

**Spatial distribution of pure water service and its quantitative efficiency  
in Al-Rumaitha city (\*)**  
**Furqan Mousa Imran and Raad Abdul-Hussein Muhammad**  
**College of Education for the Humanities, Al-Muthanna University, Iraq.**

**Abstract**

Services were one of the important needs in the life of the individual within the city, the individual is indispensable for services of all kinds, including pure water service, which was a necessity of life. Therefore, this research aims to know the reality of the pure water system in the city of Al-Rumaitha. Assessing its efficiency in light of the approved planning standards in this field. The research reached many results, the most important of which is the presence of a relative efficiency of pure water service in the study area. In addition, the per capita share of pure water, it varies according to water projects and stations. The research has come up with many suggestions, the most important of which is the completion of maintenance work for the old Al-Rumaitha water project, as well as improving the efficiency of pure water complexes and projects.

**Keywords:** efficiency, pure water, Services , Al-Rumaitha City.

**Introduction**

The system of services of all kinds is the basic premise, for any comprehensive economic and social development at the level of the city or society as a whole, as the development and well-being of cities does not depend on the volume and level of consumption of material goods only, rather, it goes beyond that to the quantity and type of services provided to individuals, also, the structure of pivotal services constitutes the main axis of the development process in its various dimensions, without it, no community development process is impossible, this applies to pure water service. The provision of which is an essential factor for various forms of urban, domestic, commercial, service, and industrial uses, without it, it is not possible to sustain and grow various forms of urban activity. Therefore, the issue of providing pure water necessary for these activities has become one of the most important goals in all countries of the world.

**1. Research problem:**

The main research problem crystallizes in the following (What is the reality of the pure water service in the city of Al-Rumaitha?), from which a set of the following questions emerge:

A. What is the nature of the distribution and spread of pure water projects and stations in the city of Al-Rumaitha?

B. What is the efficiency of the pure water system in the city of Al-Rumaitha?

**2. Research hypothesis:**

The research adopted the following hypotheses to solve the problems presented:

A. The presence of a defect in the services of the pure water system in the city.

B. The spatial distribution of pure water service in the city of Al-Rumaitha was not commensurate with its urban growth.

### **3. Research objective:**

The research aims to assess the efficiency of the performance of the pure water service in accordance with the approved standards in this field and their spatial distribution, and to identify ways to address the problems he suffers, to improve his reality to serve the residents of the city of Al-Rumaitha.

### **4. Importance of research:**

The lack of integrated systems to serve pure water in the city of Al-Rumaitha represents a real problem with clear effects for the geographer and the eye, and it is a phenomenon worthy of research, study and investigation.

### **5. Research Methods:**

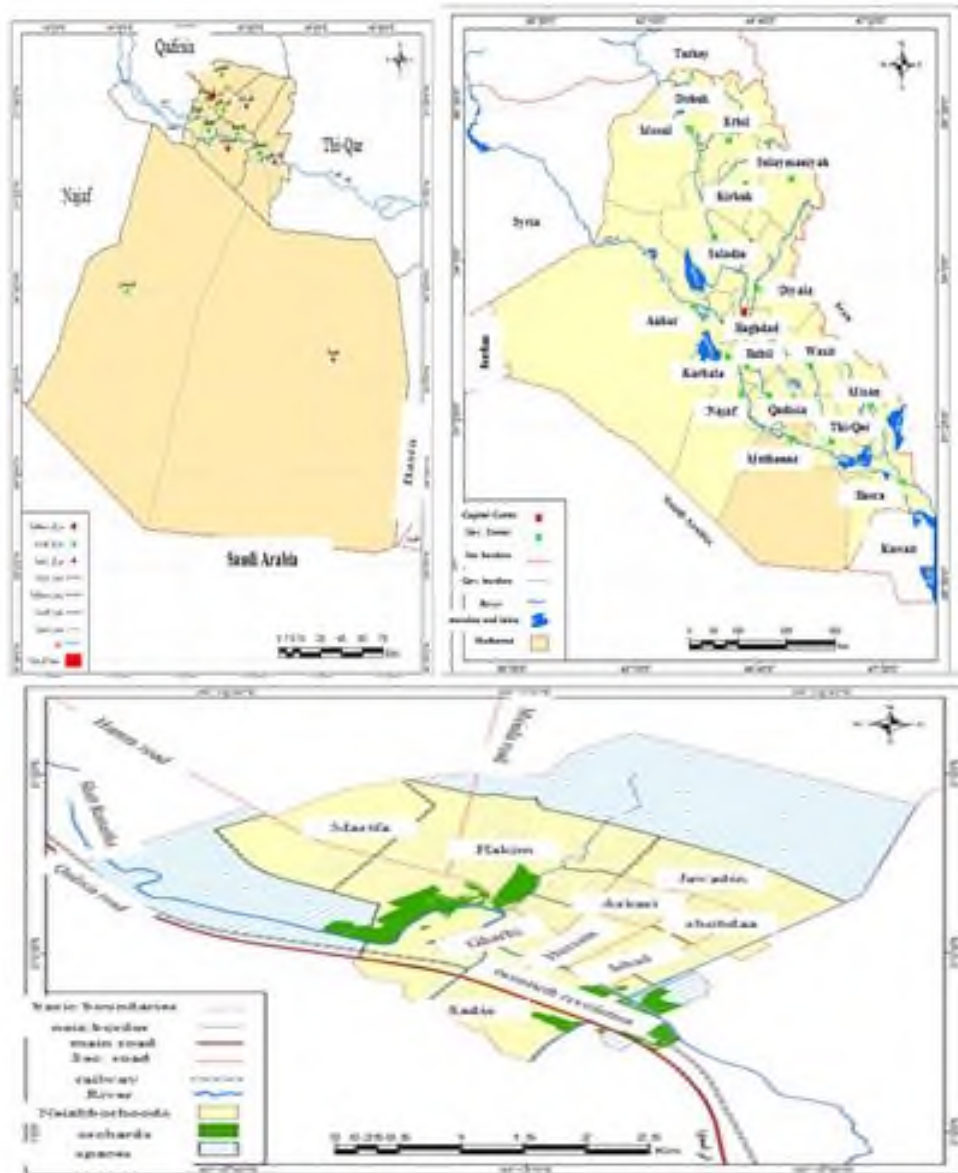
The research relied on the descriptive approach by reviewing the reality of the service, as well as the analytical approach by presenting and evaluating the variables of pure water service, and evaluating their efficiency, to measure the deficit and indicate the defects in the spatial distribution.

### **6. Research limits:**

The spatial boundaries of the research area were represented in the city of Al-Rumaitha, it was located astronomically at the intersection of latitude (55° 52' 31") north and longitude (19° 45' 19") east, it represents the administrative center of Al-Rumaitha District, which is located in the north of Al-Muthanna Governorate, as for the geographical location, it is bordered on the north by Al-Najmi, on the west by Al-Qadisiyah governorate, on the south by Al-Majd and Al-Hilal districts, and on the east by Al-Warka district. Its total area is (18541.4) hectares and its population size is (90,638 people) in 2020 distributed over eleven residential neighborhoods, (map 1), as for the temporal limits represented by (the year 2020).

### **7. Research Structure:**

The scientific necessity required dividing the research into three main sections preceded by a general introduction. **The first topic** dealt with demographic characteristics, while **the second topic** dealt with the spatial distribution of pure water projects and stations in the city, **the third topic** shows the efficiency of the service. The research concluded by presenting conclusions, suggestions, and a list of margins and sources.



**Map (1) The location of the city of Al-Rumaitha in Iraq and Al-Muthanna Governorate.**

Research source based on:

- (1) The Directorate of Urban Planning in the Governorate of Al-Muthanna, the basic design of the city of Al-Rumaitha No. (400 d for the year 2012 until 2038.
- (2) Ministry of Water Resources, General Directorate of Survey, Map Production Department, Digital Unit, Al-Muthanna Administrative Governorate Map, scale (1: 500000), Baghdad, 2020.

**first topic:**

**Population characteristics in the city of Al-Rumaitha**

**First: population size and growth:**

The rapid increase of population in urban centers, leads to the expansion of human activities and the diversity and complexity of urban problems. The rapidly growing urban centers suffer from a lack of services and infrastructure such as

potable water (Makki Aziz, Riyadh Ibrahim Al-Saadi: 1984). The population size and growth varies among the neighborhoods of Al-Rumaitha city, (Table 1), it was noted that the annual population growth rate in Al-Mustafa neighborhood has decreased to 1.7%, as for the two neighborhoods of Al-Amir and Al-Jihad, it amounted to (2.5%) for each, as for the other neighborhoods in the city, their growth rates approached (2.4%). The variation in population size and growth is reflected in the amount of demand for pure water services.

**Table (1) Growth rate of Al-Rumaitha city by residential neighborhoods for the period (2010-2020).**

o.	Neighborhood	2010 population	2020 population	Growth rate
	Al-Askari	9033	11484	2.4
	Al-Amir	5493	7030	2.5
	Al-Jihad	8920	11368	2.5
	Al-Jawadin	4372	5569	2.4
	Al-Hussain	7596	9642	2.4
	Al-Hakim	7743	9834	2.4
	Al-Zahraa	7867	9995	2.4
	Al-Shohadaa	7672	9741	2.4
	Al-Sadiq	8191	10352	2.4
<b>0</b>	Al-Mustafa	566	673	1.7
<b>1</b>	Thawra AL-Ashrin	3897	4950	2.4
<b>2</b>	Total	71350	90638	2.4

Source: The researcher based on Ministry of Planning, Central Bureau of Statistics, Directorate of Statistics of Muthanna Governorate, population estimates for the year 2020, unpublished data.

### **Second: the size and proportional distribution of the population**

The geographical distribution of the population is one of the important topics of population studies, irregular distribution pattern, leads to the creation of major problems related to the difficulty of obtaining services for the population. Therefore, knowing the geographical distribution of the population is of great importance to planners, to provide service development plans (Othman Saeed: 2013). The optimal distribution of the population in the city gives clear indications for planning on the basis of determining the type of basic services and infrastructure services (Abd Ali Al-Khaffaf: 2008). The distribution of population in cities and knowledge of neighborhoods that are characterized by the highest population sizes and percentages, it was one of the most important concepts that the geographer seeks to uncover, especially in urban studies (Raad Abdul-Hussein: 2012). The city's population was divided into three ranks, as follows:

**First:** The size represents (7880.4 people) or more and is represented by (7 residential neighborhoods), population is more than (10.63%) of the city's total population, neighborhoods of this rank may top the Al-Askari neighborhood with a population size of (11484 people), by (12.70%) of the city's total population, (Table 2).

**Second:** Residential neighborhoods with a size of (7880.3 - 4276.8 people) represent the total population of the city, this volumetric arrangement included three residential neighborhoods, population ratio ranges between (5.47 - 7.75%) of the city's population, it was topped by Al-Amir neighborhood with a population size of (7030) with (7.75%) of the city's total population.

**Third:** Representing residential neighborhoods with a population size of (4276.7 people) or less, this rank included Al-Mustafa neighborhood, whose population size was (673 people) with a percentage of (0.74%) of the city's total population.

**Table (2) Population distribution of the population of Al-Rumaitha city according to neighborhoods for the year (2020).**

<b>o.</b>	<b>Neighborhood</b>	<b>2020 population</b>	<b>Neighborhood to city population ratio</b>
	Al-Askari	11484	12.70
	Al-Amir	7030	7.75
	Al-Jihad	11368	12.54
	Al-Jawadin	5569	6.14
	Al-Hussain	9642	10.63
	Al-Hakim	9834	10.85
	Al-Zahraa	9995	11.02
	Al-Shohadaa	9741	10.74
	Al-Sadiq	10352	11.42
<b>0</b>	Al-Mustafa	673	0.74
<b>1</b>	Thawra AL-Ashrin	4950	5.47
<b>2</b>	Total	90638	%100

Source: The researcher based on Republic of Iraq, Ministry of Planning and Development Cooperation, Central Statistical Organization, Directorate of Statistics in Al-Muthanna Governorate, Al-Muthanna Governorate Population Estimates for the year 2020, unpublished data.

### **The second topic:**

#### **the spatial distribution of pure water projects and stations**

#### **First: Pure Water Projects**

##### **1. The new Rumaitha water project**

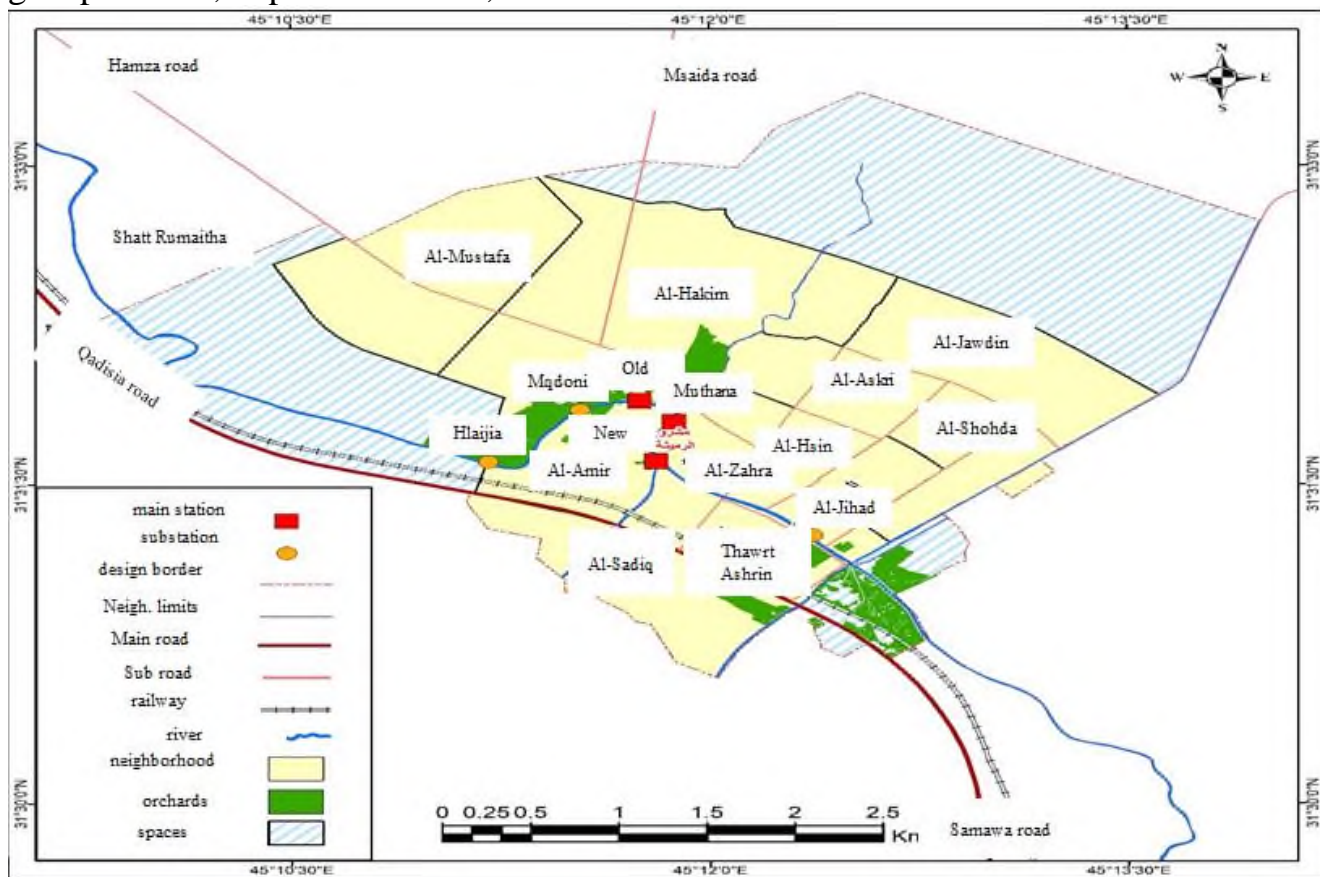
The project is located in the Al-Amir district, the project was completed in 1982, with a design capacity of (88000 m<sup>3</sup>/day) and an actual capacity (\*\*\*) in 2020

(70400 m<sup>3</sup>/day), as it allocates (7200 m<sup>3</sup> / day) of its production to serve the residents of parts of the neighborhoods (Al-Zahraa, Al-Jihad, Al-Hussein, Al-Amir) (Table 3), the source of the raw water for the project is Al-Rumaitha River. The total serviced population in these neighborhoods amounted to (14,534 people) at a rate of (16.03%) of the total city population of (90,638 people), (Table 3), and (Map 2).

**Table (3) Neighborhoods served by the new Al-Rumaitha water project, its energy and the size of the population served.**

Project name	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population	City's population percentage
New Al-Rumaitha	Al-Zahraa, Al-Jihad, Al-Hussain, Al-Amir	982	8000	0400	7200	4534	16.03

Source: Researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.



**Map (2) of the geographical distribution of pure water projects in the city of Rumaitha 2020.**

Source: the researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

**2. The old Rumaitha water purification project**

The project is located on Al-Rumaitha River in Al-Amir neighborhood (Map 2). The design capacity of the project is (36000 m<sup>3</sup>/day) and its actual capacity in 2020 amounted to (28800 m<sup>3</sup>/day). The production allocated from the project is (9000 m<sup>3</sup> / day) to serve parts of the residents of the neighborhoods (Al-Zahra, Al-Amir, Al-Husseini, Jihad, Al-Hakim). It started production for the first time in 1970. The total population served by this project amounted to (18,674 people) and they constitute (20.6%) of the city's population, (Table 4).

**Table (4) The neighborhoods served by the old Al-Rumaitha water project, its energy and the size of the population served.**

Project name	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population	City's population percentage
Old Al-Rumaitha	Al-Zahraa, Al-Amir, Al-Hussain, Al-Jihad, Al-Hakim	1970	6000	8800	9000	18674	20.6

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

**3. Al-Muthanna Water Project:**

The project is located on the Al-Rumaitha River in Al-Amir neighborhood (Map 2). The design capacity of the project is (40000 m<sup>3</sup>/day), as for its actual capacity in 2020, it amounted to (38000 m<sup>3</sup>/day). The project serves parts of the residents of the neighborhoods (Al-Hakim, Al-Mustafa), the amount of production allocated to these neighborhoods was (4320 m<sup>3</sup>/day). The project was established in 2010. The total population of the serviced neighborhoods reached (6,082 people) and constituted (6.71%) of the city's population, (Table 5).

**Table (5) The neighborhoods served by the Muthanna Water Project, its energy and the size of the population served.**

Project name	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population	City's population percentage
Al-Muthanna	Al-Hakim, Al-Mustafa				4320	6082	6.71

I-Muthanna	Hakim, Al-Mustafa	010	0000	8000		082	.71
------------	-------------------	-----	------	------	--	-----	-----

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

## Second: Pure water complexes

### 1. French Complex (Abdul Abbas):

This complex is located in Al-Sadiq neighborhood (Map 2). Completed in (2004). Its design capacity is (2400 m<sup>3</sup>/day). All of its production is devoted to serving the residents of Al-Sadiq neighborhood, who number (10,352). They constitute (11.42%) of the city's population (Table 6).

**Table (6) Neighborhoods served by the Abdul-Abbas (French) water complex, its capacity and the size of the population served.**

Complex name <sup>c</sup>	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population <sup>N</sup>	City's population percentage <sup>c</sup>
Abdul-Abbas <sup>A</sup>	Al-Sadiq	004	400	400	2400	10352 <sup>1</sup>	11.42 <sup>1</sup>

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

### 2. Water Al-Sharqi Complex:

This complex is located in the Jihad neighborhood (Map 2). Completed in (2006), with a design capacity of (2400 m<sup>3</sup> / day). All of its production is devoted to serving parts of the population of the neighborhoods (Al-Jihad, Al-Shohada). Total serviced population (7453 people). Constitute (8.20%) of the city's population (Table 7).

**Table (7) Neighborhoods served by Al Sharqi Water Complex, its capacity and the size of the population served.**

Complex name <sup>c</sup>	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population <sup>N</sup>	City's population percentage <sup>c</sup>
Al-Sharqi <sup>A</sup>	Al-Shohada, Al-Jihad	006	400	400	2400	7453 <sup>7</sup>	8.20 <sup>8</sup>

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

### 3. Al-Halajia water complex:

The complex is located in the Amir neighborhood (Map 2). Established in (2009), the design capacity is (2400 m<sup>3</sup> / day). Serving parts of the residents of the neighborhoods (Al-Hussein, Al-Shuhada, Al-Askari). The number of serviced population reached (10,112) with a rate of (11.15%), (Table 8).

Philosophical Readings XIII.4 (2022), pp. 418-433. 425

Info@philosophicalreadings.org

10.5281/zenodo.6089398



Table (8) Neighborhoods served by the Al-Halajia water complex, its capacity and the size of the population served.

Complex name	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population	City's population percentage
Al-Halajia	Al-Hussein, Al-Shohada, Al-Askari	2009	400	400	2400	12838	11.15

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

#### 4. Maqedoni water complex:

It was located in the Al-Amir neighborhood, was divided into two complexes in the same location, as follows:

**A. First Al-Amir Complex:** Its production capacity was (2400 m<sup>3</sup>/day). Serving parts of the residents of the neighborhoods (Al-Amir, Thawrat Al-Ashrin, Al-Jwadin), established in (2000). The total serviced population of this complex was (12,838 people), by (14,16%) of the city's total population, (Table 9).

**B. The Second Al-Amir Complex:** Its production capacity was (2400 m<sup>3</sup>/day). It serves some parts of the residents of the neighborhoods (Al-Shuhada, Al-Askari). The total serviced population of the complex amounted to (10,593 people) at a rate of (11.68%) of the city's population, (Table 9).

Table (9) Neighborhoods served by the Maqdoni water complex, its capacity and the size of the population served.

Complex name	Serviced neighborhoods	Year of work	Design energy m <sup>3</sup> /day	Actual power m <sup>3</sup> /day 2020	Production allocated to serviced neighborhoods m <sup>3</sup> /day	Number of served population	City's population percentage
Maqdoni	Al-Amir, Thawrt Al-Ashrin, Al-Jwadin	2000	400	400	2400	12838	14.16
	Al-Shohada, Al-Skari	2000	400	400	2400	10593	11.68

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Rumaitha Water Department, Planning Department, unpublished data, 2020.

#### Third: The amount of water consumed in Al-Rumaitha city:

Al-Rumaitha city was the main site for most of the pure water projects and complexes in Al-Muthanna Governorate (\*\*\*), because of the presence of the source of raw water, which was Al-Rumaitha River. The city serves a part of the production of the mentioned projects and complexes, and in specific quantities for each

residential neighborhood. It was shown by analyzing the data in Table (10). There was a discrepancy in the average per capita share of pure water, as there are three levels as follows:

**A. Reviving the first level in which the individual's share exceeds (526.7 liters / day):**

Represented my neighborhood (Al-Mustafa and Al-Amir), due to the small population of Al-Mustafa neighborhood, as for the Amir neighborhood, which is the main site for most of the pure water projects and complexes in the city, it was supplied from three projects, which was reflected in an increase in the amount of pure water supply.

**B. Reviving the second level, per capita share (331.3 - 526.7 liters / day):**

Includes neighborhoods (Al-Jihad, Al-Hussein, Al-Hakim and Al-Shohada). The quantity of pure water supplied to these neighborhoods was close to the local standard of (350 liters/day).

**C. Revival of the third level in which the per capita share is less than (331.3 liters / day)**

This level included neighborhoods (Al-Askari, Al-Jwadin, Al-Zahraa, Al-Sadiq, Thawrat al-Ashrin). The main reason for the decrease in the per capita share of pure water in these neighborhoods is due to the increase in the population and the advanced water supply networks in them.

**Table (10) Distribution of the quantities of pure water consumed by residential neighborhoods in the city of Al-Rumaitha 2020.**

No.	Neighborhood	Population	Water supplied quantity from stations m <sup>3</sup> /day	Waste amount m <sup>3</sup> /day	Water reaching amount m <sup>3</sup> /day	Per capita share of pure water/liter
	Al-Askari	1484	2400	40	160	188
	Al-Amir	7030	4800	80	320	14.5
	Al-Jihad	1368	4800	80	320	80
	Al-Jawadin	5569	840	4	56	35.7
	Al-Hussain	9642	4800	80	320	48
	Al-Hakim	9834	3960	96	564	62.4
	Al-Zahraa	9995	3600	60	240	24.1
	Al-Shohadaa	9741	3600	60	240	32.6
	Al-Sadiq	10352	2400	40	160	208.6
<b>0</b>	Al-Mustafa	673	540	4	86	722.1
<b>1</b>	Thawra AL-Ashrin	4950	1200	20	080	218.1
	Total	90638	34560	456	1104	343.1

2						
---	--	--	--	--	--	--

Source: The researcher based on: Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Muthanna Water Department, Technical Authority, unpublished data, for the year 2020.

### **The third topic:**

#### **The efficiency of pure water service in Al-Rumaitha city**

##### **Quantitative parameters of pure water:**

The total water produced in the pure water production projects in the city of Al-Rumaitha must be divided by its population, after excluding the amount of lost water. The population in the year 2020 reached (90,638) people, while the volume of produced water reached (34,560 m<sup>3</sup>/ day), so the average per capita share of pure water in the city of Al-Rumaitha was (381 liters/ person/ day), this was the amount above the schematic criterion set for an individual (350 liters/ person/ day). There are several factors that cause the leakage of pure water, including defects in the extended networks due to their use for a long period of time, which led to their deterioration, as well as pumping water with a pressure force greater than the energy it can bear, in addition to the occurrence of leakage due to the various excavations that cause damage and to the breakage of the main feeding tubes and the clear water exudation, the waste that occurs due to improper use by the consumer, therefore, the amount of waste is estimated at (10%) (Ministry of Municipalities: 2020). The per capita share of pure water in the city of Al-Rumaitha after extracting the amount of waste is (343.1 liters / person / day), was an approximation to the schematic norm of (350 l/person/day), the per capita share of pure water varies in the neighborhoods of Al-Rumaitha city (Table 15), which can be classified into two levels.

##### **A. The first level: The neighborhoods that achieved an efficiency in the per capita share of pure water more than (350 liters / day):**

This level included neighborhoods (Al-Amir, Al-Jihad, Al-Hussein, Al-Hakim, Al-Mustafa), share of pure water per capita was (614,5, 380, 448, 362,4, 2888 liters / day) for each, respectively. This indicates that there is a quantitative efficiency in the processing of the per capita share of pure water in these neighborhoods, due to the proximity of these neighborhoods to projects and complexes that produce pure water, as for Al-Mustafa neighborhood, the population size decreases with the increase in the quantities of water supplied, greatly increased the individual's share in it.

##### **B. The second level: Neighborhoods that suffer from a deficit in the per capita share of pure water below (350 liters/day):**

This level included a group of residential neighborhoods (Al-Askari, Al-Jwadin, Al-Zahraa, Al-Shohada, Al-Sadiq, and Thawrt Al-Shrin), whose per capita share of pure water amounted to (188, 135,7, 324.1, 332.6, 208.6 and 218.1 liters/day) for each, respectively, the reason for the decline was as a result of the excesses and the distance of some of these neighborhoods from projects and pools of

pure water, which led to a decrease in the level of processing the individual share in them (Table 11).

**Table (11) Per capita share of pure water by residential neighborhoods in the city of Al-Rumaitha 2020.**

No.	Neighborhood	Population	Water supplied quantity from stations m <sup>3</sup> /day	Waste amount m <sup>3</sup> /day	Water reaching amount m <sup>3</sup> /day	Per capita share of pure water/liter	Deficit liter	Surplus liter
	Al-Askari	1484	400	40	160	188	---	62
	Al-Amir	7030	800	80	320	614.5	64.5	---
	Al-Jihad	1368	800	80	320	380	0	---
	Al-Jawadin	5569	40	4	56	135.7	---	14.3
	Al-Hussain	9642	800	80	320	448	8	---
	Al-Hakim	9834	960	96	564	362.4	4.2	---
	Al-Zahraa	9995	600	60	240	324.1	---	5.9
	Al-Shohadaa	9741	600	60	240	332.6	---	7.4
	Al-Sadiq	10352	400	40	160	208.6	---	41.4
0	Al-Mustafa	673	160	16	944	2888	538	---
1	Thawra AL-Ashrin	4950	200	20	080	218.1	---	31.9
2	Total	90638	4560	456	1104	343.1	942.9	92.9

Source: the researcher based on Republic of Iraq, Ministry of Construction, Housing, Municipalities and Public Works, Al-Muthanna Water Department, Technical Authority, unpublished data, for the year 2020.

It was found that the highest per capita share of pure water was achieved in Al-Mustafa neighborhood (2888 liters / day), with a population of (673 people), due to the decrease in population size, this led to a higher per capita share of pure water, either the lowest level of processing for the per capita share of pure water was (188 liters / day) for the Al-Askari neighborhood, as its population reached (11484 people), the per capita share is considered inefficient in relation to the specified standard of (350 liters / day), it was fed through pools, not pure water projects (Al-Halajjia and Al-Maqdoni complex).

### Conclusions

1. These projects were affected by the population size and its geographical distribution, as the number of residents of the city of Al-Rumaitha, according to estimates in 2020 (90,638 people), distributed among (11) residential neighborhoods.

2. The study revealed the high rates of population growth in the city of Al-Rumaitha, and this increase with the appropriate conditions leads between positive and negative services in the city of Al-Rumaitha.

3. The pure water produced in the city is exposed to leakage and waste at rates of approximately (10%) of the quantity of water produced, if we know that the per capita share in the city of Rumaitha is 350 liters per day.

4. The per capita share of pure water is not equal in the neighborhoods of the city.

### **Suggestions**

1. Completing the maintenance work for old Al-Rumaitha water project, operating it, and allocating its production to serve Al-Rumaitha neighborhoods by means of a booster station.

2. Conducting a comprehensive maintenance of the Maqdoni project to operate it to a high degree and allocating its production to the Al-Shohada, Al-Amir and Al-Askari neighborhood to improve the share of beneficiaries there and to reduce pressure on the central Al-Rumaitha project. These measures will, of course, lead to an improvement in the beneficiaries' share of old Al-Rumaitha water project.

3. To make the necessary improvements for the Al-Halajia project, by establishing the alum and filtration systems for the project, in order to improve the quality of the water produced in the project.

4. The responsible authorities should take into consideration the city's expansion trend towards the north-east and north-west, and the population growth trend, when developing their future plans.

#### **Margins:**

(\*) The research is extracted from a master's thesis tagged (spatial analysis of pure water and sewage water services in the city of Al-Rumaitha).

1. Makki Aziz, and Riyadh Ibrahim Al-Saadi, Population Geography, University of Baghdad, 1984, p. 132.

2. Othman Saeed Ismail Tanka, The Role of Geographical Factors in Population Distribution, Makhmour District, 2013.

3. Abdul Ali Al-Khafaf, Abdul Karim Abdullah, The Health Reality in the Najaf Governorate, Juliet Al-Muntada magazine, No. (1), 2008, p. 51.

4. Raad Abdul-Hussein Muhammad, Services, the efficiency of the spatial distribution of educational services in the city of Samawa, PhD thesis (unpublished), College of Arts, University of Basra, 2012, p. 82.

(\*\*) Actual energy = actual production / hour x average daily working hours (18 working hours) for projects, which represents the actual daily production rate in 2020 according to the available conditions and capabilities, and (12) working hours for the complexes (Al-Rumaitha Water Directorate)..

(\*\*\*) It should be noted that the salinity rates were high in the Euphrates River during its passage in Al-Muthanna Governorate. Therefore, it was mainly relied on the Al-Rumaitha River for the production of pure water.

(\*\*\*\*) The per capita share of pure water (liters/day) was extracted by subtracting the amount of water lost from the amount of water produced within the project and multiplying the result \* 1000/ the population. (See Safa Jassim Muhammad, Helen Jaber Shallal, Evaluating the Efficiency of Drinking Water and the Future Needs of the Population, Al-Qadisiyah Journal of Human Sciences, Volume Twenty, No. 3, 2017, p. 140).

5. Republic of Iraq, Ministry of Municipalities and Public Works, Muthanna Governorate Water Directorate, Quality Control Department, unpublished data for the year 2020.

**Sources:**

1. Makki Aziz, and Riyadh Ibrahim Al-Saadi, Population Geography, University of Baghdad, 1984, p. 132.

2. Othman Saeed Ismail Tanka, The Role of Geographical Factors in Population Distribution, Makhmour District, 2013.

3. Abdul Ali Al-Khafaf, Abdul Karim Abdullah, The Health Reality in Najaf Governorate, Juliet Al-Muntada Magazine, No. (1), 2008, p. 51.

4. Raad Abdul-Hussein Muhammad, Services, the efficiency of the spatial distribution of educational services in the city of Samawa, PhD thesis (unpublished), College of Arts, University of Basra, 2012, p. 82.

5. Republic of Iraq, Ministry of Municipalities and Public Works, Muthanna Governorate Water Directorate, Quality Control Department, unpublished data for the year 2020.