahoud
306253	187	the total

Source: Researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Dhi Qar Governorate Water Directorate, Unpublished Data, 2025.

Table (3) Development indicators for drinking water services in Dhi Qar Governorate by district for the year 2024

The size of the deficit in the quantity of potable water			Per capita share of the served population (liters/day)*	Percentage of the population served as a percentage of the total population	Number of people served	Total population	Districts of the Governorate
Deficit percentage	Deficit (liters/day)**	Deficit (m3/day)**					
24.6	134867000	134867	350	46.9	340711	726421	Q. Al-Nasiriyah
2.0	10837000	10837	684	23.3	13254	56849	Q. Al-Bathaa
3.5	19454000	19454	207	35.9	25351	70612	Q. Sayed Dakheel
2.2	11866000	11866	575	22.5	12126	53818	Q. Reform
13.4	73522000	73522	165	58.7	170482	290360	Q. Al-Shatra
4.8	26369000	26369	350	27.3	28222	103550	Q. Al-Dawaya
7.6	41878000	41878	207	27.8	39766	143218	Q. Al-Gharraf
9.8	53826000	53826	135	47.9	90363	188532	Q. Al-Rifai
3.6	19589000	19589	367	51.1	61597	120599	Q. Al-Nasr
3.8	21046000	21046	451	39.2	47723	121618	Q. Sugar Castle
2.1	11223000	11223	197	100.0	73381	73381	Q. Al-Fajr
17.6	96511000	96511	104	27.7	83289	300491	Q. Souq Al-Shuyoukh
2.9	15968000	15968	423	30.1	21570	71681	Q. Karma Bani Saeed
1.8	9569000	9569	785	25.6	16469	64255	Q. Al-Jubayish
0.3	1529000	1529	579	55.7	30890	55502	Q. Al-Fahoud
100	548054000	548054	290	43.2	1055194	2440887	the total

Source: Researcher based on: 1- Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Dhi Qar Governorate Water Directorate, Unpublished Data, 2025.

2- Republic of Iraq, Ministry of Planning, Central Statistical Organization, Dhi Qar Statistics Directorate, Dhi Qar Governorate Population Estimates by Single Age Groups, Environment and Gender for 2024.

3- The planning standard for drinking water services.

3- Challenges to the sustainable development of safe drinking water services

3-1. Scarcity of water resources: Water scarcity is among the most prominent environmental and economic challenges, as the governorate suffers from a clear decrease in the quantities of water coming from the Euphrates River and the Al-Gharraf stream. The average discharge of the Euphrates River for 2024 was about (53.9 m3/s), while the average discharge of the Al-Gharraf stream was about (106.1 m3/s), and the discharges of the Al-Gharraf stream are much higher than those of the Euphrates. Streams (4, 5) This scarcity is a result of Regarding climate change and the increased evaporation resulting from high temperatures, and the policies of neighboring countries that have established many water projects and dams on the Tigris and Euphrates rivers and within Iraq, in addition to the above, the spread of the phenomenon of violations of water quotas from the governorates through which the rivers pass before entering the governorate, and the situation is exacerbated by the irrational use of water within the governorate, which affects the provision of potable water and its sustainability.

3-2. River water pollution: Dhi Qar Governorate suffers from increasing pollution in river waters as a result of the discharge of untreated sewage and industrial and agricultural waste directly into rivers without effective environmental control. This leads to the deterioration of water quality physically and chemically and the concentration of salts and polluting elements in it (Tables 6 and 7). This pollution negatively affects the quality of water designated for drinking, domestic use and other purposes, and increases the risk of the spread of waterborne diseases, thus hindering sustainable development efforts in the water sector.

Table (4) Monthly and annual average (m3/s) of the Euphrates River discharge in Dhi Qar Governorate for the period 2014-2024

Annual rate	K1	T2	T1	September	dad	July	June	Mays	April	March	February	K2	Year
95.3	88	82	85	141	123	165	75	78	73	71	70	95	2014
125.3	77	150	150	146	145	210	138	90	82	104	83	128	2015
52.8	75	48	153	29	32	26	34	32	67	37	59	42	2016
81.8	56	35	20	124	92	116	85	82	123	70	70	108	2017
89.2	96	70	120	97	90	98	89	67	118	74	67	84	2018
62.5	77	59	77	38	40	37	40	49	91	90	77	75	2019
100.3	64	61	36	202	170	179	105	75	106	76	75	55	2020
125.9	92	125	227	146	140	185	147	76	87	92	97	97	2021
109.9	132	110	152	134	127	143	96	71	93	84	90	87	2022
69.8	78	68	115	60	61	59	53	55	74	69	62	83	2023
53.9	69	51	52	45	51	47	42	52	60	47	42	89	2024

Source: Republic of Iraq, Ministry of Water Resources, Water Resources Directorate in Dhi Qar Governorate, Unpublished Data, 2025.

Table (5) Monthly and annual average (m3/s) of the flow of the Al-Gharraf stream in Dhi Qar Governorate for the period 2014-2024

Annual rate	K1	T2	T1	September	dad	July	June	Mays	April	March	February	K2	Year
103.8	114	105	119	109	102	91	104	110	98	102	92	99	2014
92.8	113	78	109	105	99	94	83	84	94	83	85	87	2015
124.4	164	107	122	125	102	96	132	144	152	115	102	132	2016
156.2	139	155	106	159	159	154	159	156	161	182	191	153	2017
142.5	148	129	146	127	137	138	150	153	150	149	136	147	2018
120.7	116	102	118	127	115	111	115	118	154	132	130	110	2019
181.3	140	136	130	206	217	211	184	188	213	213	199	139	2020
190.4	211	233	187	190	181	187	185	129	152	198	204	228	2021
160.6	184	175	171	135	162	159	146	122	133	185	174	181	2022
108.8	114	118	112	103	104	107	108	96	108	123	106	106	2023
106.1	125	115	97	94	101	94	96	100	109	116	101	125	2024

Source: Republic of Iraq, Ministry of Water Resources, Water Resources Directorate in Dhi Qar Governorate, Unpublished Data, 2025.

Table (6) Quarterly and overall average of the physical characteristics of surface and groundwater in Dhi Qar Governorate for the period 2014-2024

Physical properties of the Euphrates River water			Month
electrical connection EC (micro-Siemens/cm)	Total dissolved solids TDS	Water temperature (degrees Celsius) TEMP	
4257.3	2578.3	15.2	January (winter) average
4646.5	2775.5	28.8	July (summer) average
4451.9	2676.9	22.0	Overall average
1600	1500	Under 35°	Iraqi determinants of the aquatic environment
Non-conforming	Non-conforming	Matching	Compliance status with Iraqi standards for the aquatic environment
Physical properties of the water of the Al-Gharraf stream			Month
EC	TDS	TEMP	
1592.7	934.4	13.6	January (winter) average
1528.0	877.5	28.5	July (summer) average
1560.4	906.0	21.1	Overall average
1600	1500	Under 35°m	Iraqi determinants of the aquatic environment
Matching	Matching	Matching	Compliance status with Iraqi standards for the aquatic environment

Source: Researcher based on: 1- Republic of Iraq, Ministry of Environment, Dhi Qar Environment Directorate, Laboratories Division, Unpublished Data, 2025.
 2- Republic of Iraq, Ministry of Environment, Department of Environmental Protection and Improvement, Environmental Legislation for the Protection of Rivers from Pollution No. 25, 1998.

Table (7) Quarterly and overall average of the chemical properties of surface and groundwater in Dhi Qar Governorate for the period 2014-2024

Chemical properties of the Euphrates River water						Month
sulfates SO4(mg/L)	nitrate NO3(mg/L)	Chlorides CL(mg/L)	magnesium Mg(mg/L)	sodium Na(mg/L)	pH PH	
629.0	9.2	795.0	139.0	578.0	8.0	January (winter) average
775.4	5.1	1049.0	171.1	664.0	7.9	July (summer) average
702.2	7.2	922.0	155.5	621.0	8.0	Overall average
200	3	200	50	200	6 – 9.5	Iraqi determinants of the aquatic environment
Non-conforming	Non-conforming	Non-conforming	Non-conforming	Non-conforming	Matching	Compliance status with Iraqi standards for the aquatic environment
Chemical properties of the waters of the Al-Gharraf stream						Month
SO4	NO3	CL	Mg	Na	PH	
217.9	2.0	219.5	54.4	171.1	7.9	January (winter) average
204.6	1.8	203.1	51.5	163.7	7.9	July (summer) average
211.3	1.9	211.3	53.0	167.4	7.9	Overall average
200	3	200	50	200	6 – 9.5	Iraqi determinants of the aquatic environment
Non-conforming	Matching	Non-conforming	Non-conforming	Matching	Matching	Compliance status with Iraqi standards for the aquatic environment

Source: Researcher based on: 1- Republic of Iraq, Ministry of Environment, Dhi Qar Environment Directorate, Laboratories Division, Unpublished Data, 2025.
 2- Republic of Iraq, Ministry of Environment, Department of Environmental Protection and Improvement, Environmental Legislation for the Protection of Rivers from Pollution No. 25, 1998.

3-3. High population growth: The rapid increase in population in Dhi Qar poses a major challenge to drinking water services. After the population was (1,184,796) in 1997, it rose to (2,440,887) in 2024 (Table 8 and Map 5). This increase leads to an increase in the demand for water that exceeds the capacity of the current water networks and facilities to absorb. This continuous pressure causes a disruption in water distribution, especially in densely populated urban areas and informal settlements during the summer season in particular, which threatens the achievement of sustainable development in this important sector.

3-4. Shortage of potable water: Dhi Qar Governorate is facing a clear shortage of water suitable for human consumption, due to declining resources, high population growth and increasing demand, which leads to rationing distribution in some areas and depriving other areas of water for hours or days, which threatens water security and sustainability.

Table (8) Geographical distribution of population size in Dhi Qar Governorate by district for the period 1997 - 2024

2024		2014		1997		Districts of the Governorate
%	population	%	population	%	population	
29.8	726421	29.5	585544	28.6	339300	Q. Al-Nasiriyah
2.3	56849	2.3	46225	3.0	35574	Q. Al-Bathaa
2.9	70612	2.9	57785	3.4	39780	Q. Sayed Dakheel
2.2	53818	2.2	43947	2.0	24213	Q. Reform
11.9	290360	11.9	234994	12.0	141896	Q. Al-Shatra
4.3	103550	4.3	84400	4.6	54351	Q. Al-Dawaya
5.9	143218	5.9	116817	6.0	71029	Q. Al-Gharraf
7.7	188532	7.8	153542	7.8	91863	Q. Al-Rifai
4.9	120599	5.0	98146	5.2	61142	Q. Al-Nasr
5.0	121618	5.0	98932	4.9	58546	Q. Sugar Castle
3.0	73381	3.0	59768	2.8	32970	Q. Al-Fajr
12.3	300491	12.3	243880	12.7	150996	Q. Souq Al-Shuyoukh
2.9	71681	3.0	58630	3.0	35749	Q. Karma Bani Saeed
2.6	64255	2.6	51889	1.9	22859	Q. Al-Jubayish
2.3	55502	2.3	45063	2.1	24528	Q. Al-Fahoud
100	2440887	100	1979562	100	1184796	Governorate total

Source: Researcher based on: 1- Republic of Iraq, Ministry of Planning, Central Statistical Organization, Results of the 1997 General Population Census Table (22), p. 76.

2- Republic of Iraq, Ministry of Planning, Central Statistical Organization, Dhi Qar Statistics Directorate, population estimates of Dhi Qar Governorate according to single age groups, environment and gender for the years 2014, 2024.

3-5. Lack of water purification plants: The province faces challenges related to the scarcity and inadequacy of water treatment and desalination projects, their poor operational efficiency, and their age, as many existing treatment plants operate with outdated technologies.

Modern water systems with low production capacities do not keep pace with the increasing demand and do not meet the needs of the population. This reality exacerbates the drinking water crisis and is an obstacle to improving water services and achieving their sustainability for citizens.

3-6. Deterioration of water networks and infrastructure: The governorate suffers from a significant deterioration in its water distribution networks and related infrastructure, as many of the pipes and stations date back decades and have not undergone regular maintenance or modernization. This deterioration leads to the leakage of large quantities of water before it reaches consumers, frequent interruptions, low water pressure in the network, and contamination of water inside the pipes, which negatively affects the continuity and efficiency of the service, increases operational costs, and hinders the achievement of sustainability in the vital service sector.

3-7. Weak water planning and management: Weak water planning and management is one of the main challenges hindering the development and sustainability of drinking water services in Dhi Qar Governorate. There is a clear deficiency in setting long-term strategic plans for managing and distributing water resources fairly and effectively. The absence of accurate databases on actual water consumption and needs also hinders informed decision-making, leads to wasted resources, and delays the implementation of vital water-related projects.

3-8. Poor distribution of drinking water: The governorate suffers from a lack of fairness in the distribution of drinking water between regions, as water supply services are concentrated more in city centers, while many villages and outlying areas suffer from weak or complete lack of coverage. This disparity creates a large service gap and leads to reliance on unsafe or expensive sources such as water transported by tankers or bottled water. The lack of fairness in distribution also contributes to the exacerbation of water poverty and hinders the achievement of the principle of equity in sustainable development, as the percentage of the population that obtains drinking water has reached about (43.2%) of the total population of the governorate.

3-9. Deterioration in the quality of the produced water: Most of the water treatment plants in the governorate are inefficient and technologically outdated, resulting in the production of poor-quality water that does not meet health standards and is unsuitable for drinking, cooking, and other vital uses. This negatively impacts the sustainability of drinking water, forcing residents to resort to alternative sources of clean drinking water such as purchasing bottled water or (unclear).RO or reliance on home filters, which burdens low-income families and affects the sustainability of access to this service.

3-10. Weak community awareness and deterrent legislation: The lack of community awareness contributes to increased waste and non-rationalization of water consumption, in addition to the inadequacy of legislation and laws and their weak application to those who fall short and the absence of deterrent penalties, which has reduced the effectiveness of efforts made to achieve sustainability and hinders the improvement of water resources management in an organized and fair manner in the governorate.

3-11. Random encroachment on water networks: Random encroachment on water networks is a common problem in Dhi Qar Governorate, as some individuals or entities connect illegal water lines without coordination with the competent authorities. This leads to weak water pressure, depriving some areas of their shares and increasing waste, as well as difficulty in organizing distribution and calculating consumption, which negatively affects the efficiency of the service and hinders the achievement of fairness in delivering water to citizens.

3-12. The problem of frequent power outages: The pumping and treatment stations in the governorate rely mainly on electricity for their operation, which is characterized by frequent interruptions and instability. These frequent power outages lead to the cessation of water pumping to the population, especially in the summer, which exacerbates the drinking water crisis and affects the efficiency and quality of the service.

The research, and in light of what has been reviewed, shows that there are many challenges that hinder the achievement of sustainable development of drinking water services in Dhi Qar Governorate, which requires concerted efforts and long-term strategic planning. Between the scarcity of water resources, the deterioration of infrastructure, the decline in water quality, random violations, weak planning, and other challenges, the urgent need for radical reforms at the technical, administrative, and legislative levels is highlighted. Without addressing these challenges in

an integrated and sustainable manner, ensuring access to clean and safe water for all residents will remain a distant goal, which negatively affects the health of individuals, the stability of society, and the future development paths in the governorate.

4 Sustainable development strategy for safe drinking water services

4-1. Addressing water scarcity: The scarcity of water sources represented by the Euphrates River and the Al-Gharraf stream and the decline in their levels represent a serious challenge that threatens the sustainability of drinking water in Dhi Qar Governorate. Therefore, it is necessary to develop a strategy and alternative plans to secure water supplies by concluding international agreements with the upstream countries to secure Iraq's share fairly, as well as establishing reservoirs and emergency lines to supply drinking water stations to compensate for the shortage or interruption of water sources, as well as diversifying sources by relying on groundwater, or recycling sewage water in an advanced manner.

4-2. Addressing the water deficit: Dhi Qar Governorate suffers from a severe deficit between the demand for drinking water and the available supply quantities, as a result of a number of challenges mentioned above. Therefore, it is necessary to work on bridging this deficit by increasing the number of complexes and stations for treating and pumping pure water, increasing the production capacity of existing stations, diversifying water sources, developing treatment technologies, and adopting effective rationalization policies to achieve a balance between supply and demand.

4-3. Addressing the deterioration of water transmission networks: The aging of the networks and the frequency of malfunctions and leaks lead to the loss of large quantities of water before it reaches the consumer. Therefore, it is necessary to renew the aging lines, adopt periodic preventive maintenance programs, and use modern materials and technologies in construction to ensure the efficiency and sustainability of the networks.

4-4. Developing water management planning: The need to use modern tools to monitor and analyze future water needs, such as geographic information systems (GIS) and demand forecasting models, incorporating population growth data and river level changes, to ensure accurate and effective plans are developed to expand networks and treatment plants in order to provide drinking water sustainably to the entire Dhi Qar Governorate.

4-5. Addressing poor distribution: This strategy focuses on reducing water delivery gaps between different neighborhoods and villages and between urban and rural areas in Dhi Qar Governorate, by bringing networks to deprived areas, improving pumping and storage management, and ensuring spatial equity in water distribution to all residents.

4-6. Addressing the deterioration in the quality of the produced water: By improving the quality of water provided to consumers in the governorate, through upgrading treatment plants, adopting effective filtration and sterilization technologies, and conducting continuous periodic inspections to monitor water quality and suitability for consumption, while reducing pollution of water sources, to ensure access to clean and safe water for all residents.

4-7. Solving the problem of illegal connections to water networks: It is necessary to prevent illegal encroachments on water networks in Dhi Qar Governorate, through the installation of accurate meters, periodic monitoring of the networks, imposing penalties on violators, and regulating new connections in a legal manner to maintain the efficiency of the networks.

4-8. Implementation of laws and regulations: This strategy focuses on strengthening the legal and regulatory framework for drinking water management in the governorate, through the application of laws and regulations related to protecting sources, regulating distribution networks, preventing pollution, and controlling illegal consumption, to ensure that all parties, citizens, and investors comply with water sustainability standards.

4-9. Developing community awareness: It is necessary to raise awareness among citizens in the governorate about the importance of rationalizing drinking water consumption and protecting its sources, through educational programs and media campaigns, and to encourage community participation in monitoring networks and reporting leaks or violations, in order to ensure the sustainability of resources and improve service efficiency.

4-10. Addressing power outages at water stations: This strategy focuses on ensuring the continued operation of drinking water treatment and pumping stations in Dhi Qar Governorate despite ongoing power outages, through the installation of backup generators, the use of solar power for main pumps, and the development of emergency plans to maintain service continuity and provide drinking water to all residents without interruption.

4-11. Encouraging investment in the drinking water sector: It is necessary to attract local and international investments to develop the water sector in Dhi Qar Governorate, through partnerships with the private sector to build mineral water factories, treatment plants, improve distribution networks, and apply modern technologies, while ensuring that investors adhere to quality and sustainability standards, and that these services are offered at prices that suit the living standards of the population in the governorate.

4-12. Partnership with local and international organizations: By collaborating with NGOs and international organizations such as the United Nations to provide technical and financial support, particularly in rural and disadvantaged areas, to ensure the sustainable improvement of water services.

Results

1- It was found that there are several complexes for purifying and producing drinking water in Dhi Qar Governorate, distributed across its districts in a varied manner.

2- It became clear that the water production of these complexes does not meet the requirements of all areas of the governorate.

3- The research revealed a very large deficit in the amount of water produced in Dhi Qar Governorate, especially when compared to the planning standard for drinking water according to the population.

4- The province of Dhi Qar has great potential as sources of drinking water, represented by the Euphrates River and the Al-Gharraf stream, despite their exposure to fluctuations in the quantities of water in the waterway. This would contribute, if invested in, to achieving sustainability in providing drinking water for the province in general.

5- The research showed the existence of many challenges that hinder the achievement of sustainable development in the field of drinking water services in Dhi Qar Governorate, as well as its conclusion to propose strategies that would contribute to reducing the impact of these challenges and achieving the desired development in the drinking water services sector.

Suggestions:

1- The need to work on establishing new and advanced stations and complexes for purifying and producing potable water, as well as maintaining and upgrading existing stations in order to increase water production in line with the needs of the population, according to the Iraqi planning standard for water services.

2- Optimal investment in the available water resources in the governorate, represented by the Euphrates River and the Al-Gharraf stream, in order to provide the local need for drinking water, bridge the deficit and work to achieve sustainability in it.

3- The need to adopt the strategies that the research has developed in order to achieve sustainable development in drinking water services, and to reduce the challenges that hinder this.

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23. *Extract the per capita share of the served population (liters/day) using: Actual production capacity (m³/day) Number of served population 1000. ÷ ×
24. *The researcher calculated the drinking water deficit using: the local standard population (which equals 0.35 m³/person/day) – the quantity of water produced (actual production capacity m³/day). (Note that 0.35 m³/person/day = 1000 = 350 liters/person/day), i.e., the per capita share in liters.× ×
25. *** The deficit volume was converted from cubic meters to liters as follows: Deficit volume m³ 1000 = Deficit volume in liters.×